#### FINAL DRAINAGE REPORT FOR SADDLEHORN RANCH – FILING 4

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> September 15, 2023 Project No. 25142.06

Prepared By: JR Engineering, LLC 5475 Tech Center Drive Colorado Springs, CO 80919 719-593-2593

El Paso County PCD File No.: SF-23-006

#### **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 El Paso County for drainage reports and said report is in conformity with the 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.

Bryan Law, Colorado P.E. For and On Behalf of JR E		Date	
<b>DEVELOPER'S STAT</b> I, the developer, have read and plan.		e requirements specified in this drainage re	port
Business Name:	ROI Property Group, LL	<u>.C</u>	
By:			
Title: Address:	1280 S 800 E Suite 200 Orem, UT 84097		
	he requirements of the El Paso 1 and 2 and Engineering Criter	County Land Development Code, Drainagria Manual, as amended.	e
Joshua Palmer, P.E. County Engineer/ ECM A	dministrator	Date	
Conditions:			



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## **Purpose**

This document is the Final Drainage Report for Filing 4 of Saddlehorn Ranch. The purpose of this report is to:

- 1. Identify on-site and off-site drainage patterns.
- 2. Recommend storm water facilities to collect and convey storm runoff from the proposed development to appropriate discharge and/or detention locations.
- 3. Recommend water quality and detention facilities to control discharge release rates to below historic.
- 4. Demonstrate compliance with surrounding major drainage basin planning studies, master development drainage plans and flood insurance studies.

## GENERAL LOCATION AND DESCRIPTION

#### Location

The proposed Saddlehorn Ranch Filing 4, known as "Filing 4" from herein, is a parcel of land located in Section 3 and 10, Township 13 South, Range 64 West of the 6<sup>th</sup> Principal Meridian in El Paso County, Colorado. Saddlehorn Ranch is an 824 acre, rural, single family-development. Filing 4 is 162.3 acres and is comprised of 42 lots of the overall Saddlehorn Ranch development. Saddlehorn Ranch is bound by Judge Orr Road to the North and Curtis Road to the West. To the East, Saddlehorn Ranch is bound by undeveloped land owned by Brent Houser Enterprises, LLC. To the south, Saddlehorn Ranch is bound by undeveloped properties owned by Carolyn Gudzunas and Faye Reynolds. Filing 4 is bound by undeveloped land owned by Brent Houser Enterprises, LLC to the east, future Saddlehorn Filing 5 to the south, Judge Orr Road to the north, and by Saddlehorn Filing 3 to the west. A vicinity map is presented in Appendix A.

Currently, there are two major drainageways that will receive flows from Filing 4: Gieck Ranch (WF-R7A) and Haegler Ranch Main Stem 6 (MS-06). These drainageways were analyzed, both hydrologically and hydraulically, in the following reports:

- Haegler Ranch Basin Drainage Basin Planning Study (DBPS), May 2009.
- Santa Fe Springs Haegler Ranch Drainage Basin Letter of Map Revision, June 2004.
- Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch, May 2020.
- Gieck Ranch Drainage Basin Planning Study (DBPS), October 2007
- Gieck Ranch Tributary West Fork Reach 7A Channel Analysis Report, March 2, 2022.

The impact of these drainageways and planning studies on the proposed development will be discussed later in the report.

## **Description of Property**

Filing 4 is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling rangeland condition. In general, Filing 4 slopes from south to southeast and the existing drainageways follows this topography.

Per a NRCS web soil survey of the area, Filing 4 is made up of Type A and D soils. Type A soils cover roughly 68% of Filing 4 while Type D soils cover 32% of Filing 4. Group A soils have a high infiltration rate when thoroughly wet. Type D soils have a very slow infiltration when thoroughly wet. A NRCS soil survey map has been presented in Appendix A.

#### Floodplain Statement

Based on the FEMA FIRM Map number 08041C0558G, dated December 7, 2018, Filing 4 lies within Zone AE and Zone X. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. All proposed residential development within Filing 4 will occur in Zone X. The FIRM Map has been presented in Appendix A.

## Drainage Basins and Sub-Basins

#### **Existing Major Basin Descriptions**

Filing 4 lies within Haegler Ranch Drainage Basin based on the "*Haegler Ranch Drainage Basin Planning Study*" prepared by URS Corporation in May 2009, and the Gieck Ranch Drainage basin based on the "*Gieck Ranch Drainage Basin Planning Study*" prepared by Drexel, Barrell & Co in October 2007 (Not adopted by El Paso County as of July 2019).

The Haegler Ranch Drainage Basin covers approximately 16.6 square miles in unincorporated El Paso County, CO. The Haegler Ranch Drainage Basin is tributary to Black Squirrel Creek. In its existing condition, the basin is comprised of rolling rangeland with poor vegetative cover associated with Colorado's semi-arid climate. The natural Drainageways within the basin are typically shallow and wide with poorly defined flow paths in most areas. Anticipated land use for the basin includes residential and commercial development. Residential developments will range from 0.125 - 5 acre lots with a mix of low, medium and high density developments.

As part of its drainage research, JR Engineering reviewed the following drainage studies, reports and LOMRs:

- Haegler Ranch Drainage Basin Planning Study prepared by URS Corporation in May 2009
- Santa Fe Springs Haegler Ranch Drainage Basin Letter of Map Revision prepared by Tri-Core Engineering in June 2004.
- Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch, prepared by JR Engineering, May 2020.
- Gieck Ranch Drainage Basin Planning Study (DBPS), October 2007

Based on flood impacts, stream stability and cost effectiveness, this study recommended a sub-regional detention approach. This allows future development anywhere in the basin with the construction of an associated sub-regional pond. However, based on the *Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch*, Filing 4 will utilize two on-site full spectrum water quality and detention ponds instead. These full spectrum detention ponds will limit developed discharge into the MS-06 and WF-R7A Drainageways to less than historic rates.

*The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR* was executed on Haegler Ranch Tributary 2, 3, and 4. The LOMR revised the onsite effective flood zone from Zone A to Zone AE. See FIRM Map Panel 08041C0558G for limits of LOMR study and revised flood zones, presented in Appendix E.

The Gieck Ranch Drainage Basin covers approximately 22 square miles and begins approximately five miles northeast of the Town of Falcon and travels approximately 15 miles to the southeast. The Gieck Ranch Drainage Basin is tributary to Black Squirrel Creek which drains south to the Arkansas River near the city of Pueblo, Colorado. The majority of the area within the basin is undeveloped and is characterized as rolling rangeland typically associated with Colorado's semi-arid climates. Anticipated land use for the basin includes residential, industrial, agricultural and commercial development. Residential developments will range from 0.125-5 acre lots with a mix of low, medium and high density developments.

Based upon provided drainage maps and analysis, Gieck Ranch discharges a total of 1,017 cfs onto the site within Major Drainageway Gieck Ranch West Fork Reach 7A (WF-R7A). An existing 66" CMP and 36" CMP convey the offsite flow across Judge Orr Road onto the site. The existing culverts at Judge Orr Road are undersized for existing and future flows resulting in localized overtopping. The DBPS recommends the culvert be upsized to four –12' x 5' box culverts. The culvert will not be upsized within the context of this report and development. The culvert is owned by El Paso County and timing of the recommended improvements will be controlled by the County. The overtopping at the intersection of WF-R7A is not contained within the 100-year floodplain. However, the existing topography directs these overtopping flows away from Lot 6. The fill required for Pond D also ensures that no overtopping flows will encroach onto the site downstream. Thus, the lots near the culvert crossing at Judge Orr Road will be unaffected by overtopping flows. WF-R7A was recently analyzed by El Paso County's Floodplain Administrator. The revised 100-year floodplain with corresponding BFE's from their study can be found on the proposed drainage maps in Appendix F. The revised floodplain follows a more defined channel section instead of sprawling over the wetlands located on the site. None of the Saddlehorn Filing 4 Lots come in contact with the revised 100-year floodplain.

See Table 2 for comparison of Drainageway identification and the naming convention used within the context of this report. See Table 3 for a comparison of 100-year flows as calculated in the aforementioned DBPS and LOMR. An existing conditions drainage map is presented in Appendix E.

Table 1: Major Drainageway Naming Convention

	Major Drainageway Naming Conventions									
Saddlehorn Ranch MDDP/PDR:	Per Haegler Ranch DBPS:	Per Gieck Ranch DBPS:	Per Sante Fe Springs LOMR:							
MS-06	Main Stem (MS- 06)	N/A*	Haegler Ranch Tributary 3							
WF-R7A	N/A*	West Fork (Middle)/WF-R7A	N/A*							

Table 2: Major Drainageway – Ex. 100-Year Flow Comparison

Major Drainageways: 100-Year Flow Comparison									
Drainageway Name	Contributing Area (sq. mi.)	Q <sub>100</sub> Per Haegler Ranch DBPS:	Q <sub>100</sub> Per Gieck Ranch DBPS:	Q <sub>100</sub> Per Sante Fe Springs LOMR:					
MS-06 @ Curtis Road	1.05	590 cfs	N/A*	505 cfs					
WF-R7A @ Judge Orr Road	1.50	N/A*	1,017 cfs	N/A*					

<sup>\*</sup>N/A: Flow regime outside limits of study.

The *Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch* proposed the overall drainage facility design for Saddlehorn Ranch. Within the context of this report, onsite drainage basins with associated full spectrum water quality ponds were established. As it pertains to Filing 4, two full spectrum water quality ponds are recommended. Roadside ditches and local street culverts will be utilized to capture and convey Filing 4's runoff to the water quality ponds. Three full spectrum water quality ponds were proposed with the Saddlehorn Filing 3 improvements PCD Filing No. SF234. Saddlehorn Filing 4 will utilize two of these three ponds. The ponds were sized for both the Filing 3 and Filing 4 improvements. Pond C and Pond E will discharge into Drainageway MS-06, while Pond D will release into Drainageway WF-R7A. All ponds are full spectrum and will release at less than historic rates. All pond calculations that were completed with the Filing 3 Drainage Report can be found in Appendix E.

## Existing Sub-basin Drainage

On-site, existing sub-basin drainage patterns are generally from northwest to southeast by way of Drainageway MS-06 and Drainageway WF-R7A. On-site areas flow directly into these drainageways, which also bypass off-site flows through the site.

The existing condition Filing 4 basin delineation is as follows,

Basin C consists of Sub-basins C1 and C2 combining for a total of 106.6 acres. Sub-basin C1 consists of existing Filing 3 lots where runoff is directed to existing Pond C through swales and culverts. Basin C2 is rolling rangeland where runoff generally flows south to Pond C. Pond C releases flows to Drainageway MS-06 at less than historic rates.

Basin D consists of Sub-basins D1 and D2 combining for a total of 48.3 acres. Sub-basin D1 consists of existing Filing 3 lots where runoff is directed to existing Pond D through swales and culverts. Basin D2 is rolling rangeland where runoff generally flows east to Pond D and Drainageway WF-R7A. Pond D releases flows to Drainageway WF-R7A at less than historic rates.

Basin E consists of Filing 3 lots covering a total of 18.3 acres. Basin E flows are directed to existing Pond E through swales and culverts. Pond E releases flows to Drainageway MS-06 at less than historic rates.

Basin G consists of Sub-basins G1 and G2 combining for a total of 62.1 acres. Both basins G1 and G2 consists of rolling rangeland where runoff generally flows to Drainageway WF-R7A.

Basin H covers a total of 111.1 acres consisting of rolling rangeland where runoff generally flows west to Drainageway MS-06.

On-site, existing drainage basins were established based upon existing topography and the limits of the 100-year floodplain. These existing sub-basins were analyzed in the *Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch*. An existing drainage map and existing drainage calcs have been provided in Appendix E.

## Proposed Sub-basin Drainage

The proposed Filing 4 basin delineation is as follows;

Basin C consists of Sub-Basins C1-C8 combining for a total of 46.69 acres. In its existing condition, Basin C is rolling rangeland and runoff generally flows southeast towards Drainageway MS-06. In the proposed condition, Basin C will be rural 2.5 acre lots, paved roadway, and will include Pond C. Runoff from this basin will be collected in road side ditches and conveyed to Pond C located in the southeast corner of the Filing 4 development. Pond C will be a full spectrum water quality and detention pond, and will release at less than historic rates into Drainageway MS-06.

Basin D consists of Sub-basins D1-D9 combining for a total of 53.78 acres. In its existing condition, Basin D is rolling rangeland and runoff generally flows east to Drainageway WF-R7A. In the proposed condition, Basin D will be rural 2.5 acre lots, paved roadway, and will include Pond D. Runoff from this basin will be collected in road side ditches and conveyed west to Pond D located in the northeast corner of the Filing 4 development. Pond D is a full spectrum water quality and detention pond, and will release at less than historic rates into Drainageway WF-R7A.

Basin UD consists of Sub-basins UD1-UD4 combining for a total of 65.86 acres. In their existing condition, these basins are rolling rangeland. Runoff from Basins UD1 & UD3 generally flow south and east to Drainageway WF-R7A. Basin UD3 represents Drainageway WF-R7A and the runoff generated along the Filing 4 boundary. Basin UD4 flows south to Drainageway MS-06. In the proposed condition, Basins UD1, UD3, and UD4 will be rural 2.5 acre lots with an imperviousness = 6.2%, and will be excluded from permanent stormwater quality management per Section I.7.1.B.5 of the ECM – Stormwater Quality Policy and Procedures.

Basin OS consists of Sub-basins OS1-OS2 combining for a total of 2.98 acres of offsite area. In their existing condition, these basins are paved roadway (Judge Orr Road) and undeveloped area. In the proposed condition, these basins will be improved with 8' of pavement width for the Judge Orr Road stretch. Basins OS1-OS2 will flow on-site prior to being captured in a roadside swale and conveyed to the Full Spectrum Detention Pond D prior to being released into Drainageway WF-R7A.

A summary table of proposed basin parameters and flow rates are presented in Appendix B.

Basin D and Basin OS runoff will be captured in roadside swales and conveyed to the proposed Pond D. This full spectrum pond will release treated flows at less than historic rates to minimize adverse impacts downstream. Basin C will be captured in roadside swales and conveyed to the proposed Pond C. Pond C discharges into Drainageway MS-06, and Pond D discharges into Drainageway WF-R7A.

All pond design parameters for Ponds C & D were completed with the Filing 3 report. These pond designs and parameters can be found in Appendix E. The proposed forebay calculations for the Filing 4 pond outfalls can be found in Appendix D.

## Drainage Design Criteria

## Development Criteria Reference

Storm drainage analysis and design criteria for the project were taken from the "City of Colorado Spring/El Paso County Drainage Criteria Manual" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "Urban Storm Drainage Criteria Manual" Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the "Colorado Springs Drainage Criteria Manual (CCSDCM), dated May 2014, as adopted by El Paso County.

## Hydrologic Criteria

All hydrologic data was obtained from the "El Paso Drainage Criteria Manual" Volumes 1 and 2, and the "Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual" Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. Rational Method calculations were prepared, in accordance with Section 13.3.2.1. of the CCSDCM, for the sub-basins that directly impact the sizing of ditches and local street culverts. Rational method calculations are presented in Appendix B.

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Urban Drainage and Flood Control District's UD-Detention, Version 4.04 workbook was used for pond sizing with the Filing 3 report. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. Pond sizing spreadsheets that were completed with the Filing 3 improvements are presented in Appendix E.

#### Hydraulic Criteria

Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) was used for roadside ditch design. Ditches were checked for velocity and capacity per the CCS/EPCDCM Section 12.3.2.2. In order to check both capacity and velocity, a cross section analysis was performed on the roadside swales using the basin's maximum runoff Q and the proposed uniform slope of the swale. Swale cross sections have been presented in Appendix C.

Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) was used for local road crossing culvert design. Culvert size was determined based on 100-year flows and hydraulic criteria from EPCDCM Chapter 9 –Culvert Design. All local road crossing culvert design reports are presented in Appendix C.

## Drainage Facility Design

#### General Concept

The proposed stormwater conveyance system was designed to convey the developed Filing 4 runoff to one of two full spectrum detention ponds via roadside ditches and local street culverts. These full spectrum ponds were designed to release at less than historic rates to minimize adverse impacts downstream.

Improvements to Drainageway MS-06 within the Saddlehorn Filing 3 and Filing 4 improvements were completed with the Saddlehorn Filing 3 Drainage Report. A no rise study was conducted on the proposed Drainageway MS-06 improvements to ensure no rises to the floodplain occur as a result of the Filing 3 and 4 developments. All proposed drainageway improvements, including the San Isidro culvert crossing and channel sections were incorporated with the Saddlehorn Filing 3 improvements. FEMA approved Base Flood Elevations were received from El Paso County's Floodplain Administrator for Drainageway WF-R7A. These BFEs were used as part of the Saddlehorn Filing 4 development to ensure that the proposed improvements were not impacted by the existing 100-year floodplain, and to ensure the improvements did not impact the drainageway. Outfall protection from Pond D is the only improvement to Drainageway WF-R7A at this time. The remaining improvements to Drainageway MS-06 shall be implemented with the Filing 5 improvements.

## Specific Details

#### Four Step Process to Minimize Adverse Impacts of Urbanization

In accordance with the El Paso County Drainage Criteria Manual Volume 2, this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes, stabilizing drainageways, treating the water quality capture volume (WQCV), and consider the need for Industrial Commercial BMP's.

Step 1, Reducing Runoff Volumes: The development of the project site is proposed single family residential lots (2.5 ac. min.) with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roadways utilize soil riprap lined roadside ditches further disconnecting impervious areas. These practices will also allow for increased infiltration and reduce runoff volume.

Step 2, Stabilize Drainageways: Filing 4 utilizes roadside ditches with culvert crossings throughout. These roadside ditches direct the on-site development flows to the proposed detention ponds within the project that releases at or below historic rates into Drainageways MS-06 and WF-R7A. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impacts to downstream Drainageway MS-06 or Drainageway WF-R7A are anticipated. Drainageway MS-06 was stabilized with the Filing 3 improvements.

Step 3, Provide WQCV: Runoff from this development is treated through capture and slow release of the WQCV in full spectrum water quality and detention ponds that are designed per current El Paso County drainage criteria. Three ponds were built with the Filing 3 improvements, two of which will be utilized to treat Filing 4 flows. Both Pond C and D will be fitted with an additional forebay with the Filing 4 improvements.

Step 4 Consider the need for Industrial and Commercial BMP's: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative are prepared in conjunction with this report. Site specific temporary source control BMPs as well as permanent BMP's are detailed in this plan and narrative to protect receiving waters.

#### Water Quality

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full spectrum water quality and detention are provided for all developed basins. Outlet structure release rates are limited to less than historic rates to minimize adverse impacts to downstream stormwater facilities. Due to Pond D's proximity to the drainageway, a boring was conducted approximately 500' from the proposed Pond D to alleviate concerns of ground water interference. The groundwater table was observed at 8.5' at this location. Currently, the maximum cut for Pond D is approximately 5.00' below the existing surface. This minimal cut should allow the pond to function without groundwater interference.

#### Erosion Control Plan

The El Paso County Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate must be submitted with each Final Drainage Report. The Erosion Control Plans for Filing 4 have been submitted concurrently with this report.

#### Operation & Maintenance

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. All proposed drainage structures within the any platted County ROW will be owned and maintained by El Paso County. All proposed drainage structures within easements or tracts will be owned and maintained by the Saddlehorn Ranch Metro District. An Inspection & Maintenance Plan is submitted concurrently

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with this drainage report that details the required maintenance activities and intervals to ensure proper function of all stormwater infrastructure in the future.

#### Drainage and Bridge Fees

Drainage and Bridge Fees are due at time of final platting. An estimate of basin fees for the proposed development within Haegler Ranch drainage basin is provided below. Fee reduction for low density lots are applied to the overall basin fees in the next section. Additionally, reimbursable expenses are detailed below.

Total Filing 4 Platted Acres: 162.3 ac

Total Filing 4 Impervious Acres = 16.2 ac (162.3 ac x 10%)

#### Filing 4 Fee Totals (Prior to Reductions):

**Bridge Fees** 

**Drainage Fees** 

 $1,916/ac \times 16.2 ac = 31,039$ 

 $12,985/ac \times 16.2 ac = 210,357$ 

Filing 4 Drainage Fee Reduction: 25% Reduction for Low Density Lots: \$210,357 x 25% = \$52,589

#### Filing 4 Fee Totals (After Reductions):

**Bridge Fees** 

**Drainage Fees** 

 $1,916/ac \times 16.2 ac = 31,039$ 

\$210,357 - \$52,589 = \$157,768

#### Construction Cost Opinion

Cost opinion has been presented in Appendix A.

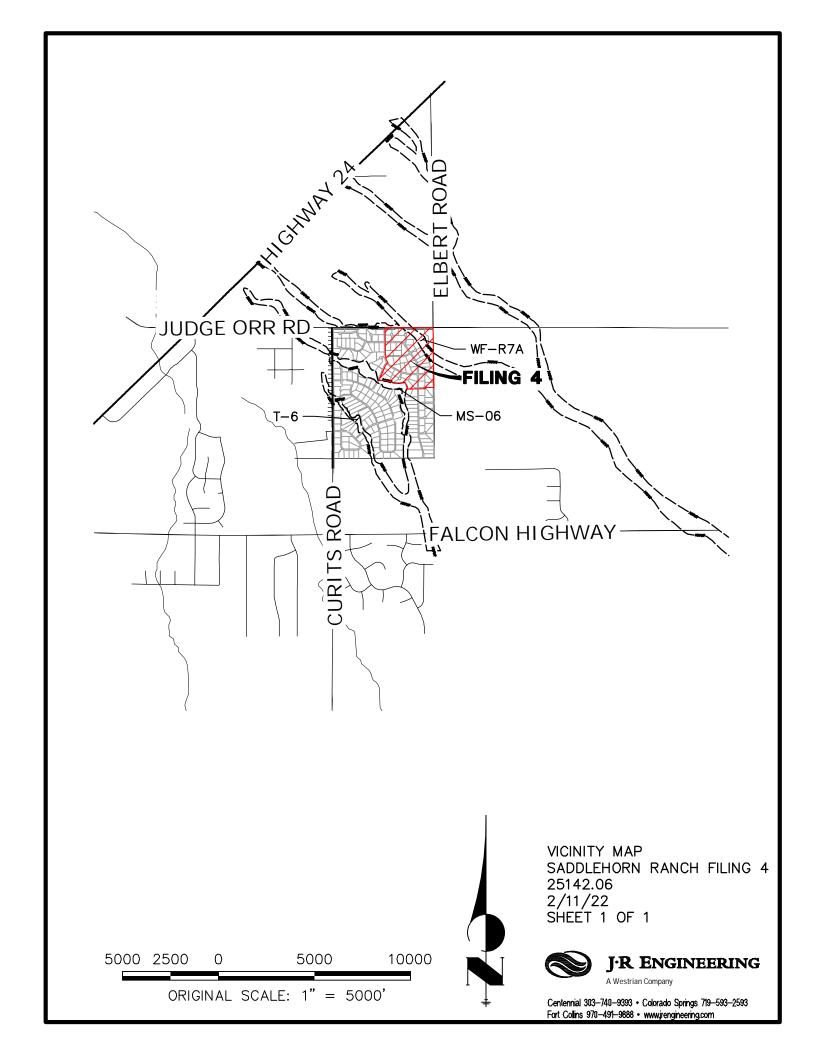
#### SUMMARY

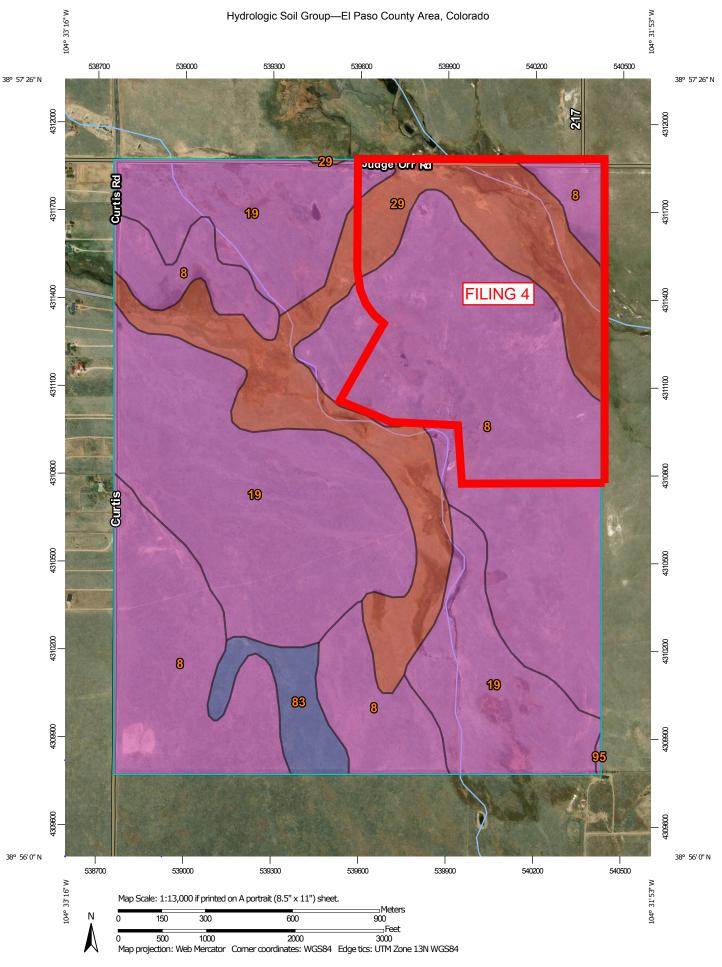
The proposed development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements, including swales, culverts, detention ponds and drainage channel improvements. The proposed development will not adversely affect the offsite major drainageways or surrounding development. This report meets the latest El Paso County Drainage Criteria requirements for this site and is in accordance with the PDR/MDDP for Saddlehorn Ranch.

## REFERENCES:

- 1. <u>City of Colorado Springs Drainage Criteria Manual Volume 1</u>, City of Colorado Springs, CO, May 2014.
- 2. <u>Urban Storm Drainage Criteria Manual</u>, Urban Drainage and Flood Control District, Latest Revision.
- Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch, JR Engineering, May 2020.
- 4. Haegler Ranch Drainage Basin Planning Study, URS Corporation, May 2009.
- 5. <u>The Santa Fe Springs Haegler Ranch Drainage Basin LOMR</u>, Federal Emergency Management Agency, October 20, 2004.
- 6. Final Drainage Report for Saddlehorn Ranch Filing 3, JR Engineering, February 4, 2022
- 7. Gieck Ranch Tributary West Fork Reach 7A Channel Analysis Report For Saddlehorn Filing No. 4, JR Engineering, February 21, 2022

# APPENDIX A FIGURES AND EXHIBITS





#### MAP LEGEND MAP INFORMATION The soil surveys that comprise your AOI were mapped at Area of Interest (AOI) С 1:24.000. Area of Interest (AOI) C/D Please rely on the bar scale on each map sheet for map Soils D measurements. Soil Rating Polygons Not rated or not available Α Source of Map: Natural Resources Conservation Service Web Soil Survey URL: **Water Features** A/D Coordinate System: Web Mercator (EPSG:3857) Streams and Canals В Maps from the Web Soil Survey are based on the Web Mercator Transportation projection, which preserves direction and shape but distorts B/D Rails --distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more Interstate Highways accurate calculations of distance or area are required. C/D **US Routes** This product is generated from the USDA-NRCS certified data as D Major Roads of the version date(s) listed below. Not rated or not available -Local Roads Soil Survey Area: El Paso County Area, Colorado Soil Rating Lines Survey Area Data: Version 16, Sep 10, 2018 Background Aerial Photography Soil map units are labeled (as space allows) for map scales 1:50,000 or larger. A/D Date(s) aerial images were photographed: May 22, 2016—Aug 17, 2017 B/D 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 C/D shifting of map unit boundaries may be evident. D Not rated or not available **Soil Rating Points** Α A/D B/D

# **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	388.3	44.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	Α	307.3	35.3%
29	Fluvaquentic Haplaquolls, nearly level	D	150.0	17.2%
83	Stapleton sandy loam, 3 to 8 percent slopes	В	24.6	2.8%
95	Truckton loamy sand, 1 to 9 percent slopes	А	0.6	0.1%
Totals for Area of Interes	est		870.8	100.0%

#### **Description**

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

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

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

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

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

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

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

## **Rating Options**

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

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

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

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

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

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

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

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

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

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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

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

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

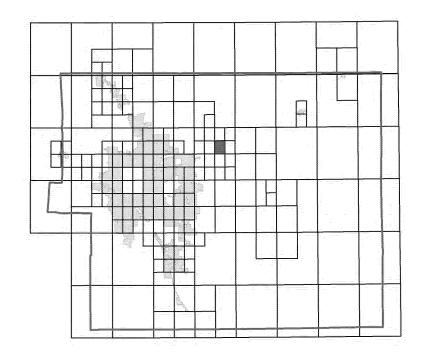
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

**Vertical Datum** Flooding Source

REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

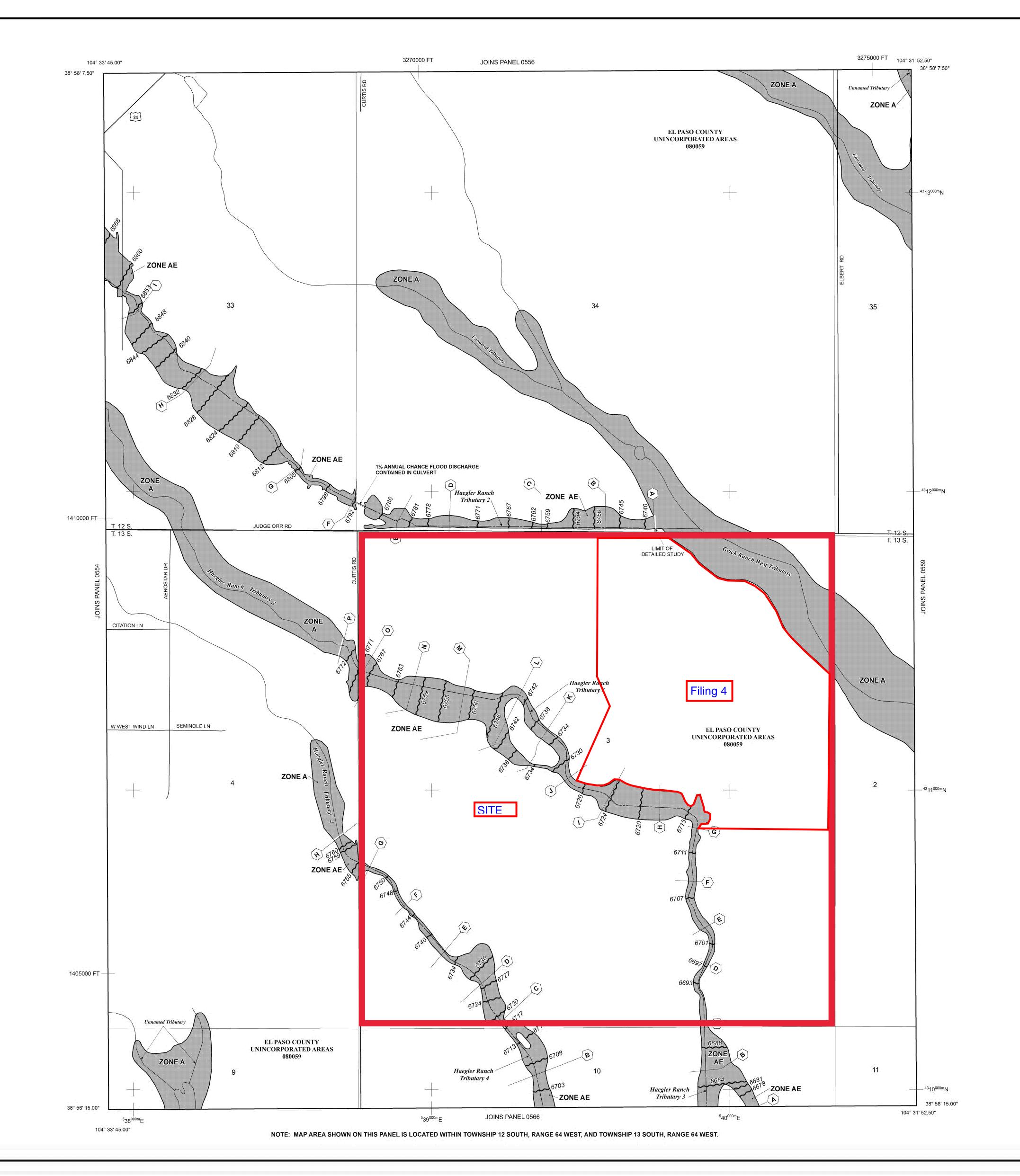
# Panel Location Map



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



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



## LEGEND

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

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

**ZONE A** No Base Flood Elevations determined. **ZONE AE** Base Flood Elevations determined.

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

protection from the 1% annual chance or greater flood.

**ZONE AR** Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide

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

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

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

Floodnlain boundary Floodway boundary Zone D Boundary

CBRS and OPA boundary .......... Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities

~~ 513 ~~ Base Flood Elevation line and value; elevation in feet\* Base Flood Elevation value where uniform within zone; (EL 987) elevation in feet\*

\* Referenced to the North American Vertical Datum of 1988 (NAVD 88) Cross section line

97° 07' 30.00" Geographic coordinates referenced to the North American 32° 22' 30.00" Datum of 1983 (NAD 83)

1000-meter Universal Transverse Mercator grid ticks, 4275000mN 5000-foot grid ticks: Colorado State Plane coordinate 6000000 FT

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

system, central zone (FIPSZONE 0502),

MAP REPOSITORIES Refer to Map Repositories list on Map Index EFFECTIVE DATE OF COUNTYWIDE

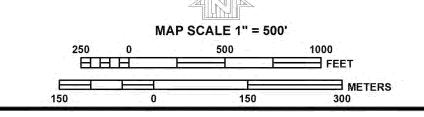
FLOOD INSURANCE RATE MAP

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.



PANEL 0558G **FIRM** 

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

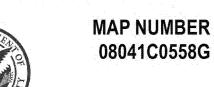
**PANEL 558 OF 1300** 

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:** 

NUMBER 080059

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



MAP REVISED **DECEMBER 7, 2018** 

Federal Emergency Management Agency

## 2023 Financial Assurance Estimate Form

(with pre-plat construction)

Updated: 9/1/2023

PROJECT INFORMATION						
Saddlehorn Filing 4	9/1/2023	SF-23-006				
Project Name	Date	PCD File No.				

			Unit				(with Pre	e-Plat	Construction)
Description	Quantity	Units	Cost			Total	% Complete		Remaining
SECTION 1 - GRADING AND EROSION CONTRO	L (Construction	<mark>and Permar</mark>	ent BMPs)						
Earthwork									
less than 1,000; \$5,300 min		CY	\$ 8.00	=	\$	-		\$	-
1,000-5,000; \$8,000 min 5,001-20,000; \$30,000 min		CY	\$ 6.00 \$ 5.00	=	\$	-		\$	-
20,001-20,000; \$30,000 min		CY	\$ 3.50	=	\$	-		\$	
50,001-200,000; \$175,000 min	100,006	CY	\$ 2.50		\$	250,015.00		\$	250,015.00
greater than 200,000; \$500,000 min	100,000	CY	\$ 2.00		\$	230,013.00		\$	230,013.00
Permanent Erosion Control Blanket		SY	\$ 8.00		\$			\$	
Permanent Seeding (inc. noxious weed mgmnt.) & Mulching	38.04	AC	\$ 1,875.00	=	\$	71,325.00		\$	71,325.00
Permanent Pond/BMP (provide engineer's estimate)	See Below	EA		=	\$	-		\$	-
Concrete Washout Basin	1	EA	\$ 1,089.00	=	\$	1,089.00		\$	1,089.00
Concrete/Riprap Forebay	2	EA	\$ 3,000.00	=	\$	6,000.00		\$	6,000.00
Inlet Protection	10	EA	\$ 202.00	=	\$	2,020.00		\$	2,020.00
Outlet Protection	11	EA	\$ 202.00	=	\$	2,222.00		\$	2,222.00
Rock Check Dam	49	EA	\$ 605.00	=	\$	29,645.00		\$	29,645.00
Rock Sock	4	EA	\$ 30.00	=	\$	120.00		\$	120.00
Safety Fence (Construction Marker)	14,001	LF	\$ 3.00	=	\$	42,002.90		\$	42,002.90
Sediment Basin	2	EA	\$ 2,132.00	=	\$	4,264.00		\$	4,264.00
Sediment Trap	0.770	EA	\$ 500.00	=	\$	- 20 222 77		\$	- 20 222 77
Silt Fence	9,778 96	LF LF	\$ 3.00	=	\$	29,332.77		\$	29,332.77
Slope Drain Straw Bale	96	EA	\$ 40.00 \$ 31.00	=	\$	3,834.80		\$	3,834.80
Straw Wattle/Erosion Logs		LF	\$ 7.00	=	\$	-		\$	-
Surface Roughening		AC	\$ 7.00	=	\$			\$	<u> </u>
Temporary Erosion Control Blanket		SY	\$ 3.00		\$			\$	
Temporary Seeding and Mulching		AC	\$ 1,666.00	=	\$			\$	
Vehicle Tracking Control	3	EA	\$ 2,867.00	=	\$	8,601.00		\$	8,601.00
				=	\$	-		\$	-
				=	\$	-		\$	-
[insert items not listed but part of construction plans]					-	10 71107		\$	42,714.87
· · · · · · · · · · · · · · · · · · ·	NTENANCE (35%	6 of Constru	ıction BMPs)	=	\$	42,714.87		Ψ	42,714.07
MAI  * - Subject to defect warranty financial assurance. A minimum of 20% shall be	NTENANCE (35%		•		_				
MAI	NTENANCE (35%		n 1 Subtotal	=	\$	493,186.34		\$	493,186.34
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS *	NTENANCE (35%		•		_				
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS		Section	n 1 Subtotal		\$	493,186.34		\$	493,186.34
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control	1	Section	n 1 Subtotal	=	\$	493,186.34		\$	493,186.34
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick		LS Tons	\$ 50,000.00 \$ 34.00	=	\$ \$	50,000.00 612,918.00		\$ \$	493,186.34
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)	1	LS Tons CY	\$ 50,000.00 \$ 34.00 \$ 61.00	=	\$ \$ \$	50,000.00 612,918.00		\$ \$ \$ \$	50,000.00 612,918.00
MAI  * - Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)	1	LS Tons CY SY	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00	=	\$ \$ \$ \$	50,000.00 612,918.00		\$ \$ \$ \$ \$	50,000.00 612,918.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)	1	LS Tons CY SY SY	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00	=	\$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 -		\$ \$ \$ \$ \$	50,000.00 612,918.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS*  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)	1 18,027	LS Tons CY SY SY SY	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 35.00	= = =	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 -		\$ \$ \$ \$ \$	50,000.00 612,918.00 -
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS*  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)	1	LS Tons CY SY SY SY Tons	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 35.00 \$ 106.00	= = =	\$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 -		\$ \$ \$ \$ \$ \$	50,000.00 612,918.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS*  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754	LS Tons CY SY SY SY Tons SF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 35.00 \$ 106.00 \$ 10.00	= = = = =	\$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00		\$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS*  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Raised Median, Paved  Regulatory Sign/Advisory Sign	1 18,027 12,754	LS Tons CY SY SY SY Tons SF EA	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 35.00 \$ 106.00 \$ 10.00 \$ 364.00	= = = = = =	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - 8,008.00		\$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS*  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Raised Median, Paved  Regulatory Sign/Advisory Sign  Guide/Street Name Sign	1 18,027 12,754 22 26	LS Tons CY SY SY SY Tons SF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 35.00 \$ 106.00 \$ 10.00 \$ 364.00 \$ 250.00	= = = = = = = = = = = = = = = = = = = =	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - 8,008.00 6,500.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - 8,008.00 6,500.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS*  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Raised Median, Paved  Regulatory Sign/Advisory Sign	1 18,027 12,754	LS Tons CY SY SY SY Tons SF EA EA	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 35.00 \$ 106.00 \$ 10.00 \$ 364.00	= = = = = =	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - 8,008.00		\$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS*  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (7" thick)  Asphalt Pavement (8" thick)  Asphalt Pavement (8" thick)  Asphalt Pavement (9" thick)	1 18,027 12,754 22 26 2,360	LS Tons CY SY SY Tons SF EA EA SF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 35.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 16.00	= = = = = = = = = = = = = = = = = = = =	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS*  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf) 10" Thick  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf) 7 " thick  Raised Median, Paved  Regulatory Sign/Advisory Sign  Guide/Street Name Sign  Epoxy Pavement Marking  Thermoplastic Pavement Marking	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY SY Tons SF EA EA SF SF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 106.00 \$ 364.00 \$ 250.00 \$ 16.00 \$ 28.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS**  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf) 40" Thick  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA SF SF EA	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 23.00 \$ 106.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 250.00 \$ 28.00 \$ 241.00	= = = = = = = = = = = = = = = = = = = =	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00   1,351,924.00  8,008.00 6,500.00 37,765.28 3,248.00 964.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS**  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA SF EA LF LF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 250.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00	= = = = = = = = = = = = = = = = = = = =	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00  - 1,351,924.00  8,008.00 6,500.00 37,765.28 3,248.00 964.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS**  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA SF EA LF LF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 10.00 \$ 10.00 \$ 250.00 \$ 16.00 \$ 250.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00	= = = = = = = = = = = = = = = = = = = =	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA EA LF LF LF SY	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 16.00 \$ 250.00 \$ 241.00 \$ 241.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 28.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 8,008.00 6,500.00 37,765.28 3,248.00 964.00		\$	50,000.00 612,918.00 - - 1,351,924.00 - - 8,008.00 6,500.00 37,765.28 3,248.00 964.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf) 10" Thick  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Raised Median, Paved  Regulatory Sign/Advisory Sign  Guide/Street Name Sign  Epoxy Pavement Marking  Thermoplastic Pavement Marking  Barricade - Type 3  Delineator - Type 1  Curb and Gutter, Type A (6" Vertical)  Curb and Gutter, Type B (Median)  Curb and Gutter, Type C (Ramp)  4" Sidewalk	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF LF SY SY	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 264.00 \$ 28.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf) 10" Thick  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Regulatory Sign/Advisory Sign  Guide/Street Name Sign  Epoxy Pavement Marking  Thermoplastic Pavement Marking  Barricade - Type 3  Delineator - Type I  Curb and Gutter, Type A (6" Vertical)  Curb and Gutter, Type B (Median)  Curb and Gutter, Type C (Ramp)  4" Sidewalk (common areas only)  5" Sidewalk  6" Sidewalk	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF SY SY SY SF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 23.00 \$ 106.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 250.00 \$ 26.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - - 8,008.00 37,765.28 3,248.00 964.00 - - -
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)  Agised Median, Paved  Regulatory Sign/Advisory Sign  Guide/Street Name Sign  Epoxy Pavement Marking  Thermoplastic Pavement Marking  Barricade - Type 3  Delineator - Type I  Curb and Gutter, Type A (6" Vertical)  Curb and Gutter, Type B (Median)  Curb and Gutter, Type C (Ramp)  4" Sidewalk (common areas only)  5" Sidewalk  8" Sidewalk	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF LF SY SY SY SY	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 10.00 \$ 10.00 \$ 250.00 \$ 260.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00   1,351,924.00 6,500.00 37,765.28 3,248.00 964.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  **ROADWAY IMPROVEMENTS**  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF LF LF SY SY SY SY EA	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 10.00 \$ 250.00 \$ 16.00 \$ 241.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 10.00 \$ 10.0		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 6,500.00 37,765.28 3,248.00 964.00 - - -		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	Section  LS Tons CY SY SY Tons SF EA EA LF LF LF LF SY SY SY SY SY LF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 16.00 \$ 250.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 16.00 \$ 16.00 \$ 28.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 8,008.00 6,500.00 37,765.28 3,248.00 964.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - 1,351,924.00 8,008.00 6,500.00 37,765.28 3,248.00 964.00 - - -
**- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (4" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF LF SY SY SY LF LF LF	\$ 50,000.00 \$ 34.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 16.00 \$ 250.00 \$ 241.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 10.00 \$ 10.		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00 - - - -		\$ s s s s s s s s s s s s s s s s s s s	50,000.00 612,918.00 - - - 1,351,924.00 6,500.00 37,765.28 3,248.00 964.00 - - - -
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (14T lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF LF SY SY SY LF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 16.00 \$ 250.00 \$ 241.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 16.00 \$ 16.		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)Z" thick  Raised Median, Paved  Regulatory Sign/Advisory Sign  Guide/Street Name Sign  Epoxy Pavement Marking  Thermoplastic Pavement Marking  Barricade - Type 3  Delineator - Type 1  Curb and Gutter, Type A (6" Vertical)  Curb and Gutter, Type B (Median)  Curb and Gutter, Type B (Median)  Curb and Gutter, Type C (Ramp)  4" Sidewalk  6" Sidewalk  6" Sidewalk  Pedestrian Ramp  Cross Pan, local (8" thick, 6' wide to include return)  Cross Pan, collector (9" thick, 8' wide to include return)  Curb Opening with Drainage Chase  Guardrail Type 3 (W-Beam)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF SY SY SY SY LF EA LF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 250.00 \$ 264.00 \$ 28.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 116.00 \$ 27.00 \$ 35.00 \$ 35.		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00 - - - -		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - - 8,008.00 37,765.28 3,248.00 964.00 - - - - -
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*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf) 10" Thick  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF SY SY SY SY LF EA LF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 23.00 \$ 10.00 \$ 10.00 \$ 10.00 \$ 250.00 \$ 264.00 \$ 260.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 16.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  SECTION 2 - PUBLIC IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf) 10" Thick  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (14T lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF LF SY SY SY LF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 10.00 \$ 250.00 \$ 260.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 16.00 \$ 28.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 16.00 \$ 116.00 \$ 35.00 \$ 35.00 \$ 364.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 369.00 \$ 369.00 \$ 37.00 \$ 37.00 \$ 116.00 \$ 1,390.00 \$ 17.90.00 \$ 17.90.00 \$ 17.90.00 \$ 60.00 \$ 87.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 - - - - - - - - 1,351,924.00 - - - - - - - - - - - - - - - - - -
*- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (5" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	Section  LS Tons CY SY SY SY Tons SF EA EA LF	\$ 50,000.00 \$ 34.00 \$ 61.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 10.00 \$ 364.00 \$ 250.00 \$ 16.00 \$ 241.00 \$ 28.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 16.00 \$ 16.00 \$ 27.00 \$ 35.00 \$ 3		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 - 8,008.00 6,500.00 37,765.28 3,248.00 964.00 - - - - -
**- Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)  **SECTION 2 - PUBLIC IMPROVEMENTS *  ROADWAY IMPROVEMENTS  Construction Traffic Control  Aggregate Base Course (135 lbs/cf) 10" Thick  Aggregate Base Course (135 lbs/cf)  Asphalt Pavement (3" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (6" thick)  Asphalt Pavement (8" thick)  Asphalt Pavement (8" thick)  Asphalt Pavement (8" thick)  Asphalt Pavement (147 lbs/cf)	1 18,027 12,754 22 26 2,360 116	LS Tons CY SY SY Tons SF EA EA LF LF LF SY SY SY LF LF EA LF LF LF EA LF	\$ 50,000.00 \$ 34.00 \$ 17.00 \$ 23.00 \$ 106.00 \$ 10.00 \$ 10.00 \$ 250.00 \$ 16.00 \$ 28.00 \$ 241.00 \$ 241.00 \$ 241.00 \$ 29.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 35.00 \$ 111.00 \$ 111.00 \$ 1390.00 \$ 111.00 \$ 1790.00 \$ 11790.00 \$ 2538.00 \$ 11790.00 \$ 11790.00 \$ 11790.00 \$ 2538.00 \$ 11790.00 \$ 11790.00 \$ 11790.00 \$ 11790.00 \$ 2538.00 \$ 2538.00 \$ 11590.00 \$ 11590.00 \$ 11590.00 \$ 11590.00 \$ 2538.00 \$ 2538.00		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 6,500.00 37,765.28 3,248.00 964.00 - - - - - - -		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	50,000.00 612,918.00 - - - 1,351,924.00 8,008.00 6,500.00 37,765.28 3,248.00 964.00 - - - - - -

PROJECT INFORMATION							
Saddlehorn Filing 4	9/1/2023	SF-23-006					
Project Name	Date	PCD File No.					

				Unit				(with Pre-	Plat	Construction)
Description		Quantity	Units	Cost			Total	% Complete		Remaining
·					=	\$		·	\$	
[insert items not listed but part of construction	n plans1				=	\$			\$	-
STORM DRAIN IMPROVEMENTS	,									
Concrete Box Culvert (M Standard), Size ( V	V x H )		LF		=	\$			\$	
18" Reinforced Concrete Pipe		49	LF	\$ 76.00	=	\$	3,724.00		\$	3,724.00
24" Reinforced Concrete Pipe		99	LF	\$ 91.00	_	\$	9,029.02		\$	9,029.02
30" Reinforced Concrete Pipe		94	LF	\$ 114.00	_	\$	10,750.20		\$	10,750.20
36" Reinforced Concrete Pipe		7-1	LF	\$ 140.00	=	\$	10,730.20		\$	10,730.20
42" Reinforced Concrete Pipe			LF	\$ 187.00	=	\$			\$	
48" Reinforced Concrete Pipe			LF	\$ 228.00	_	\$			\$	
54" Reinforced Concrete Pipe			LF	\$ 297.00	_	\$			\$	
60" Reinforced Concrete Pipe			LF	\$ 348.00	_	\$			\$	
66" Reinforced Concrete Pipe			LF	\$ 402.00	=	\$			\$	
72" Reinforced Concrete Pipe			LF	\$ 460.00		\$			\$	
18" Corrugated Steel Pipe			LF	\$ 98.00						
9 1			LF		=	\$	-		\$	-
24" Corrugated Steel Pipe			LF LF		=	\$	-		\$	-
30" Corrugated Steel Pipe		0.0	LF	\$ 143.00 \$ 171.00	=	\$	- F 404 22		\$	
36" Corrugated Steel Pipe		32			=	\$	5,494.23		\$	5,494.23
42" Corrugated Steel Pipe			LF	\$ 197.00	=	\$	-		\$	-
48" Corrugated Steel Pipe			LF	\$ 207.00	=	\$	-		\$	-
54" Corrugated Steel Pipe			LF	\$ 304.00	=	\$	-		\$	-
60" Corrugated Steel Pipe			LF	\$ 328.00	=	\$	-		\$	-
66" Corrugated Steel Pipe		36	LF	\$ 397.00	=	\$	14,403.16		\$	14,403.16
72" Corrugated Steel Pipe			LF	\$ 467.00	=	\$	-		\$	-
78" Corrugated Steel Pipe			LF	\$ 537.00	=	\$	-		\$	-
84" Corrugated Steel Pipe			LF	\$ 642.00	=	\$	-		\$	-
Flared End Section (FES) RCP Size = (unit cost = 6x pipe unit cost)	18" RCP	2	_^	\$ 402.00	=	\$	804.00		\$	804.00
Flared End Section (FES) RCP Size =		_	EA	1 11 11 11 11		+				
(unit cost = 6x pipe unit cost)	24" RCP	4	EA	\$ 486.00	=	\$	1,944.00		\$	1,944.00
Flared End Section (FES) RCP Size =		4		¢ (00.00			2 400 00		Φ.	2 400 00
(unit cost = 6x pipe unit cost)	30" RCP	4	EA	\$ 600.00	=	\$	2,400.00		\$	2,400.00
End Treatment- Headwall & Wingwall			EA	\$ 10,000.00	=	\$	-		\$	-
End Treatment - Cutoff Wall			CY		=	\$	-		\$	-
Curb Inlet (Type R) L=5', Depth < 5	'		EA	\$ 6,703.00	=	\$	-		\$	-
Curb Inlet (Type R) L=5', 5' ≤ Depth < 1	0'		EA	\$ 8,715.00	=	\$	-		\$	-
Curb Inlet (Type R) L =5', 10' ≤ Depth < 1	5'		EA	\$ 10,092.00	=	\$	-		\$	-
Curb Inlet (Type R) L =10', Depth < 5	'		EA	\$ 9,224.00	=	\$	-		\$	-
Curb Inlet (Type R) L =10', 5' ≤ Depth < 1	0'		EA	\$ 9,507.00	=	\$	-		\$	-
Curb Inlet (Type R) L =10', 10' ≤ Depth < 1	5'		EA	\$ 11,901.00	=	\$	-		\$	-
Grated Inlet (Type C), Depth < 5'			EA	\$ 5,611.00	=	\$	-		\$	-
Grated Inlet (Type D), Depth < 5'			EA	\$ 6,931.00	=	\$	-		\$	-
Storm Sewer Manhole, Box Base			EA	\$ 14,061.00	=	\$	-		\$	-
Storm Sewer Manhole, Slab Base			EA	\$ 7,734.00	=	\$	-		\$	-
Geotextile (Erosion Control)			SY	\$ 8.00	=	\$	-		\$	-
Rip Rap, d50 size from 6" to 24"		163	Tons	\$ 97.00	=	\$	15,779.96		\$	15,779.96
Rip Rap, Grouted			Tons	\$ 115.00	=	\$	-		\$	-
Drainage Channel Construction, Size ( W x	H )		LF	\$ -	=	\$	_		\$	_
Drainage Channel Lining, Concrete	,		CY	\$ 689.00	=	\$	_		\$	-
Drainage Channel Lining, Rip Rap			CY	\$ 135.00	=	\$	_		\$	
Drainage Channel Lining, Rip Rap		0.8	AC	\$ 1,776.00		\$	1,491.84		\$	1,491.84
Drainage Channel Lining, Other Stabilization		0.0		\$ 1,770.00		\$	1,771.04		\$	1,471.04
Brainage Oriainiei Linnig, Other Stabilization					_	\$			\$	
[insert items not listed but part of construction	n nlansl				=	\$	-		\$	-
* - Subject to defect warranty financial assurance. A mini					=	φ.	-		φ	-
retained until final acceptance (MAXIMUM OF 80% COM			Sectio	n 2 Subtotal	=	\$	2,137,147.69		\$	2,137,147.69
						-	,			, . ,

	PROJECT INFORMATION	
Saddlehorn Filing 4	9/1/2023	SF-23-006
Project Name	Date	PCD File No.

			Unit			(with Pre-F	Plat Construction)
Description	Quantity	Units	Cost		Total	% Complete	Remaining
SECTION 3 - COMMON DEVELOPMENT IMPRO	OVEMENTS (Priv	ate or Dis	trict and NC	T Maintai	ned by EPC)**		
ROADWAY IMPROVEMENTS	,				, ,		
				=	\$ -		-
				=	\$ -	\$	-
				=	\$ -	\$	-
				=	\$ -	\$	-
				=	\$ -	9	-
				=	\$ -	\$	-
STORM DRAIN IMPROVEMENTS (Exce	eption: Permanent Pon	nd/BMP shall	be itemized und	er Section 1)			
				=	\$ -	\$	-
				=	\$ -	4	-
				=	\$ -	\$	-
				=	\$ -	\$	-
				=	\$ -	9	-
				=	\$ -	4	-
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,	42		\$ 1,601.00			_	
Fire Cistern Installation, complete		EA					
Encode Stance and Sate of had a not of a continuation when I						_	
				=	-	3	-
		15	¢ 70.00		•	<b>—</b>	
						_	
			\$ 1,090.00				
Samary Sewer Lift Station, complete		LA					
lineart items not listed but part of construction plans?							•
	(For subdivision spe	cific condition	n of approval or		Ψ -	4	-
<u></u>	(1 or oubdivision spe		Tor approval, or		\$ -		
						_	
				=			
		EA		=	\$ -		-
** - Section 3 is not subject to defect warranty requirements		Sectio	n 3 Subtotal	=	\$ 1,170,512.75		\$ 1,170,512.75
AS-BUILT PLANS (Public Improvements inc. Permanent V	WQCV BMPs)	LS	\$ 10,000.00	=	\$ 10,000.00	\$	10,000.00
POND/BMP CERTIFICATION (inc. elevations and volume	calculations)	LS	\$ 10,000.00	=	\$ 10,000.00		10,000.00
·							
				Total C	Construction Financia	al Assurance	\$ 3,820,846.78
			(Sum of all sec				
	Total Remaini	ing Constr	uction Finan	cial Assur	ance (with Pre-Plat C	onstruction) _	\$ 3,820,846.78
	(Sum of all s	section totals	less credit for ite	ems complete	plus as-builts and pond/B	MP certification)	
				<b>Total Defe</b>	ect Warranty Financia	Il Assurance	\$ 491,697.54
	(20	0% of all items	s identified as (*	). To be colla	teralized at time of prelimin	ary acceptance)	
Δnnrovals							
• •							
					ated with the Project.		
5 . (0.5.0.1.0		=					
Engineer (P.E. Seal Required)							

Date

Date

Approved by Owner / Applicant

Approved by El Paso County Engineer / ECM Administrator

# APPENDIX B HYDROLOGIC CALCULATIONS

#### COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Saddlehorn Ranch Filing 4 Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.06
Calculated By: AAM
Checked By: Date: 3/1/22

		Paved Roads			2.5	2.5 Acre Rural Lots			Lawns			
Basin ID	Total Area (ac)	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	Weighted % Imp.	
C1	2.14	45%	1.00	21.0%	6.2%	1,14	3.3%	2%	0.00	0.0%	24.3%	
C2	22.55	45%	2.21	4.4%	6.2%	20.34	5.6%	2%	0.00	0.0%	10.0%	
C3	1.26	45%	0.61	21.8%	6.2%	0.65	3.2%	2%	0.00	0.0%	25.0%	
C4	1.36	45%	1.36	45.0%	6.2%	0.00	0.0%	2%	0.00	0.0%	45.0%	
C5	3.95	45%	1.59	18.1%	6.2%	2.36	3.7%	2%	0.00	0.0%	21.8%	
C6	4.19	45%	0.93	10.0%	6.2%	3.26	4.8%	2%	0.00	0.0%	14.8%	
C7	1.11	45%	1.11	45.0%	6.2%	0.00	0.0%	2%	0.00	0.0%	45.0%	
C8	10.13	45%	0.00	0.0%	6.2%	8.07	4.9%	2%	2.06	0.4%	5.3%	
D1	3.97	45%	1.22	13.8%	6.2%	2.75	4.3%	2%	0.00	0.0%	18.1%	
D2	5.58	45%	1.55	12.5%	6.2%	4.03	4.5%	2%	0.00	0.0%	17.0%	
D3	0.34	45%	0.34	45.0%	6.2%	0.00	0.0%	2%	0.00	0.0%	45.0%	
D4	10.01	45%	0.35	1.6%	6.2%	8.21	5.1%	2%	1.45	0.3%	6.9%	
D5	7.94	45%	0.00	0.0%	6.2%	5.15	4.0%	2%	2.79	0.7%	4.7%	
D6	17.08	45%	2.29	6.0%	6.2%	14.79	5.4%	2%	0.00	0.0%	11.4%	
D7	0.86	45%	0.86	45.0%	6.2%	0.00	0.0%	2%	0.00	0.0%	45.0%	
D8	6.00	45%	1.96	14.7%	6.2%	4.04	4.2%	2%	0.00	0.0%	18.9%	
D9	2.00	45%	1.94	43.7%	6.2%	0.06	0.2%	2%	0.00	0.0%	43.8%	
UD1	20.70	45%	0.00	0.0%	6.2%	20.70	6.2%	2%	0.00	0.0%	6.2%	
UD2	24.68	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	24.68	2.0%	2.0%	
UD3	7.68	45%	0.00	0.0%	6.2%	7.68	6.2%	2%	0.00	0.0%	6.2%	
UD4	12.80	45%	0.00	0.0%	6.2%	12.80	6.2%	2%	0.00	0.0%	6.2%	
OS1	2.26	100%	1.27	56.2%	6.2%	0.00	0.0%	2%	0.99	0.9%	57.1%	
OS2	0.72	100%	0.24	33.3%	6.2%	0.00	0.0%	2%	0.48	1.3%	34.7%	
TOTAL	169.31										10.7%	

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

2.5 A	Acre Rural Lots - Comp.	% Impervious Calculation	on
Total Area (ac)	Area (ac) - Roofs (90%)	Area (ac)- Drives (100%)	Area (ac) - Lawns (2%)
2.50	0.068	0.046	2.39
Comp % Imperviousness		6.20%	

Roads w/ Roadside [	Ditches - Comp. % Impe	rvious Calculation
Area* (ac)	Area - Ditch (5%)	Area - Roads (100%)
0.2124	0.1320	0.0804
Comp % Imperviousness	0.	41

\*Area based on 250 LF roadway from CL to outside edge of roadside ditch The above conservatively rounded to 45%.

#### COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

bdivision: Saddlehorn Ranch Filing 4 Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.06

Calculated By: AAM Checked By: TBD

Date: 3/1/22

		Basins Total	Hydro	ologic Soil (	Group	Hydro	ologic Soil (	Group	Mir	nor Coeffici	ents	Maj	jor Coeffici	ents		Basins Total
Basin ID	Total Area (ac)	Weighted % Imp.	Area A (ac)	Area B (ac)	Area C/D (ac)	% A (ac)	% B (ac)	% C/D (ac)	C <sub>5,A</sub>	C <sub>5,B</sub>	C <sub>5,C/D</sub>	C <sub>100,A</sub>	C <sub>100,B</sub>	C <sub>100,C/D</sub>	Basins Total Weighted C <sub>5</sub>	Weighted C <sub>100</sub>
C1	2.14	24.3%	1.55	0.00	0.59	72%	0%	28%	0.14	0.19	0.23	0.30	0.54	0.58	0.17	0.38
C2	22.55	10.0%	22.55	0.00	0.00	100%	0%	0%	0.05	0.07	0.12	0.19	0.47	0.52	0.05	0.19
C3	1.26	25.0%	1.26	0.00	0.00	100%	0%	0%	0.15	0.19	0.24	0.31	0.54	0.59	0.15	0.31
C4	1.36	45.0%	1.36	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
C5	3.95	21.8%	3.95	0.00	0.00	100%	0%	0%	0.12	0.16	0.21	0.28	0.53	0.57	0.12	0.28
C6	4.19	14.8%	4.19	0.00	0.00	100%	0%	0%	0.08	0.11	0.16	0.23	0.50	0.55	0.08	0.23
C7	1.11	45.0%	1.11	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
C8	10.13	5.3%	10.13	0.00	0.00	100%	0%	0%	0.02	0.04	0.08	0.15	0.45	0.51	0.02	0.15
D1	3.97	18.1%	0.11	0.00	3.86	3%	0%	97%	0.10	0.13	0.18	0.25	0.51	0.56	0.18	0.55
D2	5.58	17.0%	3.65	0.00	1.93	65%	0%	35%	0.09	0.13	0.17	0.24	0.51	0.55	0.12	0.35
D3	0.34	45.0%	0.17	0.00	0.17	50%	0%	50%	0.31	0.36	0.40	0.46	0.64	0.67	0.36	0.57
D4	10.01	6.9%	3.16	0.00	6.85	32%	0%	68%	0.03	0.05	0.09	0.16	0.46	0.51	0.07	0.40
D5	7.94	4.7%	2.43	0.00	5.51	31%	0%	69%	0.02	0.03	0.07	0.15	0.45	0.50	0.06	0.39
D6	17.08	11.4%	13.71	0.00	3.37	80%	0%	20%	0.05	0.08	0.13	0.20	0.48	0.53	0.07	0.26
D7	0.86	45.0%	0.82	0.00	0.04	95%	0%	5%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.47
D8	6.00	18.9%	6.00	0.00	0.00	100%	0%	0%	0.10	0.14	0.19	0.26	0.51	0.56	0.10	0.26
D9	2.00	43.8%	1.97	0.00	0.03	98%	0%	2%	0.30	0.35	0.39	0.45	0.63	0.66	0.30	0.46

UD1	20.70	6.2%	16.26	0.00	4.44	79%	0%	21%	0.03	0.04	0.09	0.16	0.46	0.51	0.04	0.23
UD2	24.68	2.0%	1.06	0.00	23.62	4%	0%	96%	0.01	0.01	0.05	0.13	0.44	0.49	0.05	0.48
UD3	7.68	6.2%	5.85	0.00	1.83	76%	0%	24%	0.03	0.04	0.09	0.16	0.46	0.51	0.04	0.24
UD4	12.80	6.2%	12.80	0.00	0.00	100%	0%	0%	0.03	0.04	0.09	0.16	0.46	0.51	0.03	0.16
OS1	2.26	57.1%	0.47	0.00	1.79	21%	0%	79%	0.42	0.47	0.50	0.56	0.69	0.72	0.49	0.68
OS2	0.72	34.7%	0.72	0.00	0.00	100%	0%	0%	0.22	0.27	0.32	0.38	0.59	0.63	0.22	0.38
TOTAL	169.31	10.7%	115.28	0.00	54.04	68%	0%	32%							0.07	0.30

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS				Storm Re	turn Period		
Soil Group	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	C <sub>A</sub> =	C <sub>A</sub> =	C <sub>A</sub> =	C <sub>A</sub> =	C <sub>A</sub> =	C <sub>A</sub> =	C <sub>A</sub> =
	0.84i <sup>1.302</sup>	0.86i <sup>1.276</sup>	0.87i <sup>1.232</sup>	0.84i <sup>1.124</sup>	0.85i+0.025	0.78i+0.110	0.65i+0.254
В	C <sub>B</sub> = 0.84i <sup>1.169</sup>	$C_B = 0.86i^{1.088}$	C <sub>B</sub> = 0.81 <i>i</i> +0.057	C <sub>B</sub> = 0.63 <i>i</i> +0.249	C <sub>B</sub> = 0.56 <i>t</i> +0.328	C <sub>B</sub> = 0.47 <i>i</i> +0.426	C <sub>B</sub> = 0.37 <i>i</i> +0.536
C/D	C <sub>C/D</sub> =	C <sub>C/D</sub> =	C <sub>CD</sub> =	C <sub>C/D</sub> =	C <sub>C/D</sub> =	C <sub>C/D</sub> =	C <sub>C/D</sub> =
	0.83 <i>i</i> <sup>1.122</sup>	0.82i+0.035	0.74i+0.132	0.56i+0.319	0.49i+0.393	0.41 <i>i</i> +0.484	0.32i+0.588

#### Where:

i = % imperviousness (expressed as a decimal)

 $C_A$  = Runoff coefficient for Natural Resources Conservation Service (NRCS) HSG A soils

 $C_B$  = Runoff coefficient for NRCS HSG B soils

 $C_{C/D}$  = Runoff coefficient for NRCS HSG C and D soils.

## STANDARD FORM SF-2 TIME OF CONCENTRATION

Subdivision: Saddlehorn Ranch Filing 4
Location: El Paso County

Project Name: Saddlehorn Ranch

Project No.: 25142.06

Calculated By: AAM

Checked By: TBD

Date: 3/1/22

		SUB-I	BASIN			INITI	AL/OVERI	LAND		T	RAVEL TIM	E			tc CHECK		
		DA	λTA				$(T_i)$				$(T_t)$			(U	IRBANIZED BA	SINS)	FINAL
BASIN	D.A.	Hydrologic	Impervious	$C_5$	C <sub>100</sub>	L	$S_o$	$t_i$	$L_t$	$S_t$	K	VEL.	$t_t$	COMP. $t_c$	TOTAL	Urbanized $t_c$	$t_c$
ID	(ac)	Soils Group	(%)			(ft)	(%)	(min)	(ft)	(%)		(ft/s)	(min)	(min)	LENGTH (ft)	(min)	(min)
C1	2.14	Α	24%	0.17	0.38	52	7.5%	6.2	689	1.0%	15.0	1.5	7.7	13.9	741.0	31.1	13.9
C2	22.55	А	10%	0.05	0.19	300	1.9%	26.7	630	1.0%	15.0	1.5	7.0	33.7	930.0	34.4	33.7
C3	1.26	Α	25%	0.15	0.31	143	2.4%	15.4	184	1.0%	15.0	1.5	2.0	17.5	327.0	24.2	17.5
C4	1.36	А	45%	0.31	0.46	28	13.8%	3.2	1210	1.6%	15.0	1.9	10.6	13.8	1238.0	28.8	13.8
C5	3.95	Α	22%	0.12	0.28	97	1.4%	15.5	997	1.0%	15.0	1.5	11.1	26.6	1094.0	36.1	26.6
C6	4.19	А	15%	0.08	0.23	154	3.0%	16.0	455	1.0%	15.0	1.5	5.1	21.0	609.0	30.3	21.0
C7	1.11	А	45%	0.31	0.46	28	13.8%	3.2	673	1.0%	15.0	1.5	7.5	10.7	701.0	25.7	10.7
C8	10.13	А	5%	0.02	0.15	300	3.0%	23.5	557	1.0%	15.0	1.5	6.2	29.7	857.0	34.6	29.7
D1	3.97	D	18%	0.18	0.55	266	2.4%	20.3	354	1.0%	15.0	1.5	3.9	24.2	620.0	28.0	24.2
D2	5.58	Α	17%	0.12	0.35	83	3.0%	11.2	1382	2.2%	15.0	2.2	10.4	21.6	1465.0	36.8	21.6
D3	0.34	А	45%	0.36	0.57	46	8.0%	4.6	332	1.0%	15.0	1.5	3.7	8.3	378.0	22.0	8.3
D4	10.01	D	7%	0.07	0.40	300	1.8%	26.5	1201	1.0%	15.0	1.5	13.3	39.8	1501.0	44.9	39.8
D5	7.94	D	5%	0.06	0.39	300	2.0%	26.0	426	1.0%	7.0	0.7	10.1	36.1	726.0	32.5	32.5
D6	17.08	А	11%	0.07	0.26	300	4.0%	20.4	904	1.4%	15.0	1.8	8.4	28.8	1204.0	36.0	28.8
D7	0.86	А	45%	0.31	0.47	40	8.0%	4.5	857	1.0%	15.0	1.5	9.5	14.0	897.0	27.7	14.0
D8	6.00	Α	19%	0.10	0.26	86	2.0%	13.3	1027	1.0%	15.0	1.5	11.4	24.7	1113.0	37.5	24.7
D9	2.00	Α	44%	0.30	0.46	110	3.0%	10.5	1823	1.0%	15.0	1.5	20.3	30.8	1933.0	38.6	30.8
UD1	20.70	Α	6%	0.04	0.23	300	3.0%	23.1	546	3.0%	7.0	1.2	7.5	30.6	846.0	30.3	30.3
UD2	24.68	D	2%	0.05	0.48	300	2.3%	25.0	1450	1.1%	15.0	1.6	15.4	40.3	1750.0	50.5	40.3
UD3	7.68	Α	6%	0.04	0.24	300	2.5%	24.5	818	1.5%	7.0	0.9	15.9	40.4	1118.0	36.2	36.2
UD4	12.80	А	6%	0.03	0.16	300	1.6%	28.8	628	1.9%	7.0	1.0	10.8	39.6	928.0	32.6	32.6

#### STANDARD FORM SF-2 TIME OF CONCENTRATION

Subdivision: Saddlehorn Ranch Filing 4 Location: El Paso County

Project Name: Saddlehorn Ranch Project No.: 25142.06 Calculated By: AAM Checked By: TBD

Date: 3/1/22

		SUB-l	BASIN			INITI	AL/OVER	LAND		T	RAVEL TIM	E			tc CHECK		
		DA	$(T_i)$ $(T_t)$										(U	IRBANIZED BA	SINS)	FINAL	
BASIN	D.A.	Hydrologic	Impervious	C <sub>5</sub>	C <sub>100</sub>	L	So	t i	$L_t$	$S_t$	Κ	VEL.	$t_t$	COMP. $t_c$	TOTAL	Urbanized $t_c$	t <sub>c</sub>
ID	(ac)	Soils Group	(%)			(ft)	(%)	(min)	(ft)	(%)		(ft/s)	(min)	(min)	LENGTH (ft)	(min)	(min)
OS1	2.26	D	57%	0.49	0.68	41	2.5%	5.2	45	1.1%	7.0	0.7	1.0	6.3	86.0	16.7	6.3
OS2	0.72	Α	35%	0.22	0.38	41	2.5%	7.5	43	1.0%	7.0	0.7	1.0	8.5	84.0	20.6	8.5

#### NOTES:

 $t_c = t_i + t_t$ 

Equation 6-2

Equation 6-3

Type of Land Surface Conveyance Factor, K Heavy meadow 2.5 Tillage/field 5 Short pasture and lawns 7 Nearly bare ground 10

Grassed waterway

Paved areas and shallow paved swales

15

20

Table 6-2. NRCS Conveyance factors, K

Where:

 $t_c$  = computed time of concentration (minutes)

 $t_i$  = overland (initial) flow time (minutes)

 $t_t$  = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

Where:

 $t_i$  = overland (initial) flow time (minutes)

 $C_5$  = runoff coefficient for 5-year frequency (from Table 6-4)

 $L_i$  = length of overland flow (ft)

 $S_0$  = average slope along the overland flow path (ft/ft).

$$= \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$
 Equation 6-4  $t_c = (26-17i) + \frac{L_t}{60(14i+9)\sqrt{S_t}}$ 

Equation 6-5

Where

 $t_t$  = channelized flow time (travel time, min)

 $L_t = \text{waterway length (ft)}$ 

So = waterway slope (ft/ft)

 $V_t = \text{travel time velocity (ft/sec)} = K\sqrt{S_0}$ 

K = NRCS conveyance factor (see Table 6-2).

Where:

 $t_c$  = minimum time of concentration for first design point when less than  $t_c$  from Equation 6-1.

 $L_t$  = length of channelized flow path (ft)

i = imperviousness (expressed as a decimal)

 $S_t =$  slope of the channelized flow path (ft/ft).

Use a minimum  $t_c$  value of 5 minutes for urbanized areas and a minimum  $t_c$  value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

Subdivision: Saddlehorn Ranch Filing 4
Location: El Paso County
Design Storm: 5-Year

 Project Name:
 Saddlehorn Ranch

 Project No.:
 25142.06

 Calculated By:
 AAM

 Checked By:
 TBD

 Date:
 3/1/22

				DIRE	CT RUI	NOFF			TC	OTAL F	RUNOF	F		SWALE			PI	PE		TRAV	EL TIN	1E	
																			0				
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t <sub>c</sub> (min)	3*A (Ac)	(in/hr)	O (cfs)	tc (min)	C*A (ac)	(in/hr)	O (cfs)	O <sub>street</sub> (cfs)	C*A (ac)	Slope (%)	O <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	oipe Size (inches)	ength (ft)	Velocity (fps)	t <sub>t</sub> (min)	REMARKS
							_						2.7							387	2.0	3.2	Existing flows from Saddlehorn Filing 3
	EX1								34.7	1 19	2.26	2.7											Swale conveyance to DP 1.0
									0 1117	,	L.LO		2.0	0.72	1.0					0	2.0	0.0	Roadside Swale
	1	D1	3.97	0.18	24.2	0.72	2.80	2.0															Swale conveyance to DP 1.0
													4.1	1.91	1.7					1045	2.6	6.7	Sum of DP EX1 and DP 1
	1.0								37.9	1.91	2.13	4.1	2.0	0.77	1.0					0	2.0	0.0	Swale conveyance to DP 1.1
	2	D2	5.58	0.12	21.6	0.66	2 07	2.0					2.0	0.66	1.0					U	2.0	0.0	Roadside Swale Swale conveyance to DP 1.1
		DZ	3.30	0.12	21.0	0.00	2.71	2.0					0.5	0.12	1.0					0	2.0	0.0	Roadside Swale
	3	D3	0.34	0.36	8.3	0.12	4.41	0.5					0.0	0.12						Ŭ	2.0	0.0	Swale conveyance to DP 1.1
													5.1	2.69	1.0					117	2.0	1.0	Sum of DP 1.0, DP 2, & DP 3
	1.1								44.6	2.69	1.89	5.1											Swale conveyance to DP 1.2
	EV.0								07.0	4 (0	0.40		4.3	1.62	1.9					894	2.7	5.5	Existing flows from Saddlehorn Filing 3
	EX2								27.2	1.62	2.63	4.3	1.5	0.72	1.0					0	2.7	0.0	Swale conveyance to DP 1.2 Swale
	4	D4	10.01	0.07	30.8	0.72	2.06	1.5					1.5	0.72	1.9					U	2.1	0.0	Swale conveyance to DP 1.2
	7	DŦ	10.01	0.07	37.0	0.72	2.00	1.5					9.3	5.03	0.8					623	1.7	6.0	Sum of DP 1.1, DP EX2, and DP 4
	1.2								45.6	5.03	1.85	9.3											Swale/ Pond conveyance to DP 1.6
													3.0	1.17	1.1					430	2.1	3.4	Roadside Swale
	6	D6	17.08	0.07	28.8	1.17	2.54	3.0															Swale conveyance to DP 1.3
	7	D7	0.86	0.31	14.0	0.27	3.62	1.0					1.0	0.27	1.0					0	2.0	0.0	Roadside Swale
	,	וט	0.60	0.31	14.0	0.27	3.02	1.0					3.4	1.44	1.0					136	2.0	11	Swale conveyance to DP 1.3 Sum of DP 6 and DP 7
	1.3								32.3	1.44	2.37	3.4	5.4	1.44	1.0					130	2.0		Culvert conveyance to DP 1.5
													1.7	0.61	1.1					442	2.1		Roadside Swale
	8	D8	6.00	0.10	24.7	0.61	2.77	1.7															Swale conveyance to DP 1.4
													1.5	0.60	1.1					0	2.1	0.0	Roadside Swale
	9	D9	2.00	0.30	30.8	0.60	2.44	1.5					0.0	4.04	4.0					10/	0.0		Swale conveyance to DP 1.4
	1.4								30.8	1 21	2.44	3.0	3.0	1.21	1.0					136	2.0	1.1	Sum of DP 8 and DP 9 conveyance to DP 1.5
	1.4								30.0	1.21	2.44	3.0	6.1	2.65	0.5		-			153	1.4	1.8	Sum of DP 1.3 and DP 1.4
	1.5								33.4	2.65	2.32	6.1	0.1	2.00	0.5					100	1.4	1.0	Swale/ Pond conveyance to DP 1.6
													1.1	0.45	1.0	1				0	2.0	0.0	Roadside Swale
	5	D5	7.94	0.06	32.5	0.45	2.36	1.1															Swale conveyance to DP 1.6
													13.6	8.13	0.75					0	1.7	0.0	Sum of DP 1.2, DP 1.5, and DP 5
	1.6								51.6	8.13	1.67	13.6	10	0.27	1.0	<b>!</b>		ļ		1014	2.0	10 1	Outlet structure release into Drainageway MS-06
	11	C1	2.14	0 17	12.0	0.36	3 64	1.3					1.3	0.36	1.0					1214	2.0	10.1	Roadside Swale Swale conveyance to DP 2.0
		U1	2.14	0.17	13.9	0.30	3.04	1.3					2.4	1.04	1.0	1	+			n	2.0	0.0	Roadside Swale
	12	C2	22.55	0.05	33.7	1.04	2.31	2.4															Swale conveyance to DP 2.0

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Subdivision:	Saddlehorn Ranch Filing 4
Location:	El Paso County
Design Storm:	5-Year

 Project Name:
 Saddlehorn Ranch

 Project No.:
 25142.06

 Calculated By:
 AAM

 Checked By:
 TBD

 Date:
 371722

				DIRE	CT RUI	NOFF			T	A JATC	RUNOF	F		SWALE			PI	PE		TRAV	EL TIN	1E	
STREET	Jesign Point	Basin ID	Area (Ac)	Runoff Coeff.	(min)	.*A (Ac)	(in/hr)	Q (cfs)	tc (min)	C*A (ac)	(in/hr)	Q (cfs)	O <sub>street</sub> (cfs)	C*A (ac)	Slope (%)	O <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	lpe Size (inches)	ength (ft)	Velocity (fps)	(min)	REMARKS
	ā	B	₹	2	ئ	ت		O	tc	ن	_	0	3.2		0.5		ت	S	Ŀ	278	<u>&gt;</u>	33	Sum of DP 11 & DP 12
	2.0								33.7	1.40	2.31	3.2	3.2	1.40	0.5					270	1.4		Swale conveyance to DP 2.2
													6.8	4.61	1.0					1147	2.0		Existing flows from Saddlehorn Filing 3
	EX3								58.3	4.61	1.48	6.8											Swale conveyance to DP 2.1
													1.3	0.49	1.0					0	2.0		Roadside Swale
	15	C5	3.95	0.12	26.6	0.49	2.66	1.3															Swale conveyance to DP 2.1
	2.1								E0 2	5.10	1 /0	7.6				7.	6 5.10	1.0	36	59	6.2	0.2	Sum of DP EX3 and DP 15 Culvert conveyance to DP 2.2
	2.1								36.3	5.10	1.40	7.0	0.6	0.19	1.5		0 3.10	1.0	30	1071	2.4		Roadside Swale
	13	C3	1.26	0.15	17.5	0.19	3.29	0.6					0.0	0.17	1.5					1071	2.7	7.5	Swale conveyance to DP 2.2
	1												1.5	0.42	1.0					0	2.0	0.0	Roadside Swale
	14	C4	1.36	0.31	13.8	0.42	3.65	1.5															Swale conveyance to DP 2.2
													10.5	7.11	1.0					388	2.0	3.2	Sum of DP 13, DP 14, DP 2.0, & DP 2.1
	2.2								58.5	7.11	1.48	10.5											Swale/ Pond conveyance to DP 2.4
													0.9	0.31	1.1					288	2.1	2.3	Roadside Swale
	16	C6	4.19	0.08	21.0	0.31	3.01	0.9					1.4	0.24	1 1					0	2.1	0.0	Swale conveyance to DP 2.3
	17	C7	1.11	0.31	10.7	0.34	4.03	1.4					1.4	0.34	1.1					0	2.1	0.0	Roadside Swale Swale conveyance to DP 2.3
	17	C/	1.11	0.31	10.7	0.34	4.03	1.4					1.9	0.65	1.0					649	2.0	5.4	Swale conveyance to DP 2.3 Sum of DP 16 and DP 17
	2.3								23.3	0.65	2.86	1.9		0.03	1.0					047	2.0	5.4	Swale conveyance to DP 2.4
													0.5	0.20	1.0					0	2.0	0.0	Existing Pond C, Filing 4 Lots, and Filing 4 roadways
	18	C8	10.13	0.02	29.7	0.20	2.50	0.5															Overland flow, swale, and pond conveyance to DP 2.4
													11.1	7.96	1.0					1147	2.0		Sum of DP 2.2, DP 2.3, and DP 18
	2.4								61.7	7.96	1.40	11.1											Outlet structure release into Drainageway MS-06
	LID1	LID1	20.70	0.04	20.2	0.70	2.47	1.0															Overland Flow
	ועט	ועט	20.70	0.04	30.3	0.79	2.47	1.9															Sheet flow into Drainageway WF-R7A Overland Flow
	UD2	UD2	24.68	0.05	40.3	1.21	2.04	2.5															Sheet flow into Drainageway WF-R7A
	002	002	2 1.00	0.00	10.0		2.01	2.0															Overland Flow
	UD3	UD3	7.68	0.04	36.2	0.30	2.20	0.7															Sheet flow into Drainageway WF-R7A
																							Overland Flow
	UD4	UD4	12.80	0.03	32.6	0.32	2.35	0.8															Sheet flow into Drainageway MS-06
	001	001	2.24	0.40	4.2	1 10	4.02	E 2															Overland Flow
	OS1	OS1	2.26	0.49	0.3	1.10	4.83	5.3										1					Sheet flow into Drainageway WF-R7A Overland Flow
	OS2	OS2	0.72	0.22	8.5	0.16	4.37	0.7															Sheet flow into Drainageway WF-R7A
	002	002	0.72	0.22	0.0	0.10	1.07	0.7															whose non-into oraningeria y vii terri

#### Notes

Street and Pipe C\*A values are determined by Q/i using the catchment's intensity value.

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Subdivision: Saddlehorn Ranch Filing 4
Location: El Paso County
Design Storm: 100-Year

Project Name: Saddlehorn Ranch
Project No.: 25142.06

Calculated By: AAM
Checked By: TBD
Date: 3/1/22

				DIRE	CT RUI	NOFF			TC	TAL F	RUNOF	F		SWALE			PI	PE		TRAV	EL TIN	ΛE	
																			(S)				
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (ac)	l (in/hr)	O (cfs)	tc (min)	C*A (ac)	l (in/hr)	O (cfs)	O <sub>street</sub> (cfs)	C*A (ac)	Slope (%)	O <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	REMARKS
													15.4	4.05						387	2.0	3.2	Existing flows from Saddlehorn Filing 3
	EX1								34.7	4.05	3.80	15.4											Swale conveyance to DP 1.0
	1	D1	2.07	0.55	24.2	0.10	4.71	10.0					10.3	2.18	1.0					0	2.0	0.0	Roadside Swale
		D1	3.97	0.55	24.2	2.18	4./1	10.3					22.3	6.23	1.7					1045	2.6	6.7	Swale conveyance to DP 1.0 Sum of DP EX1 and DP 1
	1.0								37.9	6.23	3.57	22.3	22.3	0.23	1.7					1045	2.0	0.7	Swale conveyance to DP 1.1
													9.7	1.95	1.0					0	2.0	0.0	Roadside Swale
	2	D2	5.58	0.35	21.6	1.95	4.99	9.7															Swale conveyance to DP 1.1
	3	D3	0.34	0.57	8 3	0.10	7.41	1.4					1.4	0.19	1.0					0	2.0	0.0	Roadside Swale Swale conveyance to DP 1.1
	3	- 03	0.34	0.37	0.3	0.17	7.41	1.4					26.5	8.37	1.0					117	2.0	1.0	Sum of DP 1.0, DP 2, & DP 3
	1.1								44.6	8.37	3.16	26.5	20.0	0.07							2.0		Swale conveyance to DP 1.2
													11.3	2.56	1.9					894	2.7	5.5	Existing flows from Saddlehorn Filing 3
	EX2								27.2	2.56	4.41	11.3											Swale conveyance to DP 1.2
													13.9	4.03	1.9					0	2.7	0.0	Swale
	4	D4	10.01	0.40	39.8	4.03	3.45	13.9					4/ 5	140/	0.0					/22	17	/ 0	Swale conveyance to DP 1.2 Sum of DP 1.1, DP EX2, and DP 4
	1.2								45.6	14 96	3.11	46.5	40.5	14.96	0.8					623	1.7	6.0	Sum of DP 1.1, DP EX2, and DP 4 Swale/ Pond conveyance to DP 1.6
	1.2								10.0		0	10.0	19.3	4.52	1.1					430	2.1	3.4	Roadside Swale
	6	D6	17.08	0.26	28.8	4.52	4.26	19.3															Swale conveyance to DP 1.3
													2.4	0.40	1.0					0	2.0	0.0	Roadside Swale
	7	D7	0.86	0.47	14.0	0.40	6.08	2.4															Swale conveyance to DP 1.3
	1 2								22.2	4.00	2.00	10 /	19.6	4.92	1.0					136	2.0		Sum of DP 6 and DP 7
	1.3								32.3	4.92	3.98	19.0	7.2	1.54	1.1					442	2.1		Culvert conveyance to DP 1.5 Roadside Swale
	8	D8	6.00	0.26	24.7	1.54	4.65	7.2					1.2	1.54	1.1					442	2.1	3.5	Swale conveyance to DP 1.4
	Ů	- 50	0.00	0.20		1101	1100	7.2					3.7	0.91	1.1					0	2.1	0.0	Roadside Swale
	9	D9	2.00	0.46	30.8	0.91	4.10	3.7															Swale conveyance to DP 1.4
													10.0	2.45	1.0					136	2.0	1.1	Sum of DP 8 and DP 9
	1.4								30.8	2.45	4.10	10.0											conveyance to DP 1.5
	1.5								22.4	7.07	2.00	20.7	28.7	7.37	0.5					153	1.4	1.8	Sum of DP 1.3 and DP 1.4
	1.5								33.4	1.31	3.89	28.7	12.4	3.13	1.0					0	2.0	0.0	Swale/ Pond conveyance to DP 1.6 Roadside Swale
	5	D5	7.94	0.39	32.5	3.13	3.96	12.4					12.4	J. 13	1.0					ı "	2.0	0.0	Swale conveyance to DP 1.6
				2.27	52.0	20	20						71.3	25.46	0.75					0	1.7	0.0	Sum of DP 1.2, DP 1.5, and DP 5
	1.6								51.6	25.46	2.80	71.3											Outlet structure release into Drainageway MS-06
													4.9	0.81	1.0					1214	2.0	10.1	Roadside Swale
	11	C1	2.14	0.38	13.9	0.81	6.10	4.9	$\vdash$				1/ 4	4.24	1.0	<b>!</b>				_	2.0	0.0	Swale conveyance to DP 2.0
	12	C2	22 55	0.10	33.7	121	2 97	16.4					16.4	4.24	1.0					0	2.0		Roadside Swale Swale conveyance to DP 2.0
	12	UZ	22.33	0.19	აა./	4.24	3.07	10.4							1								Swale conveyance to DP 2.0

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Subdivision:	Saddlehorn Ranch Filing 4
Location:	El Paso County
Design Storm:	100-Year

Project Name: Saddlehorn Ranch
Project No.: 25142.06
Calculated By: AAM
Checked By: TBD
Date: 3/1/22

	DIRECT RUNOFF						TO	OTAL F	RUNO	FF	SWALE			PIPE				TRAV	EL TIN	ЛE				
	_			نے															ches)		()			
STREET	Design Point	Basin ID	Area (ac)	Runoff Coeff.	(min)	C*A (ac)	(in/hr)	O (cfs)	(min)	C*A (ac)	(in/hr)	O (cfs)	O <sub>street</sub> (cfs)	C*A (ac)	Slope (%)	O <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	ength (ft)	Velocity (fps)	(min)	REMARKS	
	Des	Bas	Are	Rur	t <sub>c</sub> (	C* A	Ë	o (c	tc (	ر* د	ı.	) a	Str	C* A	Slop	g	.×.	Slop	Pipe	Len	Velo	t <sub>t</sub> (i		
													19.6							278	1.4	3.3	Sum of DP 11 & DP 12	
	2.0								33.7	5.05	3.87	19.6											vale conveyance to DP 2.2	
	=>/*												32.2	12.95	1.0					1147	2.0		xisting flows from Saddlehorn Filing 3	
	EX3								58.3	12.95	2.49	32.2	г о	1 11	1.0					0	2.0		vale conveyance to DP 2.1	
	15	C5	3.95	0.28	26.6	1.11	4.46	5.0					5.0	1.11	1.0					U	2.0		Roadside Swale Swale conveyance to DP 2.1	
	13	0.5	3.73	0.20	20.0	1.11	4.40	3.0															Sum of DP EX3 and DP 15	
	2.1								58.3	14.06	2.49	35.0				35.0	14.06	1.0	36	59	9.5	0.1	Culvert conveyance to DP 2.2	
														0.38	1.5					1071	2.4		Roadside Swale	
	13	C3	1.26	0.31	17.5	0.38	5.53	2.1															Swale conveyance to DP 2.2	
													3.9	0.63	1.0					0	2.0	0.0	Roadside Swale	
	14 C4 1.36 0.46 13.8 0.63 6.12 3		3.9															Swale conveyance to DP 2.2						
													50.0	20.12	1.0					388	2.0		Sum of DP 13, DP 14, DP 2.0, & DP 2.1	
	2.2								58.4	20.12	2.49	50.0		0.05						000	0.4		Swale/ Pond conveyance to DP 2.4	
	1.	0/	4.10	0.00	21.0	0.05	F 0/	4.0					4.8	0.95	1.1					288	2.1		oadside Swale	
	16	C6	4.19	0.23	21.0	0.95	5.06	4.8					2.5	0.51	11					0	2.1		wale conveyance to DP 2.3 oadside Swale	
	17	C7	1 11	0.46	10.7	0.51	6.77	3.5					3.5	0.51	1.1					U	2.1		oadside Swale wale conveyance to DP 2.3	
	17	- 07	1.11	0.40	10.7	0.01	0.77	3.3					7.0	1.46	1.0					649	2.0		Sum of DP 16 and DP 17	
	2.3								23.3	1.46	4.80	7.0											Swale conveyance to DP 2.4	
														1.54	1.0					0	2.0	0.0	Existing Pond C, Filing 4 Lots, and Filing 4 roadways	
	18	C8	10.13	0.15	29.7	1.54	4.19	6.5															Overland flow, swale, and pond conveyance to DP 2.4	
													54.3	23.12	1.0					1147	2.0	9.6	Sum of DP 2.2, DP 2.3, and DP 18	
	2.4								61.6	23.12	2.35	54.3											Outlet structure release into Drainageway MS-06	
	LID1	LID1	20.70	0.00	20.2	4.00	4 1 4	20.0															Overland Flow	
	UD1	ועט	20.70	0.23	30.3	4.83	4.14	20.0															Sheet flow into Drainageway WF-R7A Overland Flow	
	UD2	UD2	24 68	0.48	40.3	11 75	3.42	40.2															Overland Flow Sheet flow into Drainageway WF-R7A	
	ODZ	ODZ	21.00	0.10	10.0	11.70	0.12	10.2															Overland Flow	
	UD3	UD3	7.68	0.24	36.2	1.86	3.69	6.9															Sheet flow into Drainageway WF-R7A	
																							Overland Flow	
	UD4	UD4	12.80	0.16	32.6	2.02	3.95	8.0															Sheet flow into Drainageway MS-06	
	OS1	OS1	2.26	0.68	6.2	1.55	8.11	12.6															Overland Flow	
	UST	UST	2.20	0.08	0.3	1.00	0.11	12.0			-						_						Sheet flow into Drainageway WF-R7A Overland Flow	
	OS2	OS2	0.72	0.38	8.5	0.27	7.34	2.0															Sheet flow into Drainageway WF-R7A	
			0.72	0.00	0.0	0.27	,	2.0															gonuj III IIII	

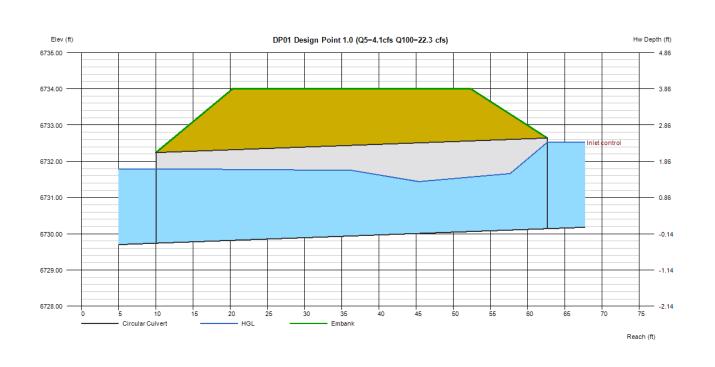
Notes: Street and Pipe C\*A values are determined by Q/i using the catchment's intensity value.

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# APPENDIX C HYDRAULIC CALCULATIONS

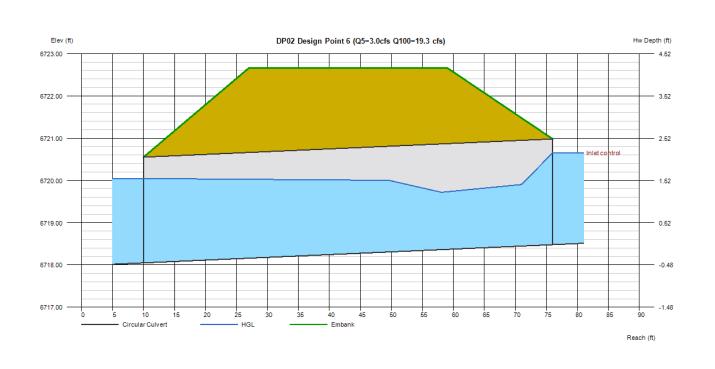
## DP01 Design Point 1.0 (Q5=4.1cfs Q100=22.3 cfs)

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+D)/2
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31.79
31.75
32.53
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et Control



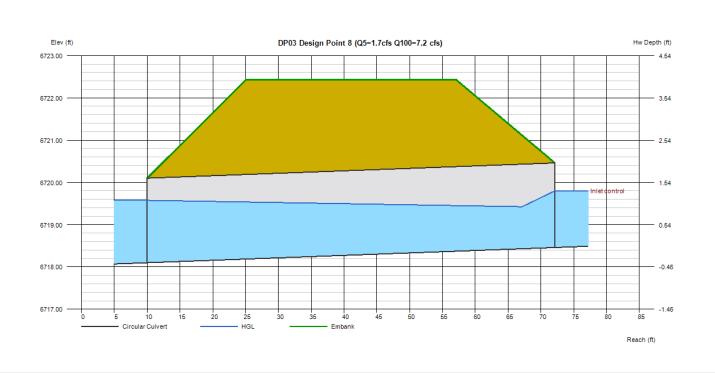
## DP02 Design Point 6 (Q5=3.0cfs Q100=19.3 cfs)

Invert Elev Dn (ft)	= 6718.05	Calculations	
Pipe Length (ft)	= 66.01	Qmin (cfs)	= 3.00
Slope (%)	= 0.65	Qmax (cfs)	= 19.30
Invert Elev Up (ft)	= 6718.48	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 30.0		
Shape	= Circular	Highlighted	
Span (in)	= 30.0	Qtotal (cfs)	= 19.30
No. Barrels	= 1	Qpipe (cfs)	= 19.30
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 4.60
Culvert Entrance	= Groove end projecting (C)	Veloc Up (ft/s)	= 6.30
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2	HGL Dn (ft)	= 6720.04
		HGL Up (ft)	= 6719.98
Embankment		Hw Elev (ft)	= 6720.65
Top Elevation (ft)	= 6722.66	Hw/D (ft)	= 0.87
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00		



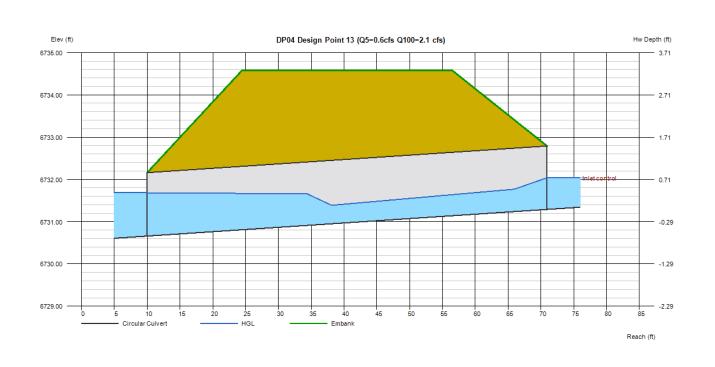
## DP03 Design Point 8 (Q5=1.7cfs Q100=7.2 cfs)

Invert Elev Dn (ft)	= 6718.10	Calculations	
Pipe Length (ft)	= 62.13	Qmin (cfs)	= 1.70
Slope (%)	= 0.58	Qmax (cfs)	= 7.20
Invert Elev Up (ft)	= 6718.46	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 24.0		
Shape	= Circular	Highlighted	
Span (in)	= 24.0	Qtotal (cfs)	= 7.20
No. Barrels	= 1	Qpipe (cfs)	= 7.20
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 2.90
Culvert Entrance	= Groove end projecting (C)	Veloc Up (ft/s)	= 4.88
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2	HGL Dn (ft)	= 6719.58
		HGL Up (ft)	= 6719.41
Embankment		Hw Elev (ft)	= 6719.80
Top Elevation (ft)	= 6722.43	Hw/D (ft)	= 0.67
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00		



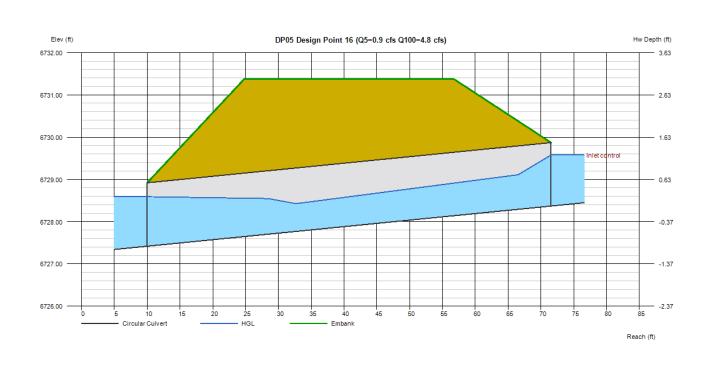
## DP04 Design Point 13 (Q5=0.6cfs Q100=2.1 cfs)

Invert Elev Dn (ft)	= 6730.66	Calculations	
Pipe Length (ft)	= 60.93	Qmin (cfs)	= 0.60
Slope (%)	= 1.03	Qmax (cfs)	= 2.10
Invert Elev Up (ft)	= 6731.29	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 18.0		
Shape	= Circular	Highlighted	
Span (in)	= 18.0	Qtotal (cfs)	= 2.10
No. Barrels	= 1	Qpipe (cfs)	= 2.10
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	<ul><li>Circular Concrete</li></ul>	Veloc Dn (ft/s)	= 1.63
Culvert Entrance	<ul><li>= Groove end projecting (C)</li></ul>	Veloc Up (ft/s)	= 3.61
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2	HGL Dn (ft)	= 6731.68
		HGL Up (ft)	= 6731.84
Embankment		Hw Elev (ft)	= 6732.04
Top Elevation (ft)	= 6734.58	Hw/D (ft)	= 0.50
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00		



## DP05 Design Point 16 (Q5=0.9 cfs Q100=4.8 cfs)

Invert Elev Dn (ft)	= 6727.42	Calculations	
Pipe Length (ft)	= 61.54	Qmin (cfs)	= 0.90
Slope (%)	= 1.54	Qmax (cfs)	= 4.80
Invert Elev Up (ft)	= 6728.37	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 18.0	, ,	, ,
Shape	= Circular	Highlighted	
Span (in)	= 18.0	Qtotal (cfs)	= 4.80
No. Barrels	= 1	Qpipe (cfs)	= 4.80
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 3.24
Culvert Entrance	= Groove end projecting (C)	Veloc Up (ft/s)	= 4.70
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2	HGL Dn (ft)	= 6728.59
		HGL Up (ft)	= 6729.21
Embankment		Hw Elev (ft)	= 6729.58
Top Elevation (ft)	= 6731.37	Hw/D (ft)	= 0.80
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00	J	
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Wednesday, Apr 19 2023

## **DP 1.0 Swale (5-Year)(FR:0.50)**

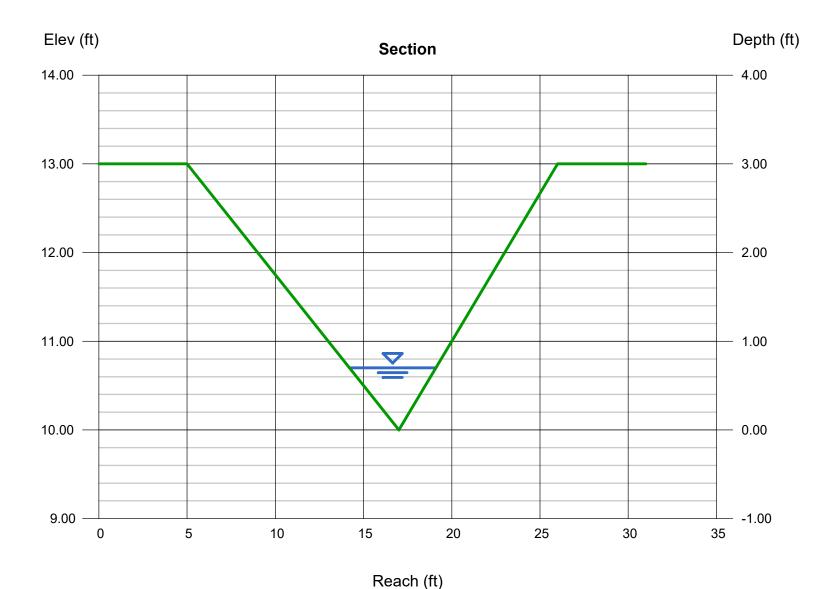
ırıangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00

Invert Elev (ft) = 10.00 Slope (%) = 1.00 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 4.10

Highlighted		
Depth (ft)	=	0.70
Q (cfs)	=	4.100
Area (sqft)	=	1.71
Velocity (ft/s)	=	2.39
Wetted Perim (ft)	=	5.10
Crit Depth, Yc (ft)	=	0.62
Top Width (ft)	=	4.90
EGL (ft)	=	0.79



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Wednesday, Apr 19 2023

= 1.53

## DP 1.0 Swale (100-Year)(FR:0.55)

Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00

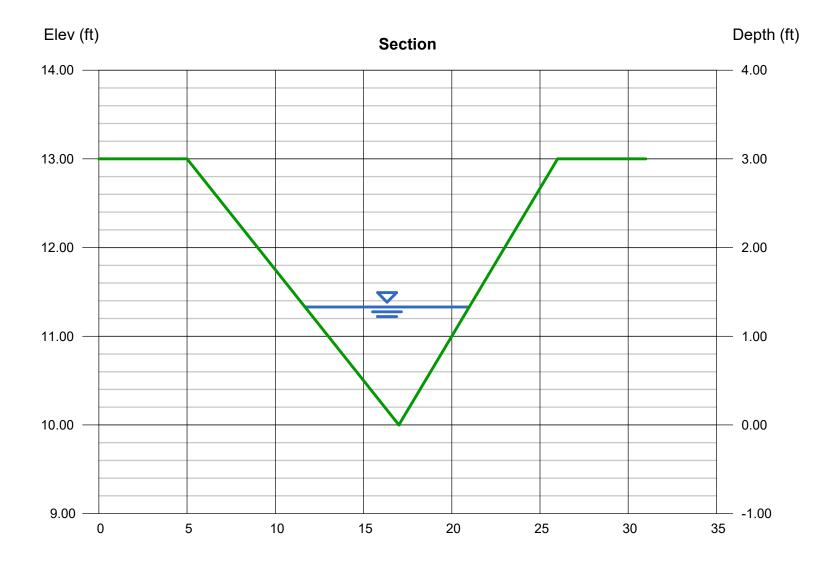
Invert Elev (ft) = 10.00 Slope (%) = 1.00 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 22.30

Highlighted		
Depth (ft)	=	1.33
Q (cfs)	=	22.30
Area (sqft)	=	6.19
Velocity (ft/s)	=	3.60
Wetted Perim (ft)	=	9.69
Crit Depth, Yc (ft)	=	1.21
Top Width (ft)	=	9.31

EGL (ft)



Reach (ft)

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Wednesday, Apr 19 2023

## **DP 1.1 Swale (5-Year)(FR:0.63)**

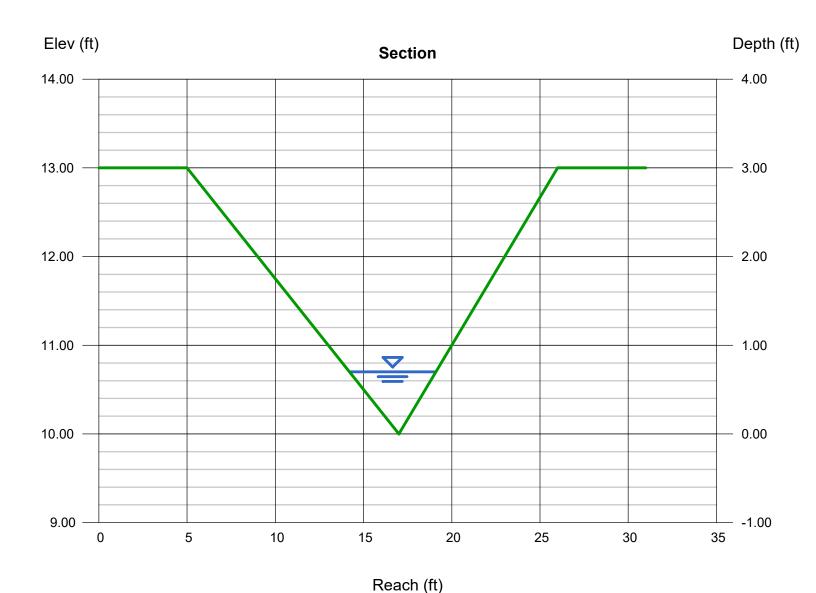
ırıangular			
Side Slopes (z:1)	= 4.00, 3.00		
Total Depth (ft)	= 3.00		
	40.00		

Invert Elev (ft) = 10.00 Slope (%) = 1.60 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 5.10

Highlighted		
Depth (ft)	=	0.70
Q (cfs)	=	5.100
Area (sqft)	=	1.71
Velocity (ft/s)	=	2.97
Wetted Perim (ft)	=	5.10
Crit Depth, Yc (ft)	=	0.67
Top Width (ft)	=	4.90
EGL (ft)	=	0.84



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Wednesday, Apr 19 2023

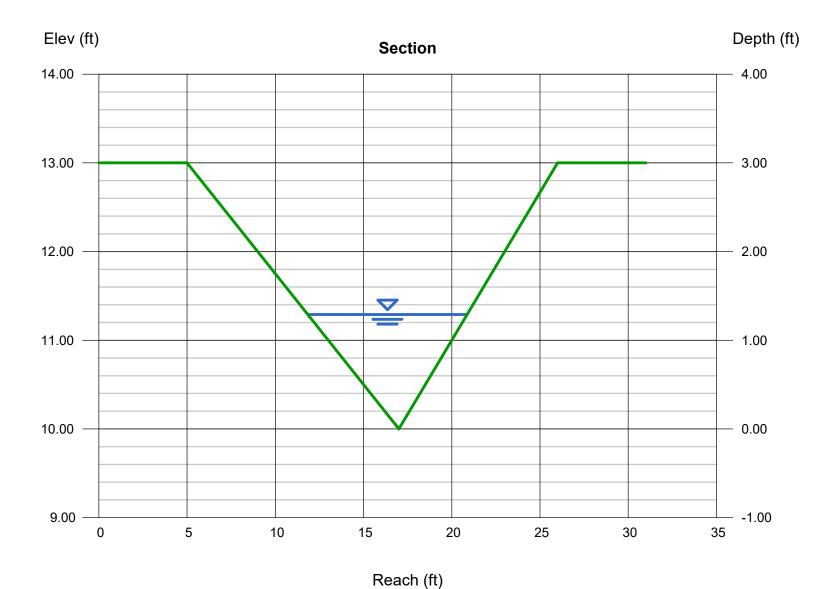
## DP 1.1 Swale (100-Year)(FR:.70)

<b>Triangular</b> Side Slopes (z:1) Total Depth (ft)	= 4.00, 3.00 = 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.60
N-Value	= 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 26.50

Highlighted	
Depth (ft)	= 1.29
Q (cfs)	= 26.50
Area (sqft)	= 5.82
Velocity (ft/s)	= 4.55
Wetted Perim (ft)	= 9.40
Crit Depth, Yc (ft)	= 1.29
Top Width (ft)	= 9.03
EGL (ft)	= 1.61



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Thursday, Aug 24 2023

#### **DP 1.2 Swale (5-Year)(FR:0.70)**

lr	'na	n	g	ul	la	r

Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 4.00

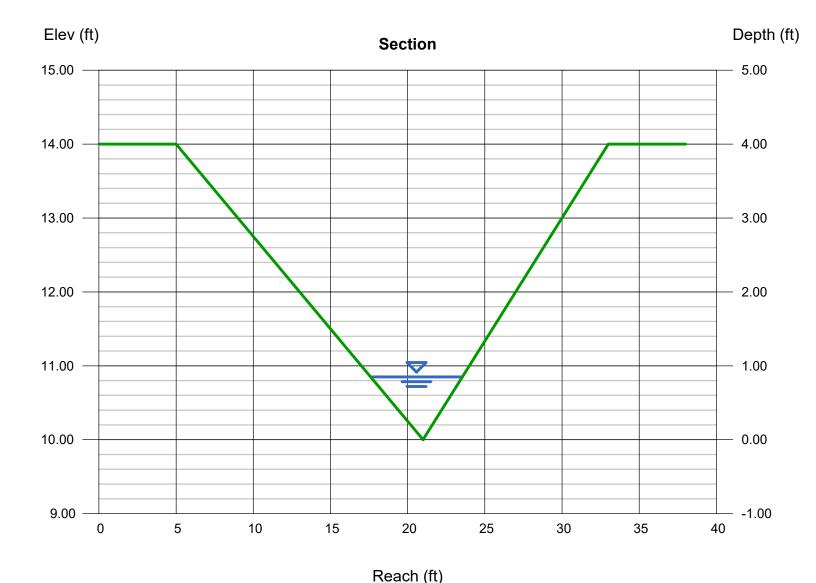
Invert Elev (ft) = 10.00 Slope (%) = 1.85 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 9.30

#### Highlighted

Depth (ft) = 0.85Q (cfs) = 9.300Area (sqft) = 2.53Velocity (ft/s) = 3.68Wetted Perim (ft) = 6.19Crit Depth, Yc (ft) = 0.85Top Width (ft) = 5.95EGL (ft) = 1.06



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Thursday, Aug 24 2023

#### **DP 1.2 Swale (100-Year)(FR:0.78)**

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Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 4.00

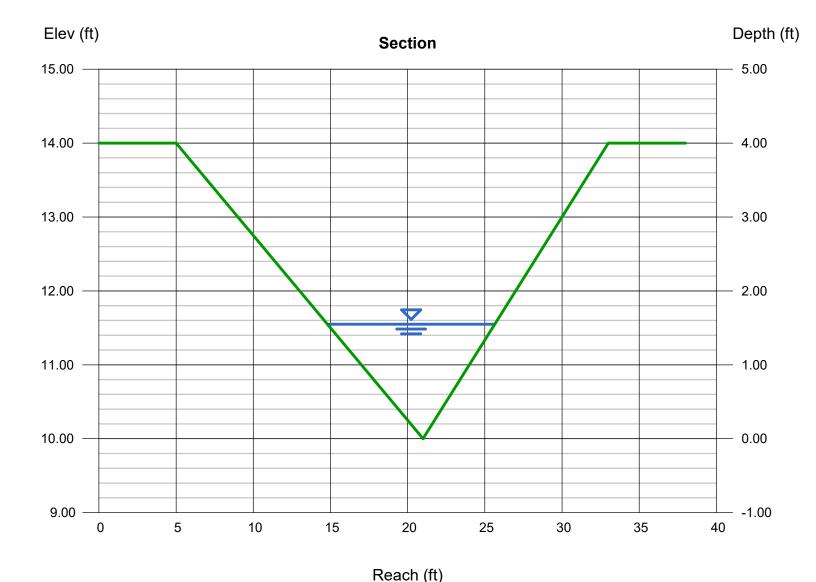
Invert Elev (ft) = 10.00 Slope (%) = 1.85 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 46.50

#### Highlighted

Depth (ft) = 1.55Q (cfs) = 46.50Area (sqft) = 8.41 Velocity (ft/s) = 5.53 Wetted Perim (ft) = 11.29 Crit Depth, Yc (ft) = 1.62Top Width (ft) = 10.85EGL (ft) = 2.03



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Wednesday, Apr 19 2023

## **DP 1.3 Swale (5-Year)(FR:0.52)**

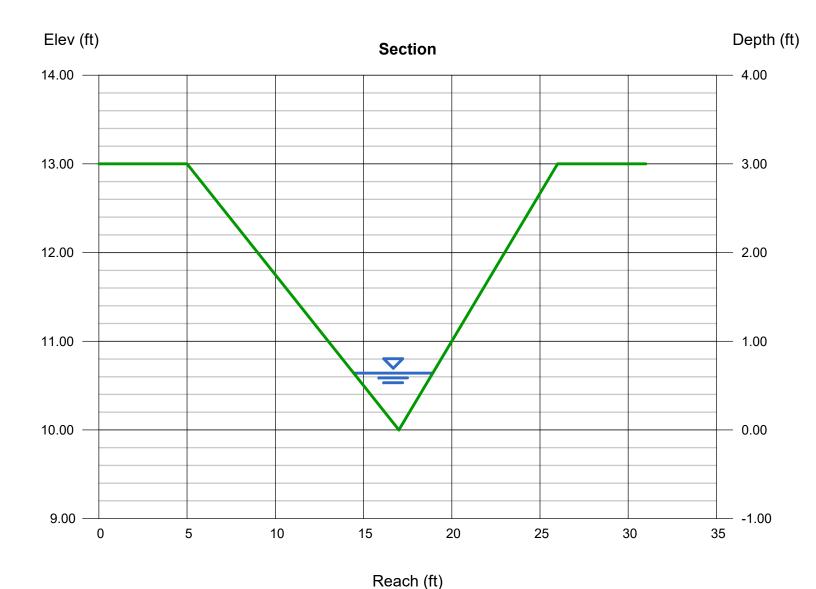
ırıangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Floy (ft)	- 10.00

Invert Elev (ft) = 10.00 Slope (%) = 1.17 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 3.40

Highlighted		
Depth (ft)	=	0.64
Q (cfs)	=	3.400
Area (sqft)	=	1.43
Velocity (ft/s)	=	2.37
Wetted Perim (ft)	=	4.66
Crit Depth, Yc (ft)	=	0.57
Top Width (ft)	=	4.48
EGL (ft)	=	0.73



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Wednesday, Apr 19 2023

#### **DP 1.3 Swale (100-Year)(FR:0.58)**

Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00

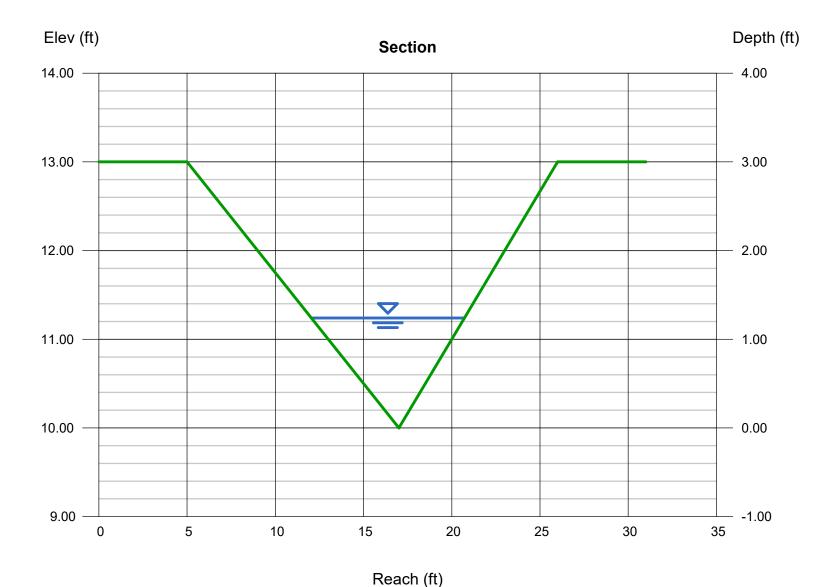
Invert Elev (ft) = 10.00 Slope (%) = 1.10 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 19.60

# Highlighted Depth (ft) = 1.24 Q (cfs) = 19.60 Area (sqft) = 5.38

Q (cfs) = 19.60 Area (sqft) = 5.38 Velocity (ft/s) = 3.64 Wetted Perim (ft) = 9.03 Crit Depth, Yc (ft) = 1.15 Top Width (ft) = 8.68 EGL (ft) = 1.45



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

Wednesday, Apr 19 2023

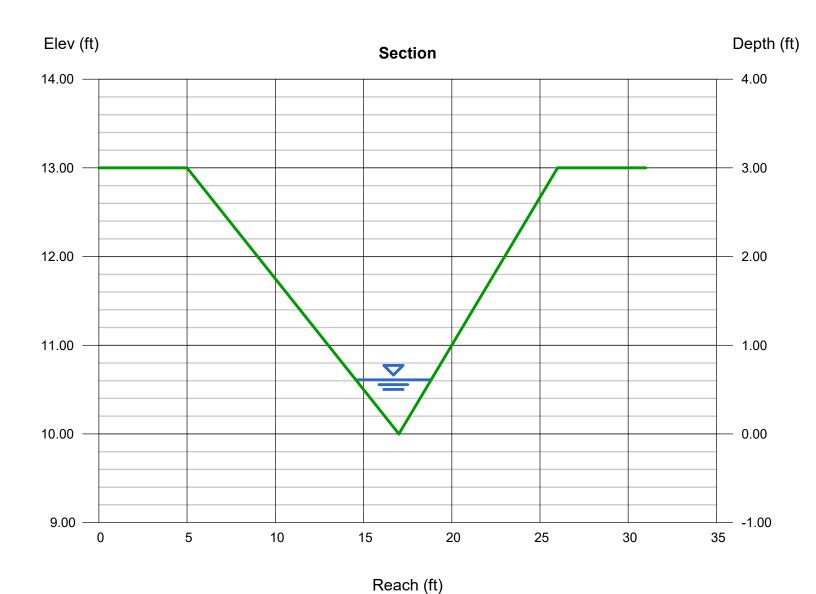
## **DP 1.4 Swale (5-Year)(FR:0.52)**

Side Slopes (z:1) Total Depth (ft)	= 4.00, 3.00 = 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.17
N-Value	= 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 3.00

Highlighted		
Depth (ft)	=	0.61
Q (cfs)	=	3.000
Area (sqft)	=	1.30
Velocity (ft/s)	=	2.30
Wetted Perim (ft)	=	4.44
Crit Depth, Yc (ft)	=	0.54
Top Width (ft)	=	4.27
EGL (ft)	=	0.69



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

Wednesday, Apr 19 2023

#### **DP 1.4 Swale (100-Year)(FR:0.57)**

T	ri	aı	าg	u	lar

Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 3.00

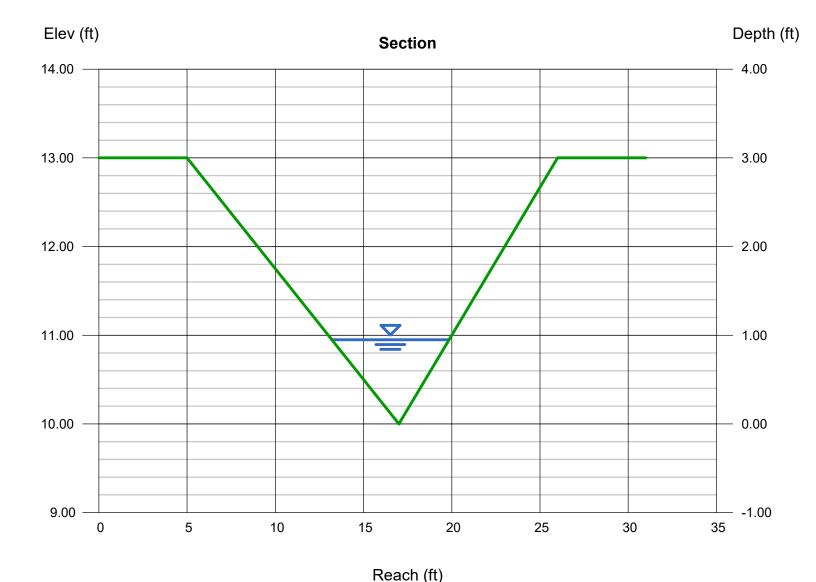
Invert Elev (ft) = 10.00 Slope (%) = 1.17 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 10.00

#### Highlighted

Depth (ft) = 0.95Q (cfs) = 10.00Area (sqft) = 3.16Velocity (ft/s) = 3.17 Wetted Perim (ft) = 6.92Crit Depth, Yc (ft) = 0.88Top Width (ft) = 6.65EGL (ft) = 1.11



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Friday, Aug 25 2023

#### **DP 1.5 Swale (5-Year)(FR:0.44)**

T	ri	a	n	g	u	la	r

Side Slopes (z:1) = 3.00, 3.00Total Depth (ft) = 3.00

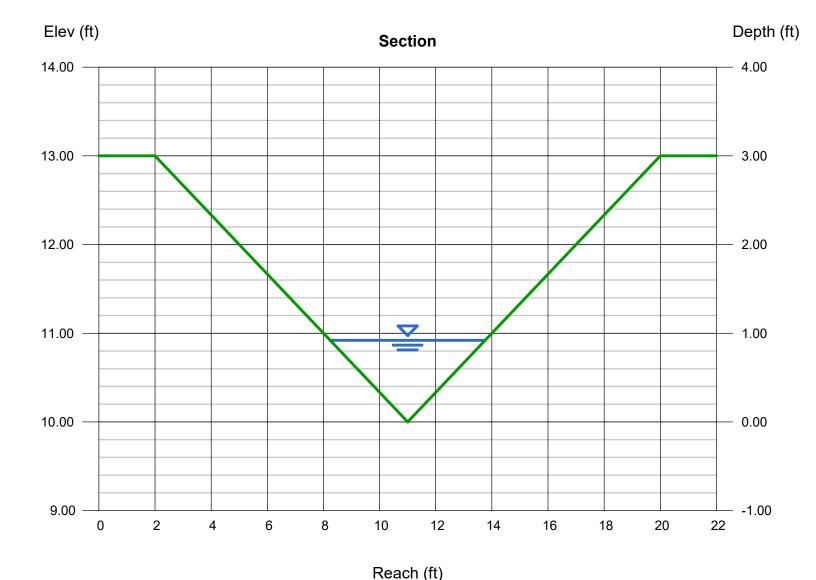
Invert Elev (ft) = 10.00 Slope (%) = 0.72 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 6.10

#### Highlighted

= 0.92Depth (ft) Q (cfs) = 6.100Area (sqft) = 2.54Velocity (ft/s) = 2.40Wetted Perim (ft) = 5.82Crit Depth, Yc (ft) = 0.77Top Width (ft) = 5.52EGL (ft) = 1.01



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

Friday, Aug 25 2023

#### **DP 1.5 Swale (100-Year)(FR:0.48)**

T	ri	a	n	g	u	la	r

Side Slopes (z:1) = 3.00, 3.00Total Depth (ft) = 3.00

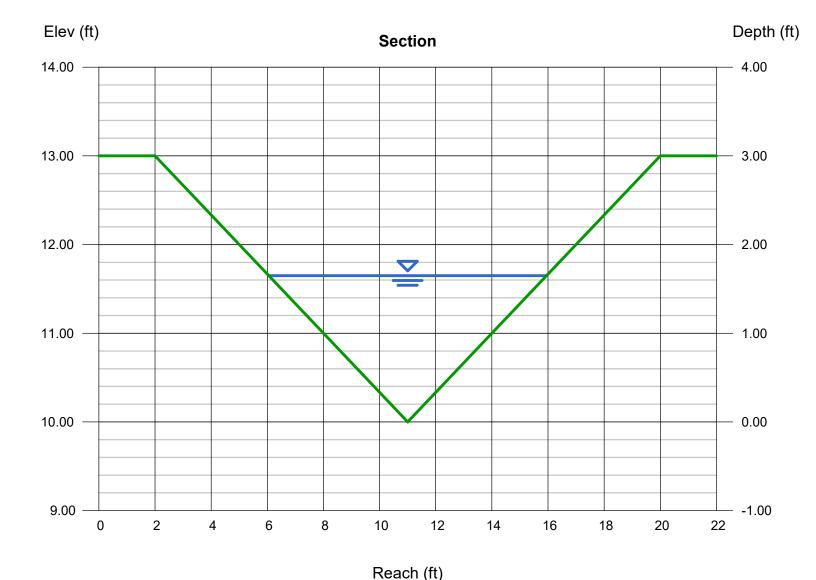
Invert Elev (ft) = 10.00 Slope (%) = 0.72 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 28.70

#### Highlighted

Depth (ft) = 1.65Q (cfs) = 28.70Area (sqft) = 8.17Velocity (ft/s) = 3.51Wetted Perim (ft) = 10.44Crit Depth, Yc (ft) = 1.42Top Width (ft) = 9.90EGL (ft) = 1.84



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

= 0.030

Friday, Jun 9 2023

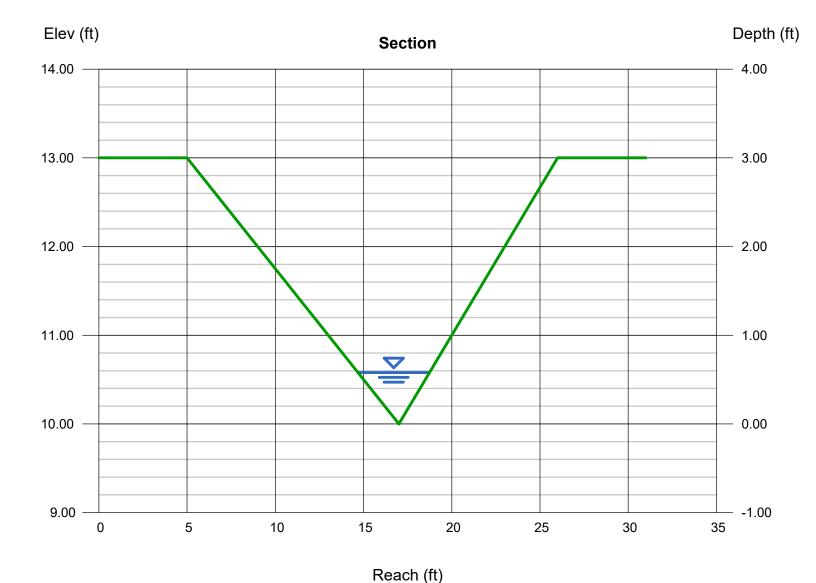
#### **DP 2.0 Swale (5-Year)(FR:0.62)**

Side Slopes (z:1) Total Depth (ft)	= 4.00, 3.00 = 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.74

**Calculations** 

N-Value

Compute by: Known Q Known Q (cfs) = 3.20 Highlighted Depth (ft) = 0.58Q (cfs) = 3.200Area (sqft) = 1.18 Velocity (ft/s) = 2.72Wetted Perim (ft) = 4.23Crit Depth, Yc (ft) = 0.56Top Width (ft) = 4.06EGL (ft) = 0.69



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

Friday, Jun 9 2023

#### **DP 2.0 Swale (100-Year)(FR:0.71)**

11	ıaı	ngu	Iar
-		$\sim$	

Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 3.00

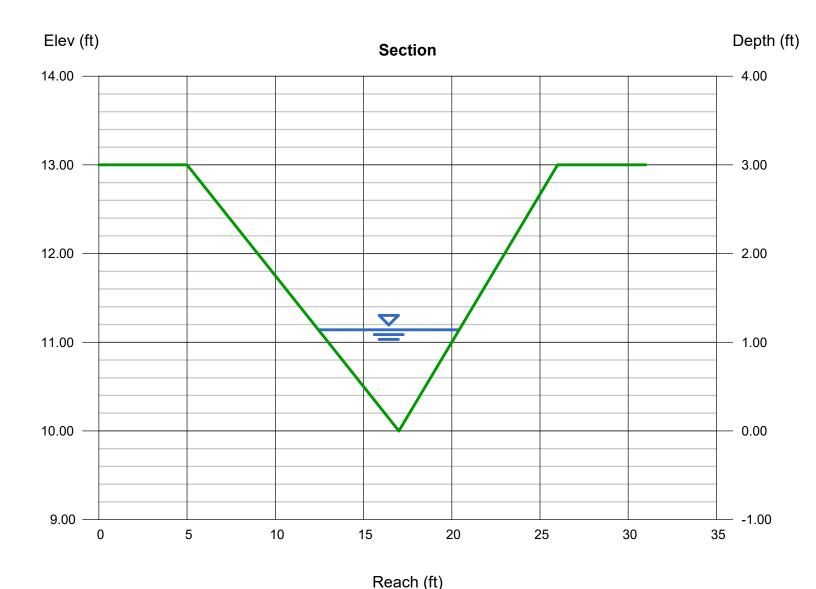
Invert Elev (ft) = 10.00 Slope (%) = 1.74 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 19.60

#### Highlighted

Depth (ft) = 1.14 Q (cfs) = 19.60Area (sqft) = 4.55Velocity (ft/s) = 4.31 Wetted Perim (ft) = 8.31 Crit Depth, Yc (ft) = 1.15 Top Width (ft) = 7.98EGL (ft) = 1.43



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

Wednesday, Apr 19 2023

## **DP 2.1 Swale (5-Year)(FR:0.51)**

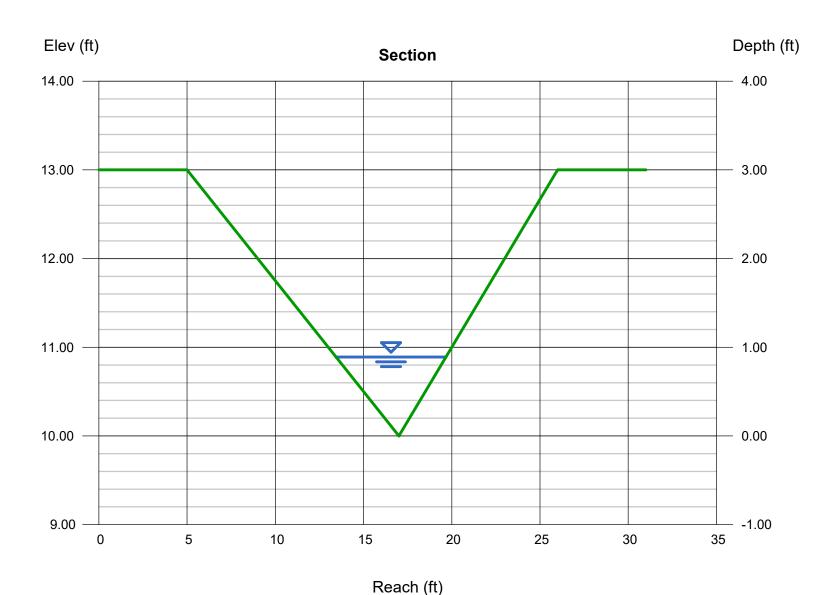
rriangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00

Invert Elev (ft) = 10.00 Slope (%) = 1.00 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 7.60

Highlighted		
Depth (ft)	=	0.89
Q (cfs)	=	7.600
Area (sqft)	=	2.77
Velocity (ft/s)	=	2.74
Wetted Perim (ft)	=	6.48
Crit Depth, Yc (ft)	=	0.79
Top Width (ft)	=	6.23
EGL (ft)	=	1.01



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

Wednesday, Apr 19 2023

#### **DP 2.1 Swale (100-Year)(FR:0.57)**

T	r	ia	n	g	u	laı

Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 3.00

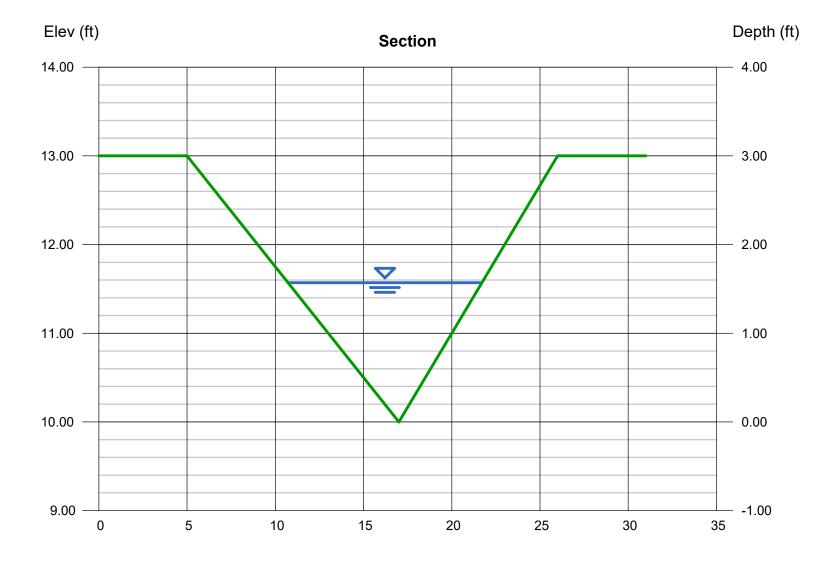
Invert Elev (ft) = 10.00 Slope (%) = 1.00 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 35.00

#### Highlighted

Depth (ft) = 1.57 Q (cfs) = 35.00Area (sqft) = 8.63Velocity (ft/s) = 4.06 Wetted Perim (ft) = 11.44 Crit Depth, Yc (ft) = 1.45Top Width (ft) = 10.99EGL (ft) = 1.83



Reach (ft)

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

Wednesday, Apr 19 2023

= 1.14

## DP 2.2 Swale (5-Year)(FR:0.69)

Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00

Invert Elev (ft) = 10.00 Slope (%) = 1.00 N-Value = 0.030

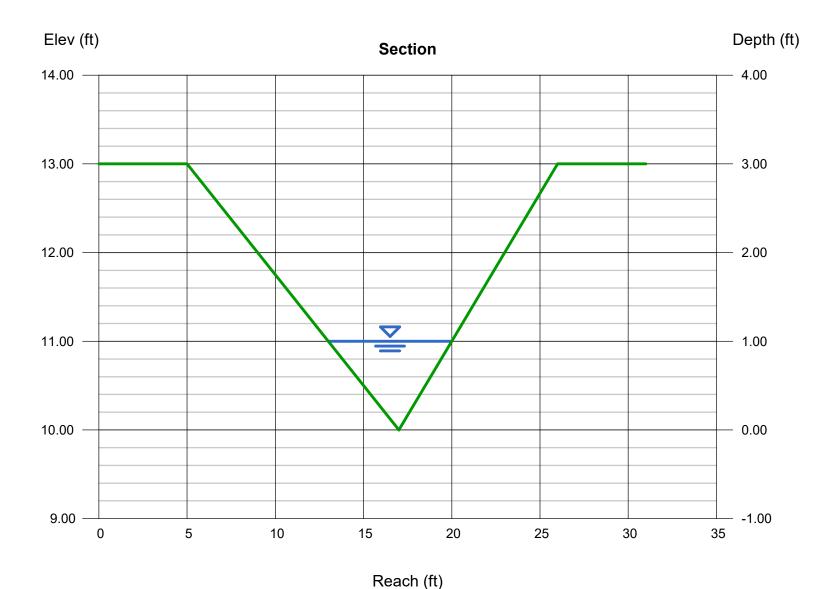
Calculations

Compute by: Known Q Known Q (cfs) = 10.50

rnginigitica	
Depth (ft)	= 1.00
Q (cfs)	= 10.50
Area (sqft)	= 3.50
Velocity (ft/s)	= 3.00
Wetted Perim (ft)	= 7.29
Crit Depth, Yc (ft)	= 0.90
Top Width (ft)	= 7.00

Highlighted

EGL (ft)



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

Wednesday, Apr 19 2023

#### **DP 2.2 Swale (100-Year)(FR:0.59)**

Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 3.00

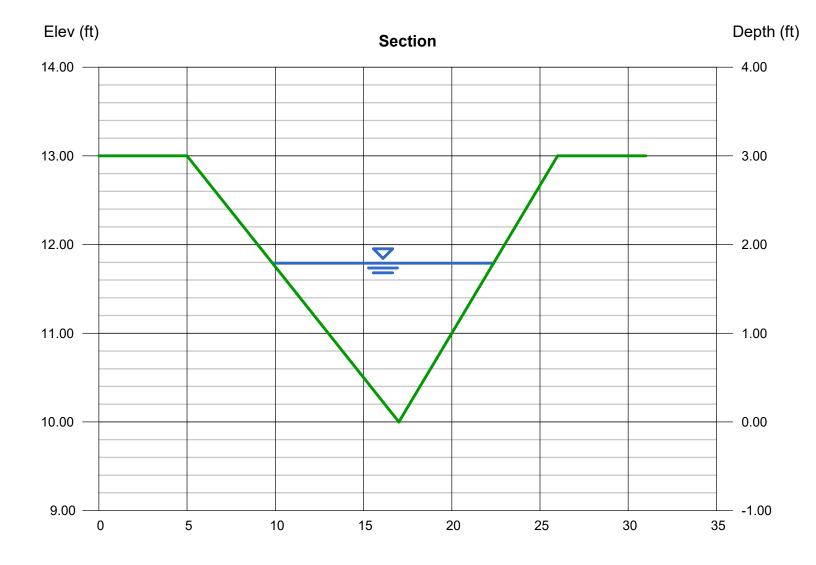
Invert Elev (ft) = 10.00 Slope (%) = 1.00 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 50.00

#### Highlighted

= 1.79Depth (ft) Q (cfs) = 50.00Area (sqft) = 11.21 Velocity (ft/s) = 4.46 Wetted Perim (ft) = 13.04Crit Depth, Yc (ft) = 1.67 Top Width (ft) = 12.53EGL (ft) = 2.10



Reach (ft)

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

Friday, Aug 25 2023

#### **DP 2.3 Swale (5-Year)(FR:0.70)**

ırıangular	
Side Slopes	(z:1)

= 3.00, 3.00Total Depth (ft) = 3.00

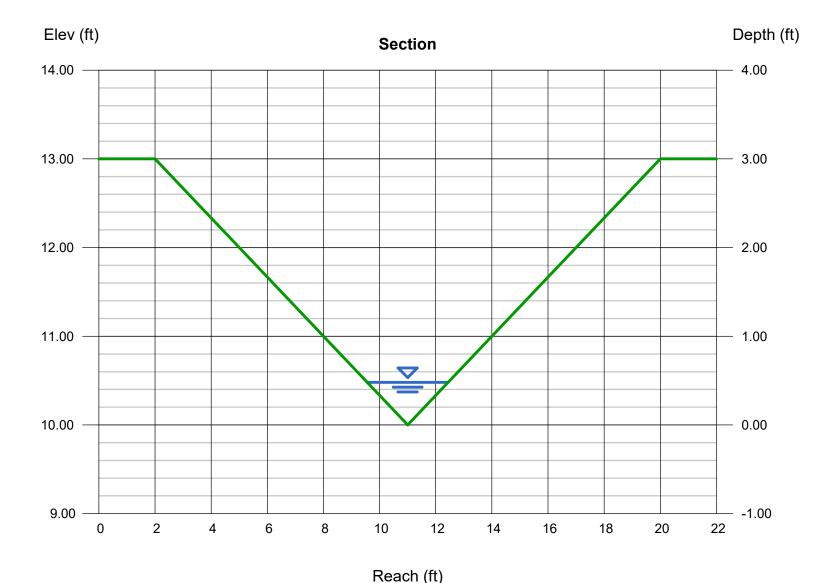
Invert Elev (ft) = 10.00 Slope (%) = 2.22 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 1.90

#### Highlighted

Depth (ft) = 0.48Q (cfs) = 1.900Area (sqft) = 0.69Velocity (ft/s) = 2.75 Wetted Perim (ft) = 3.04Crit Depth, Yc (ft) = 0.48Top Width (ft) = 2.88EGL (ft) = 0.60



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

Friday, Aug 25 2023

#### **DP 2.3 Swale (100-Year)(FR:0.74)**

Side Slopes (z:1) = 3.00, 3.00Total Depth (ft) = 3.00

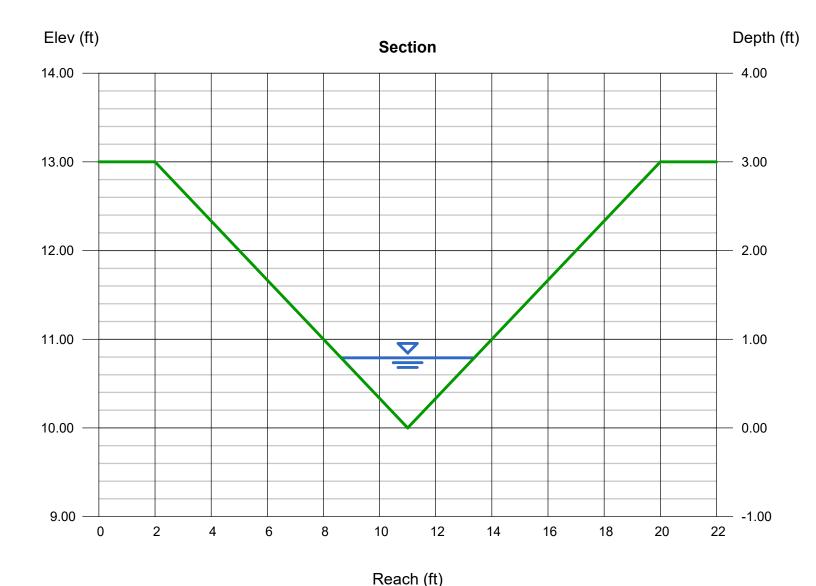
Invert Elev (ft) = 10.00 Slope (%) = 2.22 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 7.00

#### Highlighted

= 0.79Depth (ft) Q (cfs) = 7.000Area (sqft) = 1.87 Velocity (ft/s) = 3.74Wetted Perim (ft) = 5.00Crit Depth, Yc (ft) = 0.81Top Width (ft) = 4.74EGL (ft) = 1.01



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

Wednesday, Apr 19 2023

## **DP 3 Swale (5-Year)(FR:0.56)**

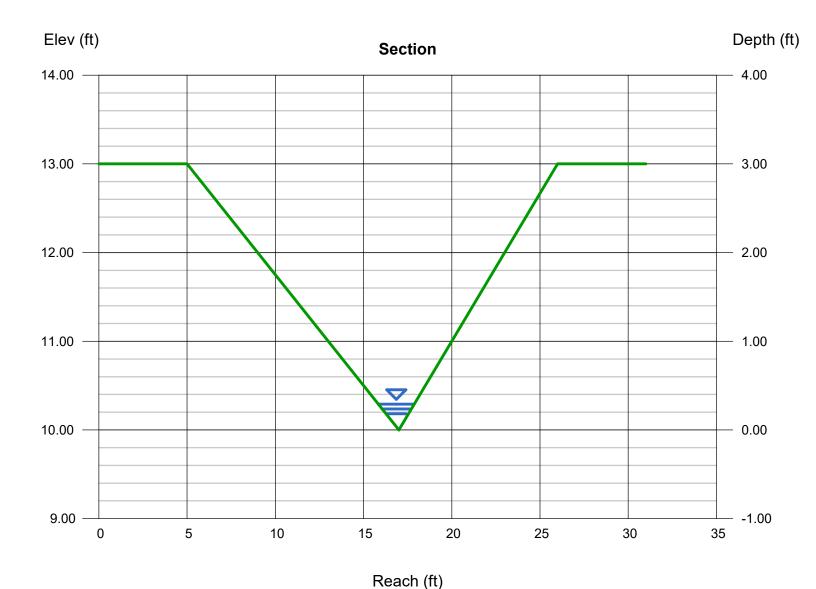
Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00

Invert Elev (ft) = 10.00 Slope (%) = 1.94 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 0.50

Highlighted		
Depth (ft)	=	0.29
Q (cfs)	=	0.500
Area (sqft)	=	0.29
Velocity (ft/s)	=	1.70
Wetted Perim (ft)	=	2.11
Crit Depth, Yc (ft)	=	0.27
Top Width (ft)	=	2.03
EGL (ft)	=	0.33



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

Wednesday, Apr 19 2023

#### **DP 3 Swale (100-Year)(FR:0.62)**

Triangular
Side Slopes (z:1) = 4.00, 3.00
Total Depth (ft) = 3.00

Invert Elev (ft) = 10.00 Slope (%) = 1.94 N-Value = 0.030

Calculations

Elev (ft)

Compute by: Known Q Known Q (cfs) = 1.40 

 Highlighted

 Depth (ft)
 = 0.42

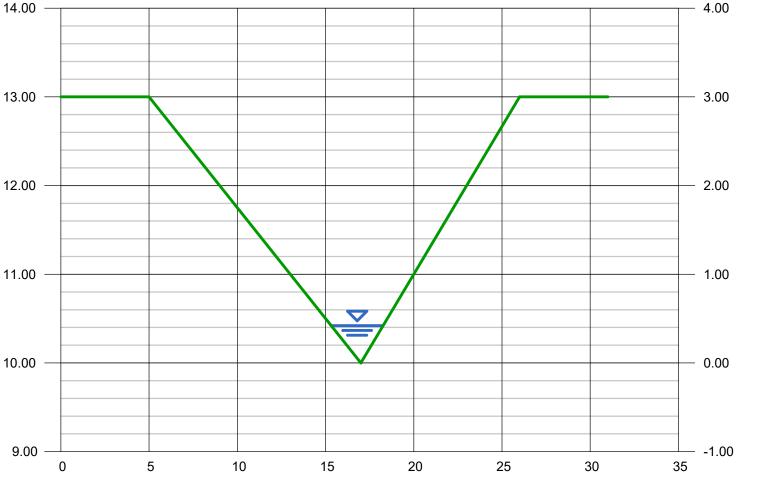
 Q (cfs)
 = 1.400

 Area (sqft)
 = 0.62

 Velocity (ft/s)
 = 2.27

Wetted Perim (ft) = 3.06Crit Depth, Yc (ft) = 0.40Top Width (ft) = 2.94EGL (ft) = 0.50

Depth (ft)



Section

Reach (ft)

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

Friday, Jun 9 2023

## **DP 6 Swale (5-Year)(FR:0.56)**

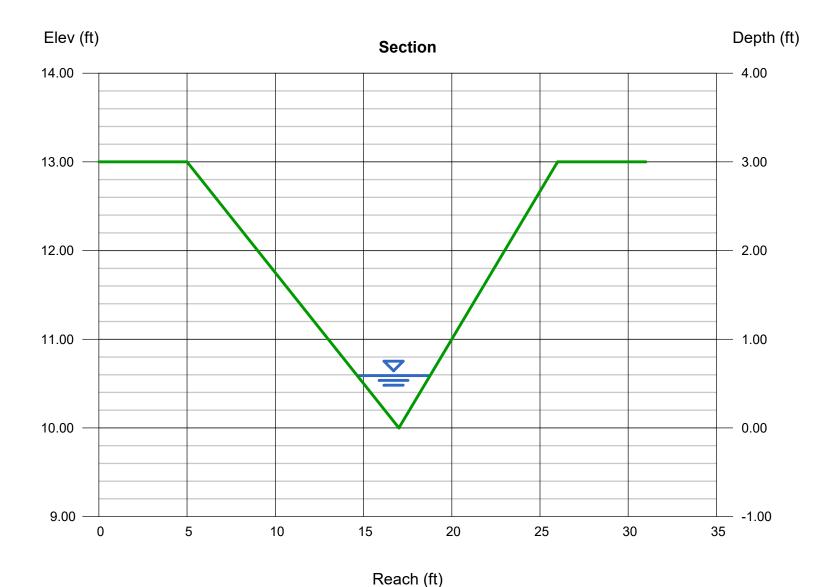
Side Slopes (z:1) Total Depth (ft)	= 4.00, 3.00 = 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.42

N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 3.00

Highlighted	
Depth (ft)	= 0.59
Q (cfs)	= 3.000
Area (sqft)	= 1.22
Velocity (ft/s)	= 2.46
Wetted Perim (ft)	= 4.30
Crit Depth, Yc (ft)	= 0.54
Top Width (ft)	= 4.13
EGL (ft)	= 0.68



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

Friday, Jun 9 2023

#### **DP 6 Swale (100-Year)(FR:0.64)**

I	r	ia	n	g	Ju	laı	r

Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 3.00

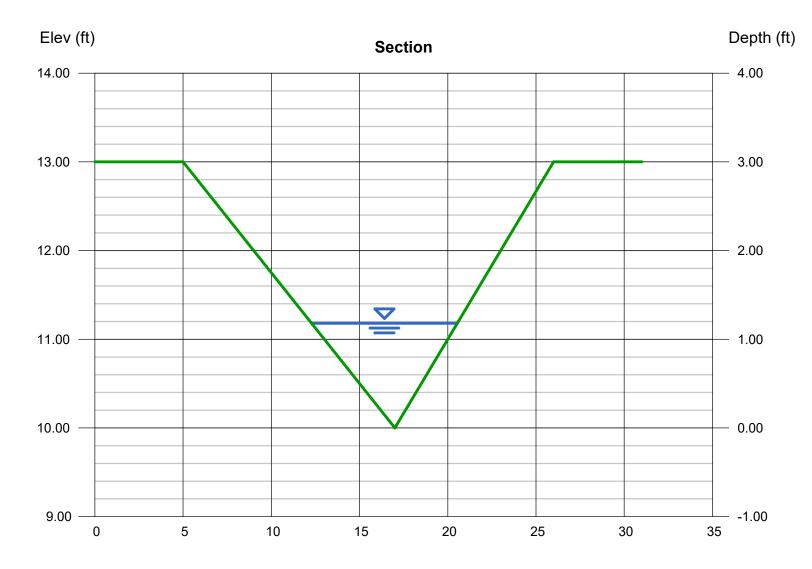
Invert Elev (ft) = 10.00 Slope (%) = 1.42 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 19.30

#### Highlighted

Depth (ft) = 1.18 Q (cfs) = 19.30Area (sqft) = 4.87 Velocity (ft/s) = 3.96Wetted Perim (ft) = 8.60Crit Depth, Yc (ft) = 1.14 Top Width (ft) = 8.26 EGL (ft) = 1.42



Reach (ft)

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

Friday, Jun 9 2023

## **DP 8 Swale (5-Year)(FR:0.54)**

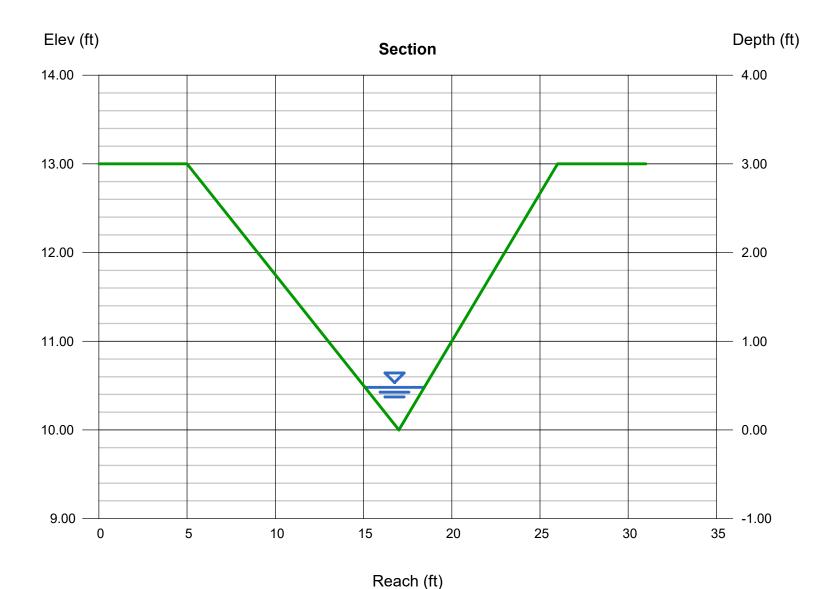
<b>Triangular</b> Side Slopes (z:1) Total Depth (ft)	= 4.00, 3.00 = 3.00
Invert Floy (ft)	- 10.00

Invert Elev (ft) = 10.00 Slope (%) = 1.42 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 1.70

Highlighted		
Depth (ft)	=	0.48
Q (cfs)	=	1.700
Area (sqft)	=	0.81
Velocity (ft/s)	=	2.11
Wetted Perim (ft)	=	3.50
Crit Depth, Yc (ft)	=	0.43
Top Width (ft)	=	3.36
EGL (ft)	=	0.55



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

Friday, Jun 9 2023

#### **DP 8 Swale (100-Year)(FR:0.61)**

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Side Slopes (z:1) = 4.00, 3.00Total Depth (ft) = 3.00

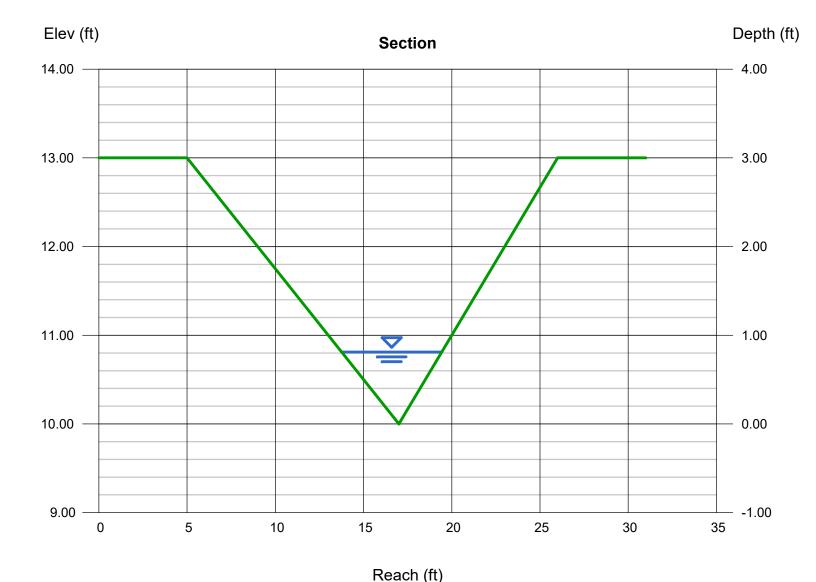
Invert Elev (ft) = 10.00 Slope (%) = 1.42 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 7.20

#### Highlighted

Depth (ft) = 0.81Q (cfs) = 7.200Area (sqft) = 2.30Velocity (ft/s) = 3.14Wetted Perim (ft) = 5.90Crit Depth, Yc (ft) = 0.77Top Width (ft) = 5.67EGL (ft) = 0.96



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Thursday, Aug 24 2023

## DP 11 Swale (5-Year)(FR:0.46)

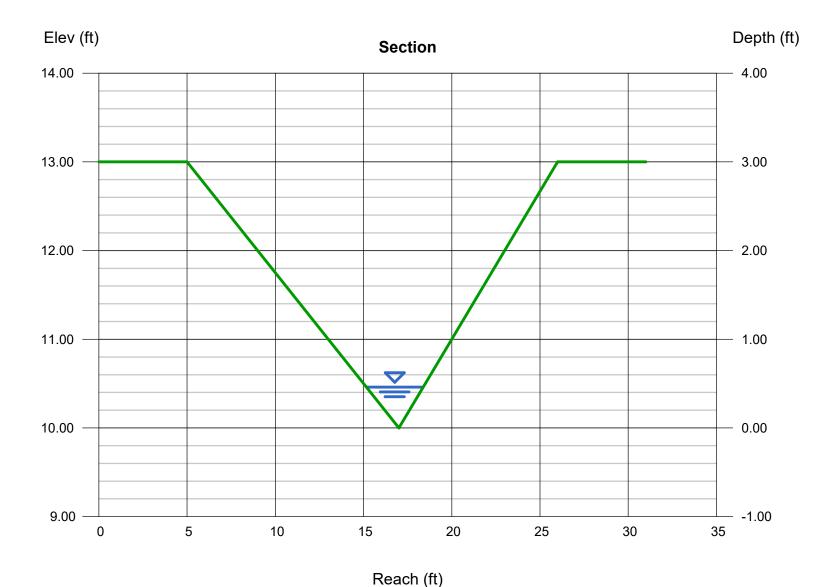
Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Flev (ft)	= 10.00

Invert Elev (ft) = 10.00 Slope (%) = 1.00 N-Value = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 1.30

Highlighted	
Depth (ft)	= 0.46
Q (cfs)	= 1.300
Area (sqft)	= 0.74
Velocity (ft/s)	= 1.76
Wetted Perim (ft)	= 3.35
Crit Depth, Yc (ft)	= 0.39
Top Width (ft)	= 3.22
EGL (ft)	= 0.51



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

Thursday, Aug 24 2023

## DP 11 Swale (100-Year)(FR:0.72)

Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00

Invert Elev (ft) = 10.00 Slope (%) = 1.00 N-Value = 0.030

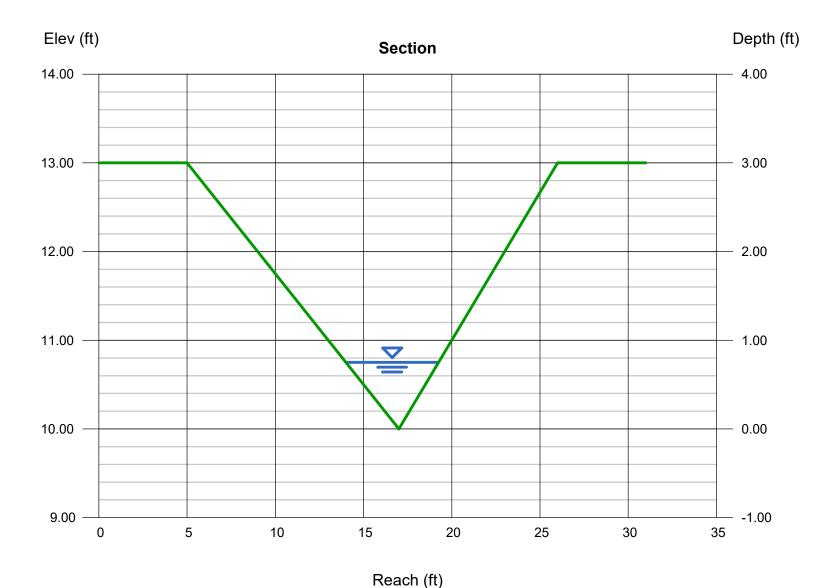
Calculations

Compute by: Known Q Known Q (cfs) = 4.90

ggc.a	
Depth (ft)	= 0.75
Q (cfs)	= 4.900
Area (sqft)	= 1.97
Velocity (ft/s)	= 2.49
Wetted Perim (ft)	= 5.46
Crit Depth, Yc (ft)	= 0.66

Highlighted

Top Width (ft) = 5.25EGL (ft) = 0.85



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

Wednesday, Apr 19 2023

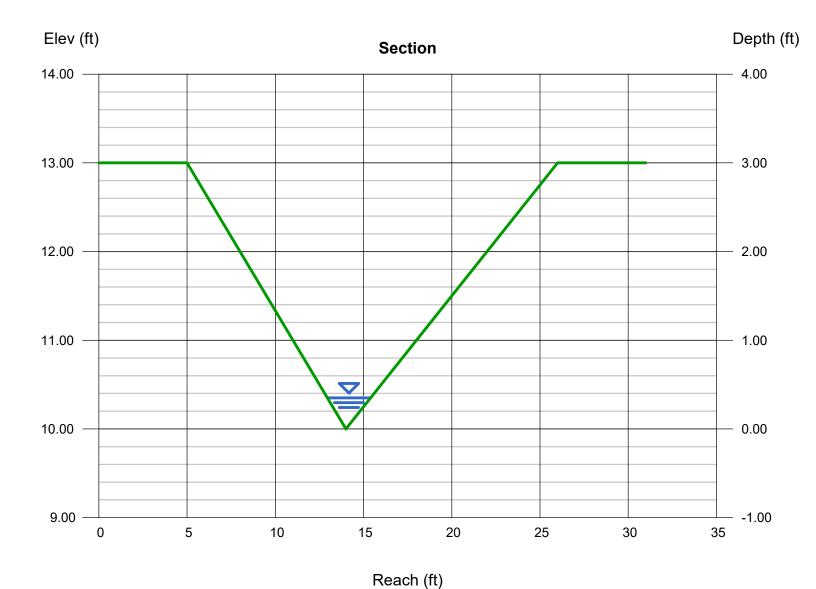
## **DP 13 Swale (5-Year)(FR:0.42)**

<b>Triangular</b> Side Slopes (z:1) Total Depth (ft)	= 3.00, 4.00 = 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 0.60

Highlighted	
Depth (ft)	= 0.35
Q (cfs)	= 0.600
Area (sqft)	= 0.43
Velocity (ft/s)	= 1.40
Wetted Perim (ft)	= 2.55
Crit Depth, Yc (ft)	= 0.29
Top Width (ft)	= 2.45
EGL (ft)	= 0.38



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

Wednesday, Apr 19 2023

## DP 13 Swale (100-Year)(FR:0.47)

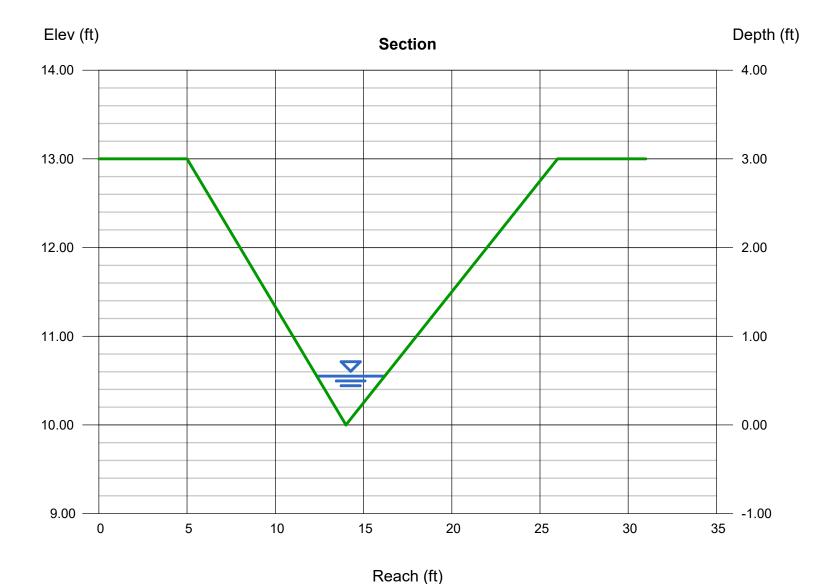
ırıangular	
Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00

Invert Elev (ft) = 10.00 Slope (%) = 1.00 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 2.10

Highlighted	
Depth (ft)	= 0.55
Q (cfs)	= 2.100
Area (sqft)	= 1.06
Velocity (ft/s)	= 1.98
Wetted Perim (ft)	= 4.01
Crit Depth, Yc (ft)	= 0.47
Top Width (ft)	= 3.85
EGL (ft)	= 0.61



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

Wednesday, Apr 19 2023

## **DP 16 Swale (5-Year)(FR:0.48)**

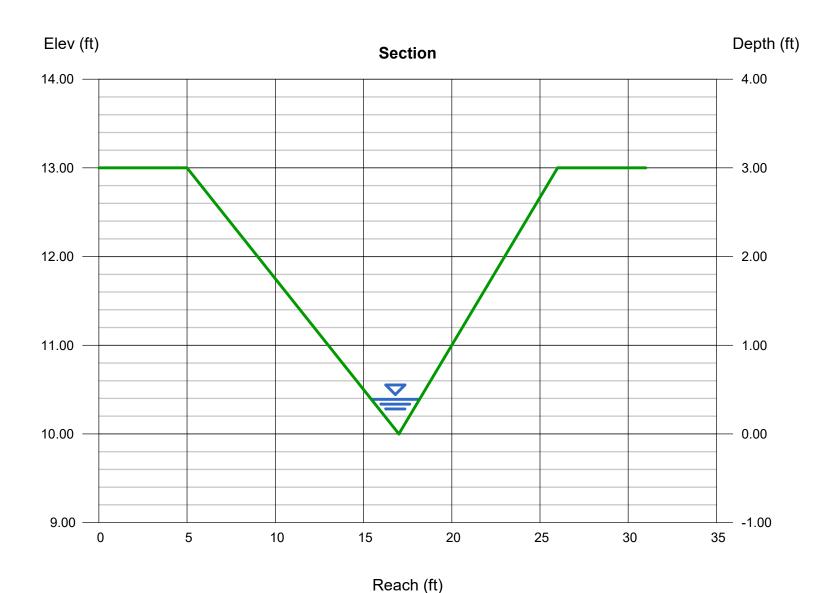
ırıangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Fley (ft)	= 10.00

Invert Elev (ft) = 10.00 Slope (%) = 1.09 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 0.90

Highlighted		
Depth (ft)	=	0.39
Q (cfs)	=	0.900
Area (sqft)	=	0.53
Velocity (ft/s)	=	1.69
Wetted Perim (ft)	=	2.84
Crit Depth, Yc (ft)	=	0.34
Top Width (ft)	=	2.73
EGL (ft)	=	0.43



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

Wednesday, Apr 19 2023

#### **DP 16 Swale (100-Year)(FR:0.51)**

Triangular	
Side Slopes (z:1)	

= 4.00, 3.00

Total Depth (ft)

= 3.00

Invert Elev (ft) Slope (%) N-Value

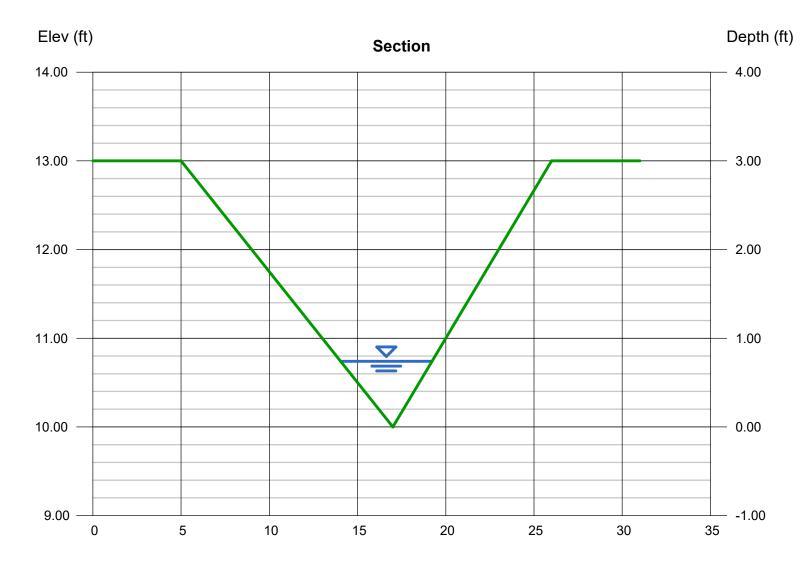
= 10.00= 1.09= 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 4.80

#### Highlighted

Depth (ft) = 0.74Q (cfs) = 4.800Area (sqft) = 1.92Velocity (ft/s) = 2.50Wetted Perim (ft) = 5.39Crit Depth, Yc (ft) = 0.66Top Width (ft) = 5.18EGL (ft) = 0.84



Reach (ft)

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

Friday, Aug 25 2023

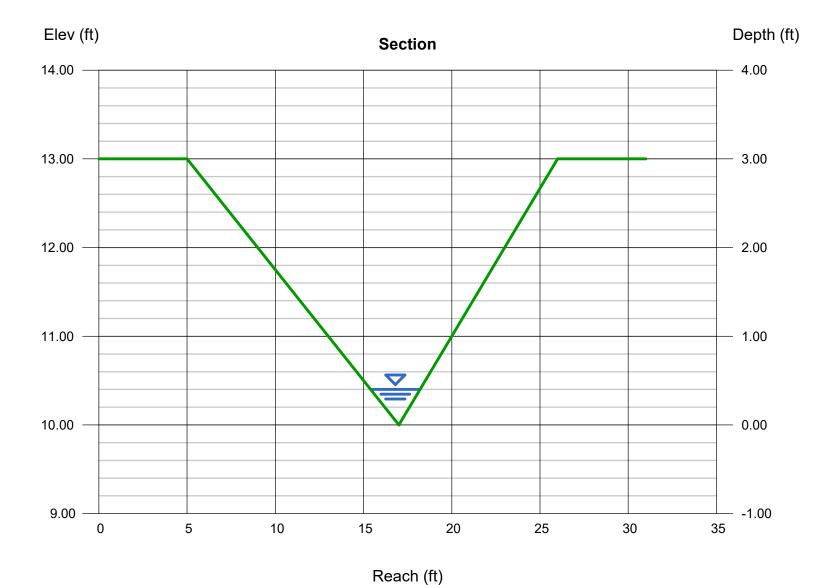
## **DP 17 Swale (5-Year)(FR:0.69)**

Side Slopes (z:1) Total Depth (ft)	= 4.00, 3.00 = 3.00
Invert Elev (ft)	= 10.00
Slope (%) N-Value	= 2.33 = 0.030

Calculations

Compute by: Known Q Known Q (cfs) = 1.40

Highlighted	
Depth (ft)	= 0.40
Q (cfs)	= 1.400
Area (sqft)	= 0.56
Velocity (ft/s)	= 2.50
Wetted Perim (ft)	= 2.91
Crit Depth, Yc (ft)	= 0.40
Top Width (ft)	= 2.80
EGL (ft)	= 0.50



#### **Channel Report**

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

Friday, Aug 25 2023

#### DP 17 Swale (100-Year)(FR:0.72)

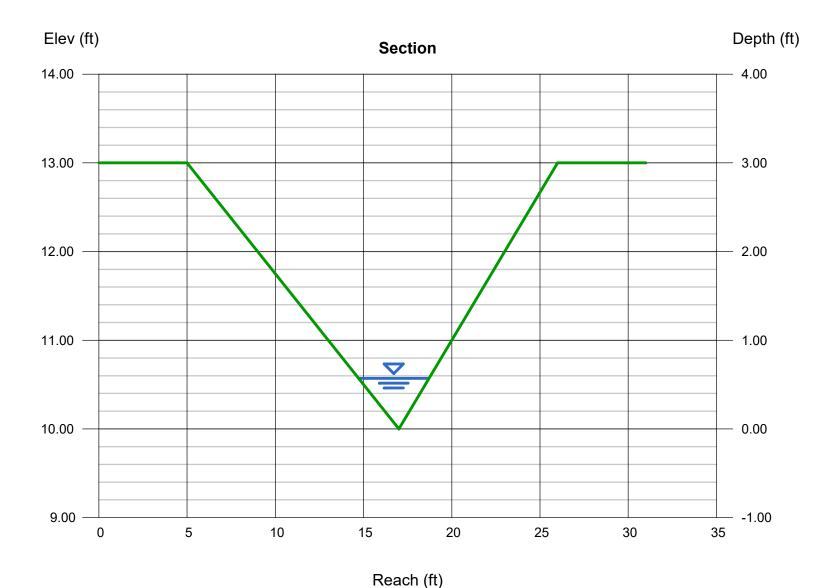
Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00

Invert Elev (ft) = 10.00 Slope (%) = 2.33 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 3.50

Highlighted		
Depth (ft)	=	0.57
Q (cfs)	=	3.500
Area (sqft)	=	1.14
Velocity (ft/s)	=	3.08
Wetted Perim (ft)	=	4.15
Crit Depth, Yc (ft)	=	0.58
Top Width (ft)	=	3.99
EGL (ft)	=	0.72



#### PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Saddlehorn Ranch Filing 4
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.06
Calculated By: AAM
Checked By: TBD
Date: 3/1/22

	S	STORM DRAIN SYSTEN		
	Culvert DP01 DP 1	Culvert DP02 DP 6		Notes
Q <sub>100</sub> (cfs):	10.3	19.3	7.2	Flows are the greater of proposed vs. future
Conduit	Pipe	Pipe	Pipe	
$D_c$ , Pipe Diameter (in):	30	30	24	
W, Box Width (ft):	N/A	N/A	N/A	
H, Box Height (ft):	N/A	N/A	N/A	
$Y_t$ , Tailwater Depth (ft):	1.95	1.95	1.55	If unknown, use $Y_t/D_c$ (or $H$ )=0.4
$Y_t/Dc$ or $Y_t/H$	0.78	0.78	0.78	
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	1.04	1.95	1.27	
Supercritical?	No	No	No	
$Y_n$ , Normal Depth (ft) [Supercritical]:	0.00	0.00	0.00	
$D_a$ , $H_a$ (in) [Supercritical]:	N/A	N/A	N/A	$D_a = (D_c + Y_n)/2$
Riprap $d_{50}$ (in) [Supercritical]:	N/A	N/A	N/A	
Riprap $d_{50}$ (in) [Subcritical]:	0.97	1.82	0.95	
Required Riprap Size:	L	L	L	Fig. 9-38 or Fig. 9-36
d <sub>50</sub> (in):	9	9	9	
Expansion Factor, $1/(2 \tan \theta)$ :	6.75	6.75	6.75	Read from Fig. 9-35 or 9-36
$\theta$ :	0.07	0.07	0.07	
Erosive Soils?	No	No	No	
Area of Flow, $A_t$ (ft <sup>2</sup> ):	1.47	2.76	1.03	$A_t = Q/V$
Length of Protection, $L_p$ (ft):	-11.8	-7.3	-9.0	L=(1/(2 tan θ))(At/Yt - D)
Min Length (ft)	7.5	7.5	6.0	Min L=3D or 3H
Max Length (ft)	25.0	25.0	20.0	Max L=10D or 10H
Min Bottom Width, $T$ (ft):	0.8	1.4	0.7	$T=2*(L_p*tan\theta)+W$
Design Length (ft)	7.5	7.5	6.0	
Design Width (ft)	0.8	1.4	0.7	
Riprap Depth (in)	18	18	18	Depth=2(d <sub>50</sub> )
Type II Bedding Depth (in)*	6	6	6	*Not used if Soil Riprap
Cutoff Wall	No	No	No	
Cutoff Wall Depth (ft)				Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

<sup>\*</sup> For use when the flow in the culvert is supercritical (and less than full).

#### PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Saddlehorn Ranch Filing 4
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.06
Calculated By: AAM
Checked By: TBD
Date: 3/1/22

	S	TORM DRAIN SYSTEM	1	T
	Culvert DP04 DP 13	Culvert DP05 DP 16	OS1 66" CMP	Notes
Q <sub>100</sub> (cfs):	2.1	4.8	6.6	Flows are the greater of proposed vs. future
Conduit	Pipe	Pipe	Pipe	
$D_c$ , Pipe Diameter (in):	18	18	66	
W, Box Width (ft):	N/A	N/A	N/A	
H, Box Height (ft):	N/A	N/A	N/A	
$Y_t$ , Tailwater Depth (ft):	1.05	1.20	0.68	If unknown, use $Y_t/D_c$ (or $H$ )=0.4
$Y_t/Dc$ or $Y_t/H$	0.70	0.80	0.12	
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	0.76	1.74	0.09	
Supercritical?	No	No	Yes	
$Y_n$ , Normal Depth (ft) [Supercritical]:	0.00	0.00	0.67	
$D_a$ , $H_a$ (in) [Supercritical]:	N/A	N/A	3.09	$D_a = (D_c + Y_n)/2$
Riprap $d_{50}$ (in) [Supercritical]:	N/A	N/A	2.06	
Riprap $d_{50}$ (in) [Subcritical]:	0.48	0.94	N/A	
Required Riprap Size:	L	L	L	Fig. 9-38 or Fig. 9-36
d <sub>50</sub> (in):	9	9	9	
Expansion Factor, $1/(2 \tan \theta)$ :	6.75	6.75	6.75	Read from Fig. 9-35 or 9-36
$\theta$ :	0.07	0.07	0.07	
Erosive Soils?	No	No	No	
Area of Flow, $A_t$ (ft <sup>2</sup> ):	0.30	0.69	0.94	$A_t = Q/V$
Length of Protection, $L_p$ (ft):	-8.2	-6.3	-27.8	L=(1/(2 tan θ))(At/Yt - D)
Min Length (ft)	4.5	4.5	16.5	Min L=3D or 3H
Max Length (ft)	15.0	15.0	55.0	Max L=10D or 10H
Min Bottom Width, $T$ (ft):	0.3	0.6	1.4	$T=2*(L_p*tan\theta)+W$
Design Length (ft)	4.5	4.5	16.5	
Design Width (ft)	0.3	0.6	1.4	
Riprap Depth (in)	18	18	18	Depth=2(d <sub>50</sub> )
Type II Bedding Depth (in)*	6	6	6	*Not used if Soil Riprap
Cutoff Wall	No	No	No	
Cutoff Wall Depth (ft)				Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

<sup>\*</sup> For use when the flow in the culvert is supercritical (and less than full).

#### PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Saddlehorn Ranch Filing 4
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.06
Calculated By: AAM
Checked By: TBD
Date: 3/1/22

	S	STORM DRAIN SYSTE	EM	
	OS1 36" CMP			Notes
Q <sub>100</sub> (cfs):	73.0			Flows are the greater of proposed vs. future
Conduit	Pipe	Pipe	Pipe	
$D_c$ , Pipe Diameter (in):	36			
W, Box Width (ft):	N/A	N/A	N/A	
H, Box Height (ft):	N/A	N/A	N/A	
$Y_t$ , Tailwater Depth (ft):	2.70	0.00	0.00	If unknown, use $Y_t/D_c$ (or $H$ )=0.4
$Y_t/Dc$ or $Y_t/H$	0.90			
Q/D <sup>2.5</sup> or Q/(WH <sup>3/2</sup> )	4.68			
Supercritical?	Yes	No	No	
$Y_n$ , Normal Depth (ft) [Supercritical]:	3.00	0.00		
$D_a$ , $H_a$ (in) [Supercritical]:	3.00			$D_a = (D_c + Y_n)/2$
Riprap $d_{50}$ (in) [Supercritical]:	4.40			
Riprap $d_{50}$ (in) [Subcritical]:	N/A			
Required Riprap Size:	L			Fig. 9-38 or Fig. 9-36
d 50 (in):	9			
Expansion Factor, $1/(2 \tan \theta)$ :	6.75			Read from Fig. 9-35 or 9-36
$\theta$ :	0.07			
Erosive Soils?	No	No	No	
Area of Flow, $A_t$ (ft <sup>2</sup> ):	10.43			$A_t = Q/V$
Length of Protection, $L_p$ (ft):	5.8			$L=(1/(2 \tan \theta))(At/Yt - D)$
Min Length (ft)	9.0			Min L=3D or 3H
Max Length (ft)	30.0			Max L=10D or 10H
Min Bottom Width, $T$ (ft):	3.9			$T=2*(L_p*tan\theta)+W$
Design Length (ft)	9.0			
Design Width (ft)	3.9			
Riprap Depth (in)	18			Depth=2(d <sub>50</sub> )
Type II Bedding Depth (in)*	6			*Not used if Soil Riprap
Cutoff Wall	No	No	No	
Cutoff Wall Depth (ft)				Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

<sup>\*</sup> For use when the flow in the culvert is supercritical (and less than full).

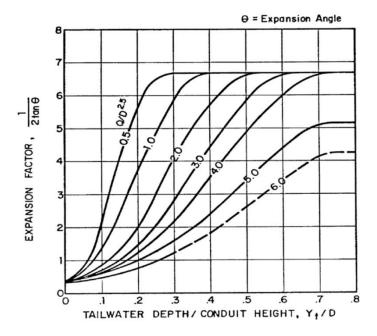


Figure 9-35. Expansion factor for circular conduits

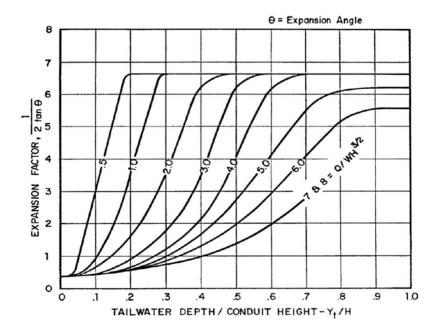


Figure 9-36. Expansion factor for rectangular conduits

Open Channels Chapter 8

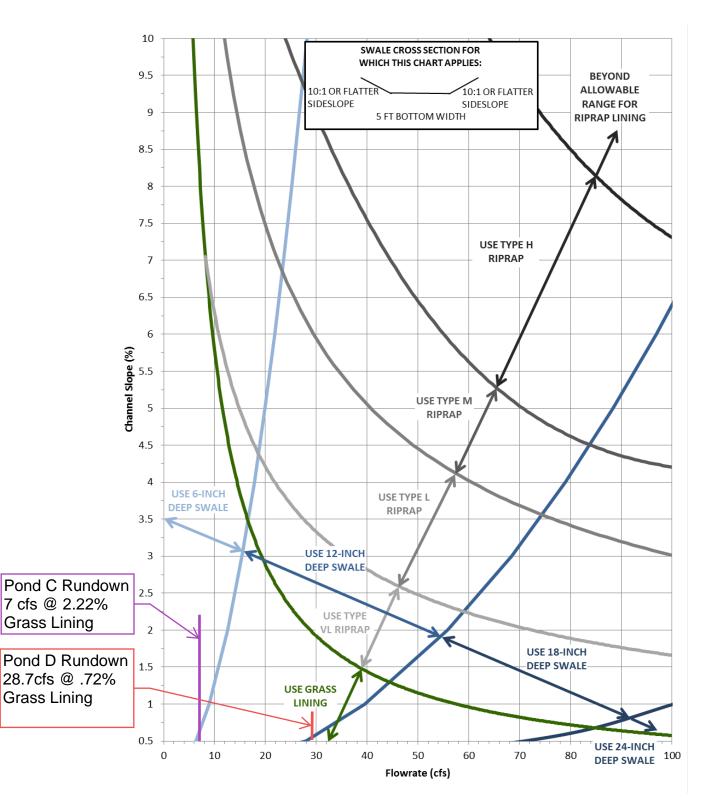


Figure 8-25. Swale stability chart: greater than 4-foot bottom width and 10:1 (or flatter) side slopes (Note: Riprap classifications refer to gradation for riprap used in soil riprap or void-filled riprap. See Figure 8-34 for gradations.) (Source: Muller Engineering Company)

Chapter 12 Storage

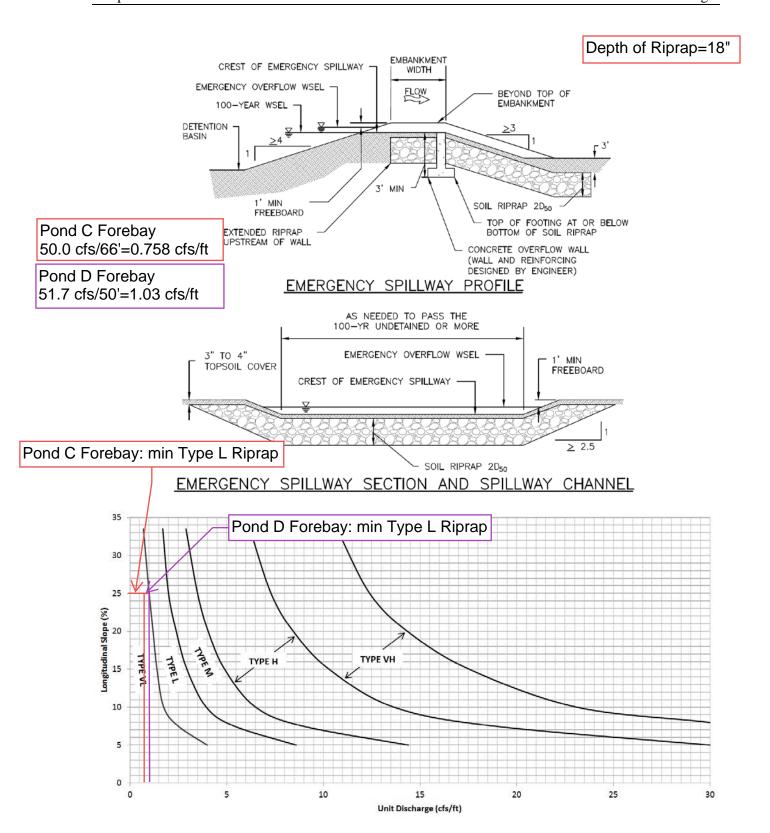


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

## APPENDIX D WATER QUALITY AND DETENTION CALCULATIONS

#### POND C FOREBAY VOLUME REQUIREMENTS

Equation 3-1  $WQCV = a(0.91I^3 - 1.19I^2 + 0.781I)$ a=1 (40 hour drain time)

PROPOSED FOREBAY I=.211 WQCV= 0.120148

Equation 3-3 V=(WQCV/12)A

PROPOSED FOREBAY A= 5.30 Acres V= 0.053

3% OF WQCV

FOREBAY TOTAL VOLUME= .03(V)

VOLUME REQUIRED FOR PROPOSED FOREBAY = 0.002 AC-FT 69 CF

VOLUME PROVIDED FOR PROPOSED FOREBAY = 0.005 AC-FT 210 CF

Q<sub>100</sub> DISCHARGES 2% OF Q<sub>100</sub>

Q<sub>100</sub> PROPOSED FOREBAY= .02\*7.0 CFS= 0.14 CFS

#### **Weir Report**

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

Wednesday, Mar 2 2022

#### **Pond C Forebay 1 Notch**

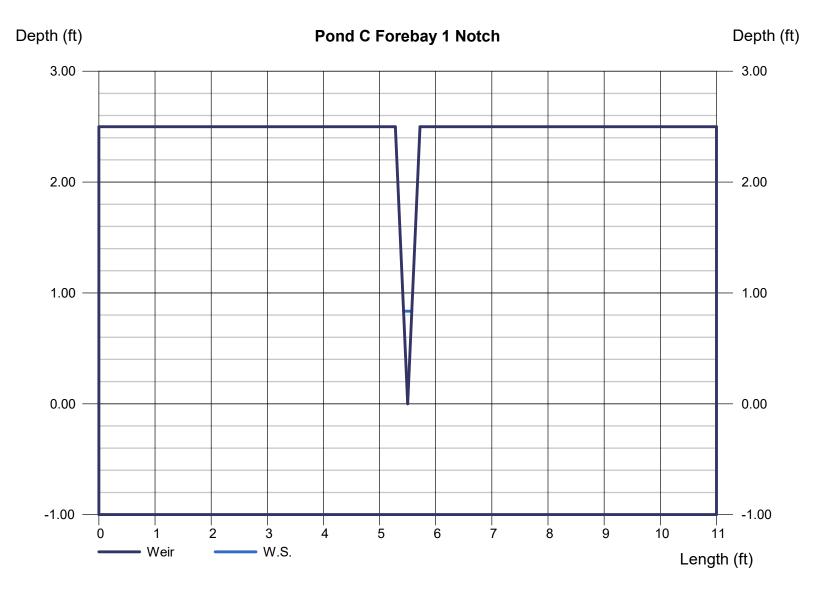
V-Notch Weir	
Crest	= Sharp
Angle (Deg)	= 10
Total Depth (ft)	= 2.50

**Calculations** 

Weir Coeff. Cw = 0.22 Compute by: Known Q Known Q (cfs) = 0.14

#### Highlighted

Depth (ft) = 0.83 Q (cfs) = 0.140 Area (sqft) = 0.06 Velocity (ft/s) = 2.30 Top Width (ft) = 0.15



#### POND D FOREBAY VOLUME REQUIREMENTS

WQCV=  $a(0.91I^3-1.19I^2+0.781I)$ a=1 (40 hour drain time) Equation 3-1

Proposed Forebay I=.167 WQCV= 0.10131

Equation 3-3

V=(WQCV/12)A

Proposed Forebay A= 25.94 Acres 0.219

3% OF WQCV

FOREBAY TOTAL VOLUME= .03(V)

**VOLUME REQUIRED FOR PROPOSED FOREBAY=** 0.007 AC-FT 286 CF

VOLUME PROVIDED FOR PROPOSED FOREBAY = 0.014 AC-FT 615 CF

Q<sub>100</sub> Discharges 2% OF Q<sub>100</sub>

Q<sub>100</sub> Proposed Forebay 1= .02\*28.7 CFS= .57 CFS

#### **Weir Report**

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

Wednesday, Mar 2 2022

#### **Pond D Forebay 1 Notch**

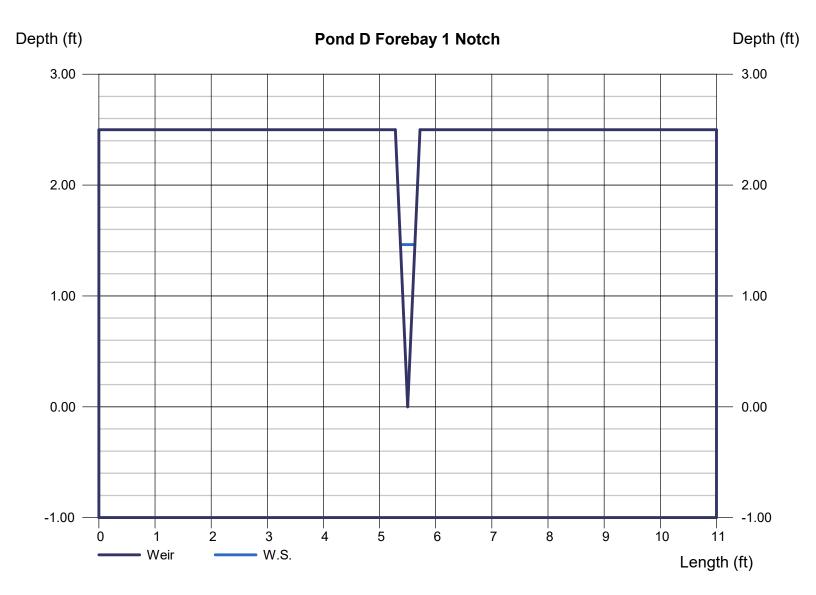
V-Notch Weir	
Crest	= Sharp
Angle (Deg)	= 10
Total Depth (ft)	= 2.50

**Calculations** 

Weir Coeff. Cw = 0.22Compute by: Known Q Known Q (cfs) = 0.57

#### Highlighted Depth (ft)

= 1.46Q (cfs) = 0.570Area (sqft) = 0.19Velocity (ft/s) = 3.04Top Width (ft) = 0.26



## APPENDIX E REFERENCE MATERIALS



# Federal Emergency Management Agency

Washington, D.C. 20472

### LETTER OF MAP REVISION **DETERMINATION DOCUMENT (CONTINUED)**

### PUBLIC NOTIFICATION OF REVISION

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised BFEs presented in this LOMR may be changed.

A notice of changes will be published in the Federal Register. This information also will be published in your local newspaper on or about the dates listed below.

LOCAL NEWSPAPER

Name: El Paso County News

Dates: 11/10/2004

11/17/2004

### **PUBLIC NOTIFICATION**

		BFE (FEE	MAP PANEL	
FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	EFFECTIVE	REVISED	NUMBER(\$)
Haegler Ranch Tributary 2	Approximately 310 feet upstream of confluence with Geick Ranch West Tributary	None	6,735	08041C0575 F
naegiei Raikii Hibutary z	Approximately 3,140 feet upstream of confluence with Geick Ranch West Tributary	None	6,779	08041C0575 F
Haegler Ranch Tributary 3	Approximately 8,100 feet downstream of Curtis Road	None	6,672	08041C0575 F
nacyel Naikai Ilibutaiy S	Approximately 300 feet upstream of Curtis Road	None	6,769	08041C0575 F
Haegler Ranch Tributary 4	Approximately 4,000 feet downstream of Curtis Road	None	6,688	08041C0575 F
Hacylei Italion Tributary 4	Approximately 300 feet upstream of Curtis Road	None	6,758	08041C0575 F

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Kevin C Jong

Kevin C. Long, CFM, Project Engineer Hagard Identification Section

Mitigation Division

Emergency Preparedness and Response Directorate 102929 101104080587 102IAC

CHANGES ARE MADE IN DETERMINATIONS OF BASE FLOOD ELEVATIONS FOR THE UNINCORPORATED AREAS OF EL PASO COUNTY, COLORADO, UNDER THE NATIONAL FLOOD INSURANCE PROGRAM

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On March 17, 1997, the Department of Homeland Security's Federal Emergency Management Agency identified Special Flood Hazard Areas (SFHAs) in the unincorporated areas of El Paso County, Colorado, through issuance of a Flood Insurance Rate Map (FIRM). The Mitigation Division has determined that modification of the elevations of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) for certain locations in this community is appropriate. The modified Base Flood Elevations (BFEs) revise the FIRM for the community.

The changes are being made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and are in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65.

A hydraulic analysis was performed to incorporate new hydrologic, hydraulic, and topographic data for Haegler Ranch Tributary 2 from approximately 310 feet upstream to approximately 3,140 feet upstream of the confluence with Geick Ranch West Tributary; for Haegler Ranch Tributary 3 from approximately 8,100 feet downstream to approximately 400 feet upstream of Curtis Road; and for Haegler Ranch Tributary 4 from approximately 4,100 feet downstream to approximately 400 feet upstream of Curtis Road. This has resulted in increases and decreases in SFHA width and increased BFEs for the above-mentioned tributaries. The table below indicates existing and modified BFEs for selected locations along the affected lengths of the flooding source(s) cited above.

Location	Existing BFE (feet)*	'Modified BFE (feet)*
Haegler Ranch Tributary 2:		
Approximately 310 feet upstream of confluence with		
Geick Ranch West Tributary	None	6,735
Approximately 3,140 feet upstream of confluence with		
Geick Ranch West Tributary	None	6,779
Haegler Ranch Tributary 3:		
Approximately 8,100 feet downstream of Curtis Road	None	6,672
Approximately 300 feet upstream of Curtis Road	None	6,769
Haegler Ranch Tributary 4:	•	
Approximately 4,000 feet downstream of Curtis Road	None	6,688
Approximately 300 feet upstream of Curtis Road	None	6,758

<sup>\*</sup>National Geodetic Vertical Datum, rounded to nearest whole foot

Under the above-mentioned Acts of 1968 and 1973, the Mitigation Division must develop criteria for floodplain management. To participate in the National Flood Insurance Program (NFIP), the community must use the modified BFEs to administer the floodplain management measures of the NFIP. These modified BFEs will also be used to calculate the appropriate flood insurance premium rates for new buildings and their contents and for the second layer of insurance on existing buildings and contents.

Upon the second publication of notice of these changes in this newspaper, any person has 90 days in which he or she can request, through the Chief Executive Officer of the community, that the Mitigation Division reconsider the determination. Any request for reconsideration must be based on knowledge of changed conditions or new scientific or technical data. All interested parties are on notice that until the 90-day period elapses, the Mitigation Division's determination to modify the BFEs may itself be changed.

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Any person having knowledge or wishing to comment on these changes should immediately notify:

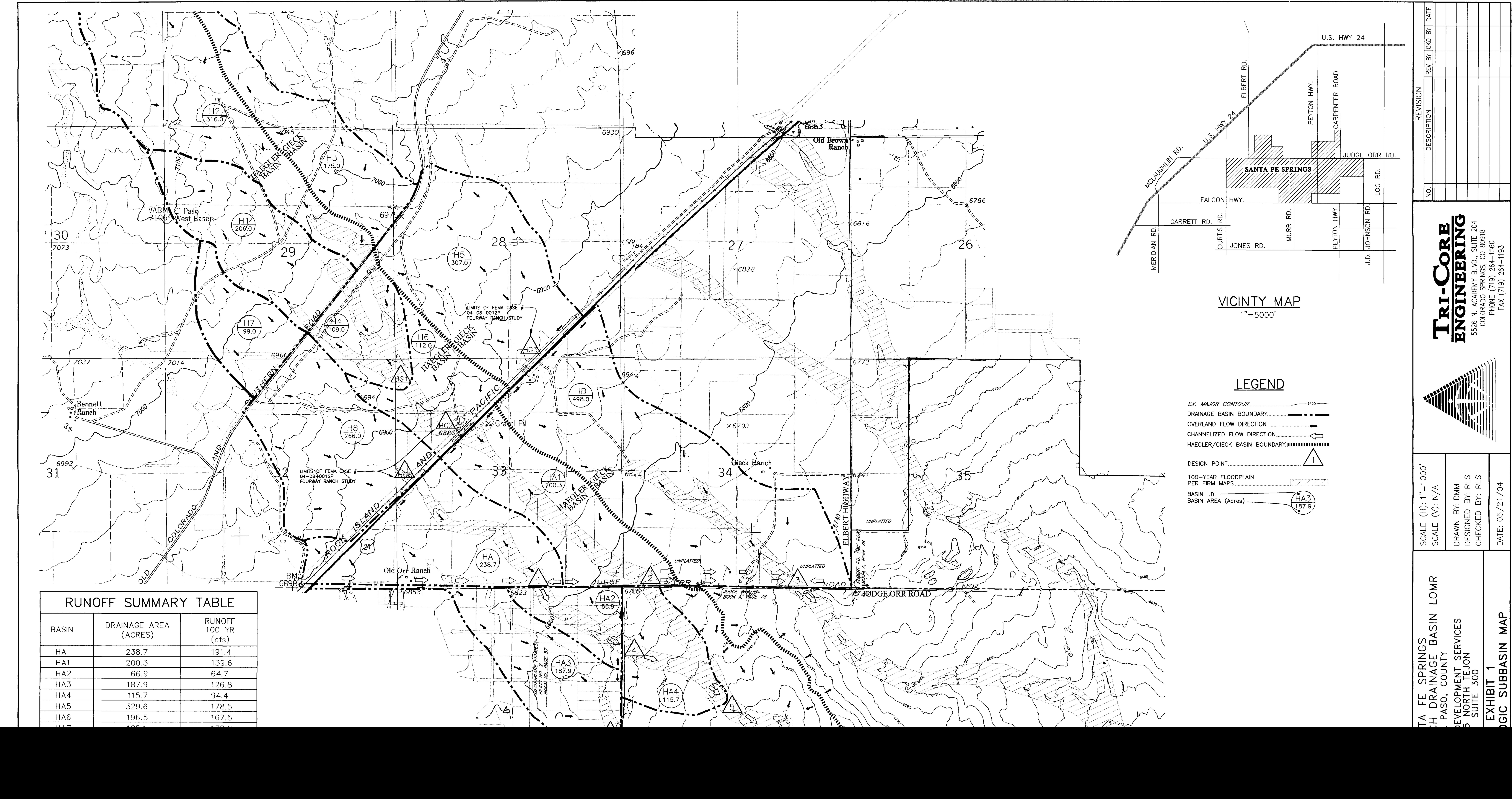
The Honorable Chuck Brown
Chairman, El Paso County
Board of Commissioners
27 Vermijo Avenue
Colorado Springs, CO 80903-2208

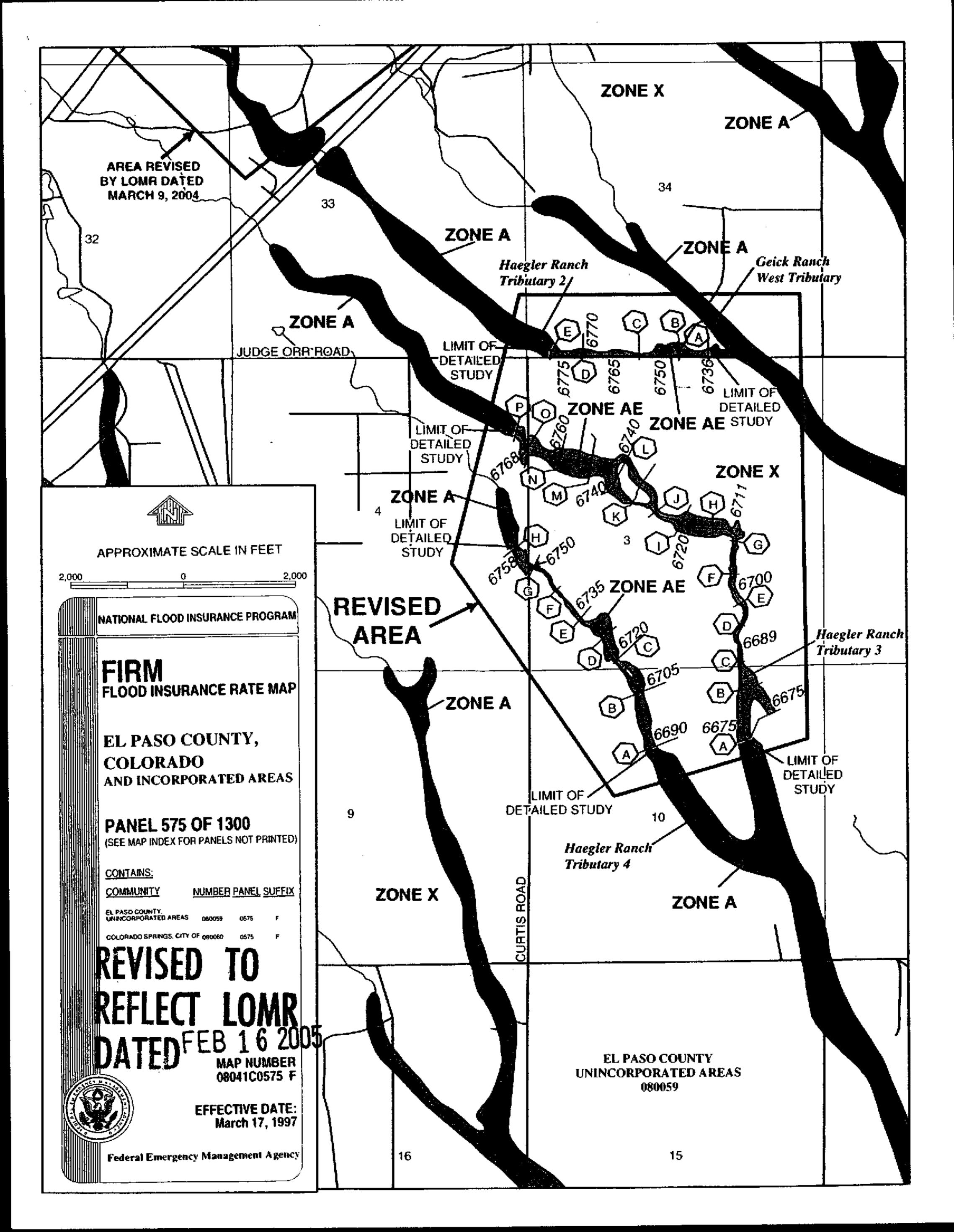
Table 3. Summary of Discharges

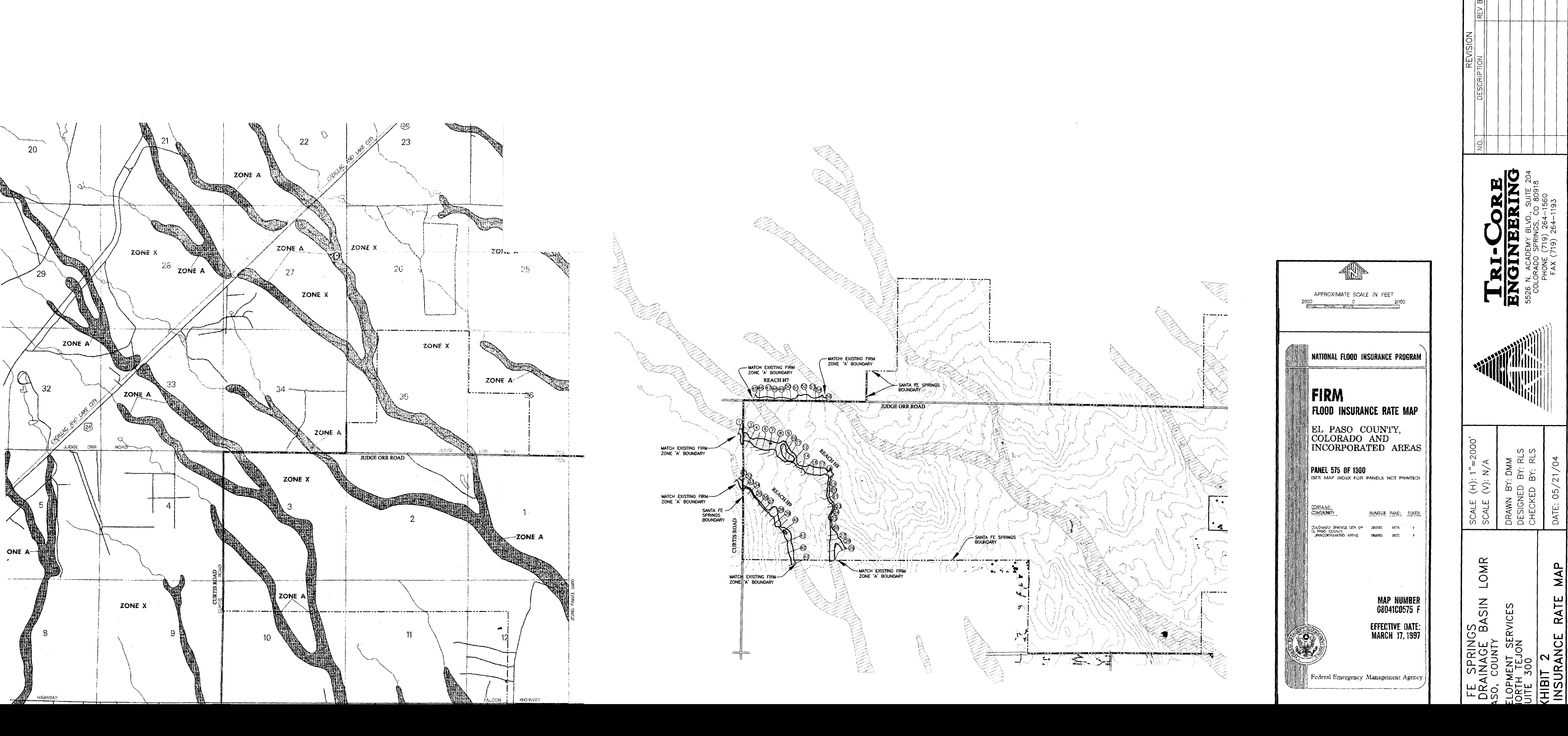
	Drainage Area	Pea	Peak Discharges (cubic feet per second)			
Flooding Source and Location	(square miles)	10-Year	50-Year	100-Year	500-Year	
Haegler Ranch Tributary 2 At the confluence with Geick						
Ranch West Tributary	1.47	1	1	592	11	
Haegler Ranch Tributary 3 At approximately 2,300 feet upstream of the confluence with Haegler Ranch Tributary 4	1.09	1	1	505	1	
Haegler Ranch Tributary 4 At approximately 3,700 feet upstream of the confluence with Haegler Ranch Tributary 3	0.60	1	1	130	1	

1 Data Not Available

REVISED TO REFLECT LOMR DATED FEB 1 6 2005

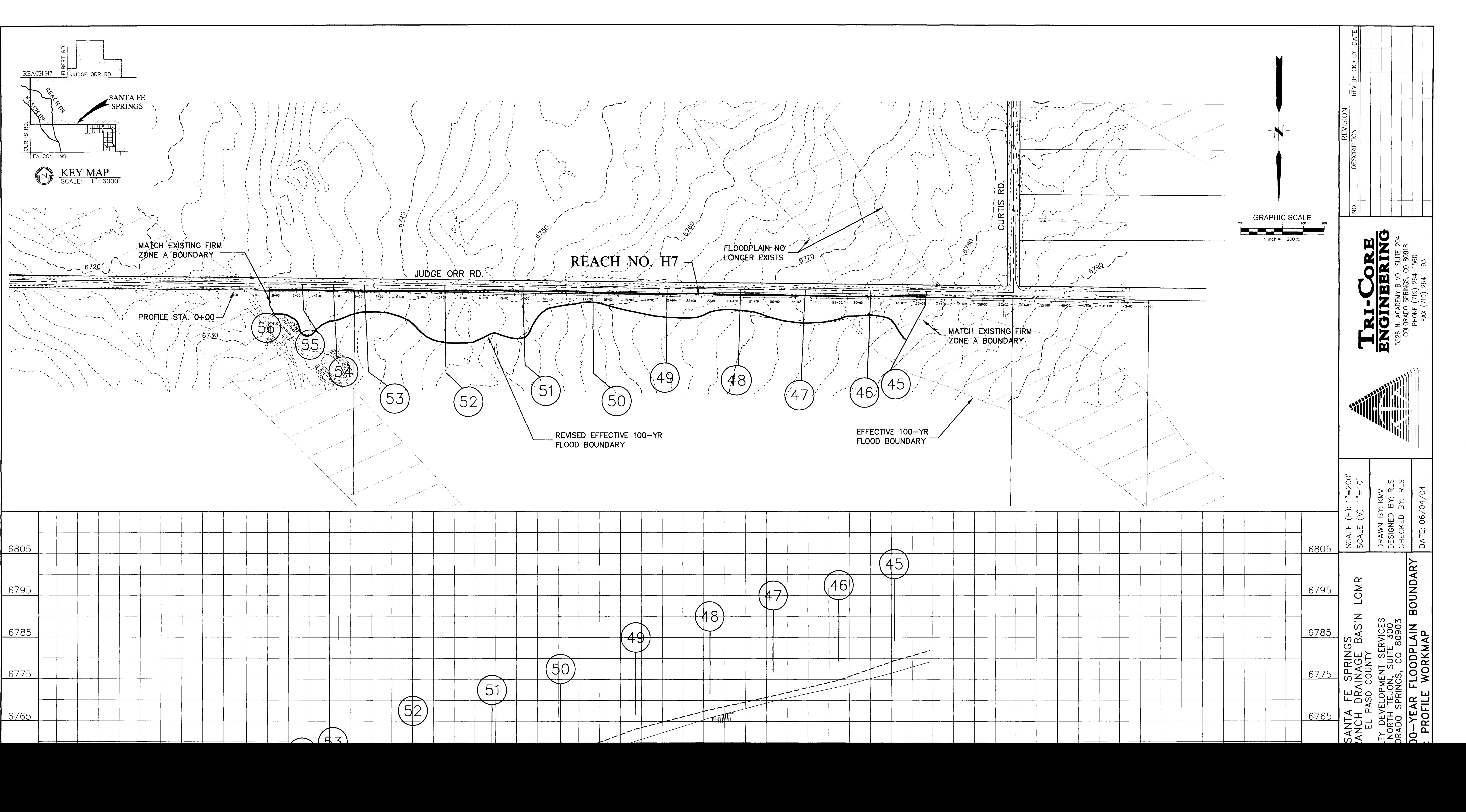


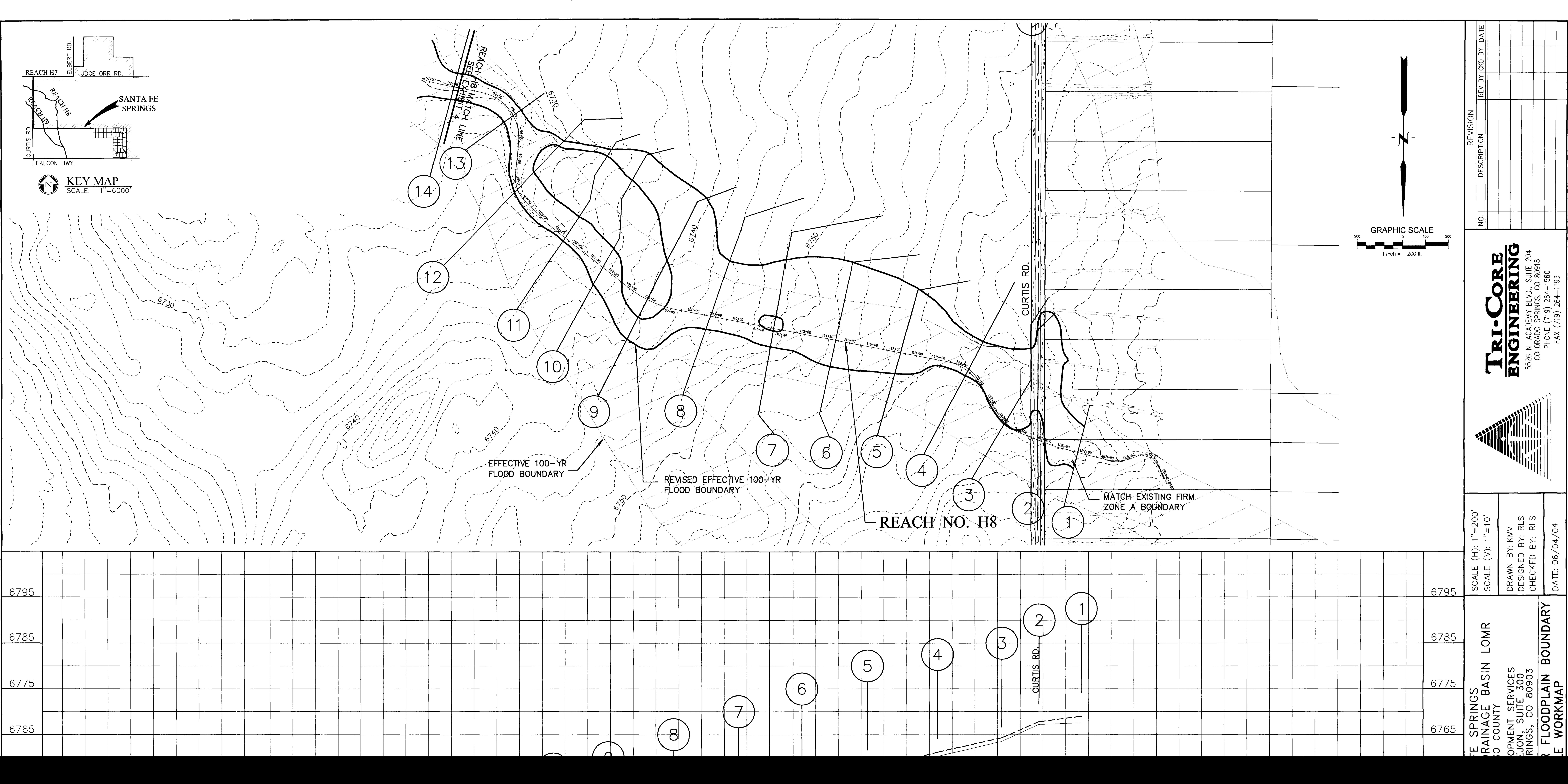


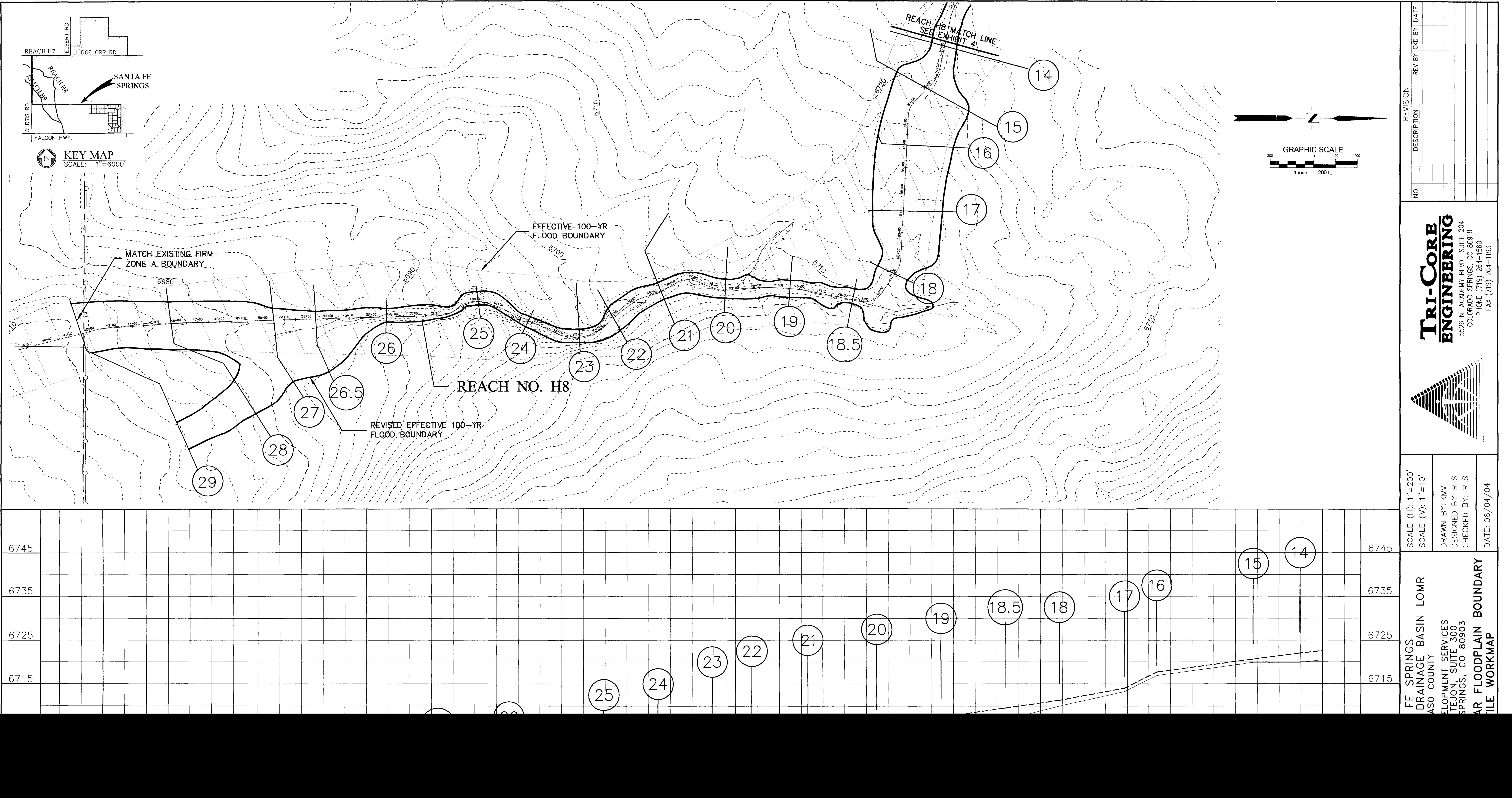


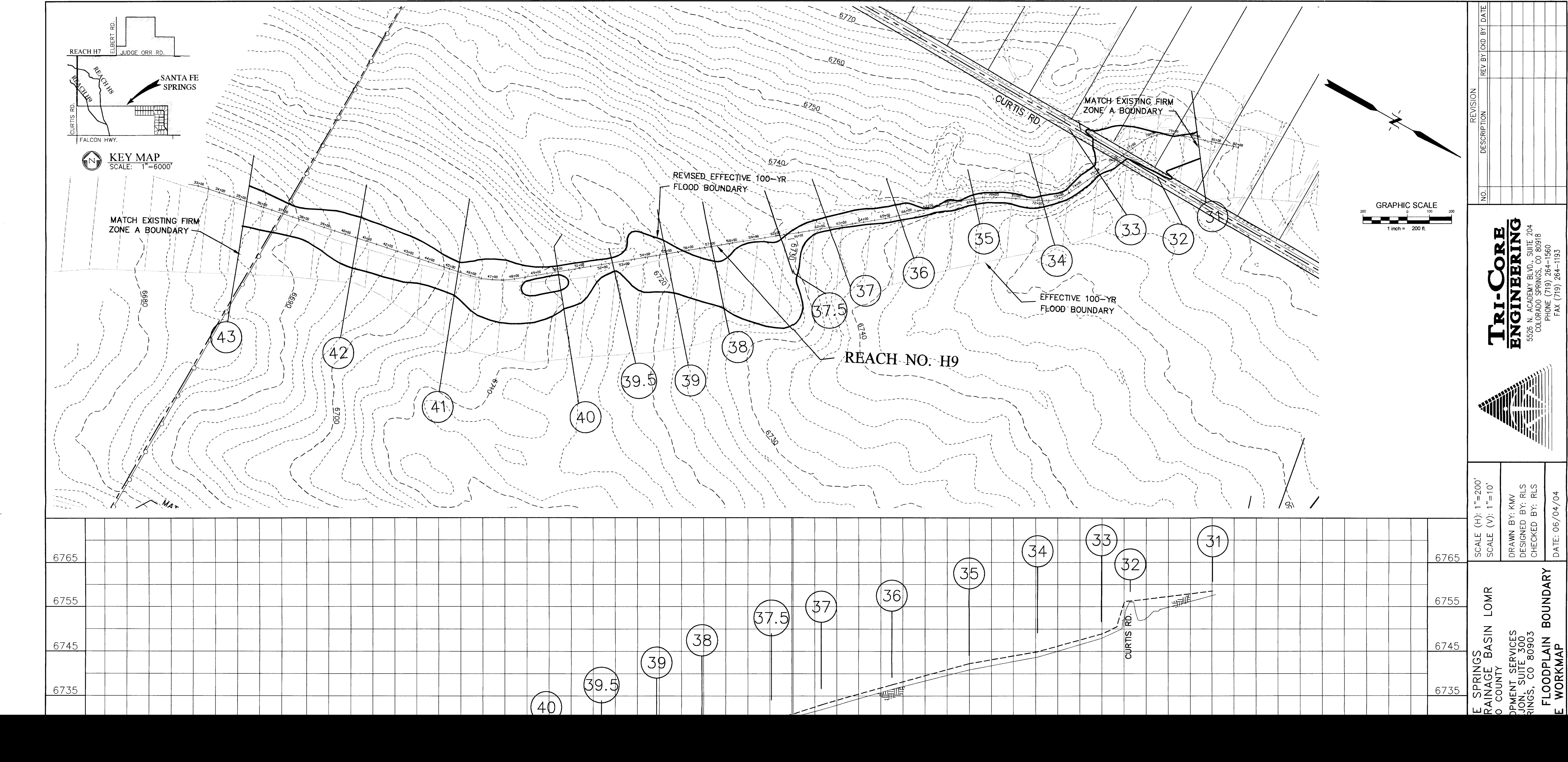
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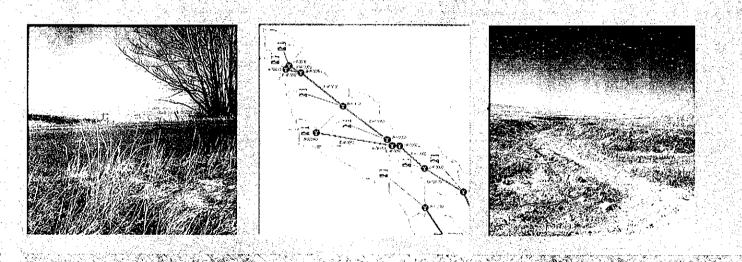
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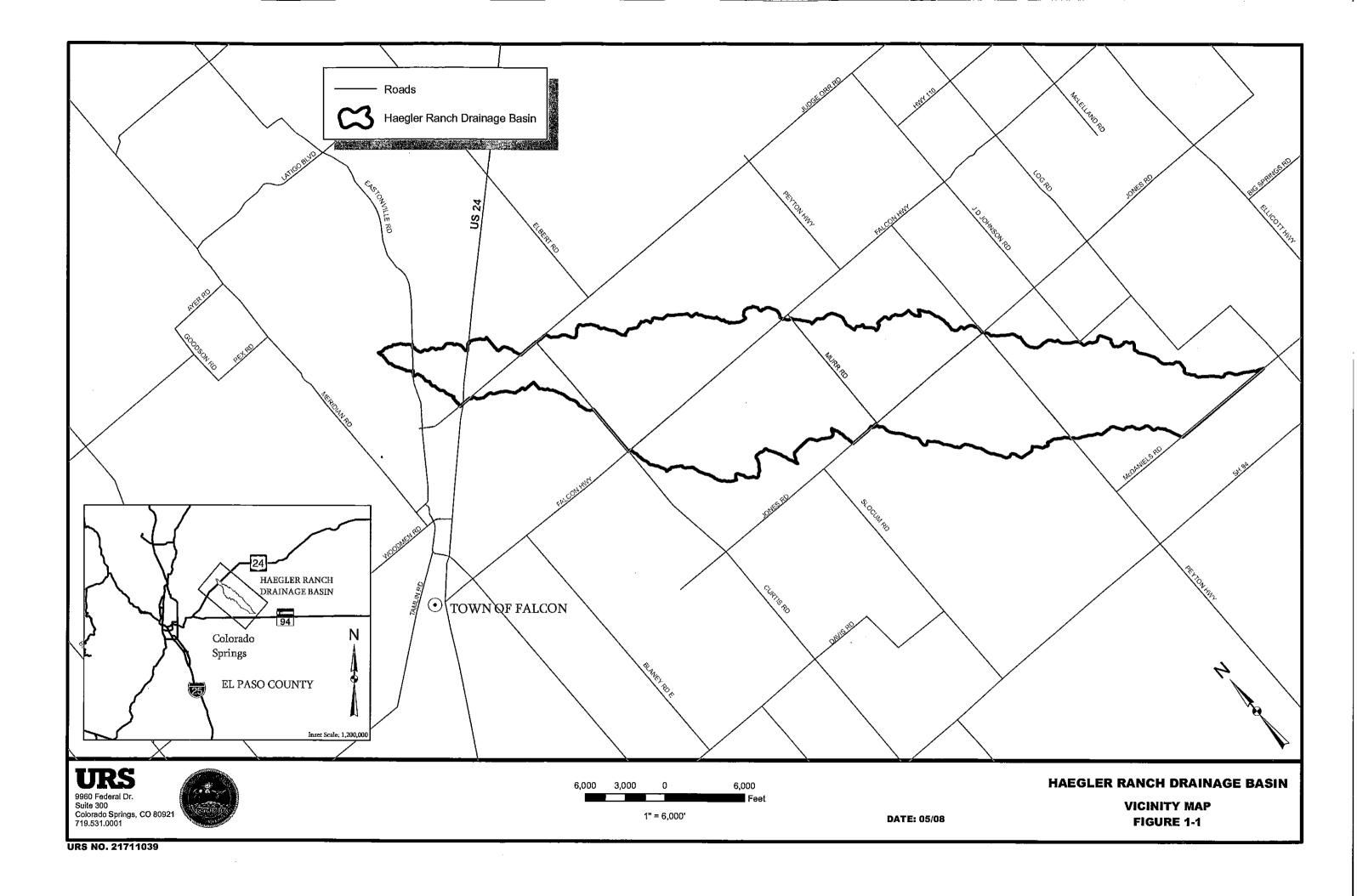


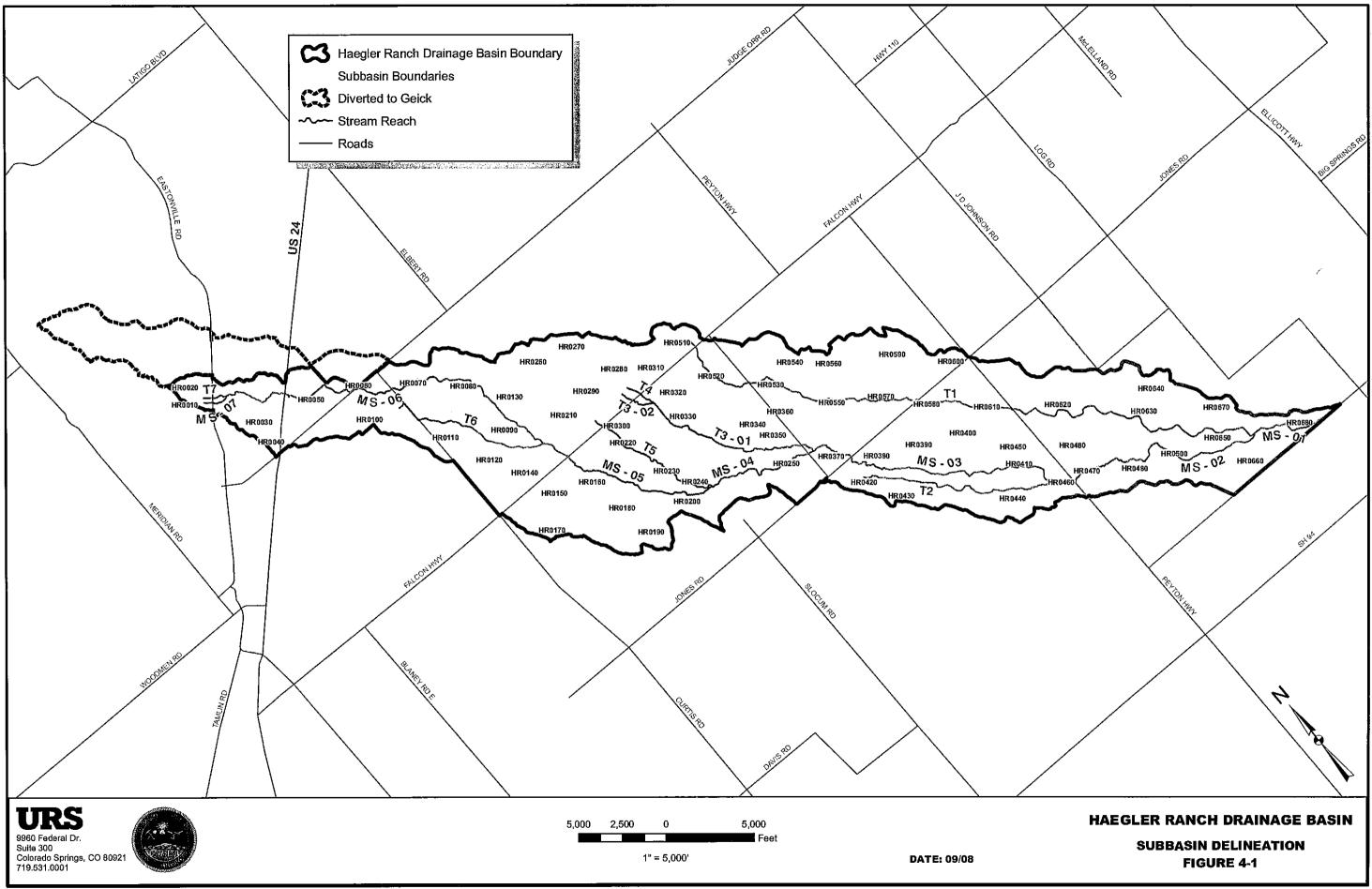
Howeviller Rowalder Bounder Study

May 2009









**Table 5-3 Existing Hydraulic Deficiencies** 

Facility Number	Road Crossing	Channel	Existing Size	Existing 100-yr Flow (cfs)	Deficiency
633	Sagecreek Road	N/A	24" CMP	N/A	N/A
634	Sagecreek Road	N/A	24" CMP	N/A	N/A
701	Curtis Road	N/A	18" CMP	N/A	N/A
702	Curtis Road	Tributary 6 (T6)	36" CMP	120	Overtops
703	Curtis Road	Main Stem (MS-06)	24" CMP	590	Overtops
704	Judge Orr Road	Main Stem (MS-06)	Blocked Culvert	540	Overtops
705	Judge Orr Road	N/A	18" CMP	N/A	N/A
706	US 24	N/A	20" Steel Pipe	N/A	N/A
707	US 24	N/A	24" CMP	N/A	N/A
801	Pedestrain Bridge	Main Stem (MS-06)	Bridge	350	Meets Capacity
802	US24	Main Stem (MS-06)	2-66" CMPs	350	Meets Capacity
803	Eastonville Road	Main Stem (MS-07)	27"X21" CMP	25	Overtops
804	Eastonville Road	Tributary 7 (T7)	18" CMP	99	Overtops

Note: 69 Structures were cataloged and located. N/A indicates that the structure was not analyzed because it was not on one of the main channels.

#### 5.14. Results

Hydraulic conditions from the hydraulic model results are summarized in Table 5-4. This includes channel velocity, flow depth, and top width for existing conditions at key locations. Water surface profiles for Haegler Ranch Drainage Basin for the 100-year recurrence interval flood for the existing conditions are presented in Figure 5-4 the HEC-RAS model for Haegler Ranch Drainage Basin for the existing conditions is provided in Appendix B.

The approximate 100-year floodplain as seen in Figure 5-4 varies from a contained floodplain with in a defined channel to a wide floodplain with shallow flooding. Three areas were designated as flooding: 1) the approximate 100-year floodplain as delineated by HEC-RAS, 2) split flow flooding that was estimated from HEC-RAS elevation upstream and contours, and 3) shallow areas connected to the floodplain with less than 1 foot of flooding.

Table 5-4 Existing Conditions HEC-RAS Model

	Reach and	HEC-RAS Result	Recurrence Intervals				
Key Location	Station	HEC-RAS RESUL	2-yr	5-yr	10-yr	100-yr	
		Channel velocity (ft/sec)	1.1	1.63	1.98	2.92	
Main stem at US 24	MS-06 72276	Water surface depth in channel (ft)	1.36	2.44	3.24	6.49	
	12210	Top width (ft)	18.23	24.85	29.7	255.62	
		Channel velocity (ft/sec)	3.33	4.09	1.76	3.48	
Main stem at Judge Orr Road	MS-06 67666	Water surface depth in channel (ft)	0.52	1.04	1.05	1.35	
	01000	Top width (ft)	174.53	534.34	535.52	569.34	
		Channel velocity (ft/sec)	1.05	1.6	2.04	3.59	
Main stem at Falcon Highway	MS-05 52353	Water surface depth in channel (ft)	1.79	3.69	4.96	5.74	
	3233	Top width (ft)	31.42	83.76	556.41	592.33	
	MS-03 33189	Channel velocity (ft/sec)	2.45	3.7	1.27	2.51	
Main stem at Jones Road		Water surface depth in channel (ft)	3.2	5.83	9.25	10.46	
		Top width (ft)	47.98	105.51	580.28	667.17	
	MS-02 18474	Channel velocity (ft/sec)	0.16	0.4	0.59	1.43	
Main stem at Peyton Highway		Water surface depth in channel (ft)	4.14	4.35	4.51	5.15	
		Top width (ft)	813.21	871.68	882.22	925.27	
		Channel velocity (ft/sec)	0.62	1.02	1.47	3.2	
Southeast Tributary at Jones Road	T1 22297	Water surface depth in channel (ft)	2.45	3.52	3.59	3.82	
		Top width (ft)	197.35	345.68	351.74	372.17	
		Channel velocity (ft/sec)	1.67	2.25	2.65	4.05	
Southeast Tributary at Peyton Highway	T1 16611	Water surface dcpth in channel (ft)	0.08	0.17	0.24	0.51	
- mga ( w)	10011	Top width (ft)	239.82	241.36	242.51	247.41	
		Channel velocity (ft/sec)	3.44	0.11	0.18	0.67	
Southeast Tributary at Confluence with Main stem	T1 410	Water surface depth in channel (ft)	1.69	2.01	2.01	2.01	
Confidence with Main stem		Top width (ft)	31.89	1169.3	1169.3	1169.3	
		Channel velocity (ft/sec)	2.68	3.85	19.89	17.33	
At Confluence with Geick Basin	MS-01 82	Water surface depth in channel (ft)	1.45	2.17	1.11	2.36	
23011	<u>V</u>	Top width (ft)	75.88	255.32	60.67	262.84	

Grass channels are designed for depths and velocities to be within the limits of allowable shear stress. Grass lined channels are limited to 1.0 psf shear stress. If calculated shear stress is above this, drop structures must be added to flatten the natural slope of the channel.

Using these criteria, several channel sections were developed to accommodate a range of future flow rates from 100 cfs to 3500 cfs, as shown in Table 6-2. The approximate channel sections were used in the alternatives to accommodate future flows as necessary,

Table 6-2 Channel Dimensions based on Flow Rates

-2 Channel Dimensions pascu on Flo						
Λ	Grass					
Q (cfs)	Sideslope (h:v)	Bottom (ft)	Depth (ft)			
300	4	6	5			
500	4	8	5			
600	4	15	5			
800	4	20	5			
900	4	25	5			
1000	4	30	5			
1500	4	50	5			
2000	4	80	5			
3000	4	120	5			
3500	4	140	5			

#### 6.2.2. Culvert Design

Culvert sizes for use in alternative evaluation were estimated based on full flow capacity of reinforced concrete pipe with a minimum slope of 0.50% and concrete end sections. For flows up to 300 cfs single RC pipe culverts with a maximum of 72" diameter were used. For greater flows, multiple RC pipes or 6-foot by 6-foot concrete box culverts with headwalls and flared wingwalls were used. Proposed culverts sizes based on existing flow rates are listed in Table 6-3.

Table 6-3 Existing Conditions Culvert Design

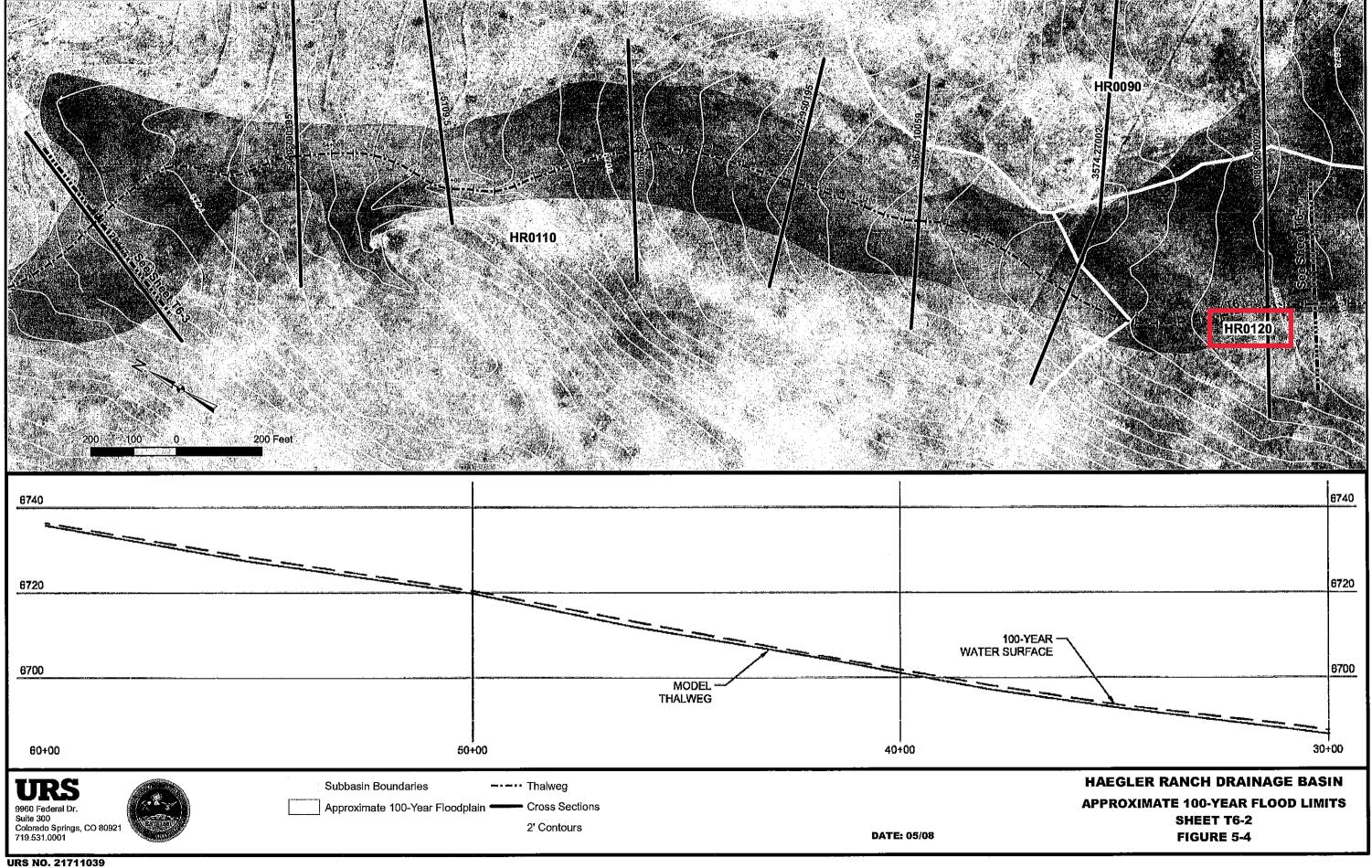
Table of Datisting Contactions Cultivity Design						
Facility Number	Road Crossing	Channel	Existing Size	Existing 100-yr Flow (cfs)	Deficiency	Necessary Facility
N/A	Peyton Highway	Tributary 1 (T1)	No Culvert	500	Overtops	2-72" RCPs
N/A	Falcon Highway	Tributary 1 (T1)	No Culvert	33	Overtops	36" RCP
301	Peyton Highway	Main Stem (MS-02)	2-33"X48" CMPs	2,500	Overtops	7-6'X6' RCBs
401	Jones Road	Tributary 1 (T1)	2-24" CMPs	370	Overtops	6'X6' RCB
403	Jones Road	Main Stem (MS-03)	3-60" CMPs	2,300	Overtops	6-6'X6' RCBs

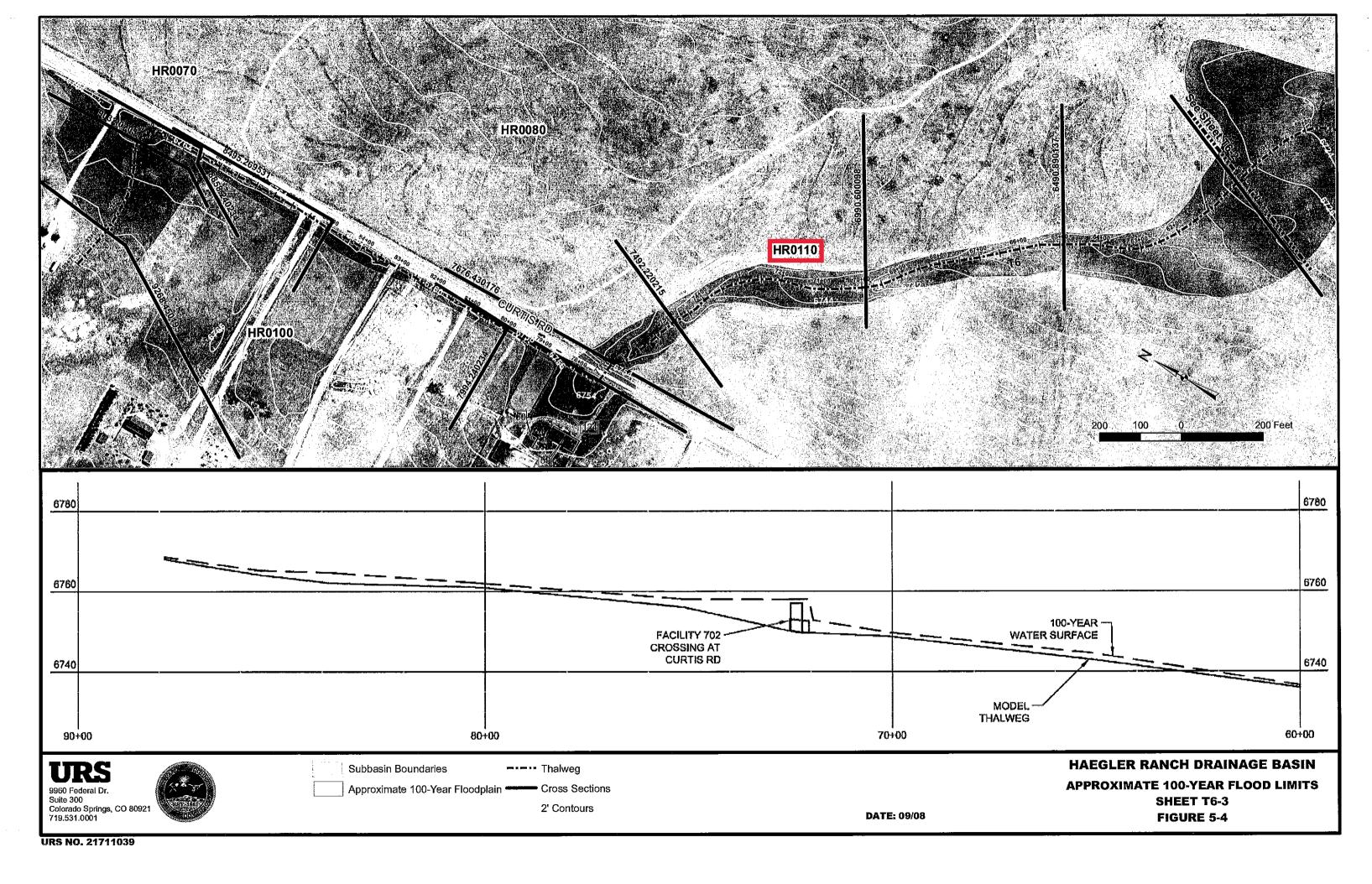
Facility Number	Road Crossing	Channel	Existing Size	Existing 100-yr Flow (cfs)	Deficiency	Necessary Facility
405	Murr Road	Main Stem (MS-04)	66" RCP	1,700	Overtops	5-6'X6' RCBs
407	Murr Road	Tributary 3 (T3-01)	66" RCP	670	Overtops	2-6'X6' RCBs
507	Peerless Farms Road	Tributary 3 (T3-01)	60°, CMP	600	Overtops	2-6'X6' RCBs
509	Murr Road	Tributary 1 (T1)	2-15" RCPs	220	Overtops	66" RCP
601	Whiting Way	Tributary 1 (T1)	24" CMP	220	Overtops	66" RCP
604	Max Road	Tributary 1 (T1)	18" CMP	220	Overtops	66" RCP
609	Falcon Highway	Tributary 3 (T3-02)	18" CMP	180	Overtops	66" RCP
610	Falcon Highway	Tributary 4 (T4)	24" CMP	200	Overtops	66" RCP
612	Falcon Highway	Tributary 5 (T5)	24" CMP	150	Overtops	60" RCP
628	Falcon Highway	Main Stem (MS-05)	2-60" CMPs	1,000	Overtops	3-6'X6' RCBs
702	Curtis Road	Tributary 6 (T6)	36" CMP	120	Overtops	54" RCP
703	Curtis Road	Main Stem (MS-06)	24" CMP	590	Overtops	2-6'X6' RCBs
704	Judge Orr Road	Main Stem (MS-06)	Blocked Culvert	540	Overtops	2-72" RCPs
801	Pedestrain Bridge	Main Stem (MS-06)	Bridge	350	Meets Capacity	Existing Bridge
802	US24	Main Stem (MS-06)	2-66'' CMPs	350	Meets Capacity	Existing Culvert
803	Eastonville Road	Main Stem (MS-07)	27"X21" CMP	25	Overtops	30" RCP
804	Eastonville Road	Tributary 7 (T7)	18" CMP	99	Overtops	48" RCP

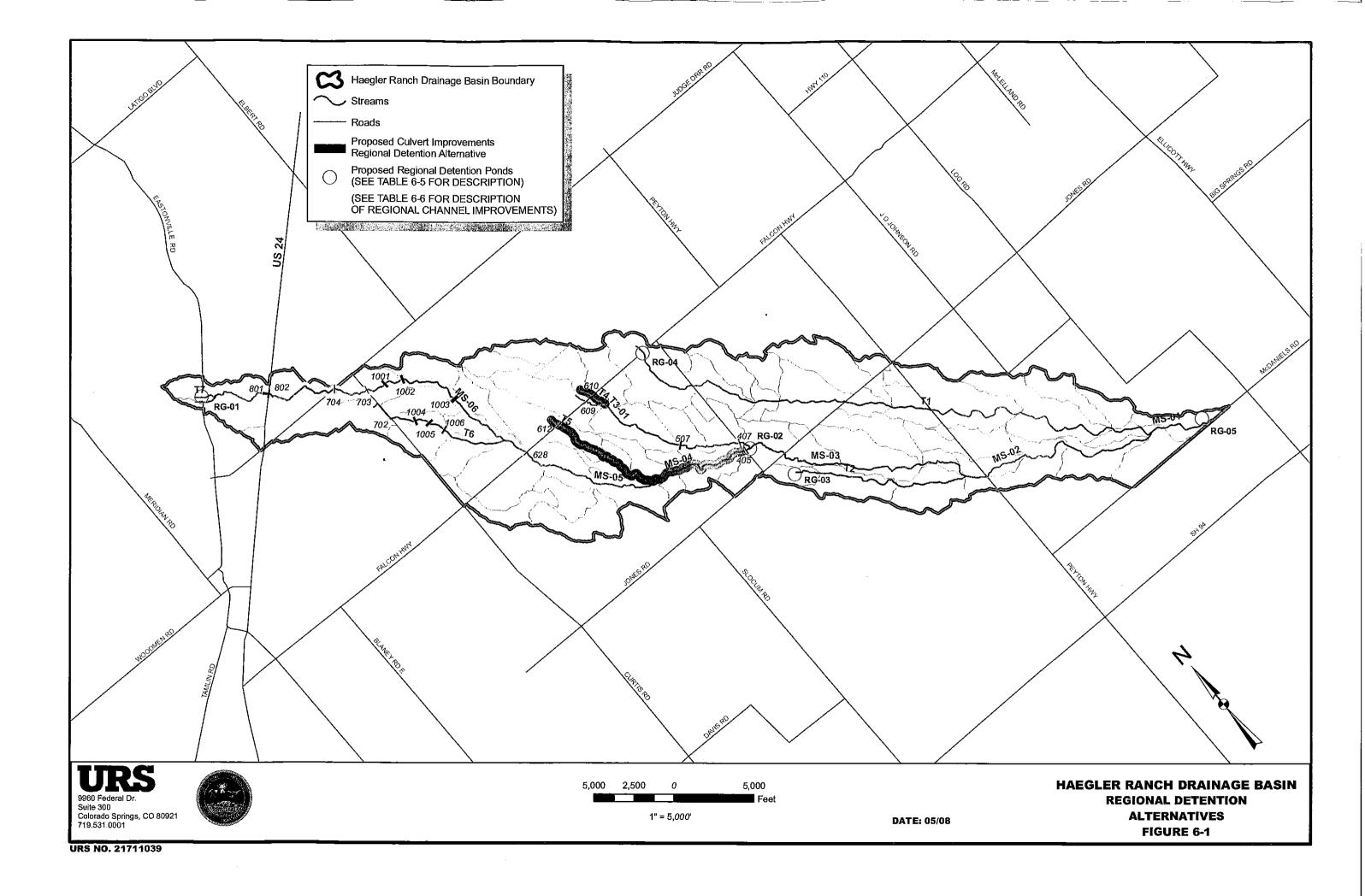
#### 6.2.3. Detention Design

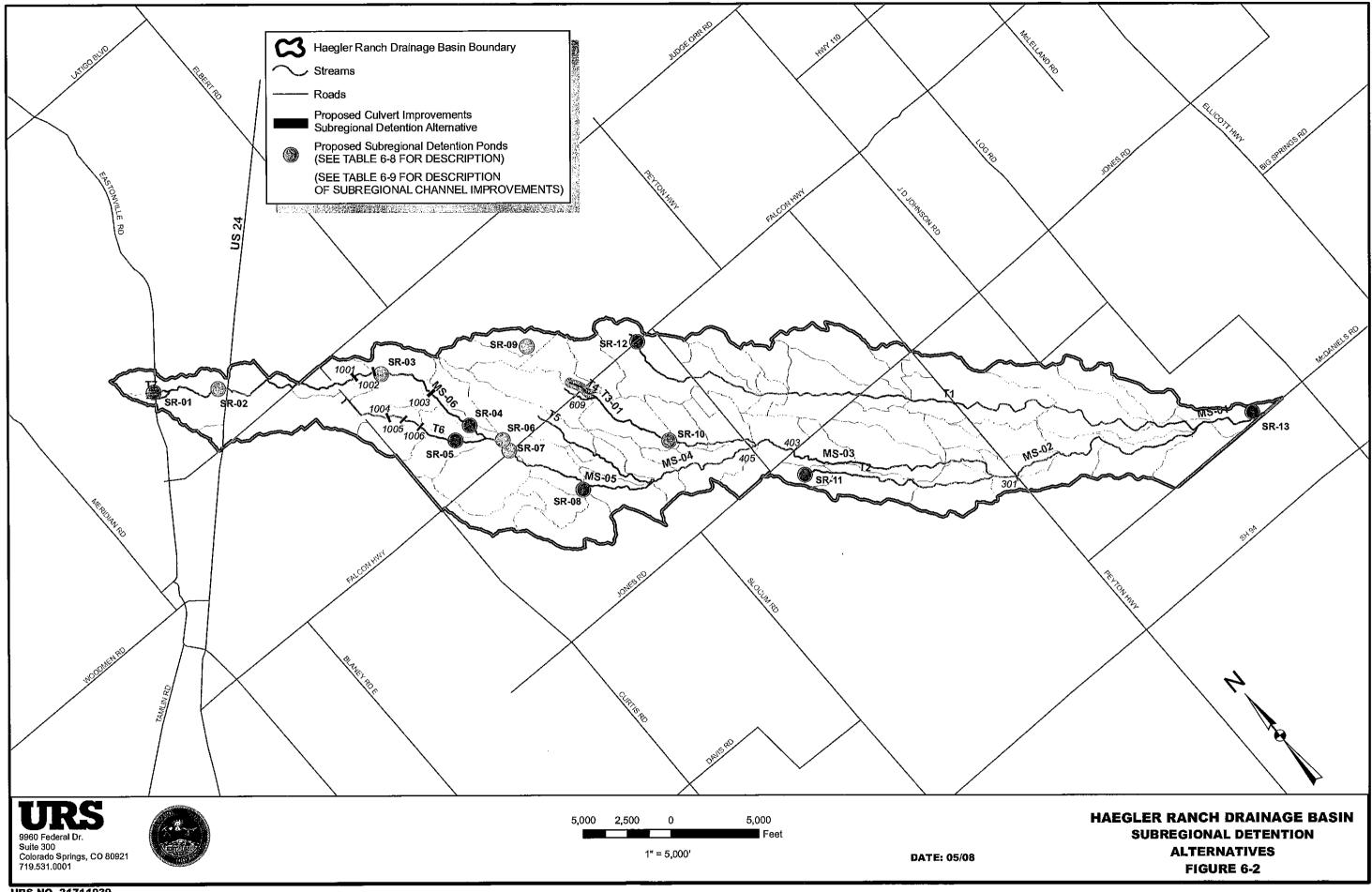
All detention pond design is based on Chapter 10, Storage, of the UDFCD SDCM. All ponds were assumed to be "full spectrum" per the SDCM. For final design to be performed later, some of the ponds may be separated into a water quality pond and an off-line major detention pond.

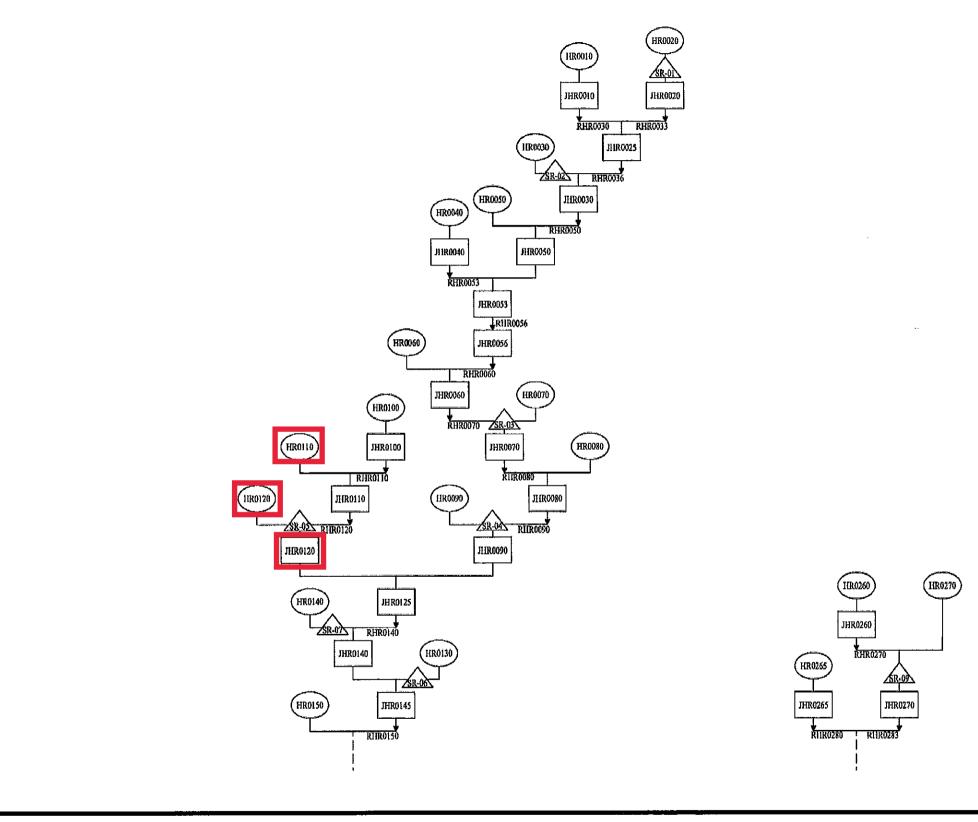
For the Regional Detention Alternative, either the simplified full spectrum sizing method or the hydrograph method was used to size the facility. If the contributing area is less than 160 acres and no











9960 Federal Dr. Sulte 300 Colorado Springs, CO 80921 719.531.0001



HAEGLER RANCH DRAINAGE BASIN
SUBREGIONAL DETENTION ALTERNATIVE
SHEET 1
FIGURE 6-3

#### 6.4.1. Channel & Culvert Costs

Channel costs for each alternative are based on cubic yards of excavation, plus the cost of the channel lining and drop structures. These costs are presented in Table 6-13 and Table 6-14.

Table 6-13 Regional Detention Alternative Channel Cost Estimates

Channel	Design Flow (cfs)	-Channel Length (ft)	Total Cost	Drop Structure Cost
Main Stem (MS-04)	3,500	7,140	\$1,626,000	none
Main Stem (MS-05)	3,000	11,100	\$2,216,000	\$2,539,000
Main Stem (MS-06)	900	7,330	\$482,000	\$589,000
Main Stem (MS-06)	1,000	3,170	\$231,000	\$268,000
Main Stem (MS-06)	1,500	4,450	\$450,000	\$548,000
Main Stem (MS-06)	2,000	3,330	\$477,000	\$636,000
Tributary 3 (T3-01)	1,500	6,710	\$1,082,000	\$1,302,000
Tributary 4 (T4)	600	1,840	\$96,000	\$127,000
Tributary 5 (T5)	300	930	\$37,000	\$36,000
Tributary 5 (T5)	500	7,770	\$325,000	\$370,000
Tributary 6 (T6)	500	4,270	\$179,000	\$222,000
Tributary 6 (T6)	600	3,940	\$204,000	\$253,000
Sub-Total		\$7,405,000	\$6,888,000	
30% Construction Cor	ntingency	\$2,222,000	\$2,066,000	
15% Engineering Contingency			\$1,110,000	\$1,033,000
Total		\$10,737,000	\$9,988,000	

(See Tables C6 and C7 in Appendix C for details)

**Table 6-14 Sub-Regional Detention Alternative Channel Cost Estimates** 

Table 0-14 Sub-Regional Detention Alternative Channel Cost Estimates							
Channel	Design Flow (cfs)	Channel Length (ft)	Total Cost	Drop Structure Cost			
Main Stem (MS-05)	2,000	1,560	\$224,000	\$367,000			
Main Stem (MS-06)	600	3,120	\$162,000	\$295,000			
Main Stem (MS-06)	1,000	4,535	\$331,000	\$375,000			
Main Stem (MS-06)	800	3,190	\$188,000	\$368,000			
Tributary 3 (T3-01)	600	5,000	\$259,000	\$422,000			
Tributary 3 (T3-02)	500	420	\$18,000	\$37,000			
Tributary 4 (T4)	500	940	\$40,000	\$74,000			
Tributary 6 (T6)	500	4,280	\$179,000	\$333,000			
Tributary 6 (T6)	300	1,400	\$55,000	\$107,000			
Sub-Total		\$1,456,000	\$2,374,000				
30% Construction Con	tingency	\$430,000	\$712,000				
15% Engineering Contingency			\$218,000	\$356,000			
Total			\$2,111,000	\$3,442,000			

(See Tables C6 and C8 in Appendix C for details)

Culverts costs are based on a per linear foot of pipe with two flared end sections or two wing walls, as appropriate, complete-in-place. Culvert costs for each alternative are presented in Table 6-15 and Table 6-16.

**Table 6-15 Regional Detention Alternative Roadway Crossing Cost Estimate Sumary** 

Facility Number	Road Crossing	Channel	Existing Size	Proposed 100-yr Flow (cfs)	Necessary Facility for Proposed 100- year Flow	Estimated Cost		
405	Murr Road	Main Stem (MS-04)	66" RCP	3,400	9-6'X6' RCBs	\$256,000		
507	Peerless Farms Road	Tributary 3 (T3-01)	60" CMP	1200	4-6'X6' RCBs	\$139,000		
609	Falcon Highway	Tributary 3 (T3-02)	18" CMP	460	2-66" RCPs	\$51,600		
610	Falcon Highway	Tributary 4 (T4)	24" CMP	570	2-72" RCPs	\$51,000		
612	Falcon Highway	Tributary 5 (T5)	24" CMP	240	72" RCP	\$26,000		
628	Falcon Highway	Main Stem (MS-05)	2-60" CMPs	2,200	6-6'X6' RCBs	\$243,000		
702	Curtis Road	Tributary 6 (T6)	36" CMP	140	60" RCP	\$29,000		
703	Curtis Road	Main Stem (MS-06)	24" CMP	890	3-6'X6' RCBs	\$142,000		
704	Judge Orr Road	Main Stem (MS-06)	Blocked Culvert	830	3-6'X6' RCBs	\$185,000		
1001	Future Pastura Street	Main Stem (MS-06)	N/A	930	3-6'X6' RCBs	\$99,000		
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	N/A	930	3-6'X6' RCBs	\$99,000		
1003	Future Arroyo Hondo Blvd. N	Main Stem (MS-06)	N/A	1500	4-6'X6' RCBs	\$143,000		
1004	Future Pastura Street	Tributary 6 (T6)	N/A	440	2-66" RCPs	\$43,000		
1005	Future El Vado Road	Tributary 6 (T6)	N/A	440	2-66" RCPs	\$43,000		
1006	Future Socorro Trail	Tributary 6 (T6)	N/A	440	2-66" RCPs	\$43,000		
Sub-Total								
30% Construction Contingency								
15% Engineering Contingency								
Total	Total							

(See Table C4 in Appendix C for details)

Table 6-16 Sub-Regional Detention Roadway Crossing Cost Estimate Summary

Facility Number	Road Crossing	Channel	Proposed 100-yr Flow (cfs)	Necessary Facility for Proposed 100-year Flow	Estimated Cost
301	Peyton Highway	Main Stem (MS-02)	3,370	9-6'X6' RCBs	\$402,000
403	Jones Road	Main Stem (MS-03)	2,970	8-6'X6' RCBs	\$358,000
405	Murr Road	Main Stem (MS-04)	2,870	8-6'X6' RCBs	\$283,000
609	Falcon Highway	Tributary 3 (T3-02)	460	2-6'X6' RCBs	\$106,000
N/A	Falcon Highway	Tributary 1 (T1)	110	2 - 36" RCP	\$20,000
1001	Future Pastura Street	Main Stem (MS-06)	610	2-6'X6' RCBs	\$107,000
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	610	2-6'X6' RCBs	\$87,000
1003	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	530	2-6'X6' RCBs	\$87,000
1004	Future Pastura Street	Tributary 6 (T6)	440	2-66" RCPs	\$43,000
1005	Future El Vado Road	Tributary 6 (T6)	440	2-66" RCPs	\$43,000
1006	Future Socorro Trail	Tributary 6 (T6)	440	2-66" RCPs	\$43,000
Sub-Total					\$1,582,000
30% Constru	ction Contingency				\$475,000
15% Engine	ering Contingency				\$237,000
Total					\$2,294,000

(See Tables C5 in Appendix C for details)

#### 6.4.2. Detention Pond Costs

The cost of detention ponds, both regional and subregional, is based on the cubic yards of excavation, an estimated outlet structure, and the cost of the land required for the facility. These costs are presented in Table 6-17 and Table 6-18.

**Table 6-17 Regional Detention Pond Cost Summary** 

Table of Principles of Control of the Control of th				
Facility	Storage (AF)	Total Cost Including Construction and Engineering Contingencies		
RG-01 9.02	9.02	\$542,000		
RG-02 64.52	64.52	\$4,053,000		
RG-03 0.04	0.04	\$146,000		
RG-04 1.07	1.07	\$160,000		
RG-05 0.03	0.03	\$146,000		
Total	_	\$5,048,000		

(See Tables C1 in Appendix C for details)

Haegler Ranch Drainage Basin Planning Study Table 6-18 Sub-Regional Detention Pond Cost Summary

Facility	Storage (AF)	Total Cost Including Construction and Engineering Contingencies
SR-01	10	\$899,000
SR-02	5	\$640,000
SR-03	16	\$868,000
SR-04	25	\$1,453,000
SR-05	24	\$1,557,000
SR-06	9	\$547,000
SR-07	5	\$524,000
SR-08	5	\$326,000
SR-09	20	\$861,000
SR-10	23	\$1,069,000
SR-11	2	\$182,000
SR-12	9	\$477,000
SR-13	3	\$376,000
Total		\$9,780,000

(See Table C1 in Appendix C for details)

#### 6.4.3. Other Costs

Design Engineering costs are also included as 15% of the construction costs. Construction contingencies (30%) include such items as utility relocations, mobilization, temporary erosion control, and construction engineering.

### 6.4.4. Conceptual Alternative Costs

The total estimated capital costs for each alternative are based on the sum of the cost of the proposed facilities, plus costs for engineering and construction contingencies. These costs are listed in Table 6-19.

Table 6-19 Concentual Alternative Costs

Table 0-13 Conceptual Afternative Costs				
	Regional Alternative	Subregional Alternative 😅		
Detention Ponds	\$5,048,000	\$9,780,000		
Channel Improvements	\$10,737,000	\$2,110,000		
Drop Structures	\$9,988,000	\$3,442,000		
Roadway Crossing Culverts	\$2,307,000	\$2,294,000		
Total	\$28,080,000	\$17,627,000		

impacted by site development, utility, roadway and landscape construction activities have in some cases negatively affected downstream areas.

El Paso County has enacted an erosion control ordinance to address these problems. In general, it is the responsibility of the entity conducting any land disturbance activity to properly control surface runoff, erosion and sedimentation during and after the activity. Technical criteria identifying measures which help mitigate the impacts of erosion and sedimentation are available and being used throughout the region. Minimum requirements must be developed to properly control erosion.

Erosion control is necessary to prevent environmental degradation caused by wind or water-borne soil. The following minimum criteria and standards are intended to prevent excessive erosion. El Paso County as well as other affected agencies will enforce the Clean Water Act standards if the planned erosion control measures fail to perform satisfactorily. Proper installation and maintenance is necessary to achieve the desired function of erosion control measures. By paying attention to quality, reinstallation can be avoided. General requirements for erosion control are as follows:

- 1. Any land disturbing activity shall be conducted so as to effectively reduce unacceptable erosion and resulting sedimentation.
- 2. All land disturbing activities shall be designed, constructed, and completed in such a manner that the exposure time of disturbed land shall be limited to the shortest possible period of time.
- 3. Sediment caused by accelerated soil erosion and runoff shall be intercepted by erosion control measures such as hay bales, silt fences and / or sediment ponds, and contained within the site.
- 4. Any facility designed and constructed to convey storm runoff shall be designed to be non-erosive.
- 5. Erosion control measures will be used prior to and during construction.

Temporary erosion control measures are required during construction, and permanent erosion control measures are required for all developments. Maintenance of erosion control measures is the responsibility of the property owner.

Various structures have been proposed in this plan to help control localized erosion and sedimentation problems. It is important that the erosion control plan for any land disturbing activity be strictly adhered to and maintained so that the above minimum criteria can be achieved in the Haegler Ranch Basin.

# 7.4. Operations and Maintenance

Maintenance of drainage way facilities is essential in preventing long term degradation of the creek and overbank areas. Along the drainageway, clearing of debris and dead vegetation should be considered within the low flow area of the creek and its tributaries. On the overbanks, limited maintenance of the existing vegetative cover is recommended. Semi-annual clearing of trash and debris at roadway crossings is also recommended to increase the effectiveness of the crossings. Sediments cleared from the channel or culvert should not be left on the overbank. This disturbs the native vegetation, creates a potential water quality concern if the dredgings are subsequently washed into the drainageway by natural erosion, and reduces the capacity of the overbank. In those reaches designated to be selectively

lined and the floodplain preserved, maintenance activities should be carried out with the least disturbances to native vegetation that is practical.

Similar practices should be employed when removing sediment from detention basins. Although some channels degrade and others agrade, all detention basins will collect sediment and agrade. The use of an easily accessible concrete lined forebay in the final design of a detention facility can make the cleaning of the larger debris and trash more easily accomplished with motorized equipment. If forebays are provided, they will need clearing semi-annually and after major storm events. More frequent routine maintenance may be required depending on the type of development upstream and the access provided to the public. Plan for annual removal of sediment and debris from the detention area of a facility with a forebay.

Deposition in drainage facilities of wind-blown trash and debris, should be expected in this region. This means that regular maintenance, even without rainfall events, should be performed.

### 7.5. Drainage and Bridge Fee Calculations

The cost estimates and basin fee calculation for the major drainageways, tributary drainageways, roadway culverts, regional detention basins, and related improvements for the Sub-Regional Detention Facilities are presented in Table 7-2. The sub-regional detention capital construction cost estimates include the cost for the construction of the embankment, water quality, and outlet structures. Bridges in the Sub-Regional Detention Alternative are presented in Table 7-3. The cost estimates include engineering and construction costs for the entire Haegler Ranch Basin as presented on the Conceptual Design Drawings in Appendix D. These estimates do not include costs for local or initial systems, and therefore no costs attributable to local or minor drainage systems have been computed in the estimation of the drainage basin fee. These systems are expected to be provided with proposed development. Costs associated with utility relocations have not been estimated but would be included in construction contingencies. A review of utility maps indicates that the majority of the potential relocations occur at the roadway crossings. Land acquisition costs for the detention facilities were not included for calculation of fees per Appendix L of the El Paso County Criteria Manual.

Unplatted acreage within Haegler Ranch was obtained from El Paso County, and is shown in Figure 7-I. A total of 8,953 acres is estimated to be currently unplatted and subject to future development. This unplatted land is projected to have an average imperviousness of approximately 15%, corresponding to approximately 1,343 unplatted impervious acres. All drainage and bridge fees are calculated per *impervious* acre. (See Appendix D for an unplatted area breakdown by subbasin and average imperviousness calculations.)

Reimbursable costs calculated for the Haegler Ranch Basin are listed in Table 7-4. These costs are based on improvements required under existing conditions. The term "reimbursable costs" used on Table 7-4 means those costs that have been used in estimation of drainage basin fees. Costs considered "non-reimbursable" are costs for the replacement of existing, undersized culverts, or costs to rehabilitate or maintain an existing lined segment of drainageway. For the most part, all of the drainageway costs for Haegler Ranch Basin are considered reimbursable.

The calculated drainage basin fee presented in Table 7-2 is \$ 7,633 per impervious acre, and the bridge fee is \$1,126 per impervious acre, as shown in Table 7-3.

**Table 7-2 Drainage Basin Fec Calculations** 

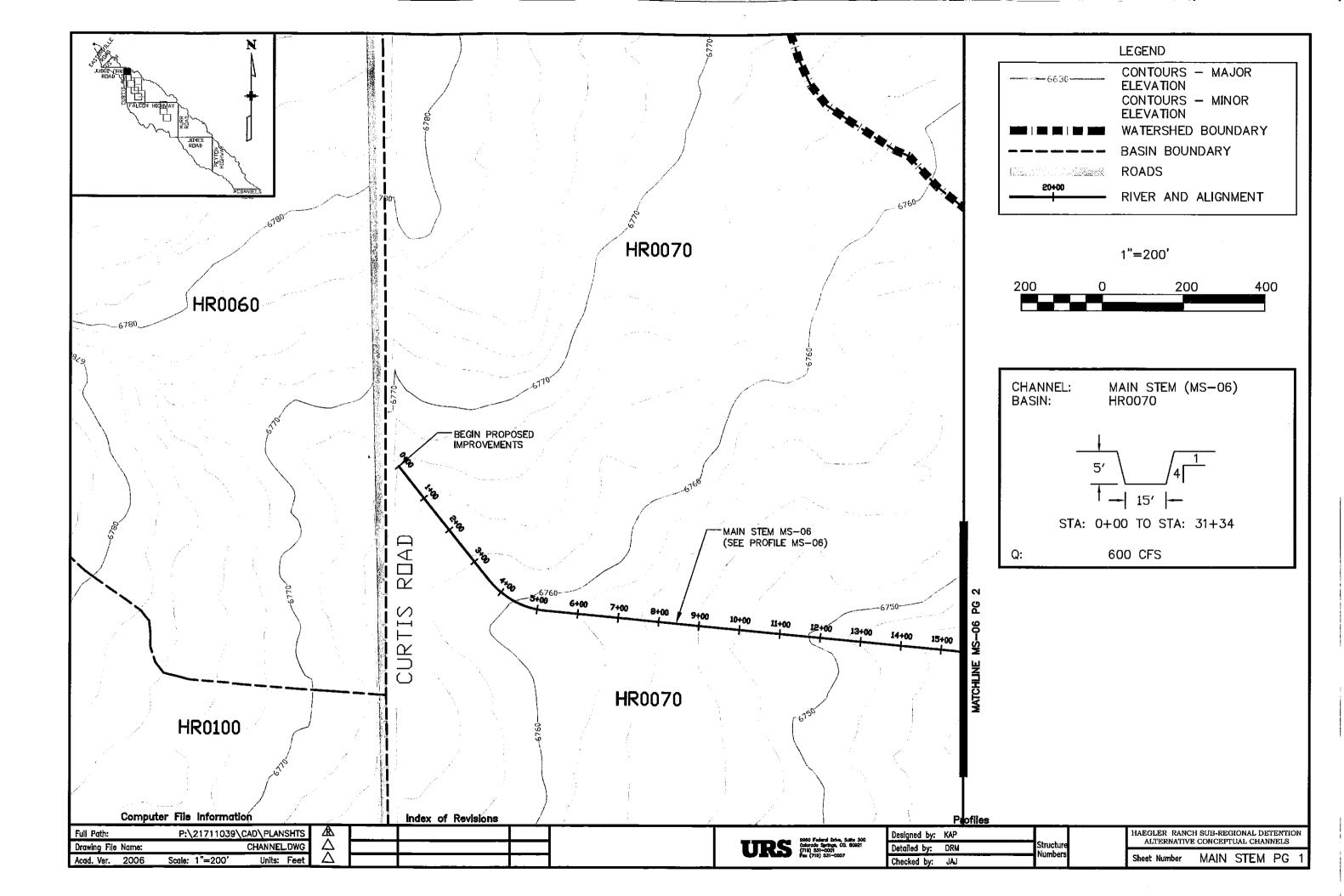
		Channel Improvemen			
			Drop Structure		
		Channel	Construction	Contingency	
Channel	Basins	Construction Cost	Cost	Cost	Total Cost
Main Stem (MS-05)	HR0200	\$224,000	\$363,600	\$264,420	\$852,020
Main Stem (MS-06)	HR0070	\$162,000	\$295,400	\$205,830	\$633,230
Main Stem (MS-06)	HR0080	\$331,000	\$374,500	\$317,475	\$1,022,975
Main Stem (MS-06)	HR0090	\$188,000	\$368,000	\$250,200	\$806,200
Tributary 3 (T3-01)	HR0330	\$259,000	\$422,000	\$306,450	\$987,450
Tributary 3 (T3-02)	HR0300	\$18,000	\$37,000	\$24,750	\$79,750
Tributary 4 (T4)	HR0300	\$40,000	\$74,000	\$51,300	\$165,300
Tributary 6 (T6)	HR0110	\$179,000	\$333,000	\$230,400	\$742,400
Tributary 6 (T6)	HR0120	\$55,000	\$106,500	\$72,675	\$234,175
Subtotal Channel Costs					\$5,553,500
		Culvert Improvement	<b>s</b>		
			Culvert		
			Construction	Contingency	
Culvert	Road Crossing	Channel	Cost	Cost	Total Cost
609	Falcon Highway	Tributary 3 (T3-02)	\$106,301	\$47,836	\$154,137
N/A	Falcon Highway	Tributary 1 (T1)	\$19,500	\$8,775	\$28,275
1001	Future Pastura Street	Main Stem (MS-06)	\$106,301	\$47,836	\$154,137
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	\$87,301	\$39,286	\$126,587
1003	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	\$87,301	\$39,286	\$126,587
1004	Future Pasture Street	Tributary 6 (T6)	\$51,000	\$22,950	\$73,950
1005	Future El Vado Road	Tributary 6 (T6)	\$19,500	\$8,775	\$28,275
1006	Future Socorro Trail	Tributary 6 (T6)	\$42,800	\$19,260	\$62,060
Subtotal Culvert Costs			<u> </u>		\$754,007
		etention Improvemer	nts 🔻 💮		
				Contingency	
Facility	Storage (AF)	Construction Cost		Cost 😹	Total Cost
SR-01	10	\$296,701		\$133,516	\$430,217
SR-02	5	\$207,949		\$93,577	\$301,525
SR-03	16	\$186,252		\$83,814	\$270,066
SR-04	25	\$390,182		\$175,582	\$565,764
SR-05	24	\$455,235		\$204,856	\$660,091
SR-06	9	\$140,670		\$63,301	\$203,971
SR-07	5	\$162,046		\$72,921	\$234,967
SR-08	5	\$87,489		\$39,370	\$126,860
SR-09	20	\$188,250		\$84,713	\$272,963
SR-10	23	\$331,635		\$149,236	\$480,871
SR-11	2	\$56,880		\$25,596	\$82,476
SR-12	9	\$108,987		\$49,044	\$158,031
SR-13	3	\$107,812		\$48,515	\$156,327
Subtotal Detention Cos	sts			·	\$3,944,129
Total Cost	- x	<u> </u>			\$10,251,636
Total Unplatted Impervious Acres					1,343
Fee Per Impervious A					\$7,633
Too Tot vinhor (1040 ()					ψ 7,000

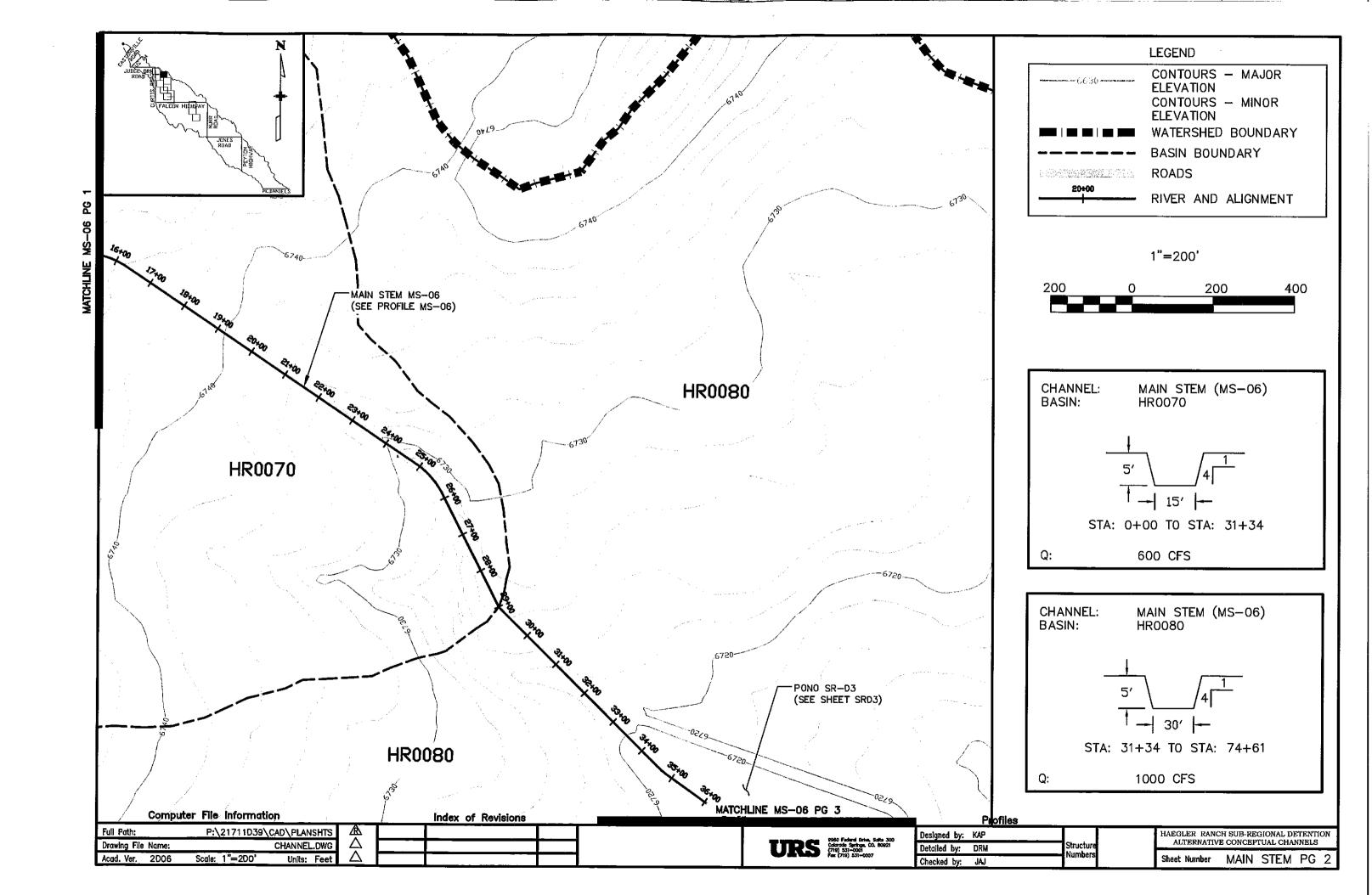
Table 7-3 Bridge Fce Calculation

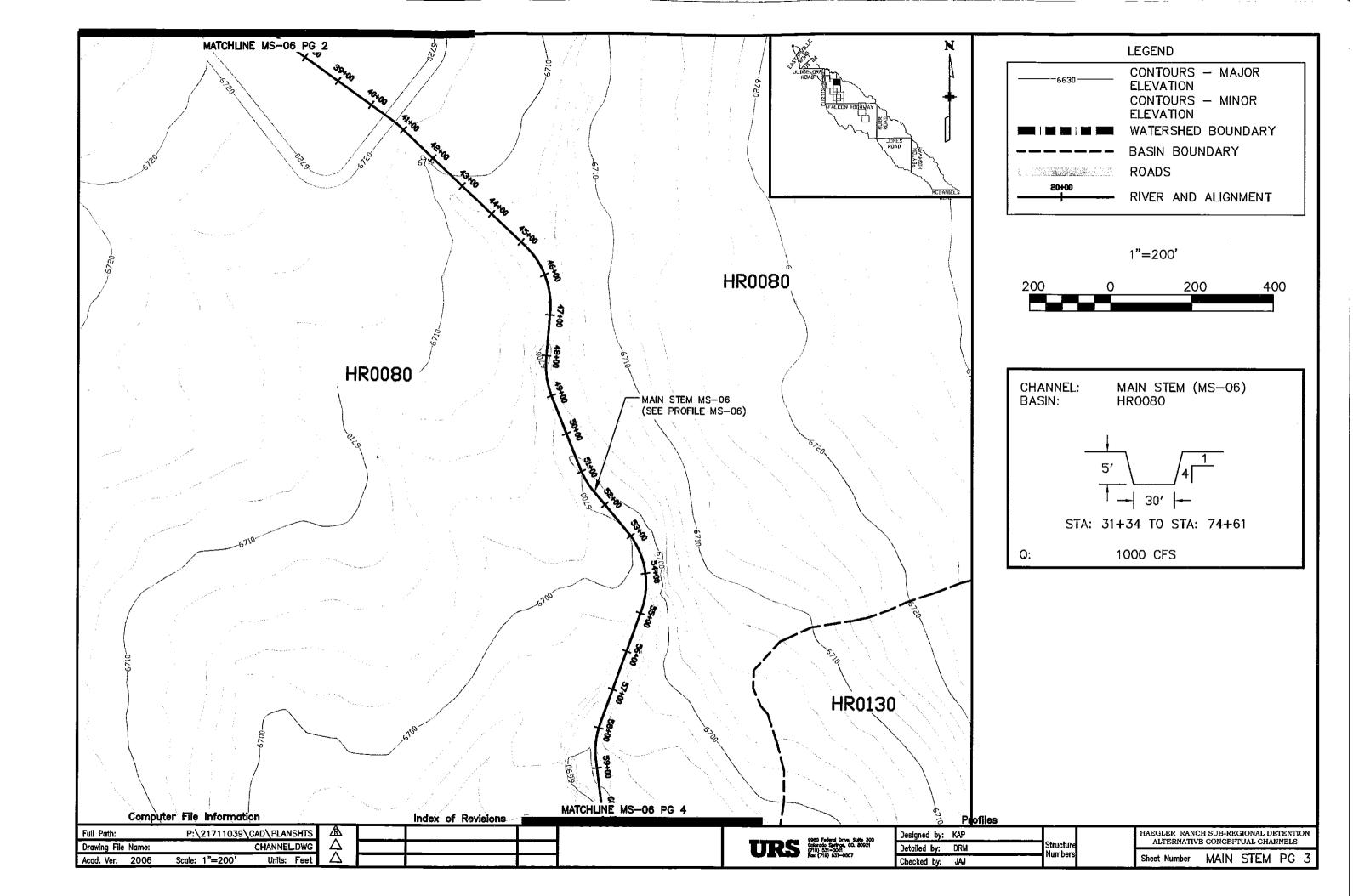
301	Peyton Highway	Main Stem (MS-02)	401,710	\$180,770	\$582,480
403	Jones Road	Main Stem (MS-03)	358,123	\$161,155	\$519,278
405	Murr Road	Main Stem (MS-04)	282,941	\$127,323	\$410,264
Subtotal	Subtotal Bridge Costs				
Total Cost					\$1,512,022
Total Unplatted Impervious Acres					1,343
Bridge F	Bridge Fec Per Impervious Acre				\$1,126

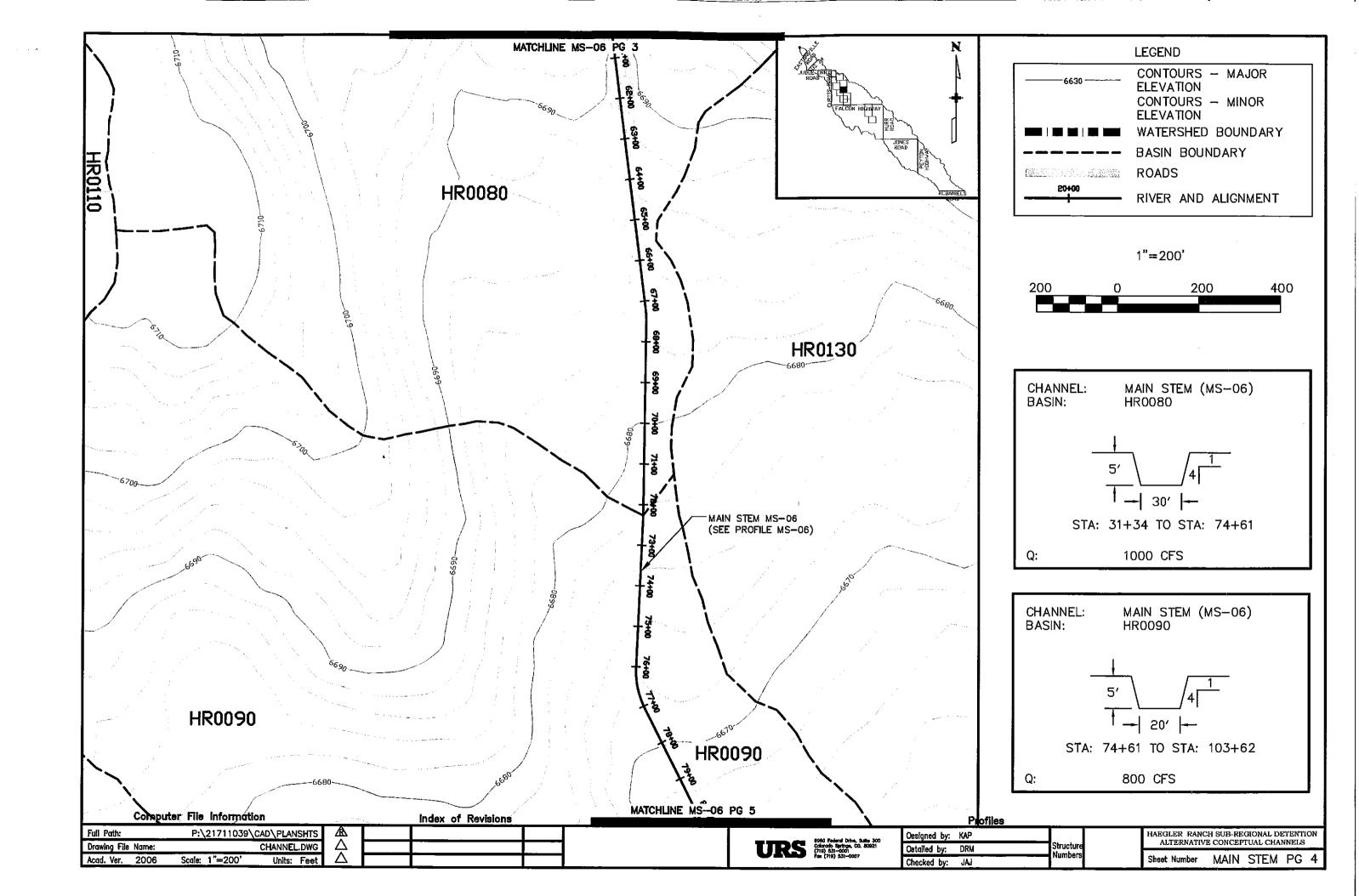
Table 7-4 Reimbursable Costs

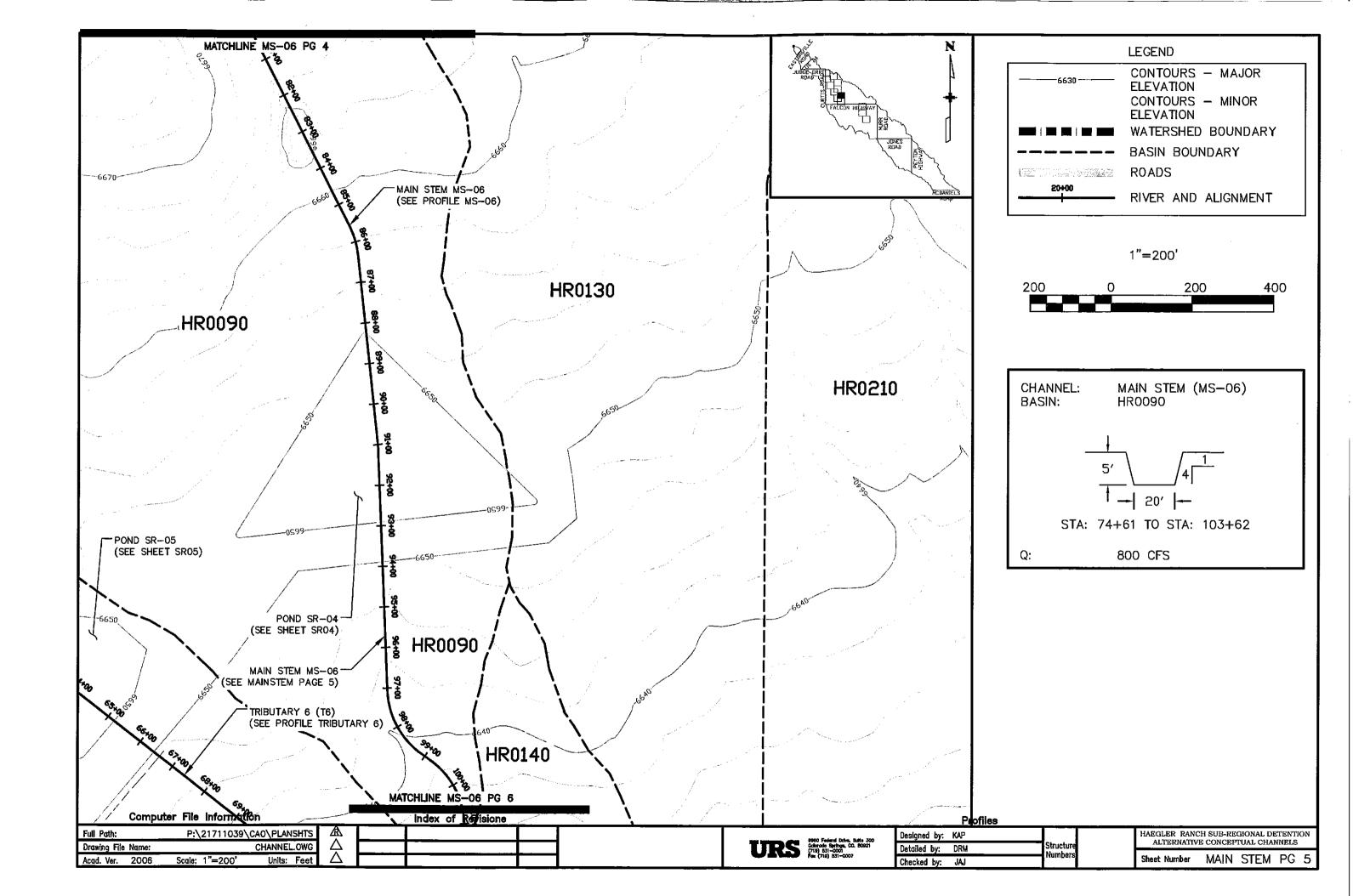
	IXCIIII	bursable Culvert Impro	vements		
			Culvert Construction	Contingency	
Culvert	Road Crossing	Channel	Cost	Cost	Total Cost
N/A	Peyton Highway	Tributary 1 (T1)	\$51,000	\$22,950	\$73,950
N/A	Falcon Highway	Tributary 1 (T1)	\$9,7580	\$4,388	\$14,138
301	Peyton Highway	Main Stem (MS-02)	\$314,535	\$141,541	\$456,076
401	Jones Road	Tributary 1 (T1)	\$53,111	\$23,900	\$77,011
403	Jones Road	Main Stem (MS-03)	\$270,947	\$121,926	\$392,874
405	Murr Road	Main Stem (MS-04)	\$180,371	\$81,167	\$261,538
407	Murr Road	Tributary 3 (T3-01)	\$77,801	\$35,011	\$112,812
507	Peerless Farms Road	Tributary 3 (T3-01)	\$115,801	\$52,111	\$167,912
509	Murr Road	Tributary 1 (T1)	\$19,300	\$8,685	\$27,985
601	Whiting Way	Tributary 1 (T1)	\$23,500	\$10,575	\$34,075
604	Max Road	Tributary 1 (T1)	\$19,300	\$8,685	\$27,985
609	Falcon Highway	Tributary 3 (T3-02)	\$25,600	\$11,520	\$37,120
610	Falcon Highway	Tributary 4 (T4)	\$23,500	\$10,575	\$34,075
612	Falcon Highway	Tributary 5 (T5)	\$21,200	\$9,540	\$30,740
628	Falcon Highway	Main Stem (MS-05)	\$154,741	\$69,633	\$224,375
702	Curtis Road	Tributary 6 (T6)	\$23,150	\$10,418	\$33,568
703	Curtis Road	Main Stem (MS-06)	\$125,301	\$56,386	\$181,687
704	Judge Orr Road	Main Stem (MS-06)	\$83,200	\$37,440	\$120,640
803	Eastonville Road	Main Stem (MS±07)	\$9,680	\$4,356	\$14,036
804	Eastonville Road	Tributary 7 (T7)	\$14,980	\$6,741	\$21,721
Subtotal Channel Costs	<del></del>		4,2-0-	444	\$2,344,315
	Reimb	ursable Detention Impr	ovements		
		The state of the s	A Company of the Comp	Contingency	
Facility	Storage (AF)	Construction Cost		Cost	Total Cost
SR-01	10	\$296,701		\$133,516	\$430,217
SR-02 SR-03	5	\$207,949		\$93,577	\$301,525
SR-03 SR-04	16 25	\$186,252		\$83,814	\$270,066
SR-05	23	\$390,182 \$455,235		\$175,582	\$565,764
SR-06	9	\$140,670		\$204,856 \$63,301	\$660,091 \$203,971
SR-07	5	\$162,046		\$72,921	\$203,971
SR-08	5	\$87,489	<del></del>	\$39,370	\$126,860
	20	\$188,250		\$84,713	\$272,963
SR-09	23	\$331,635		\$149,236	\$480,871
SR-09 SR-10					
	2	\$56,880		\$25,596	\$82.476
SR-10 SR-11 SR-12		\$56,880 \$108,987		\$25,596 \$49,044	\$82,476 \$158,031
SR-10 SR-11	2				\$82,476 \$158,031 \$156,327
SR-10 SR-11 SR-12	2 9 3	\$108,987		\$49,044	\$158,031

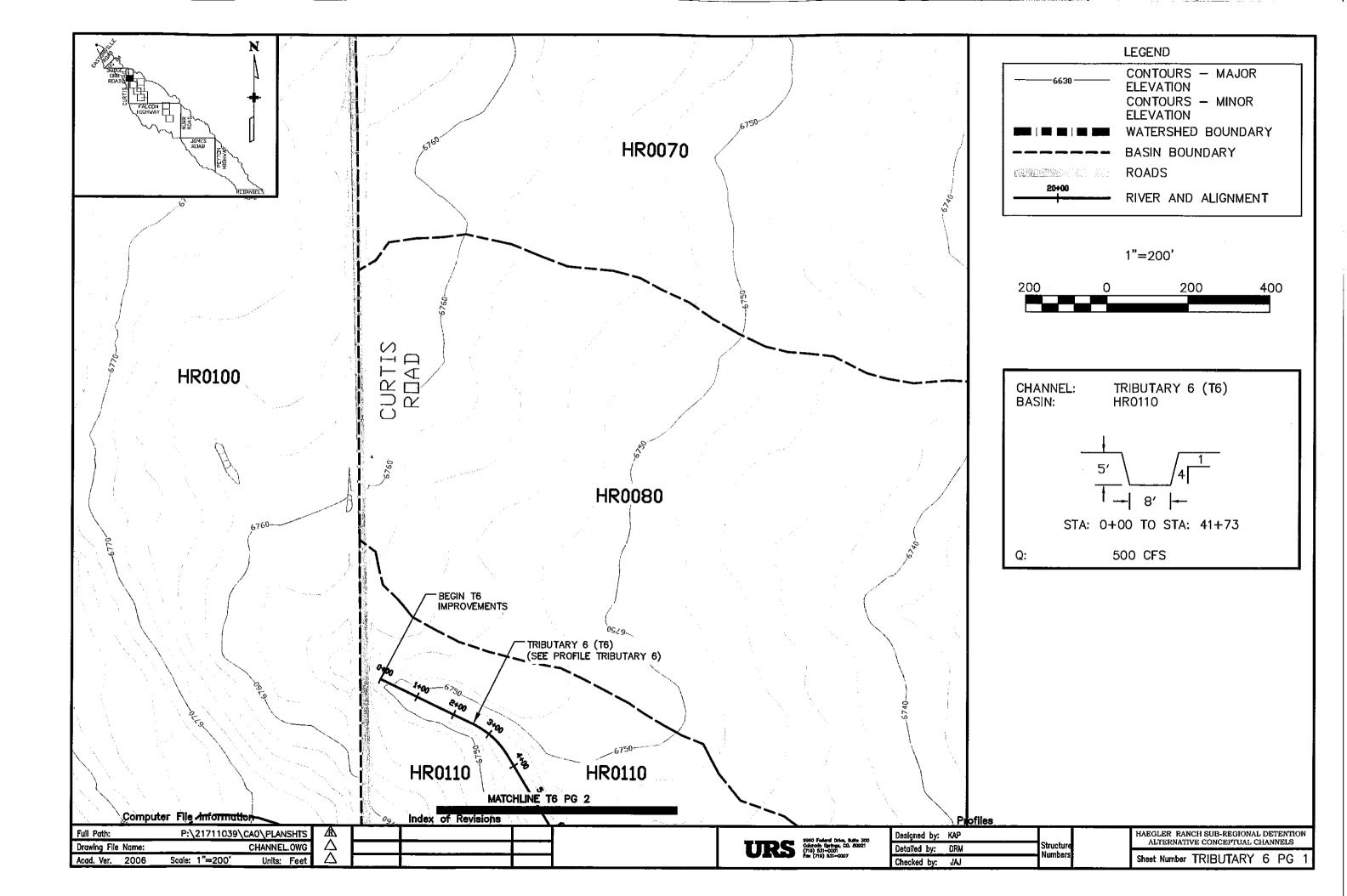


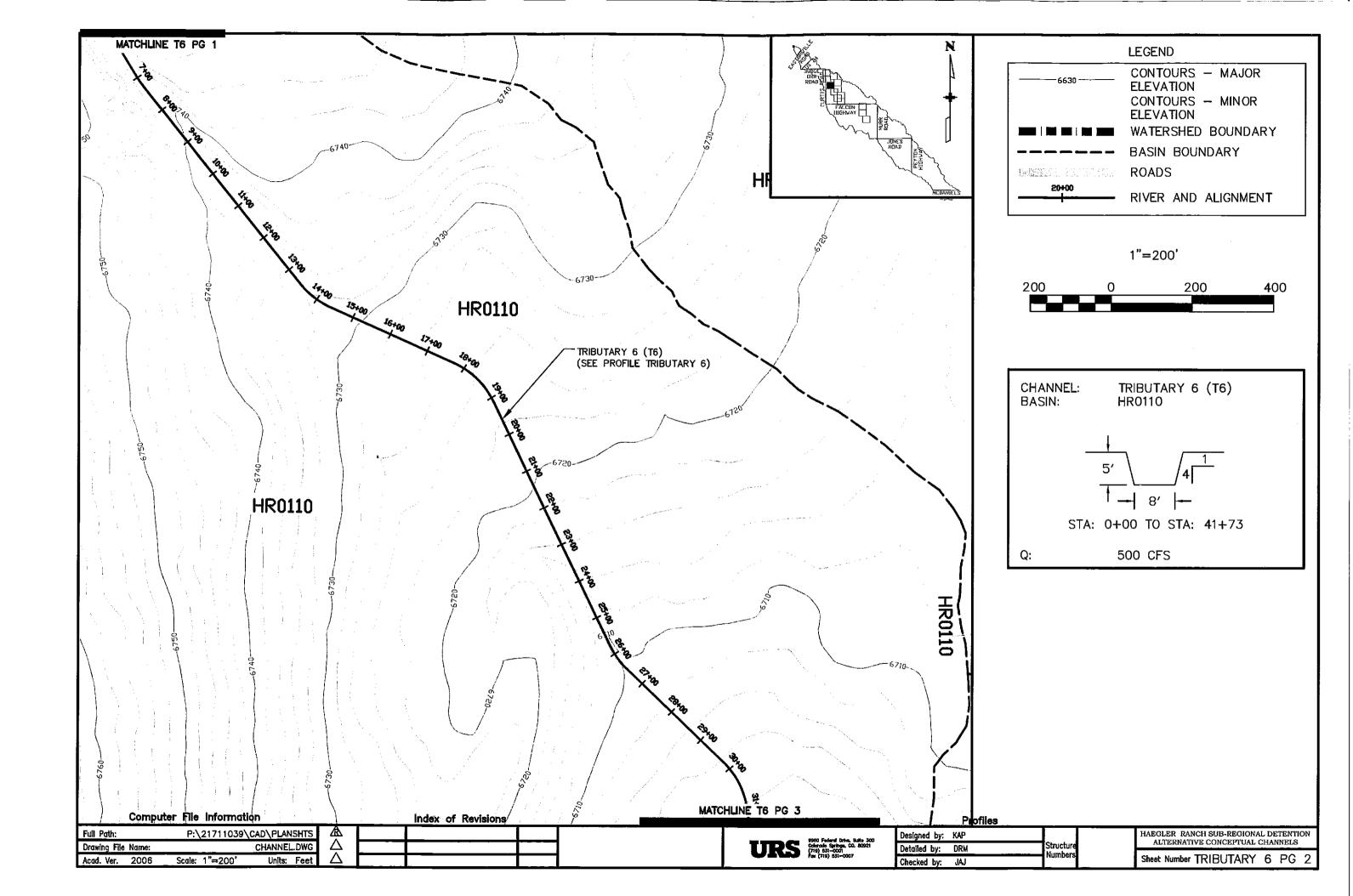


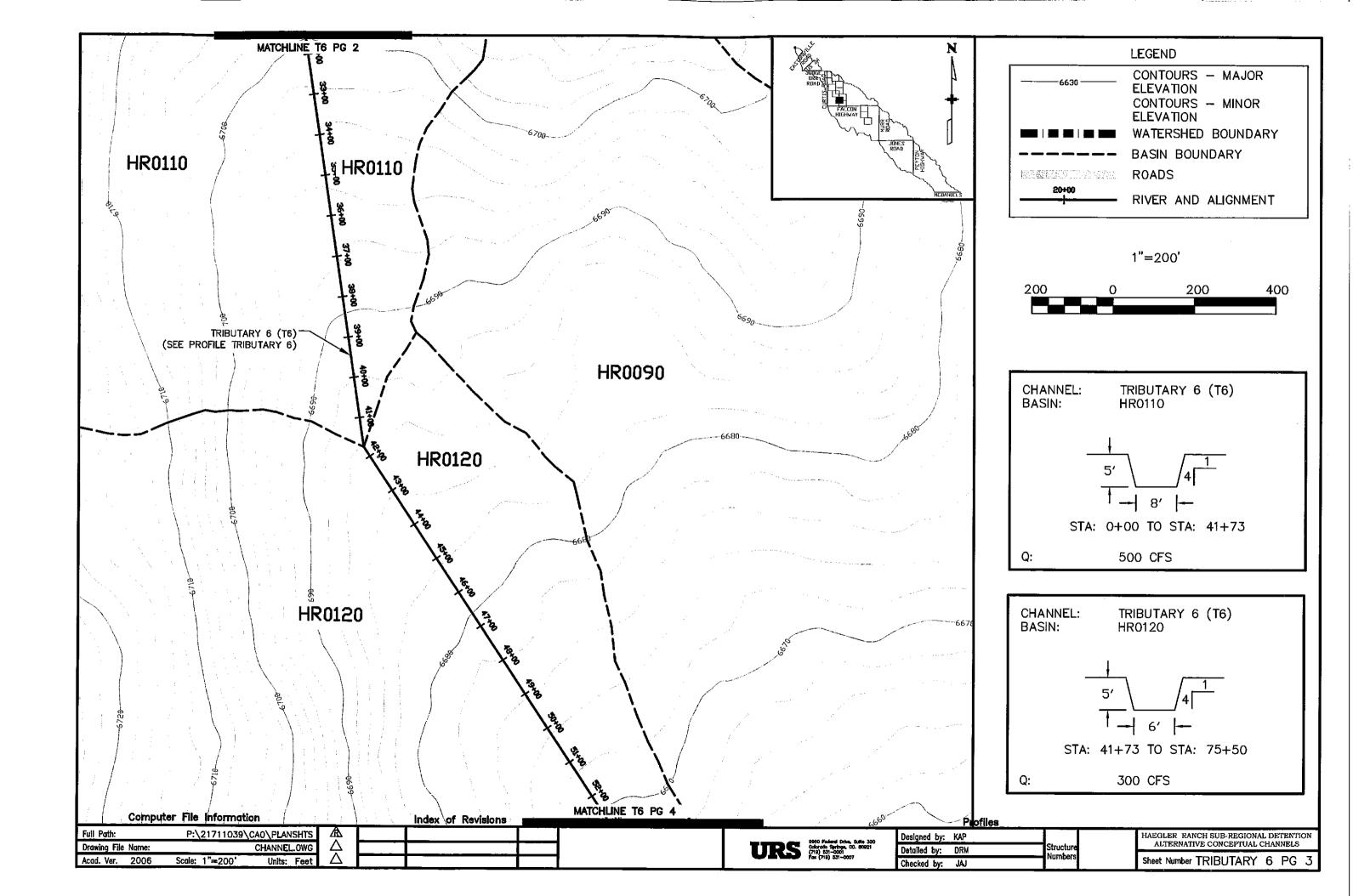


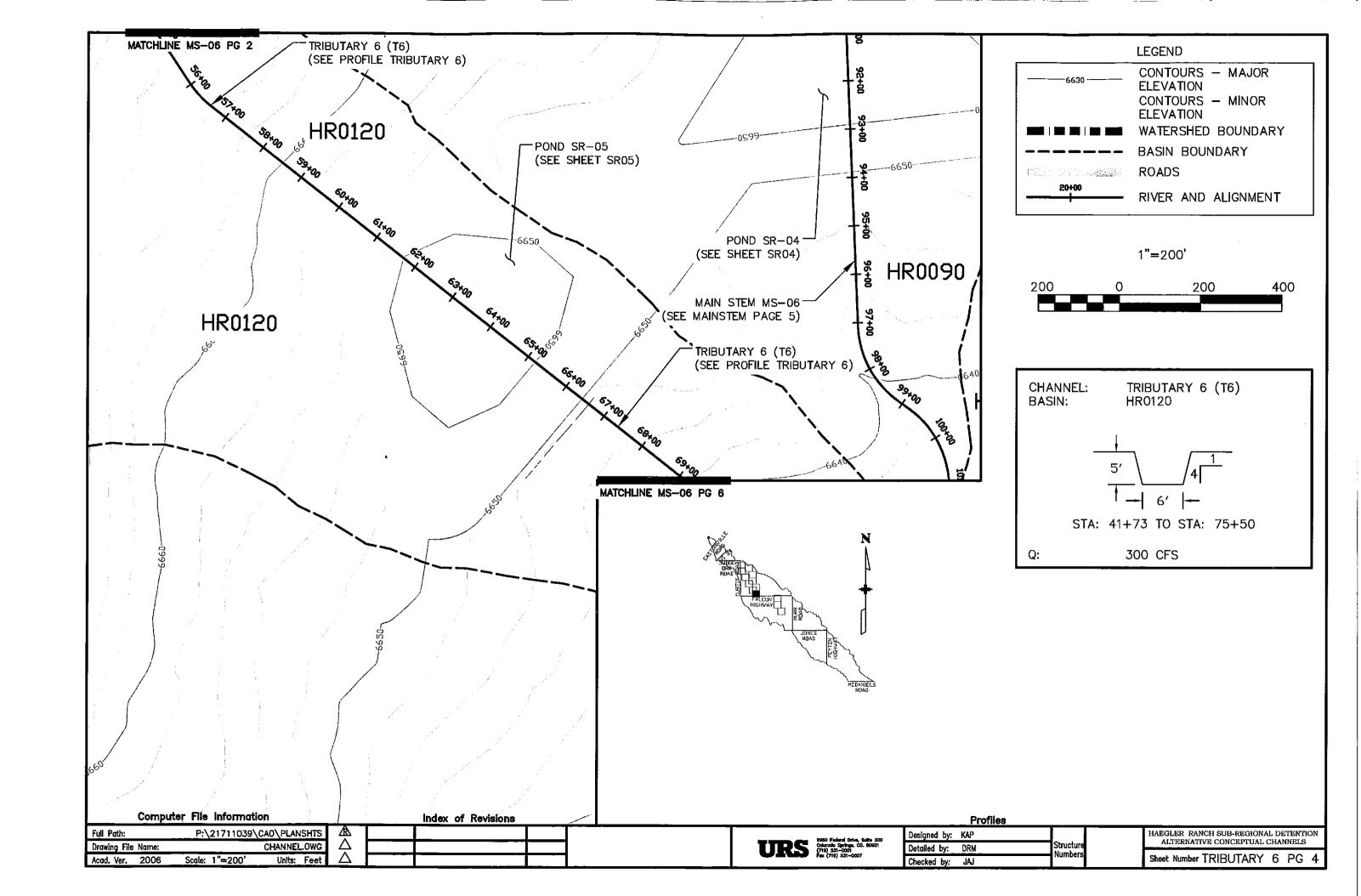












MS-06 HR0070

SLOPE = 0.60%

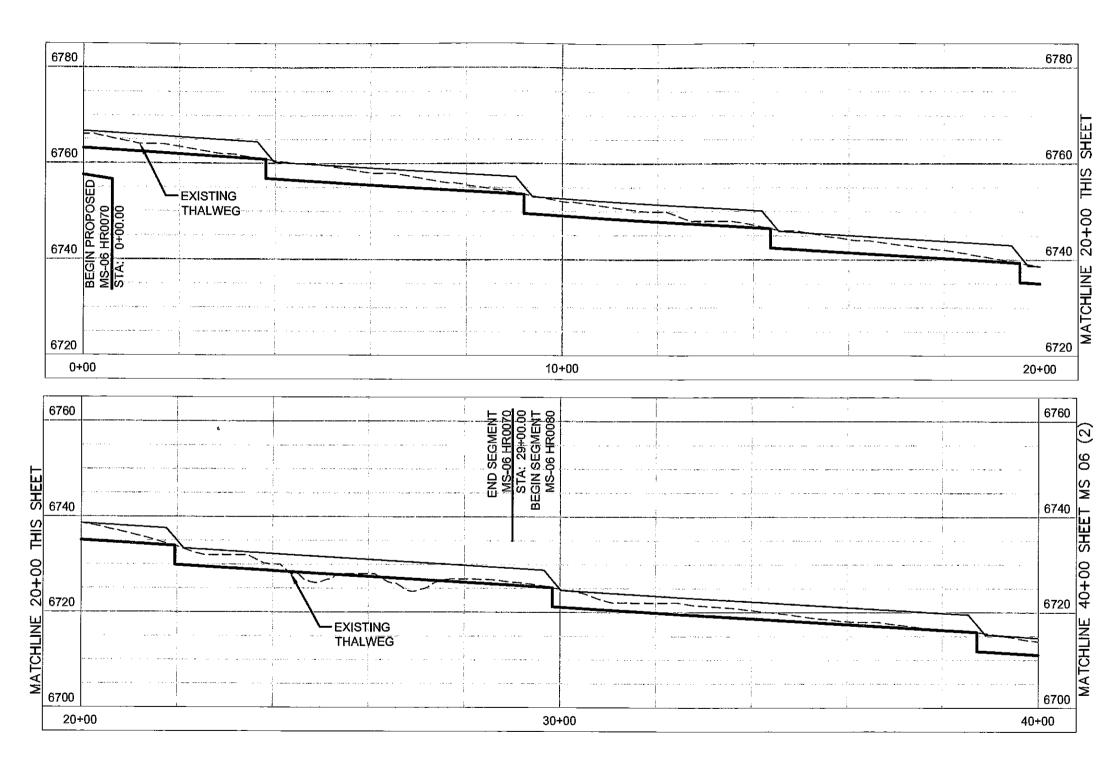
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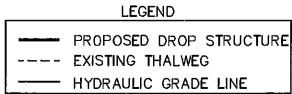
MS-06 HR0080

SLOPE = 0.60%

(7) 4' DROPS

# PROFILE MAIN STEM (MS-06 & MS-05)

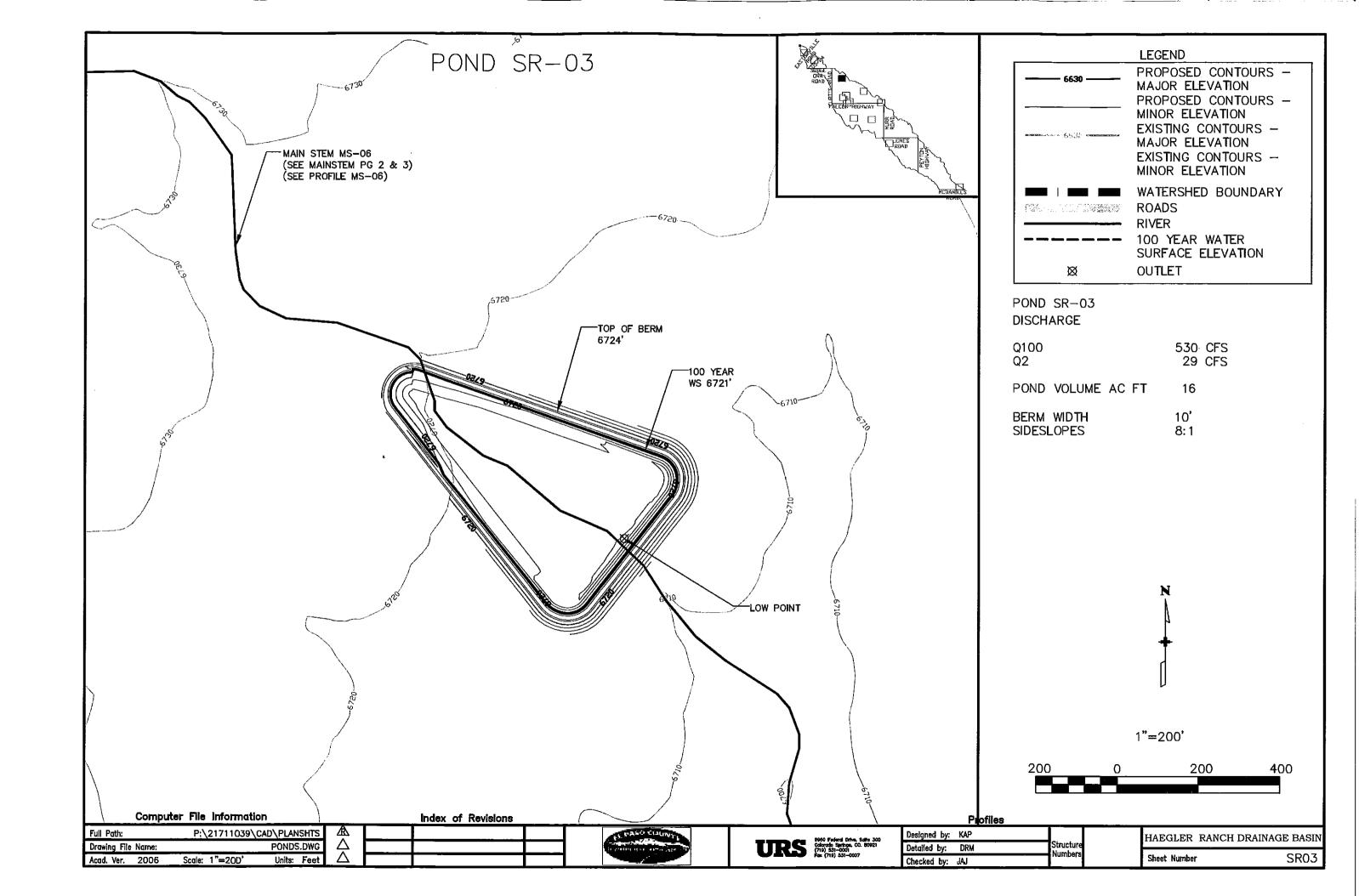


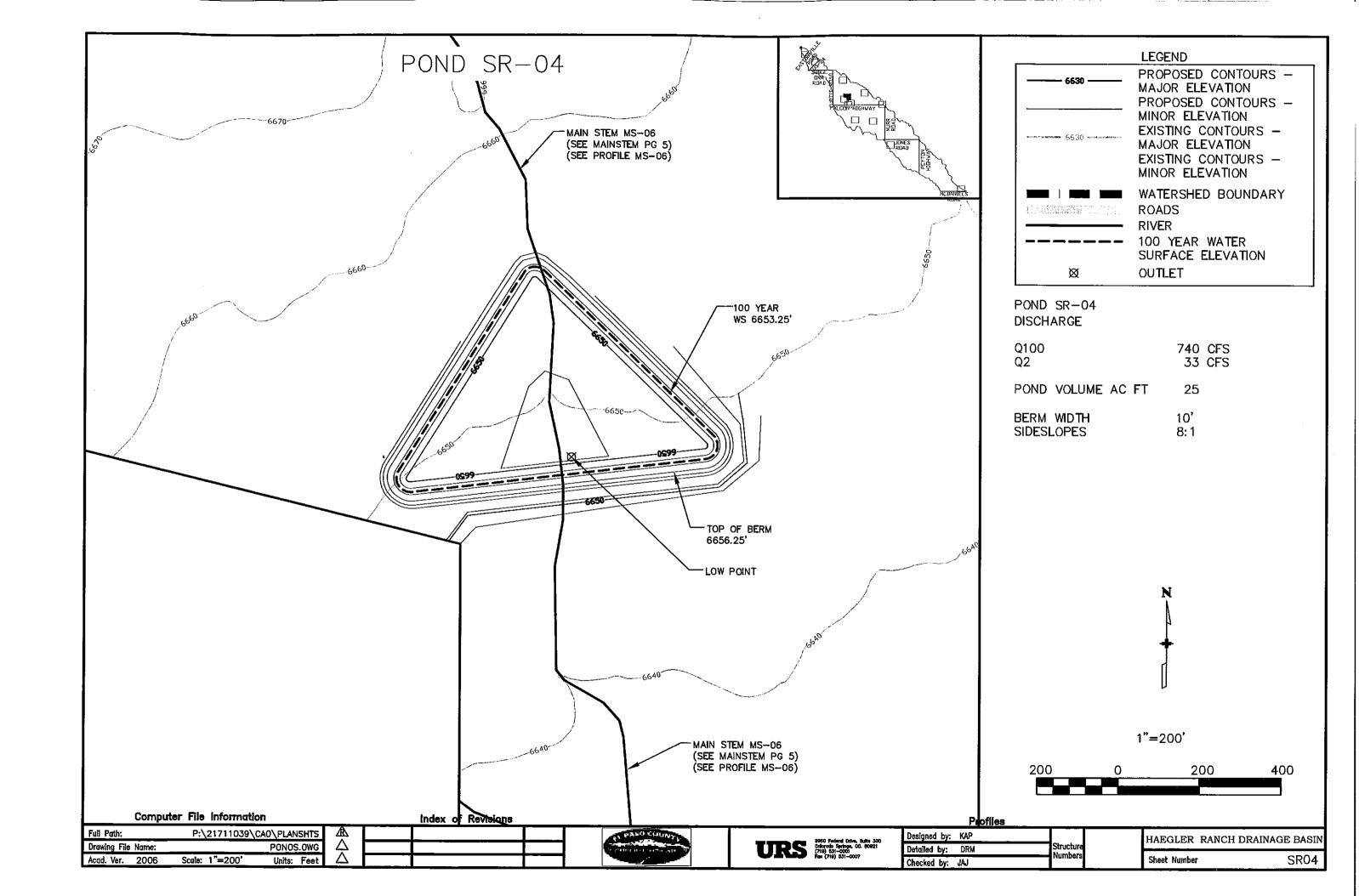


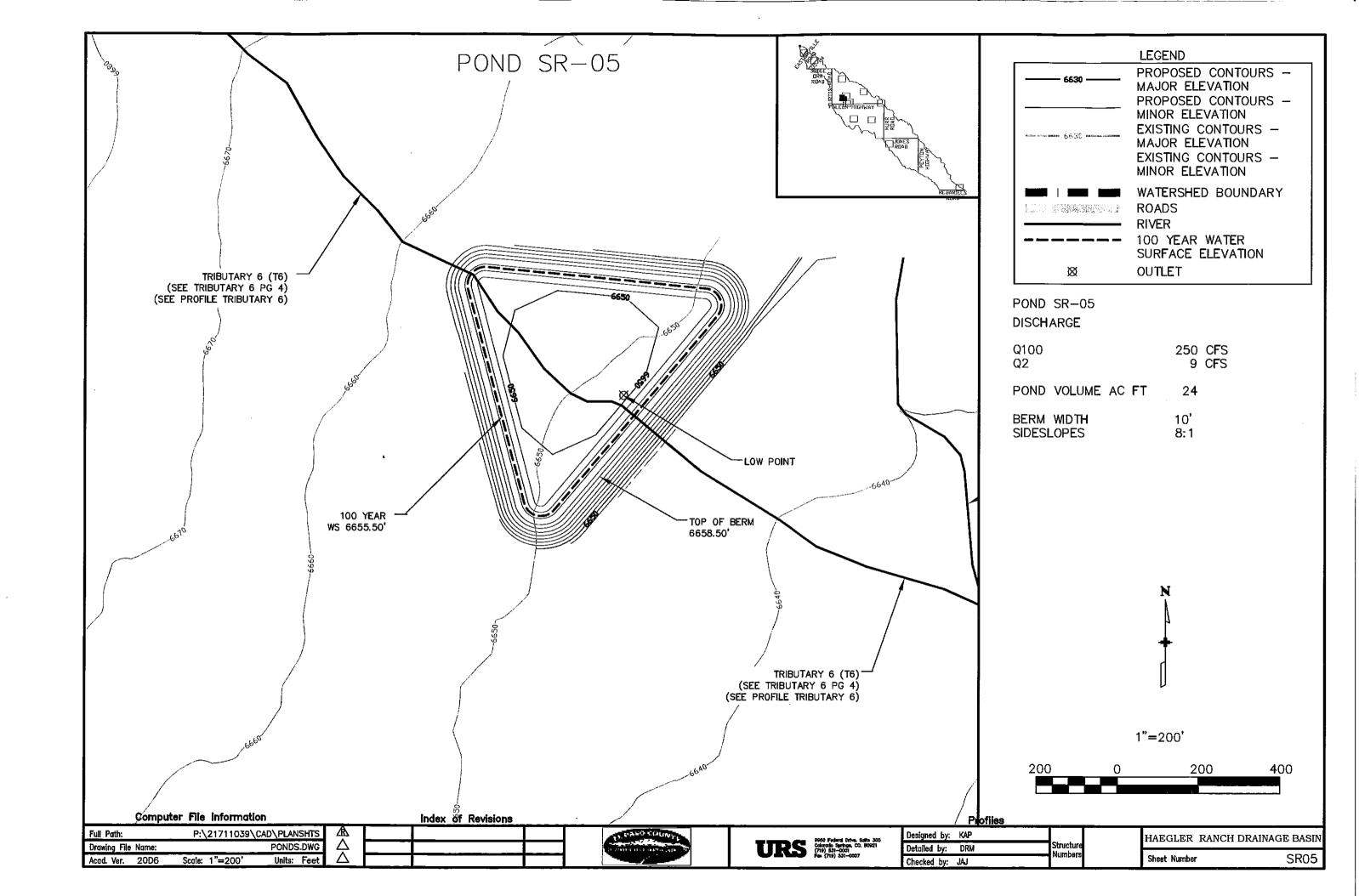
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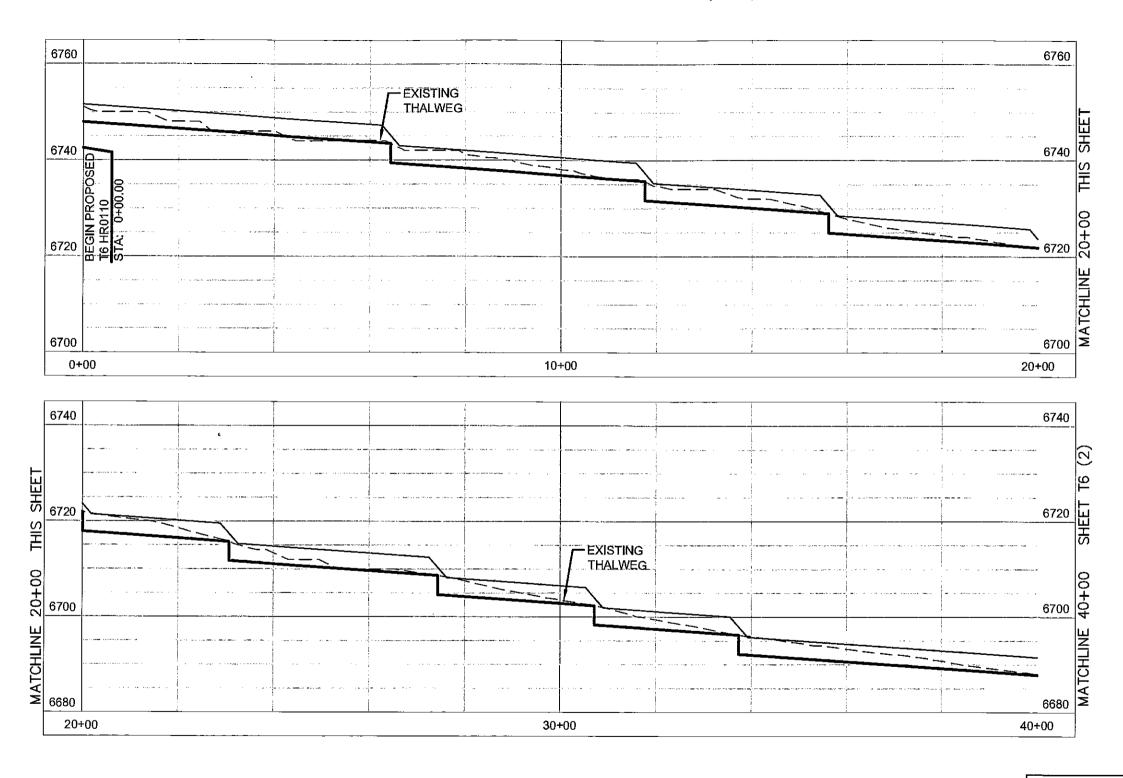


T6 HR0110

SLOPE = 0.70%

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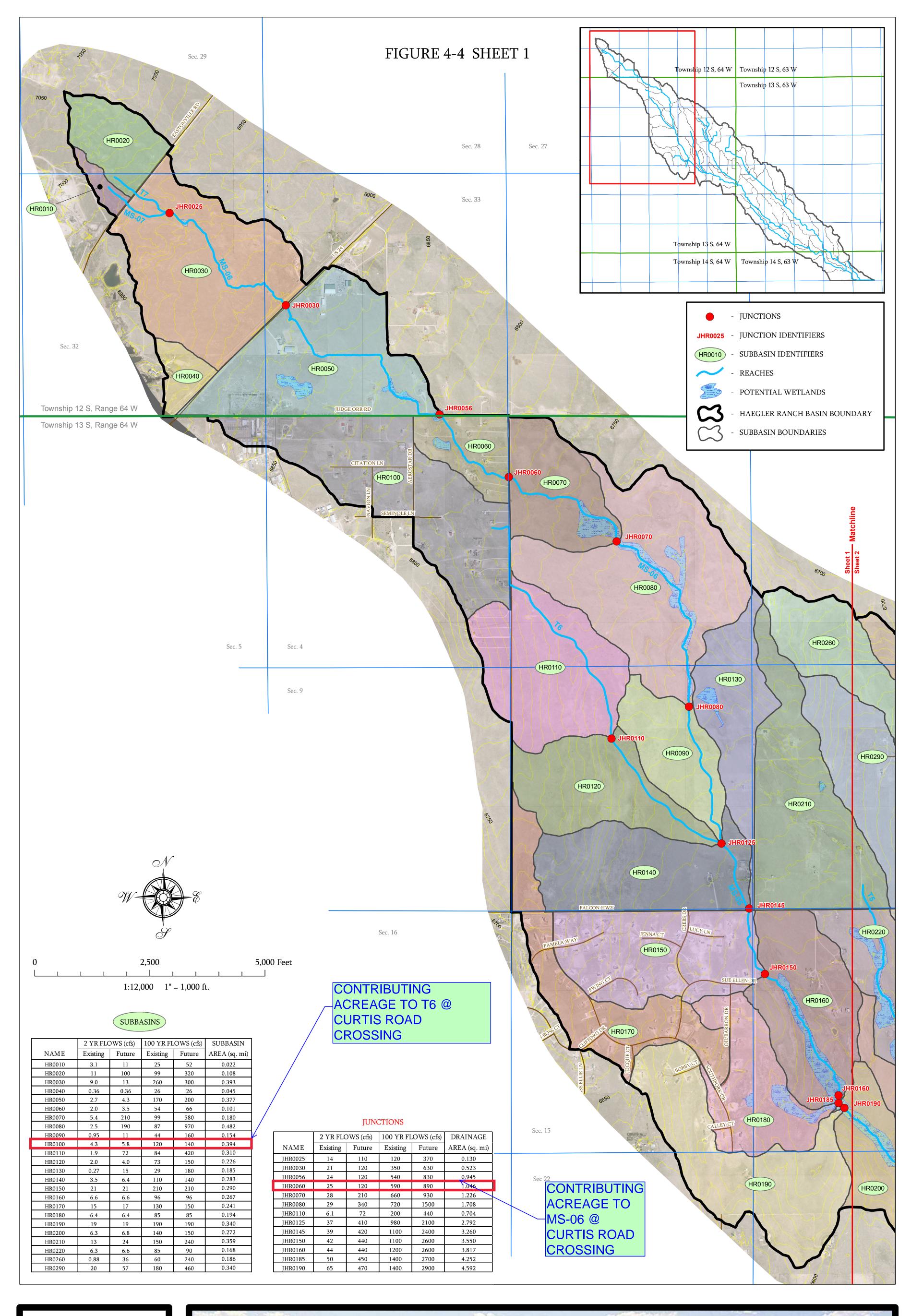




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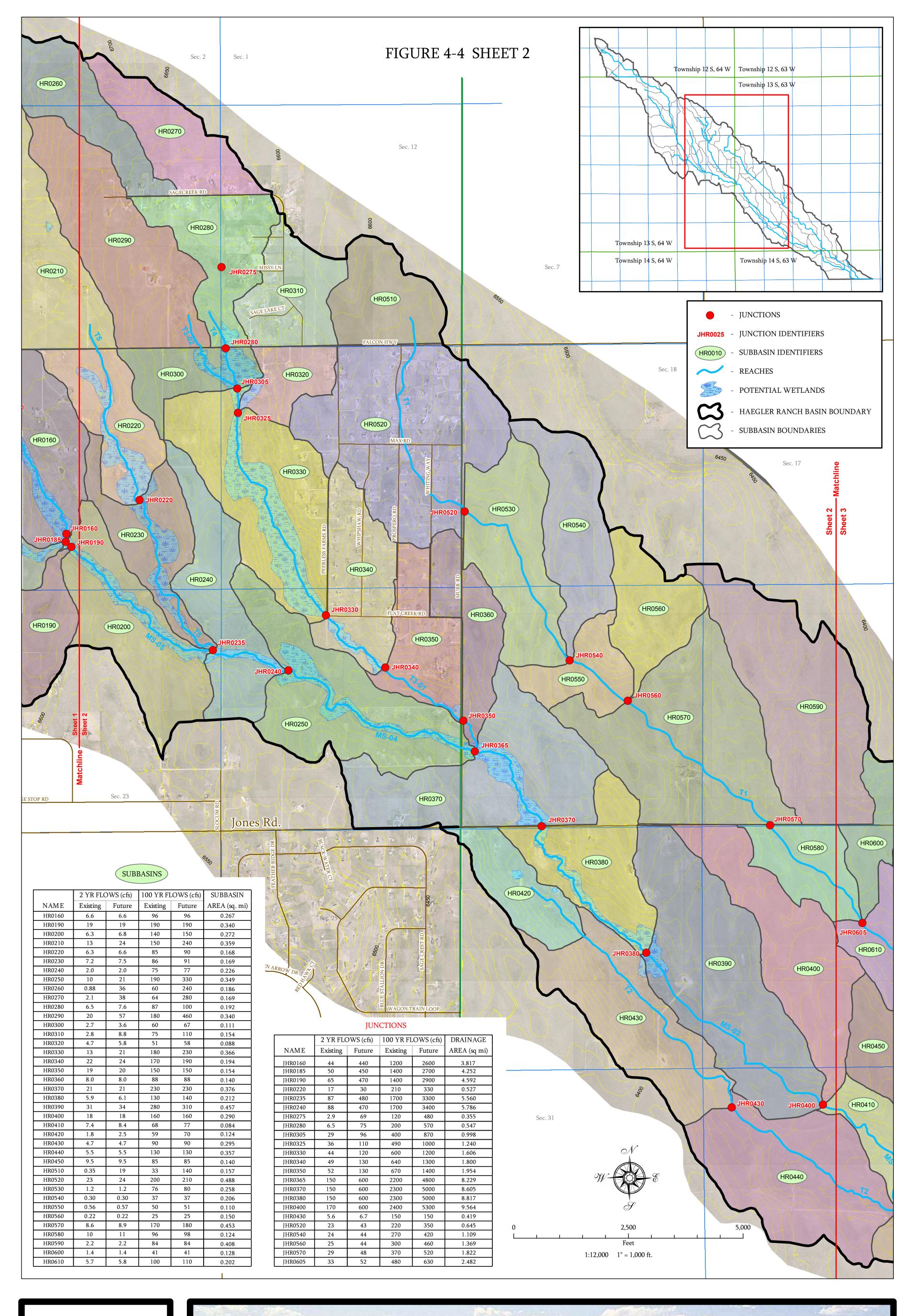




# HAEGLER RANCH DRAINAGE BASIN

EXISTING AND FUTURE CONDITIONS HYDROLOGIC MODEL

URS NO. 21711039 DATE: 09/08

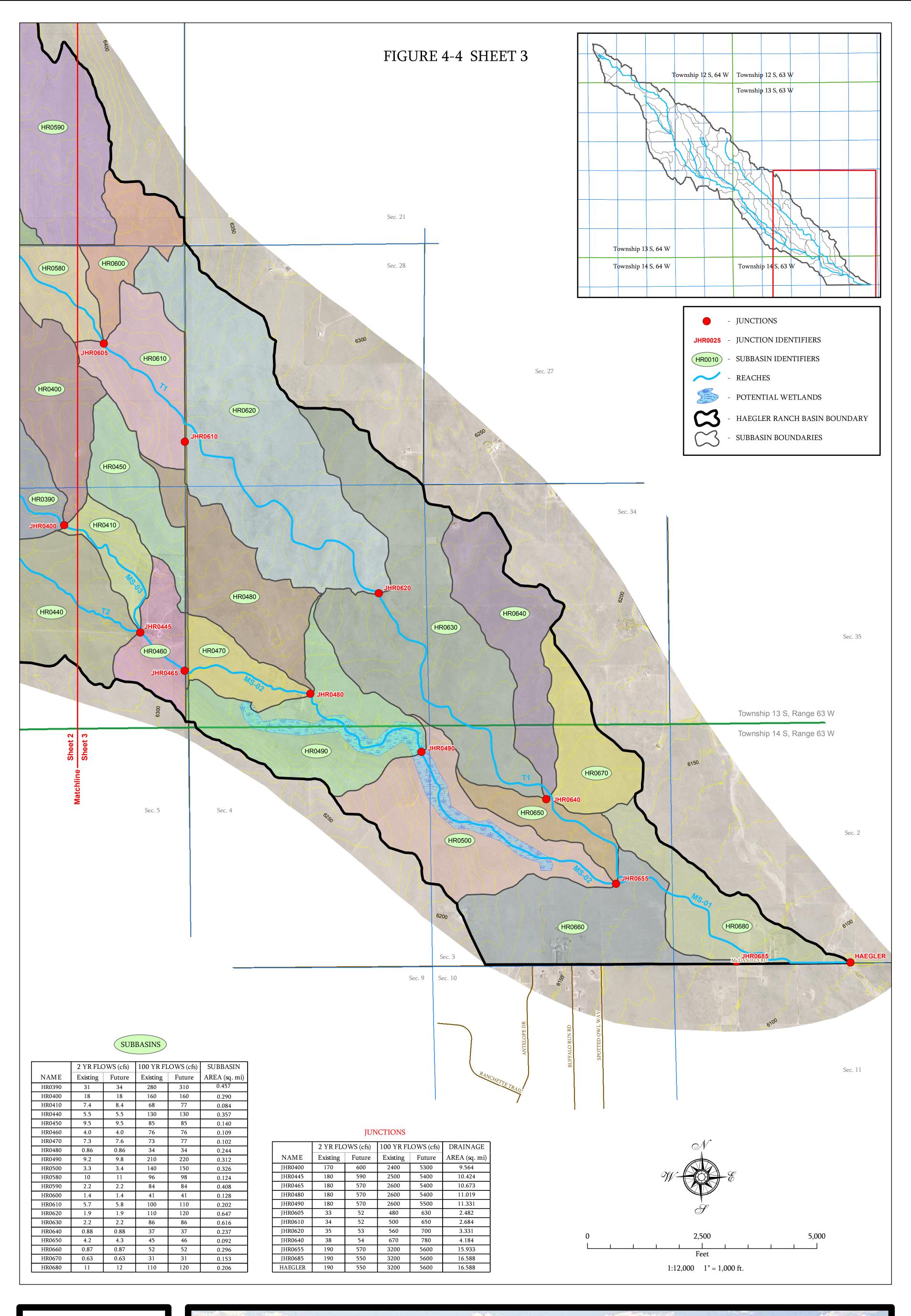




# HAEGLER RANCH DRAINAGE BASIN

EXISTING AND FUTURE CONDITIONS HYDROLOGIC MODEL

URS NO. 21711039 DATE: 09/08





# HAEGLER RANCH DRAINAGE BASIN

EXISTING AND FUTURE CONDITIONS HYDROLOGIC MODEL

URS NO. 21711039 DATE: 09/08

### MASTER DEVELOPMENT DRAINAGE PLAN and PRELIMINARY DRAINAGE REPORT FOR SADDLEHORN RANCH

Prepared For: ROI Property Group, LLC 2495 Rigdon Street Napa, CA 94558 (707) 365-6891

> May 8, 2020 Project No. 25142.00

Prepared By: JR Engineering, LLC 5475 Tech Center Drive Colorado Springs, CO 80919 719-593-2593

El Paso County PCD File No. SP-19-006

#### **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 El Paso County for drainage reports and said report is in conformity with the 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.

, , , , , , , , , , , , , , , , , , ,	Tike Bramlett, Colorado P.E. # 32314  Date or and On Behalf of JR Engineering, LLC					
<b>DEVELOPER'S STA</b> I, the developer, have report and plan.		the requirements specified in this drainage				
Business Name:	ROI Property Group, LI	<u>.C</u>				
By:						
Title: Address:	2495 Rigdon Street Napa, CA 94558					
		so County Land Development Code, neering Criteria Manual, as amended.				
Jennifer Irvine, P.E. County Engineer/ ECN	✓ Administrator	Date				
Conditions:						



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## **PURPOSE**

This document is the Master Development Drainage Plan (MDDP)/Preliminary Drainage Report (PDR) for the proposed Saddlehorn Ranch. The purpose of this report is to:

- 1. Identify on-site and off-site drainage patterns.
- 2. Recommend preliminary storm water facilities to collect and convey storm runoff from the proposed development to appropriate discharge and/or detention locations.
- 3. Recommend preliminary water quality and detention facilities to control discharge release rates to below historic.
- 4. Demonstrate compliance with surrounding major drainage basin planning studies, master plan and flood insurance studies.

## GENERAL LOCATION AND DESCRIPTION

#### Location

The proposed Saddlehorn Ranch, known as "the site" from herein, is a parcel of land located in Section 3 and 10, Township 13 South, Range 65 West of the 6<sup>th</sup> Principal Meridian in El Paso County, Colorado. The proposed 824 acre, rural, single family-development is bound by Judge Orr Road to the North and Curtis Road to the West. To the East, the site is bound by undeveloped land owned by Brent Houser Enterprises, LLC. To the south, the site is bound by undeveloped properties owned by 7120 Sudiev, LLC and Faye Reyonlds. A vicinity map and property owner map is presented in Appendix A.

Currently, there are three major drainageways that run through the site: Haegler Ranch Main Stem 6 (MS-06), Haegler Ranch Tributary 6 (T-6), and Gieck Ranch West Fork – Reach 7A (WF-R7A). These drainageways were analyzed, both hydrologically and hydraulically, in the following reports:

- 1. Geick Ranch Drainage Basin Planning Study (DBPS), October 2007
- 2. Haegler Ranch Basin DBPS, May 2009
- Sante Fe Springs Haegler Ranch Drainage Basin Letter of Map Revision (LOMR), October 2004

The impact of these drainageways and planning studies on the proposed development will be discussed later in the report.

# Description of Property

The proposed development contains approximately 824 acres and will be comprised of 227 rural 2.5 – 5 acre lots. The site is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling range land condition. In general, the site slopes from northwest to southeast and the existing drainageways follow this topography.

Per a NRCS web soil survey of the area, the site is made up of Type A, B and D soils. Type A soils cover roughly 80% of the site while Type B soils cover 3% and Type D cover the remaining 17% of the site. Group A soils have a high infiltration rate when thoroughly wet. Type B soils have a moderate infiltration when thoroughly wet. Type D soils have a very slow infiltration rate when thoroughly wet and have a high shrink-swell potential. A NRCS soil survey map has been presented in Appendix A.

Two existing wells are located in the southwest corner of the site. A 12" Cherokee Metropolitan District waterline runs through the site just south of the northern property line. Approximately a mile south of the Curtis Road and Judge Orr Road intersection, a two lane dirt road proceeds from Curtis Road east towards approximate center of the site. A water tank, pond and windmill are located within Major Drainageway MS-06 at the end of the dirt road.

### Floodplain Statement

Based on the FEMA FIRM Map number 08041C0558G, dated December 7, 2018, the site lies within Zone A, Zone AE, and Zone X. Zone A is defined as areas subject to inundation by the 1-percent-annual-chance flood determined using approximate methodologies because BFEs have not been established. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. All proposed development within the site will occur in Zone X.

In the northeast corner of the site, proposed development borders the Zone A boundary of the Geick Ranch West Tributary (WF-R7). At time of Final Drainage Report for this future phase of the development, a LOMR will be presented to establish base flood elevations (BFEs) for all lots that border the current Zone A boundary. The current FIRM Map has been presented in Appendix A.

## Drainage Basins and Subbasins

# Major Basin Descriptions

The site lies within two major drainage basins: the Gieck Ranch Drainage Basin based on the "Gieck Ranch Drainage Basin Planning Study" (DBPS) prepared by Drexel, Barrell & Co. in October, 2007 and revised in February 2010 and the Haegler Ranch Drainage Basin based on the "Haegler Ranch Drainage Basin Planning Study" prepared by URS Corporation in May 2009.

The Gieck Ranch Drainage Basin covers approximately 22 square miles and begins approximately five miles northeast of the Town of Falcon and travels approximately 15 miles to the southeast. The Gieck Ranch Drainage Basin is tributary to Black Squirrel Creek which drains south to the Arkansas River near the city of Pueblo, Colorado. The majority of the area within the basin is undeveloped and is characterized as rolling range land typically associated with Colorado's semi-arid climates.

MDDP / Preliminary Drainage Report Saddlehorn Ranch Preliminary Plan

Anticipated land use for the basin includes residential, industrial, agricultural and commercial development. Residential developments will range from 0.125 - 5 acre lots with a mix of low, medium and high density developments.

The Haegler Ranch Drainage Basin covers approximately 16.6 square miles in unincorporated El Paso County, CO. The Haegler Ranch Drainage Basin is tributary to Black Squirrel Creek. In its existing condition, the basin is comprised of rolling rangeland with poor vegetative cover associated with Colorado's semi-arid climate. The natural drainageways within the basin are typically shallow and wide with poorly defined flow paths in most areas. Anticipated land use for the basin includes residential and commercial development. Residential developments will range from 0.125 – 5 acre lots with a mix of low, medium and high density developments.

As part of its drainage research, JR Engineering reviewed the following drainage studies, reports and LOMRs:

- Gieck Ranch Drainage Basin Planning Study prepared by Drexel, Barrell & Co. in October, 2007 and revised in February 2010. (Not adopted by El Paso County as of July 2019)
- Haegler Ranch Drainage Basin Planning Study prepared by URS Corporation in May 2009
- Santa Fe Springs Haegler Ranch Drainage Basin Letter of Map Revision prepared by Tri-Core Engineering in June 2004.

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

The "Gieck Ranch Drainage Basin Planning Study" evaluated existing and future drainage conditions, identified future improvements, and established basin and bridge fees for the Gieck Ranch Drainage Basin. It should be noted that as of today the "Gieck Ranch Drainage Basin Planning Study" has not yet been approved and adopted by the County. All referenced information from the aforementioned report is presented for information purposes only.

Based upon provided drainage maps and analysis, Gieck Ranch discharges a total of 1,017 cfs onto the site within Major Drainageway Gieck Ranch West Fork Reach 7A (WF-R7A). An existing 66" CMP and 36" CMP convey the offsite flow across Judge Orr Road onto the site. The existing culverts at Judge Orr Road are undersized for existing and future flows resulting in localized overtopping. The DBPS recommends the culvert be upsized to four –12' x 5' box culverts. The culvert will not be upsized within the context of this report and development. The culvert is owned by El Paso County and timing of the recommended improvements will be controlled by the County. The overtopping at the intersection of WF-R7A is not contained within the 100-year floodplain. Therefore, at time of Final Drainage Report, berming will be provided that will protect proposed lots from overtopping flows. An overtopping analysis is presented in Appendix D and the limits of overtopping are presented on the existing and proposed drainage maps in Appendix F.

Based on existing channel analysis, the *Gieck Ranch DBPS* recommends WF-R7A channel improvements approximately 200' upstream and 300' downstream of the culvert crossing at Judge Orr Road (50' bottom width, 10:1 side slopes and vegetative augmentation). The recommended

channel improvements result from upsizing the culvert at Judge Orr Road, requiring the channel to be lowered. The channel improvements were not recommended due to existing channel instability. Existing velocities in the channel were found to be 2.19 ft/s, as presented in Appendix E. Per the MS4 permit requirements, the onsite reach of WF-R7A will be analyzed for channel stability with the corresponding Final Drainage Report for that phase of the development. At the time of Final Drainage Report, any necessary improvements to WF-R7A to satisfy the MS4 permit will be evaluated. It should be noted that the onsite reach of WF-R7A, where the aforementioned channel improvements were recommended, is comprised of jurisdictional wetlands which will limit the allowable improvements. Coordination with the Army Corps of Engineers will be required to grant permission to disturb the jurisdictional wetlands. Recommended channel improvements from the *Gieck Ranch DBPS* are presented in Appendix E.

#### Existing Haegler Ranch Drainage Basin

The "Haegler Ranch Drainage Basin Planning Study" was used to establish a stormwater management plan for the existing and future stormwater infrastructure needs within the Haegler Ranch Drainage Basin. Based on provided drainage maps and analysis, in the existing condition Haegler Ranch contributes a total of 710 cfs onto the site. Of the 710 cfs, 590 cfs crosses Curtis Road in an existing 24" CMP onto the site. Major Drainageway MS-06 conveys the stormwater through the site and to its off-site confluence with Major Drainageway MS-05. The remaining 210 cfs crosses Curtis Road in an existing 36" CMP onto the site. Major Drainageway T-6 conveys the stormwater through the site and to its off-site confluence with Major Drainageway MS-05. Both Curtis Road culverts are undersized for existing and future flows and overtopping occurs locally near the culvert crossings. Overtopping at the intersection of Curtis Road and T-6 is contained within the 100-year floodplain and will not affect proposed lots. The overtopping at the intersection of MS-06 and Curtis Road is not contained within the 100-year floodplain limits. Therefore, at time of Final Drainage Report, berming will be provided that will protect proposed lots from overtopping flows. An overtopping analysis is presented in Appendix D and the limits of overtopping are presented on the existing and proposed drainage maps in Appendix F.

The culverts are not proposed to be upsized within the context of this report and development. The culverts are owned by El Paso County and timing of the recommended improvements will be controlled by the County.

Furthermore, the *Haegler Ranch DBPS* recommends channel improvements within drainageways MS-06 and T-6. Per the *Haegler Ranch DBPS*, all recommended channel sections are trapezoidal with side slopes of 4:1 and a maximum depth of five feet. Within the limits of the site, three (3) channel bottom widths are recommended for MS-06. The first reach, from station 0+00 – 31+34, is proposed with a 15' bottom width, the second reach from 31+34 to 74+61, MS-06 is proposed with a 30' bottom width, and the last reach from station 74+61 - 103+62 is proposed with a 20' channel bottom. The *Haegler Ranch DBPS* recommends Major Drainageway T-6 be improved to a trapezoidal channel with an 8' bottom width, 4:1 side slopes and depth of 5'. Drop structures have

# MDDP / Preliminary Drainage Report Saddlehorn Ranch Preliminary Plan

also been recommended within MS-06 and T-6. These improvements will not occur within the context of this report or development. However, due to the addition of culvert crossings within MS-06 and T-6, channel improvements are anticipated up and downstream of the proposed culverts. The extent of these channel improvements will be addressed with corresponding Final Drainage Reports for those phases of the development. At that time, channel stability will be evaluated and any necessary improvements will be proposed. Recommended channel improvements from the *Haegler Ranch DBPS* are presented in Appendix E.

Based on flood impacts, stream stability and cost effectiveness, this study recommended a sub-regional detention approach. This allows future development anywhere in the basin with the construction of an associated sub-regional pond. Within the boundary of Saddlehorn Ranch, the DBPS recommended a total of three (3) sub-regional ponds. Based on discussion with El Paso County, the site will utilize full spectrum water quality and detention ponds instead. These full spectrum detention ponds will limit developed discharge into the drainageways to less than historic rates. Future, upstream development will also require full spectrum detention in accordance with current El Paso County criteria, which is an effective alternative to the sub-regional pond approach.

The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR was executed on Haegler Ranch Tributary 2, 3, and 4. The LOMR revised the onsite effective flood zones from Zone A to Zone AE for the three drainageways. Upstream stretches of Tributary 3 and 4 are classified Zone A but those channel reaches are off site. All stretches of Tributary 3 and 4 onsite are Zone AE. See FIRM Map Panel 080059-0575G for limits of LOMR study and revised flood zones, presented in Appendix E.

## Existing Sub-basin Drainage

On-site, existing drainage patterns are generally from northwest to southeast by way of existing, natural drainageways (MS-06, T-6, WF-R7A). On-site areas flow directly into these drainageways which also bypass off-site flows through the site. Offsite flows within the major drainageways that pass through the site will influence the on-site culvert designs and any channel improvements.

On-site, existing drainage basins were established based upon existing topography and the limits of 100-year floodplain. The site was divided into eleven existing sub-basins. See Table 1 below for summary of existing drainage sub-basins and corresponding peak flows. An existing drainage map is provided in Appendix F.

Table 1: Existing Drainage Basin Summary

EXIST	EXISTING BASIN SUMMARY TABLE					
Tributary Sub-Basin	Area (acres)	Percent Impervious	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)		
G1	10.1	2.0%	0.00	0.1		
G2	87.6	2.0%	1.5	76.4		
H1	166.5	2.0%	0.1	81.0		
H2	111.1	2.0%	0.2	91.1		
Н3	118.9	2.0%	0.9	64.1		
H4	63.3	2.0%	1.4	73.2		
H5	53.2	2.0%	0.3	28.2		
H6	87.6	2.0%	0.2	110.1		
CH1	23.9	2.0%	5.4	21.0		
CH2	84.2	2.0%	2.6	33.7		
CH3	19.1	2.0%	0.1	6.5		
Total	825.4	N/A	12.7	585.4		

The existing condition of the three major drainageways are discussed below;

#### Existing Geick Ranch West Fork Reach 7A (WF-R7A)

The first major drainageway is the Gieck Ranch West Fork Reach 7A (WF-R7A), per the *Gieck Ranch DBPS*. WF-R7A crosses onto the site along Judge Orr Road, approximately ¼ mile west of the intersection with Elbert Road. Discharge from the developed site into this drainageway will be limited to historic rates via a full spectrum detention pond prior to discharge. This drainageway includes jurisdictional wetlands and the entire drainageway onsite is classified Zone A. Access to the drainage way will be provided from internal roadways and along an equestrian trail will be constructed adjacent to the drainageway. The equestrian train can be utilized for maintenance equipment as well.

#### Existing Haegler Ranch Main Stem (MS-06)

The second drainageway is the Haegler Ranch Main Stem (MS-06), per the *Haegler Ranch DBPS*, which crosses onto the site along Curtis Road, approximately 1,600' south of the intersection with Judge Orr Road. MS-06 flows south towards its offsite confluence with Black Squirrel Creek. MS-06 exits the site along the southern property line. Discharge from the developed site into this drainageway will be limited to historic rates via a full spectrum detention pond prior to discharge. This drainageway includes non-jurisdiction wetlands and the entire drainageway is classified Zone AE. Access to the channel will be provided at the culvert crossing of MS-06 and San Isidro Trail via

# MDDP / Preliminary Drainage Report Saddlehorn Ranch Preliminary Plan

a 15' wide maintenance and access road that will proceed from San Isidro trail to the channel bottom. From here, access through the channel is achievable with existing grades within the channel. Furthermore, an equestrian trail will be constructed adjacent to the drainageway that can be utilized for maintenance equipment as well. The road alignments are displayed on the proposed drainage map presented in Appendix F.

#### Existing Haegler Ranch Tributary 6 (T-6)

The third drainageway is the Haegler Ranch Tributary 6 (T-6), per the *Haegler Ranch DBPS*, which crosses onto the site along Curtis Road, approximately ¾ mile south of the intersection with Judge Orr Road. T-6 conveys flows south through the site and towards its off-site confluence with Black Squirrel Creek. Discharge from the developed site into this drainageway will be limited to historic rates via a full spectrum detention pond prior to discharge. This drainageway is absent of any on-site wetlands and the entire drainageway is classified Zone AE. Access to the channel will be provided at the culvert crossing of T-6 and Del Cerro Trail via a 15' wide maintenance and access road that will proceed from Del Cerro Trail to the channel bottom. From here, access through the channel is achievable with existing grades within the channel. Furthermore, an equestrian trail will be constructed adjacent to the drainageway that can be utilized for maintenance equipment as well. The road alignments are displayed on the proposed drainage map presented in Appendix F.

The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR was executed on three Haegler Ranch basin drainageways. Two of the drainageways that were evaluated pass through the proposed development. These drainageways are the: Haegler Ranch Tributary 3 & 4. Within the boundary of the proposed development, Haegler Ranch Tributary 3 and 4 are synonymous with Main Stem 6 and Tributary 6 from the Haegler Ranch DBPS. The purpose of the LOMR was to revise the flood hazard depicted in the current Flood Insurance Study. Additionally, the LOMR provided existing, 100-year velocities within the drainageways that will be utilized in the design of any potential channel improvements. A FIRM panel with the limits of the detailed study as well as BFEs has been presented in Appendix E.

See Table 2 for comparison of drainageway identification and the naming convention used within the context of this report. See Table 3 for a comparison of 100-year flows as calculated in the aforementioned DBPS' and LOMR. An existing conditions drainage map is presented in Appendix F.

Table 2: Major Drainageways

	•					
Major Drainageway Naming Conventions						
Saddlehorn Ranch MDDP/PDR:	Per Haegler Ranch DBPS:	Per Geick Ranch DBPS:	Per Sante Fe Springs LOMR:			
WF-R7A	N/A*	West Fork (Middle)/WF- R7A	N/A*			
MS-06	Main Stem (MS- 06)	N/A*	Haegler Ranch Tributary 3			
T-6	Tributary 6 (T-6)	N/A*	Haegler Ranch Tributary 4			

Table 3: Major Drainageways – Ex. 100-Year Flow Comparison

Major Drainageways: 100-Year Flow Comparison						
Drainageway Name	Contributing Area (sq. mi.)	Q <sub>100</sub> Per Haegler Ranch DBPS:	Q <sub>100</sub> Per Geick Ranch DBPS:	Q <sub>100</sub> Per Sante Fe Springs LOMR:		
WF-R7A @ Judge Orr Road	1.50	N/A*	1,017 cfs	N/A*		
MS-06 @ Curtis Road	1.05	451 cfs	N/A*	505 cfs		
T-6 @ Curtis Road	0.39	120 cfs	N/A*	130 cfs		

<sup>\*</sup>N/A: Flow regime outside limits of study.

## Proposed Sub-basin Drainage

The proposed basin delineation is as follows;

Basin A is approximately 9.2 acres and in its existing condition is rolling rangeland. Runoff generally flows southeast away from Drainageway MS-06. In the proposed condition, Basin A will be rural 2.5 acre lots and roadway. Runoff from this basin will be collected in road side swales and conveyed south along Barrosito Drive to Pond A. Pond A, while considered temporary in this MDDP, will need to meet Full Spectrum Detention Criteria unless deviations are approved in the Final Drainage Report for this future filing. It is anticipated that Barrosito Drive will be extended south as part of the development of the adjacent parcel to the south. The most logical place for a permanent Full Spectrum pond is located approximately 1,000 feet south at the future road crossing with MS-06. When that pond is constructed, the Saddlehorn Metropolitan District No. 1 will remove Pond A. The peak flow rate for Basin A in the 5 and 100-year storm are 9.5 cfs and 20.7 cfs, respectively. However, Pond A will discharge at less than historic rates.

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Basin B is approximately 60.4 acres and in its existing condition is rolling rangeland. Runoff generally flows southwest across the basin towards Drainageway MS-06. In the proposed condition, Basin B will be rural 2.5 acre lots, paved roadway and will include Pond B. Runoff from this basin will be collected in road side swales and conveyed south along Barrosito Drive to Pond B. The peak flow rate for Basin B in the 5 and 100-year storm are 9.9 cfs and 46.3 cfs, respectively. However, Pond B will discharge at less than historic rates. A portion of Basin B is inundated by the existing 100-year floodplain, however; at time of final platting berming will be constructed to reduce the floodplain limits within the drainageway tract and a corresponding LOMR will be executed on this stretch of channel to establish the revised floodplain.

Basin C is approximately 102.5 acres and in its existing condition is rolling rangeland. Runoff generally flows southwest across the basin towards Drainageway MS-06. In the proposed condition, Basin C will be rural 2.5 acre lots, paved roadway and will include Pond C. Runoff from this basin will be collected in road side swales and conveyed south along Barrosito Drive and Del Cambre Drive to Pond C. The peak flow rate for Basin C in the 5 and 100-year storm are 15.8 cfs and 69.4 cfs, respectively. However, Pond C will discharge at less than historic rates.

Basin D is approximately 99.2 acres and in its existing condition is rolling rangeland. Runoff generally flows east across the basin towards Drainageway WF-R7A. In the proposed condition, Basin D will be rural 2.5 acre lots, paved roadway and will include Pond D. Runoff from this basin will be collected in road side swales and conveyed east along Barrosito drive to Pond D. The peak flow rate for Basin D in the 5 and 100-year storm are 29.4 cfs and 95.4 cfs, respectively. However, Pond D will discharge at less than historic rates. A portion of Basin D is inundated by the existing 100-year floodplain, however; at time of final platting berming will be constructed to reduce the floodplain limits within the drainageway tract and a corresponding LOMR will be executed on this stretch of channel to establish the base flood elevations.

Basin E is approximately 11.6 acres and in its existing condition is rolling rangeland. Runoff generally flows east across the basin towards Drainageway MS-06. In the proposed condition, Basin E will be rural 2.5 acre lots, paved roadway and will include Pond E. Runoff from this basin will be collected in road side swales and conveyed southwest along San Isidro Trail to Pond E. The peak flow rate for Basin E in the 5 and 100-year storm are 2.0 cfs and 9.9 cfs, respectively. However, Pond E will discharge at less than historic rates.

Basin F is approximately 117.4 acres and in its existing condition is rolling rangeland. Runoff generally flows southeast across the basin towards Drainageway MS-06. In the proposed condition, Basin F will be rural 2.5 acre lots, paved roadway and will include Pond F. Runoff from this basin will be collected in road side swales and conveyed southwest along Benito Wells Trail to Pond F. The peak flow rate for Basin F in the 5 and 100-year storm are 17.0 cfs and 69.9 cfs, respectively. However, Pond F will discharge at less than historic rates.

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Basin G is approximately 39.9 acres and in its existing condition is rolling rangeland. Runoff generally flows south across the basin towards Drainageway T-6. In the proposed condition, Basin G will be rural 2.5 acre lots, paved roadway and will include Pond G. Runoff from this basin will be collected in road side swales and conveyed southwest along El Raiceno Trail to Pond G. The peak flow rate for Basin G in the 5 and 100-year storm are 6.1 cfs and 25.3, respectively. However, Pond G will discharge at less than historic rates.

Basin H is approximately 30.7 acres and in its existing condition is rolling rangeland. Runoff generally flows east across the basin towards Drainageway T-6. In the proposed condition, Basin H will be rural 2.5 acre lots, paved roadway and will include Pond H. Runoff from this basin will be collected in road side swales and conveyed north along Rosalia Place to Pond H. The peak flow rate for Basin H in the 5 and 100-year storm are 3.7 cfs and 17.9 cfs, respectively. However, Pond H will discharge at less than historic rates.

Basin I is approximately 46.6 acres and in its existing condition is rolling rangeland. Runoff generally flows east across the basin towards Drainageway T-6. In the proposed condition, Basin I will be rural 2.5 acre lots, paved roadway and will include Pond I. Runoff from this basin will be collected in road side swales and conveyed south down Carrizo Springs Trail and east down Zaragoza Trail to Pond I. The peak flow rate for Basin I in the 5 and 100-year storm are 15.9 cfs and 63.1 cfs, respectively. However, Pond I will discharge at less than historic rates.

Basin J is approximately 10.1 acres and in its existing condition is rolling rangeland. This basin will not be developed and will remain in its existing condition, per Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedures this basin will not be detained in a full spectrum water quality and detention pond. Runoff generally flows east across the basin towards Drainageway T-6. In the proposed condition, Basin J will be an undeveloped tract. Undeveloped runoff from this basin will follow existing drainage patterns and sheet flow into Drainageway WF-R7A. The peak flow rate for Basin J in the 5 and 100-year storm are 3.0 cfs and 10.5 cfs, respectively.

Basins CH1, CH2 and CH3 are existing drainageway basins that will remain undeveloped in the proposed condition. There will be no development within Basin CH1-CH3, however; Basin CH2 & CH3 will require channel grading to accommodate proposed culverts. The scope of this grading will leave the channels in an undeveloped condition per Section I.7.1.B.7 and therefore will be excluded from permanent stormwater management. Basin CH1 contains jurisdictional wetlands. Basin CH2 contains non-jurisdictional wetlands. There are no wetlands located in Basin CH3. Peak flow rates for proposed undeveloped basins are presented in Appendix B.

Basins UD1-UD11 acre comprised of rural 2.5+ acre residential lots and will follow existing drainage patterns in the proposed condition. Development in these basins will be limited to a maximum of 10% impervious development via a plat covenant. Therefore, these basins can be excluded from permanent stormwater detention per Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedures (2.5+ acre lots with imperviousness less than 10% can be excluded from

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permanent stormwater management practices). Therefore, Basins UD1-UD11 will not be included in the developments permanent stormwater management facilities. A Permanent BMP applicability form is presented in Appendix D to justify these exclusions. A map detailing each development site and any exclusion is presented in Appendix F. Basin UD1 flows directly into Major Drainageway WF-R7A. Basins UD2, UD2.1, UD2.2, UD3, UD4, UD5 and UD8 flow directly into Major Drainageway MS-06. Basins UD6, UD7, UD9, and UD9.1 flow directly into Major Drainageway T-6. Basins UD8.1, UD10, and UD11 follow existing drainage patterns as well but flow directly off-site prior to being captured in major drainageways. A portion of Basin UD2.2 is inundated by the existing 100-yr floodplain. However, at time of final drainage report, lot lines will be adjusted outside floodplain limits. Furthermore, a portion of Basin UD10 is inundated by the existing 100-year floodplain, however; at time of final platting berming will be constructed to reduce the floodplain limits within the drainageway tract and a corresponding LOMR will be executed on this stretch of channel to establish the revised floodplain.

In addition to undeveloped lot areas, a small portion of Del Cerro Trail (portion of Basins UD9 & UD9.1) and San Isidro Trail (a portion of Basin UD5) will be allowed to directly discharge into Drainageway T-6 and MS-06, respectively, and excluded from the developments permanent stormwater management facilities. Per Section I.7.1.C.1, the County may exclude up to 20 percent, not to exceed 1 acre, of the applicable development site area from permanent stormwater management. Approximately, 16,240 ft<sup>2</sup> of Del Cerro Drive and 14,000 ft<sup>2</sup> square feet of San Isidro Trail, totaling 0.08% of the total development area, will be excluded from stormwater management, which is significantly less than the 20% limit.

A summary of all basin parameters has been presented in Appendix B.

Developed basin's runoff will be captured in roadside ditches and conveyed to a full spectrum water quality and detention pond per El Paso County DCM Volume 1. Each full spectrum pond will release treated flows at less than historic rates to minimize adverse impacts downstream. Pond D will discharge into Major Drainageway WF-7A, Pond B, C, E, and F will discharge into Major Drainageway T-6. Due to existing topography, Pond A will discharge into open space south of the site. Based on existing topography in the area, this flow will eventually be captured off-site by Major Drainageway MS-06.

See Table 4 for comparison of proposed pond parameters including a comparison of proposed basin discharge versus existing discharge.

Table 4: Pond Summary

		POND	SUMMARY	TABLE			
Tributary Sub- Basin	Pond Name	Tributary Acres	WQ Volume (ac-ft)	100-Year Volume (ac-ft)	Provided Volume (ac-ft)	100-Year Peak Discharge (cfs)	Ex. 100- Year Peak Discharge (cfs)
Α	POND A	9.2	0.20	1.14	1.14	2.5	2.8
В	POND B	60.4	0.35	1.46	2.17	18.9	21.0
С	POND C	102.5	0.64	2.69	2.77	26.0	28.9
D	POND D	99.2	0.59	2.86	2.97	47.7	53.0
Е	POND E	11.6	0.05	0.23	0.39	4.7	5.2
F	POND F	117.4	0.65	3.20	3.35	50.7	56.3
G	POND G	39.9	0.34	1.36	1.62	10.1	11.2
Н	POND H	30.7	0.16	0.70	1.18	10.5	11.7
I	POND I	46.6	0.25	1.09	1.41	26.8	29.8

#### DRAINAGE DESIGN CRITERIA

#### Development Criteria Reference

Storm drainage analysis and design criteria for the project were taken from the "City of Colorado Spring/El Paso County Drainage Criteria Manual" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "Urban Storm Drainage Criteria Manual" Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the "Colorado Springs Drainage Criteria Manual (CCSDCM), dated May 2014, as adopted by El Paso County, as well as the July 2019 El Paso County Engineering Criteria Manual update.

#### Hydrologic Criteria

All hydrologic data was obtained from the "El Paso Drainage Criteria Manual" Volumes 1 and 2, and the "Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual" Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. Runoff was calculated using CUHP Version 2.0.0, developed by Urban Drainage and Flood Control District. The model utilizes the raingage classified as "a design storm by temporal distribution of one-hour rain depths with area correction factors". The following Colorado Springs rainfall depths were utilized in the model: 2.52 inches for 1-hour 100-year depth and 3.5 inches for 6-hour 100-year depth. EPA SWMM 5.1 was utilized to route runoff flow rates for the sizing of stormwater storage facilities. The CUHP calculations and SWMM model are presented in Appendix B.

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Urban Drainage and Flood Control District's UD-Detention, Version 3.07 workbook was used for preliminary pond sizing. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. Pond sizing spreadsheets are presented in Appendix D.

#### Hydraulic Criteria

The Federal Highway Administration's HY-8 program (Volume 7.50) was used to analyze the proposed box culvert within Major Drainageways MS-06 and T-6. Per Section 14.3.2 of the CCS/EPCDCM, a maximum headwater-to-rise ratio of 1.5 was used for the sizing of box culverts. Furthermore, box culverts will be designed in conjunction with channel improvements to maintain the current floodplain and base flood elevations. Culvert sizing and corresponding channel improvements will be revised as roadway geometry becomes better defined. Preliminary culvert design sheets are presented in Appendix C.

Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) was used for preliminary roadside ditch design. For the purposes of this PDR/MDDP, the maximum roadside ditch size was determined based on peak 100-year flows and minimum roadway slopes within each basin. Swales were checked for velocity and Froude number per the EPC DCM Chapter 10, Section 10-7 and Table 10-4. Swale cross sections with a 100-year velocity greater than 5 ft/s or a Froude number greater than 0.9 will be lined with erosion control blanket and native grasses, or another approved method of stabilization, to limit erosive potential. Final swale designs and cross section details will be included with the Final Drainage Report. Preliminary swale design sheets are presented in Appendix C.

Autodesk Inc.'s Hydraflow Express Extension (Volume 10.5) will be used for final local road crossing culvert design with in the Final Drainage Report. All onsite, local road crossing culverts are assumed to be 18" or 24" CMP based on preliminary calculations. Culvert size was determined based on 100-year flows and hydraulic criteria from EPCDCM Chapter 9 –Culvert Design. The Final Drainage Report will provide final local road crossing culvert designs.

#### **DRAINAGE FACILITY DESIGN**

#### General Concept

The proposed stormwater conveyance system was designed to convey the developed Saddlehorn Ranch flows to full spectrum water quality and detention ponds. Water quality and detention ponds will be designed to release at less than historic rates to minimize adverse impacts downstream. All full spectrum water quality and detention ponds have been sized such that State Engineer review or approval is not required. Undeveloped basins are allowed to follow existing drainage patterns and discharge directly into major drainageways or off-site.

The undeveloped portion of developed lots will be allowed to discharge directly into Drainageways MS-06, T-6 and WF-R7A. Per the "Jurisdictional Determination Request for the 824 Acres Curtis Road subdivision Project" completed by Ecosystem System Services in October 2018, MS-06 and T-

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6 are not waters of the state and WF-R7A is a water of the state however, any direct discharge into this drainageway will be historic, undeveloped flows. The direct discharge into drainageway situation occurs anywhere a lot naturally drains toward a drainageway rather than the street. It was determined for these lots that all development (i.e. house and driveway) will occur in the first 200' of the lot, measured from the street into the lot. The 200' developed region of the lot will drain towards the road and be conveyed to a full spectrum water quality pond, however; the remainder of the lot (undeveloped) will be allowed to follow historic drainage patterns and flow directly into the drainageways. Furthermore, at time of platting, a covenant will be established for the development that will limit imperviousness to 10% for areas draining directly to the drainageways in order to satisfy Section I.7.1.B.5 of the ECM Stormwater Quality Policy and Procedures.

A box culvert will be proposed within Major Drainageway MS-06 and T-6 to convey existing, off site and developed, on-site flows underneath proposed roadways and through the site, in accordance with the *Haegler Ranch DBPS*. Culverts will not be required in Major Drainageway WF-R7A to maintain the drainage patterns established in the *Gieck Ranch DBPS*.

Channel improvements will be proposed immediately up and downstream of culvert improvements in order to maintain the current floodplain. Further channel improvements may be required within the major drainageways and the need for these potential improvements will be evaluated in the Final Drainage Report for each Filing. Access roads will be provided from local roadways down into the drainageways to provide culvert and drainageway maintenance access. A proposed drainage map is presented in Appendix F showing locations of culvert improvements, approximate channel improvements and access roads.

#### Specific Details

#### Four Step Process to Minimize Adverse Impacts of Urbanization

In accordance with the El Paso County Drainage Criteria Manual, Volume 2 this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes; stabilizing drainageways, treating the water quality capture volume (WQCV), and consider the need for Industrial Commercial BMP's.

Step 1, Reducing Runoff Volumes: The development of the project site is proposed as single family residential (2.5 ac. min.) with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roadways will utilize roadside ditches further disconnecting impervious areas. These practices will also allow for increased infiltration and reduce runoff volume.

Step 2, Stabilize Drainageways: This site will utilize roadside ditches with culvert crossings throughout the site. These roadside ditches will then direct the on-site development flows to the multiple detention ponds within the project that will be designed to release at or below historic rates in the natural channels. The natural channels will be stabilized in reaches with high velocity by the

use of drop structures incorporated at each roadway culvert crossing and isolated grade control structures where warranted. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impact to downstream drainageways is anticipated.

Step 3, Provide WQCV: Runoff from this development will be treated through capture and slow release of the WQCV in multiple permanent detention basins that will be designed per current El Paso County drainage criteria.

Step 4 Consider the need for Industrial and Commercial BMP's: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative will be prepared for each future Filing. Site specific temporary source control BMPs as well as permanent BMP's will be detailed in this plan and narrative to protect receiving waters.

#### Water Quality

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full spectrum water quality and detention will be provided for all of the development site not meeting exclusions present in the ECM - Stormwater Quality Policy and Procedures Section I.7.1.B and C. Any areas of the development site not being included in the site's permeant stormwater management are presented on the MS4 Development Site Map with their specific exclusion, presented in Appendix F. Outlet structure release rates will be limited to less than historic rates to minimize adverse impacts to downstream stormwater facilities. Complete pond and outlet structure designs will be provided with the Final Drainage Report. Preliminary pond design parameters are presented in Appendix D.

#### Erosion Control Plan

The El Paso County Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate must be submitted with each Final Drainage Report. We respectfully request that the Erosion Control Plan and Cost Estimate be submitted in conjunction with the grading and erosion control plans and construction assurances posted prior to obtaining a grading permit.

#### **Operation & Maintenance**

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. All proposed drainage structures within the any platted County ROW (roadside ditches and local road culverts) will be owned and maintained by El Paso County. All proposed drainage structures within easements or tracts (full spectrum water quality ponds, drainageway culverts and drainageway improvements) will be owned and maintained by the Saddlehorn Ranch Metropolitan District No.1. Inspection access for El Paso County will be provided through a maintenance easement.

#### Drainage and Bridge Fees

An estimate of total basin fees for the proposed development within Haegler Ranch Drainage Basin is provided in Table 6. A portion of Saddlehorn Ranch (Basin J and CH1) is not within an approved

drainage basin, therefore; no drainage or bridge fees will be required for this area. Drainage and Bridge fees are for informational purposes only and do not include reductions for rural lots, permanent water quality facilities or reimbursable channel improvements. Final drainage reports for each phase of development will establish official drainage and bridge fees to be paid at time of platting.

Table 5: Site Composite Percent Imperviousness

Total S	Site Compo	site % Impervious	for Basin Fees
Daala	Area	%	(Area) *
Basin	(ac)	Imperviousness	(% lmp.)
Α	9.2	67%	6.13
В	60.4	10%	6.28
С	102.5	11%	11.69
D	99.2	11%	10.71
E	11.6	12%	1.35
F	117.4	10%	11.62
G	39.9	17%	6.70
Н	30.7	9%	2.89
I	46.6	9%	4.38
J	10.1	9%	0.89
UD1	12.4	2%	0.25
UD2	12.8	2%	0.26
UD2.1	14.8	2%	0.30
UD2.2	7.2	2%	0.14
UD3	13.4	2%	0.27
UD4	4.8	2%	0.10
UD5	36.4	2%	0.73
UD6	22.1	2%	0.44
UD7	9.3	2%	0.19
UD8	4.6	2%	0.09
UD8.1	5.3	2%	0.11
UD9	4.8	2%	0.10
UD9.1	6.4	2%	0.13
UD10	10.4	2%	0.21
UD11	6.0	2%	0.12
CH1	23.9	2%	0.48
CH2	84.2	2%	1.68
CH3	19.0	2%	0.38
Total	825.4	-	68.59
Com	p. % lmp. =	= 68.59%*ac/825.4	1 ac = 8.31%

Table 6: Drainage Basin Fees

	El Paso County - Haegler Ranch Drainage Basin Fees									
Area (acre)	Composite % Impervious	Total Impervious Acreage	2019 Drainage Fee (per Impervious Acre)	2019 Bridge Fee (per Impervious Acre)	Saddlehorn Ranch Drainage Fee	Saddlehorn Ranch Bridge Fee				
825.4	8.31%	68.59	\$10,324	\$1,524	\$708,123	\$104,531				

#### Construction Cost Opinion

(For Information Only / Non-Reimbursable)

Cost opinion to be provided with Final Drainage Report.

#### **SUMMARY**

The proposed development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements, including ditches, culverts, detention ponds and drainage channel improvements. The proposed development will not adversely affect the offsite major drainageways or surrounding development. This report meets the latest El Paso County Drainage Criteria requirements for this site.

#### REFERENCES:

- <u>City of Colorado Springs Drainage Criteria Manual Volume 1</u>, City of Colorado Springs,
   CO, May 2014.
- 2. <u>Urban Storm Drainage Criteria Manual</u>, Urban Drainage and Flood Control District, Latest Revision.
- 3. <u>Gieck Ranch Drainage Basin Planning Study</u>, Drexel, Barrell & Co., October 2007 and revised in February 2010.
- 4. Haegler Ranch Drainage Basin Planning Study, URS Corporation, May 2009.
- 5. <u>The Santa Fe Springs Haegler Ranch Drainage Basin LOMR</u>, Federal Emergency Management Agency, October 20, 2004.

## APPENDIX B HYDROLOGIC CALCULATIONS

#### Colorado Urban Hydrograph Procedure

Version 2.0.0 - Release Date: 9/9/2016

Urban Drainage and Flood Control District Denver, Colorado email: udfcd@udfcd.org

Purpose:	This program produces hydrographs using the Colorado Unit Hydrograph Procedure (CUHP)
Functions:	
Edit Raingages	Add/Remove Raingages and change names
Edit Subcatchments	Edit subcatchment parameters
Edit Multiple Run Options	Edit the Multiple Run options (Advanced User Features)
Import CUHP 2005 File	Import an older CUHP 2005 workbook into this updated version of CUHP
Check Subcatchments	Check whether subcatchment inputs conform to UDFCD guidelines
Check SWMM Nodes	Check whether all subcatchment target nodes are included in the SWMM .inp file
Run CUHP	Calculate effective precipitation and generate hydrographs for each subcatchment
Settings:	Fill in the blue cells to begin:  Project Title: Saddlehorn Ranch  Project Comment: Ex. Conditions Analysis  Time Step Between Computations: 5 Minute(s); typically 5 or 1 (peak flow rate will differ slightly).  Use Relative Path Names  Output Workbook Filename: X:\2510000.all\2514200\CUHP-SWMM\Existing_CUHP_2002.xlsm.xlsx  CUHP/SWMM Interface Filename (Optional): X:\2510000.all\2514200\CUHP-SWMM\Existing_CUHP_2002.xlsm.txt  EPA SWMM 5 Input Filename (Optional): X:\2510000.all\2514200\CUHP-SWMM\Ex. Conditions Model.inp  EPA SWMM 5 Application File (Optional): SWMM Hydrograph Start Time (Optional):
Acknowledgements:	Thanks to Ben Urbonas, P.E., D.WRE and James C.Y.Guo, PhD, P.E., for the development of the CUHP project.

#### **CUHP SUBCATCHMENTS**

Columns with this color heading are for required user-input

Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

						Maximum Depre (Watershe	_	Но	rton's Infiltrat Parameters	ion	DCIA		
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (mi²)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Rate	Level 0, 1, or 2
CH1	CH1	EPC	0.0373438	0.210994318	0.4289773	0.01	2	0.4	0	3	0.0018	0.5	2
CH2	CH2	EPC	0.1318594	0.930530303	1.4477273	0.015	2	0.4	0	4	0.0013	0.75	2
CH3	CH3	EPC	0.0329219	0.420583333	0.7320076	0.015	2	0.4	0	4.81	0.0011	0.85	2
H1	H1	EPC	0.2601406	0.229166666	0.821917	0.01	2	0.4	0	5	0.0007	1	2
H2	H2	EPC	0.1735781	0.129545454	0.4912879	0.025	2	0.4	0	5	0.0007	1	2
H3	H3	EPC	0.18325	0.490719697	0.932197	0.015	2	0.4	0	4.64	0.0009	0.73	2
H4	H4	EPC	0.0988906	0.085984848	0.5267045	0.0225	2	0.4	0	3.82	0.0008	0.74	2
H5	H5	EPC	0.0831875	0.236931818	0.7267045	0.02	2	0.4	0	4.93	0.0009	0.94	2
H6	H6	EPC	0.1367969	0.046022727	0.4	0.04	2	0.4	0	5	0.0007	1	2
G1	G1	EPC	0.01575	0.210606061	0.3015152	0.018	2	0.4	0	5	0.00007	1	2
G2	G2	EPC	0.1368125	0.235606061	0.6857955	0.02	2	0.4	0	4.32	0.0011	0.83	2

#### **RUN MULTIPLE CUHP AND SWMM SCENARIOS**

Columns with this color heading are for required user-input Columns with this color heading are for program-calculated values

SWMM Run Wait Time (sec) (Optional) SWMM Time Series Inflow "Modification Type" (LU, RP, or LU&RP)

Subcatchment Name	Existing Landuse % Imperviousness	Future Landuse % Imperviousness
CH1	2	2
CH2	2	2
CH3	2	2
H1	2	2
H2	2	2
H3	2	2
H4	2	2
H5	2	2
H6	2	2
G1	2	2
G2	2	2

Raingage	Return Period (Years)	1 Hr Depths (in)	6 Hr Depths (in)
	WQ	0.6	N/A
	2	1.19	2.1
	5	1.5	2.7
EPC	10	1.75	3.2
	25	2	3.6
	50	2.25	4.2
	100	2.52	4.6
-			

Enter "X" to Run Scenario	Scenario ID	Land Use (E or F)	Return Period (yr)	Correction Area (Sq.Mi.)
Х	WQ	E	WQ	0
	2-YR	E	2	1
X	5-YR	E	5	1
	10-YR	E	10	1
	25-YR	E	25	1
	50-YR	E	50	1
X	100-YR	E	100	1

(Optional) SWMM Time Series Inflow Table "NAME"

Comment	El Paso County F	Rainfall Depths		
1Hr Depth		inches	2hr Depth	2.86 inches
6Hr Depth		inches	3hr Depth	3.11 inches
Correction Area		Sq. Mi.		
Return Period		Years		
Time		Unadjusted Depth		NOAA Atlas 14 Point Precipitation Frequency
0:05		0.0252		
0:10	0.0756	0.0756		
0:15		0.1159		
0:20	0.2016	0.2016		
0:25		0.3528		
0:30	0.6300	0.6300		
0:35	0.3528	0.3528		
0:40	0.2016	0.2016		
0:45		0.1562		
0:50		0.1260		
0:55		0.1008		
1:00		0.1008		
1:05		0.1008		
1:10	0.0504	0.0504		
1:15		0.0504		
1:20	0.0302	0.0302		
1:25		0.0302		
1:30	0.0302	0.0302		
1:35		0.0302		
1:40	0.0302	0.0302		
1:45		0.0302		
1:50		0.0302		
1:55		0.0302		
2:00		0.0302		
2:05		0.0000		
2:10	0.0000	0.0000		
2:15		0.0000		
2:20		0.0000		
2:25		0.0000		
2:30	0.0000	0.0000		
2:35	0.0000	0.0000		
2:40	0.0000	0.0000		
2:45	0.0000	0.0000		
2:50	0.0000	0.0000		
2:55	0.0000	0.0000		
3:00	0.0000	0.0000		
3:05	0.0000	0.0000		
3:10	0.0000	0.0000		
3:15	0.0000	0.0000		
3:20	0.0000	0.0000		
3:25	0.0000	0.0000		
3:30	0.0000	0.0000		
3:35	0.0000	0.0000		
3:40	0.0000	0.0000		
3:45		0.0000		
3:50	0.0000	0.0000		

#### **SADDLEHORN RANCH - EX. 5-YEAR FLOW RESULTS**

#### Node Inflow Summary

Node	Туре	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Day of Maximum Inflow	Hour of Maximum Inflow	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
CH1	JUNCTION	5.40	5.40	0	00:50	0.232	0.232	0.000
CH2	JUNCTION	2.58	2.58	0	01:00	0.176	0.176	0.000
СНЗ	JUNCTION	0.11	0.11	0	00:45	0.00701	0.00701	0.000
DP1	JUNCTION	0.00	6.79	0	00:46	0	0.268	0.000
DP2	JUNCTION	0.00	1.46	0	00:40	0	0.0359	0.000
DP3	JUNCTION	0.00	0.13	0	00:40	0	0.00379	0.000
DP4	JUNCTION	0.00	0.16	0	00:35	0	0.00252	0.000
DP5	JUNCTION	0.00	0.90	0	00:45	0	0.0334	0.000
DP6	JUNCTION	0.00	1.35	0	00:35	0	0.0209	0.000
DP7	JUNCTION	0.00	4.06	0	01:05	0	0.237	0.000
DP8	JUNCTION	0.00	0.21	0	00:30	0	0.00194	0.000
DP9	JUNCTION	0.00	0.43	0	00:40	0	0.0172	0.000
G1	JUNCTION	0.00	0.00	0	00:00	0	0	0.000
G2	JUNCTION	1.46	1.46	0	00:40	0.0359	0.0359	0.000
H1	JUNCTION	0.13	0.13	0	00:40	0.00379	0.00379	0.000
H2	JUNCTION	0.16	0.16	0	00:35	0.00252	0.00252	0.000
Н3	JUNCTION	0.90	0.90	0	00:45	0.0334	0.0334	0.000

SWMM 5.1 Page 1

#### **SADDLEHORN RANCH - EX. 5-YEAR FLOW RESULTS**

Node	Туре	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Day of Maximum Inflow	Hour of Maximum Inflow	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
H4	JUNCTION	1.35	1.35	0	00:35	0.0209	0.0209	0.000
H5	JUNCTION	0.33	0.33	0	00:40	0.0102	0.0102	0.000
Н6	JUNCTION	0.21	0.21	0	00:30	0.00194	0.00194	0.000
J13	JUNCTION	0.00	0.07	0	01:50	0	0.00485	0.000
J14	JUNCTION	0.00	0.06	0	02:28	0	0.00242	0.000
J15	JUNCTION	0.00	0.83	0	01:03	0	0.0333	0.000
J16	JUNCTION	0.00	0.09	0	00:49	0	0.00188	0.000

SWMM 5.1 Page 2

#### **SADDLEHORN RANCH - EX. 100-YR FLOW RESULTS**

#### Node Inflow Summary

Node	Туре	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Day of Maximum Inflow	Hour of Maximum Inflow	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
CH1	JUNCTION	1038.04	1038.04	0	00:55	165	165	0.000
CH2	JUNCTION	485.11	485.11	0	01:15	75.2	75.2	0.000
СНЗ	JUNCTION	127.25	127.25	0	01:10	19.9	19.9	0.000
DP1	JUNCTION	0.00	1114.02	0	00:51	0	167	0.000
DP2	JUNCTION	0.00	76.38	0	00:50	0	2.23	0.000
DP3	JUNCTION	0.00	80.97	0	00:45	0	2.08	0.000
DP4	JUNCTION	0.00	91.06	0	00:40	0	1.38	0.000
DP5	JUNCTION	0.00	64.08	0	01:00	0	2.67	0.000
DP6	JUNCTION	0.00	73.15	0	00:40	0	1.47	0.000
DP7	JUNCTION	0.00	704.90	0	01:08	0	83	0.000
DP8	JUNCTION	0.00	110.05	0	00:35	0	1.06	0.000
DP9	JUNCTION	0.00	248.10	0	00:45	0	21.9	0.000
G1	JUNCTION	0.09	0.09	0	00:40	0.00364	0.00364	0.000
G2	JUNCTION	76.38	76.38	0	00:50	2.23	2.23	0.000
H1	JUNCTION	80.97	80.97	0	00:45	2.08	2.08	0.000
H2	JUNCTION	91.06	91.06	0	00:40	1.38	1.38	0.000
Н3	JUNCTION	64.08	64.08	0	01:00	2.67	2.67	0.000
H4	JUNCTION	73.15	73.15	0	00:40	1.47	1.47	0.000
Н5	JUNCTION	28.20	28.20	0	00:50	0.959	0.959	0.000
Н6	JUNCTION	110.05	110.05	0	00:35	1.06	1.06	0.000

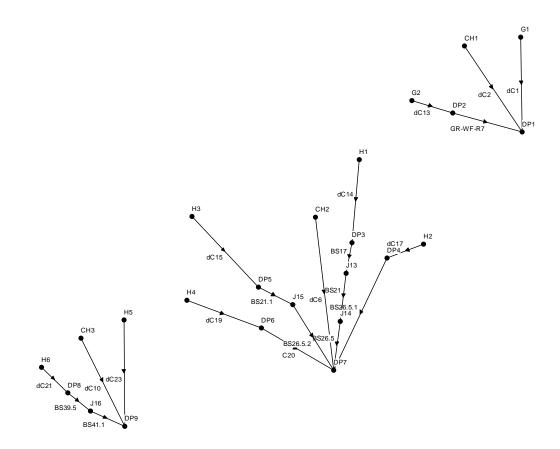
#### SADDLEHORN RANCH - EX. 100-YR FLOW RESULTS

Node	Туре	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Day of Maximum Inflow	Hour of Maximum Inflow	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
J13	JUNCTION	0.00	69.43	0	01:03	0	2.18	0.000
J14	JUNCTION	0.00	68.26	0	01:09	0	2.19	0.000
J15	JUNCTION	0.00	63.63	0	01:07	0	2.68	0.000
J16	JUNCTION	0.00	103.79	0	00:38	0	1.08	0.000

SWMM 5.1 Page 2

#### **SADDLEHORN RANCH - EX. CONDITIONS SWMM MODEL**

01/01/2005 00:15:00



SWMM 5.1 Page 1

## APPENDIX C HYDRAULIC CALCULATIONS

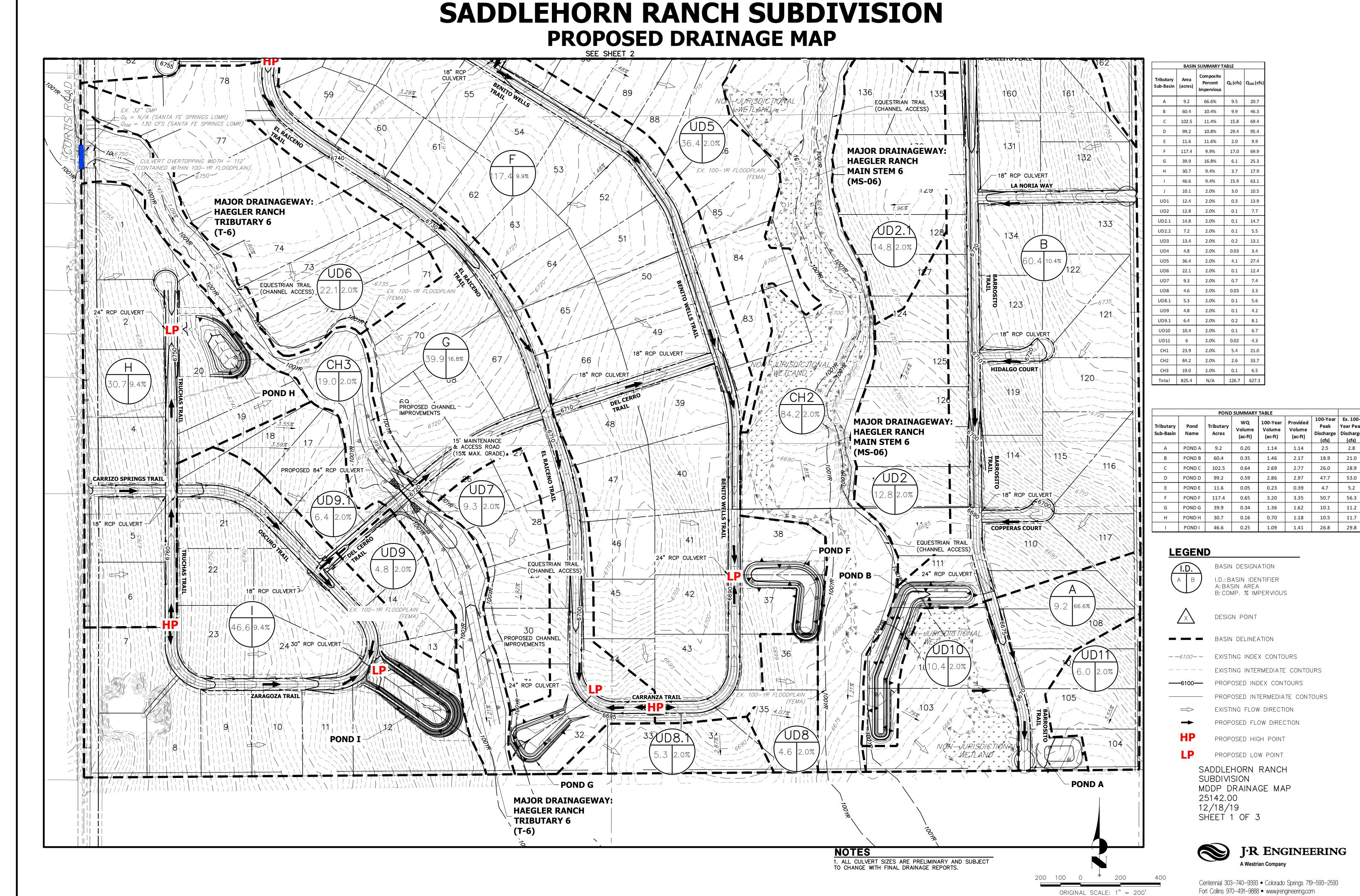
## APPENDIX D WATER QUALITY AND DETENTION CALCULATIONS

## APPENDIX E REFERENCE MATERIALS

## APPENDIX F DRAINAGE MAPS

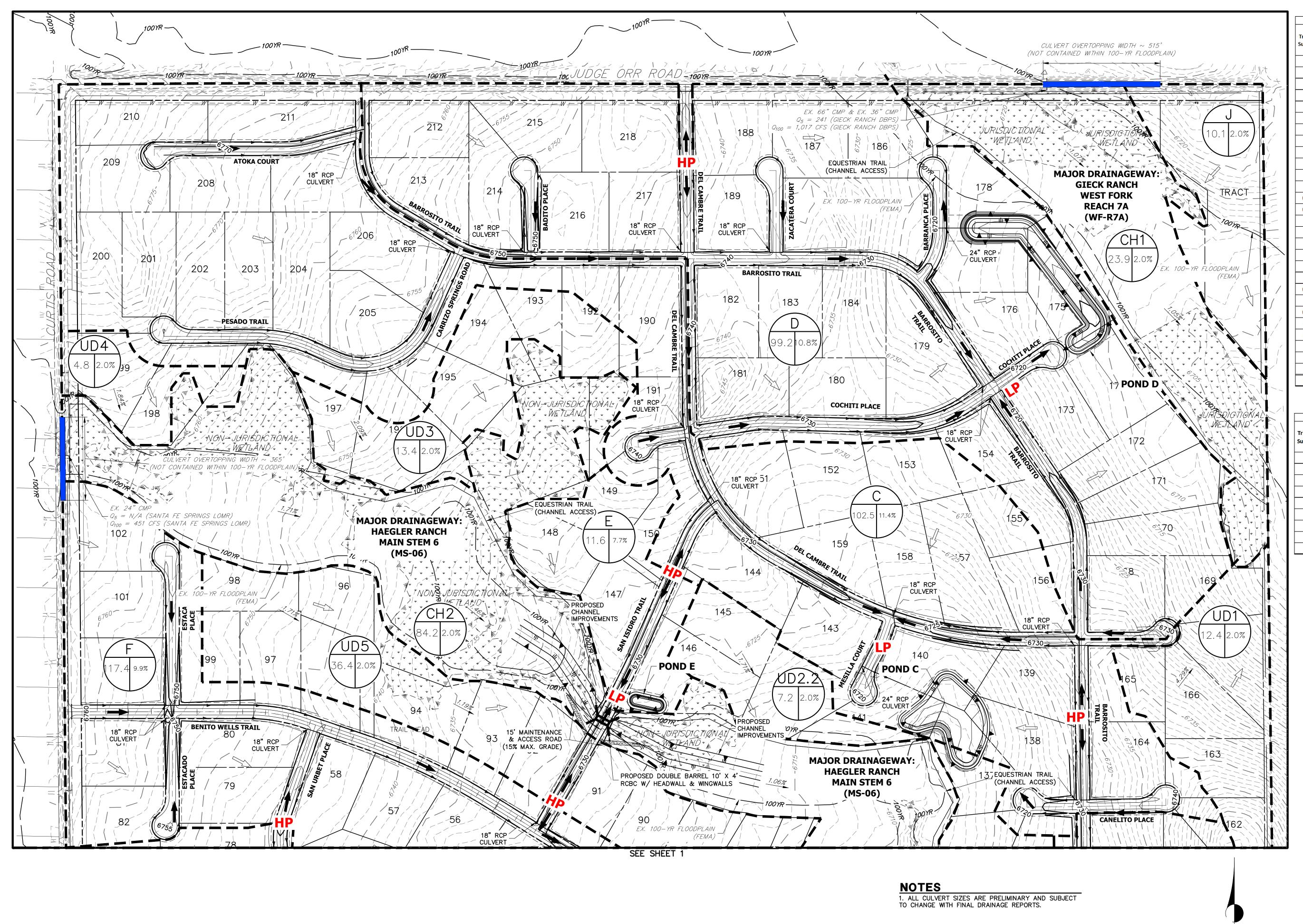
#### 824 ACRE CURTIS ROAD SUBDIVISION **EX. CONDITIONS DRAINAGE MAP** CONTAINED WITHIN 100-YR FLOODPLAIN, REC. NO. 206173721 MARTIN *ESCOBEDO* REC. NO. **MAJOR DRAINAGEWAY:** COMBS **GIECK RANCH TRIBUTARY** REC. NO. OWNER: BRÉNT HOUSER **WEST FORK REACH 7A** ENTERPRISES LLC MAILING ADDRESS: 11890 GARRETT ROAD, PEYTON, CO (WF-R7A) MILLIGAN REC. NO. 21205738<u>9</u> **MAJOR DRAINAGEWAY:** EDW & MSW TRUST WEST **HAEGLER RANCH MAIN STEM 6** REC. NO. (MS-06)214045605 CARTER CHANDRA A REC. NO. REC. NO. 204050998 MCINTOSH. JON L REC. NO. 94159962 RAUENZAHN MICHAEL A REC. NO. 212131655 REC. NO. 2032<u>29281</u> GABRIEL REC. NO. 219056906 ADAM 0 REC. NO. 215064502 BERNSTEIN JAY REC. NO. 18.93 2% BRITT / REC. NO. 214109817 LÄNOTTE $Q_{100} = 120$ CFS (SANTA FE SPRINGS LOMR FLOW) DANIEL ( & ROCAL CULVERT OVERTOPPING WIDTH ~ 112 \address: N/A \ OWNER: BRENT HOUSER \ENTERPRISES LLC MAILING ADDRESS: 11890 \ GARRETT ROAD, PEYTON, CO **MAJOR DRAINAGEWAY:** 4.54% EX. WINDMILL, WATER TANK & **HAEGLER RANCH TRIBUTARY 6 (T-6)** STOCK POND MARK o MICHELE BUNGER GEORG REC. NO. 215137907 RUSHING JOHNN REC. NO. 201018524 EX. 100-YR FLOODPLAIN (2018 FEMA) SAUDER **MAJOR DRAINAGEWAY:** EX. 100-YR FLOODPLAIN ALLEN R REC. NO. HAEGLER RANCH MAIN STEM 6 219013941 (MS-06) RENZ LARAE M REC. NO. \ 213139543 -EX. GRAVEL ROAD -63.29 MEWADOW LAKE AIRPORT ASSOC. REC. NO. H6 213139543 5.42% ADDRESS: N/A OWNER: BRENT HOUSER ENTERPRISES LLC MAILING ADDRESS: 11890 GARRETT ROAD, PEYTON, CO VENTIMIGLIA DOROTHY **MAJOR DRAINAGEWAY:** TRUST HAEGLER RANCH TRIBUTARY 6 (T-6) REC. NO: 217077397 -vŮRĬ,SĎIEŤIOŇAL ADDRESS: 7120 FALCON GRASSY HEIGHTS OWNER: 7120 SUDIEV LLC ADDRESS: N/A (FALCON HIGHWAY) MAILING ADDRESS: 7120 FALCON GRASSY HEIGHTS, PEYTON, CO 80831 OWNER: REÝNOLDS FAYE MAILING ADDRESS: 6634 MASTERS RD, MANVEL, TEXAS 77578 **LEGEND DESIGN POINT BASIN SUMMARY TABLE** BASIN DESIGNATION (1.D.) **SUMMARY TABLE** Tributary Area Percent Q<sub>5</sub> (cfs) Q<sub>100</sub> (cfs) I.D.: BASIN IDENTIFIER Impervious Sub-Basin (acres) Tributary Q<sub>5</sub> (cfs) | Q<sub>100</sub> (cfs) A: BASIN AREA 10.1 2.0% G1 0.00 0.1 B: % IMPERVIOUS 1017.0 241.00 0.1 G2 87.6 2.0% 1.5 76.4 451.0 0.2 166.5 81.0 H12.0% 0.1 DESIGN POINT 0.3 120.0 91.1 H2 111.1 2.0% 0.2 6.9 1114.0 118.9 2.0% 0.9 64.1 **H3** 2 1.5 76.4 BASIN DELINEATION **H4** 2.0% 1.4 73.2 63.3 0.1 80.9 **H5** 53.2 2.0% 0.3 28.2 EXISTING INDEX CONTOURS *− −6100− −* 0.1 91.1 2.0% 110.1 H<sub>6</sub> 87.6 0.2 0.9 64.1 5.4 21.0 23.9 2.0% CH1 EXISTING INTERMEDIATE CONTOURS 6 1.4 73.2 2.0% 2.6 33.7 CH2 84.2 EXISTING FLOW DIRECTION $\qquad \qquad \Box$ 4.1 704.9 CH3 19.1 2.0% 0.1 6.5 0.2 110.1 N/A 12.7 585.4 **Total** 825.4 0.4 248.1 EX. DRAINAGE MAP 824 CURTIS ROAD 25142.00 5/8/20 SHEET 1 OF 1 J·R ENGINEERING A Westrian Company 300 300 150 0 Centennial 303-740-9393 • Colorado Springs 719-593-2593 ORIGINAL SCALE: 1" = 300' Fort Collins 970-491-9888 • www.jrengineering.com

X:\2510000.all\2514200\Drawings\Sheet Dwgs\\_Drainage\2018-10-09\_Ex.Drainage Map.dwg, EX. DR01,



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# SADDLEHORN RANCH SUBDIVISION PROPOSED DRAINAGE MAP



Tributary Sub-Basin	Area (acres)	Composite Percent Impervious	Q₅ (cfs)	Q <sub>100</sub> (cfs)
Α	9.2	66.6%	9.5	20.7
В	60.4	10.4%	9.9	46.3
С	102.5	11.4%	15.8	69.4
D	99.2	10.8%	29.4	95.4
E	11.6	11.6%	2.0	9.9
F	117.4	9.9%	17.0	69.9
G	39.9	16.8%	6.1	25.3
Н	30.7	9.4%	3.7	17.9
Ī	46.6	9.4%	15.9	63.1
J	10.1	2.0%	3.0	10.5
UD1	12.4	2.0%	0.3	13.9
UD2	12.8	2.0%	0.1	7.7
UD2.1	14.8	2.0%	0.1	14.7
UD2.2	7.2	2.0%	0.1	5.5
UD3	13.4	2.0%	0.2	13.1
UD4	4.8	2.0%	0.03	3.4
UD5	36.4	2.0%	4.1	27.4
UD6	22.1	2.0%	0.1	12.4
UD7	9.3	2.0%	0.7	7.4
UD8	4.6	2.0%	0.03	3.3
UD8.1	5.3	2.0%	0.1	5.6
UD9	4.8	2.0%	0.1	4.2
UD9.1	6.4	2.0%	0.2	8.1
UD10	10.4	2.0%	0.1	6.7
UD11	6	2.0%	0.02	4.3
CH1	23.9	2.0%	5.4	21.0
CH2	84.2	2.0%	2.6	33.7
CH3	19.0	2.0%	0.1	6.5
Total	825.4	N/A	126.7	627.3

POND SUMMARY TABLE										
Tributary Sub-Basin	Pond Name	Tributary Acres	WQ Volume (ac-ft)	100-Year Volume (ac-ft)	Provided Volume (ac-ft)	100-Year Peak Discharge (cfs)	Ex. 100- Year Peak Discharge (cfs)			
Α	POND A	9.2	0.20	1.14	1.14	2.5	2.8			
В	POND B	60.4	0.35	1.46	2.17	18.9	21.0			
С	POND C	102.5	0.64	2.69	2.77	26.0	28.9			
D	POND D	99.2	0.59	2.86	2.97	47.7	53.0			
E	POND E	11.6	0.05	0.23	0.39	4.7	5.2			
F	POND F	117.4	0.65	3.20	3.35	50.7	56.3			
G	POND G	39.9	0.34	1.36	1.62	10.1	11.2			
н	POND H	30.7	0.16	0.70	1.18	10.5	11.7			
I	POND I	46.6	0.25	1.09	1.41	26.8	29.8			

#### **LEGEND**



BASIN DESIGNATION

I.D.: BASIN IDENTIFIER
A: BASIN AREA
B: COMP. % IMPERVIOUS

X

ORIGINAL SCALE: 1" = 200'

DESIGN POINT

BASIN DELINEATION

--6100-- EXISTING INDEX CONTOURS

EXISTING FLOW DIRECTION

PROPOSED FLOW DIRECTION

PROPOSED HIGH POINT

SADDLEHORN RANCH

PROPOSED LOW POINT

MDDP DRAINAGE MAP 25142.00 12/18/19 SHEET 2 OF 3



Centennial 303-740-9393 • Colorado Springs 719-593-2593 Fort Collins 970-491-9888 • www.jrengineering.com



January 5, 2022

Keith Curtis, PE, CFM Floodplain Administrator, PPRBD 2880 International Circle Colorado Springs, CO 80910

Re: Engineer's Certification of No Impact

Case No.:

Dear Mr. Curtis,

This letter serves as Certification of No Impact to the Floodplain for the project entitled "Saddlehorn Ranch – Filing 3." The project is located in the unincorporated El Paso County and involves a proposed rural 2.5 acre lot subdivision.

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) shows the project area located on Panel No. 08041C0558G for El Paso County, Colorado dated December 7, 2018. The project area is located along Haegler Ranch MS-06 and is within a designated Zone AE Special Flood Hazard Area (SFHA).

JR Engineering has evaluated the effects of the proposed development on the Haegler Ranch floodplain using the effective modeling as a baseline. The HEC-RAS modeling was obtained in PDF format from the "Santa Fe Springs — Haegler Ranch Drainage Basin Letter of Map Revision (LOMR)" by Tri-Core Engineering, dated October 20, 2004, from the Federal Emergency Management Agency (FEMA). The effective model is the "Santa Fe Springs — Haegler DB. — Letter of Map Revision" prepared for FEMA by Tri-Core Engineering. The effective model was pared down to the stretch between Cross Sections 4 and 19 along Reach H8 (Haegler Ranch Tributary 3) for purposes of analysis within the context of this project.

JR Engineering utilized the calculated 100-year water surface from the aforementioned model to establish the existing 100-year floodplain. Proposed channel and culvert improvements were modeled utilizing the 100-year flow of 505 cfs established in the "Santa Fe Springs – Haegler Ranch Drainage Basin Letter of Map Revision (LOMR)". Cross sections located between cross sections 4 and 19 were modeled using AutoCAD Hydraflow Express, Version 2020.4. Cross Section 13 aligns with the front of the project's proposed dual 12'x4' RCBC. Therefore, the Federal Highway Authority's HY-8, Version 7.60, was used for modeling the backwater effect to establish an accurate base flood elevation. The computed water surface elevation at each cross section was compared to the effective model to ensure a no rise scenario.

Select results of the analysis are presented in Table 1, on the following page:

Table 1: Base Flood Elevation Comparison

	Base Flood Elevation (ft)			
Cross Section	Ex. 100- Year	Pr. 100- Year		
13	6723.61	6721.71		
14	6722.03	6720.43		
15	6720.65	6719.28		
16	6717.71	6717.59		
17	6714.03	1714.03		

Based on the results of the proposed cross section modeling and the HY-8 culvert analysis, no increase to either the floodplain width or water surface elevation will result from the proposed site development.

Sincerely,

Bryan Law PE Colorado P.E. #25043

#### No Rise Certification

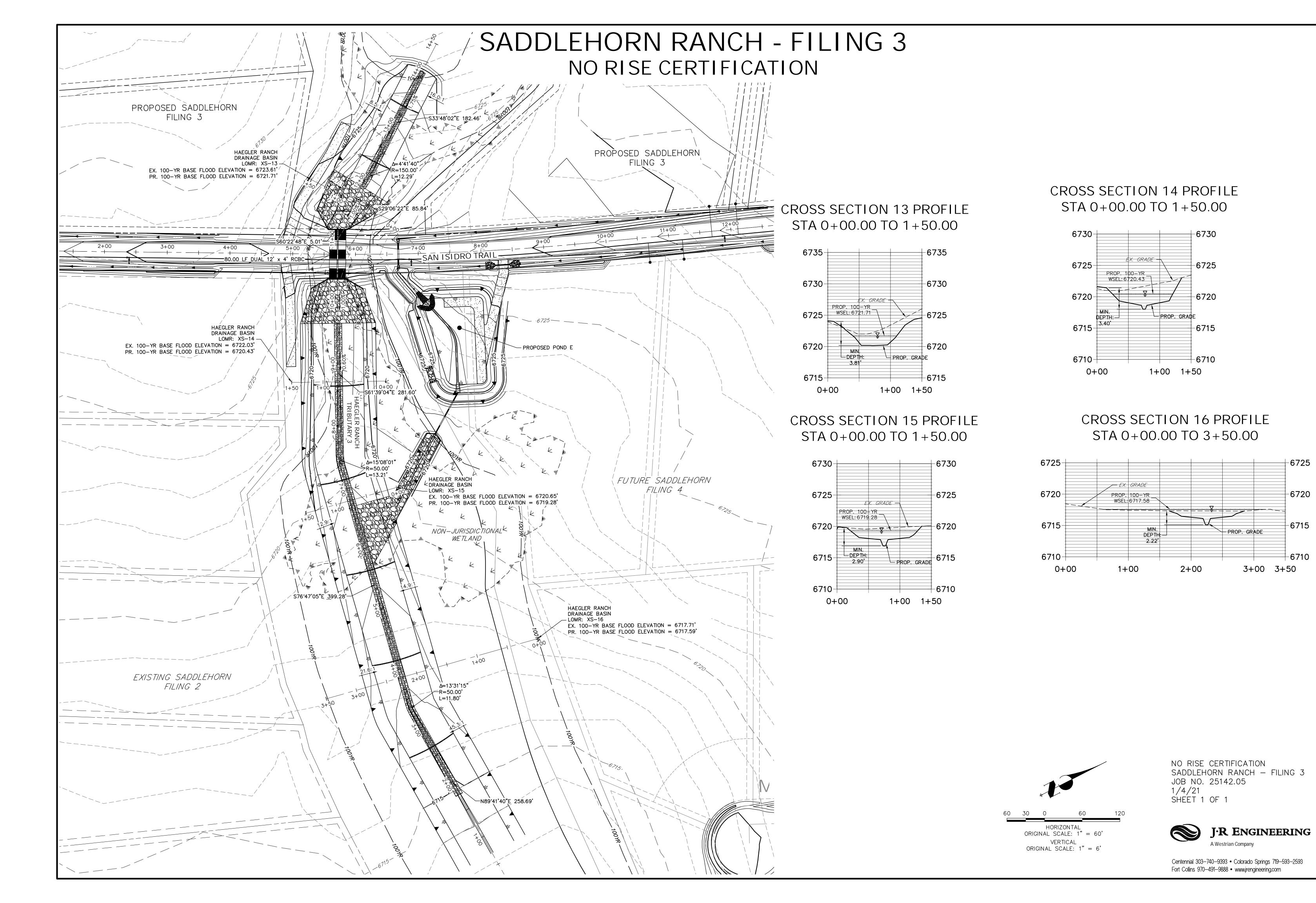
I certify that I am a duly qualified registered Professional Engineer in the State of Colorado.

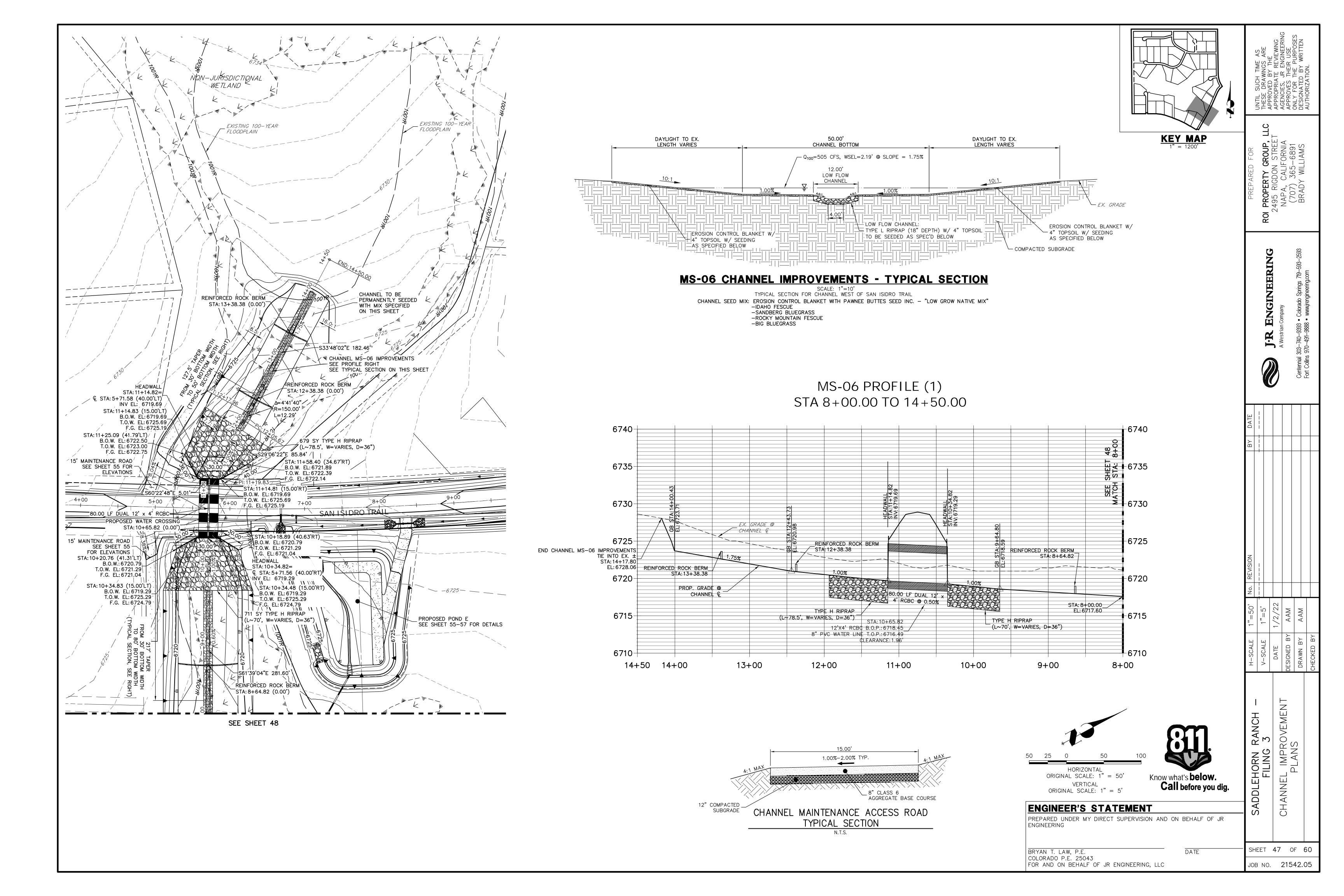
I certify the proposed project, Saddlehorn Ranch Filing No. 3, as detailed on the following sheets and calculations will result in zero rise in the FEMA designated 100 year flood heights, and no increase in the 100-year discharge and no increase in the 100-year floodplain width, at published and unpublished cross sections of the current FEMA floodplain of Haegler Ranch MS-06 as shown on FEMA map 08041C0558G. This certification is intended as proof of meeting the requirements set forth in the Pikes Peak Regional Building Code RBC313.20.1.

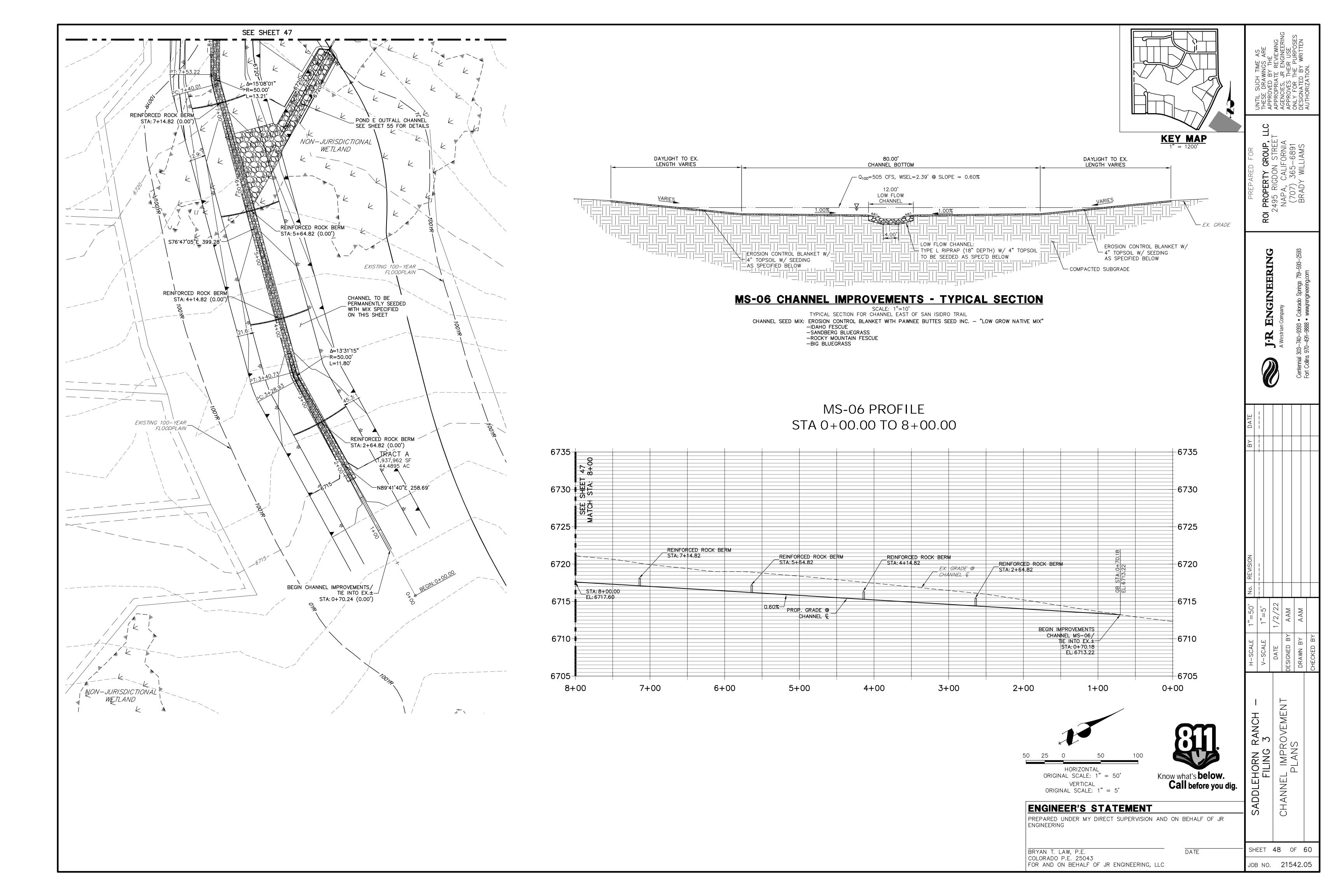
I further certify that the design conditions needed to meet the zero rise, box culvert and wing walls, are detailed in sufficient nature to allow for field confirmation and included among the supporting documentation.

I further certify that the structure in question will be securely anchored to prevent flotation, collapse or lateral movement in order to withstand the velocity of floodwaters as required by RCB313.18.1 and RBC313.21.2.

Bryan Law PE Colorado P.E. #25043







#### **HY-8 Culvert Analysis Report**

#### **Crossing Discharge Data**

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

Minimum Flow: 400 cfs Design Flow: 505 cfs Maximum Flow: 600 cfs

Table 1 - Summary of Culvert Flows at Crossing: San Isidro Crossing

Headwater Elevation (ft)	Total Discharge (cfs)	San Isidro Crossing Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6722.88	400.00	400.00	0.00	1
6722.99	420.00	420.00	0.00	1
6723.11	440.00	440.00	0.00	1
6723.22	460.00	460.00	0.00	1
6723.34	480.00	480.00	0.00	1
6723.48	505.00	505.00	0.00	1
6723.57	520.00	520.00	0.00	1
6723.68	540.00	540.00	0.00	1
6723.80	560.00	560.00	0.00	1
6723.91	580.00	580.00	0.00	1
6724.03	600.00	600.00	0.00	1
6728.59	1176.67	1176.67	0.00	Overtopping

#### Rating Curve Plot for Crossing: San Isidro Crossing

### Total Rating Curve Crossing: San Isidro Crossing

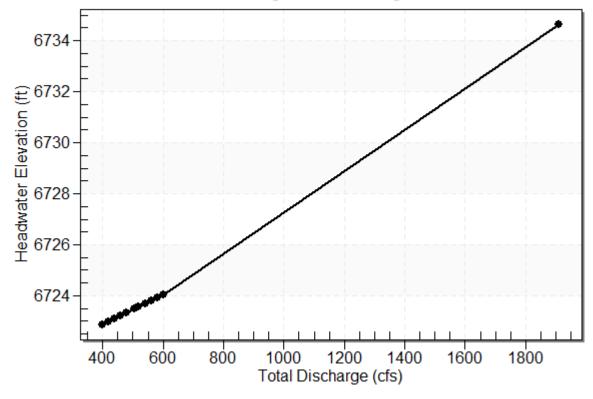


Table 2 - Culvert Summary Table: San Isidro Crossing

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
400.00	400.00	6722.88	3.460	2.468	1-S2n	1.613	2.051	1.708	2.429	9.757	4.329
420.00	420.00	6722.99	3.575	2.556	1-S2n	1.666	2.119	1.767	2.470	9.901	4.394
440.00	440.00	6723.11	3.689	2.646	1-S2n	1.718	2.185	1.826	2.510	10.041	4.457
460.00	460.00	6723.22	3.803	2.737	1-S2n	1.769	2.251	1.884	2.550	10.176	4.517
480.00	480.00	6723.34	3.917	2.829	1-S2n	1.819	2.316	1.941	2.588	10.305	4.576
505.00	505.00	6723.48	4.060	2.947	5-S2n	1.881	2.396	2.011	2.635	10.462	4.646
520.00	520.00	6723.57	4.146	3.019	5-S2n	1.918	2.443	2.053	2.663	10.553	4.687
540.00	540.00	6723.68	4.261	3.116	5-S2n	1.967	2.505	2.108	2.699	10.672	4.740
560.00	560.00	6723.80	4.377	3.214	5-S2n	2.015	2.567	2.163	2.735	10.787	4.792
580.00	580.00	6723.91	4.494	3.315	5-S2n	2.063	2.627	2.218	2.769	10.894	4.842
600.00	600.00	6724.03	4.612	3.417	5-S2n	2.110	2.687	2.273	2.804	11.000	4.891

Straight Culvert

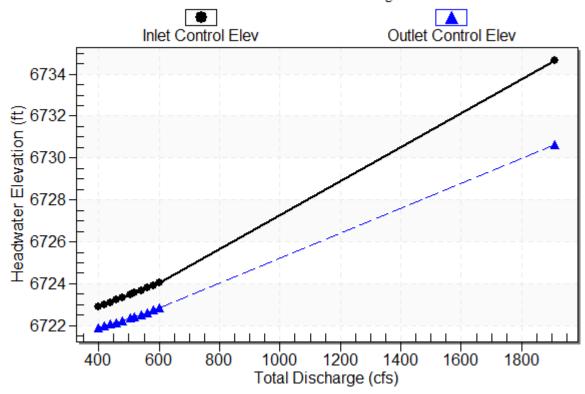
Inlet Elevation (invert): 6719.42 ft, Outlet Elevation (invert): 6719.00 ft

Culvert Length: 83.50 ft, Culvert Slope: 0.0050

# **Culvert Performance Curve Plot: San Isidro Crossing**

# Performance Curve

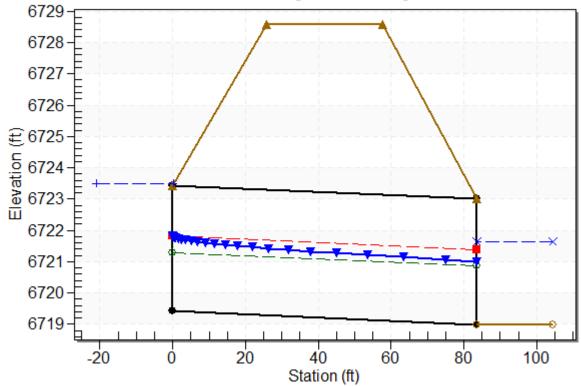
Culvert: San Isidro Crossing



#### Water Surface Profile Plot for Culvert: San Isidro Crossing

# Crossing - San Isidro Crossing, Design Discharge - 505.0 cfs

Culvert - San Isidro Crossing, Culvert Discharge - 505.0 cfs



# Site Data - San Isidro Crossing

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6719.42 ft
Outlet Station: 83.50 ft
Outlet Elevation: 6719.00 ft

Number of Barrels: 2

#### **Culvert Data Summary - San Isidro Crossing**

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft Barrel Rise: 4.00 ft

Barrel Material: Concrete Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

**Table 3 - Downstream Channel Rating Curve (Crossing: San Isidro Crossing)** 

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
400.00	6721.43	2.43	4.33	0.91	0.70
420.00	6721.47	2.47	4.39	0.92	0.70
440.00	6721.51	2.51	4.46	0.94	0.70
460.00	6721.55	2.55	4.52	0.95	0.70
480.00	6721.59	2.59	4.58	0.97	0.70
505.00	6721.64	2.64	4.65	0.99	0.71
520.00	6721.66	2.66	4.69	1.00	0.71
540.00	6721.70	2.70	4.74	1.01	0.71
560.00	6721.73	2.73	4.79	1.02	0.71
580.00	6721.77	2.77	4.84	1.04	0.71
600.00	6721.80	2.80	4.89	1.05	0.72

# Tailwater Channel Data - San Isidro Crossing

Tailwater Channel Option: Irregular Channel

# Roadway Data for Crossing: San Isidro Crossing

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 6.00 ft

Crest Elevation: 6728.59 ft Roadway Surface: Paved Roadway Top Width: 32.00 ft

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Tuesday, Dec 21 2021

#### Section 13

Trapezoidal

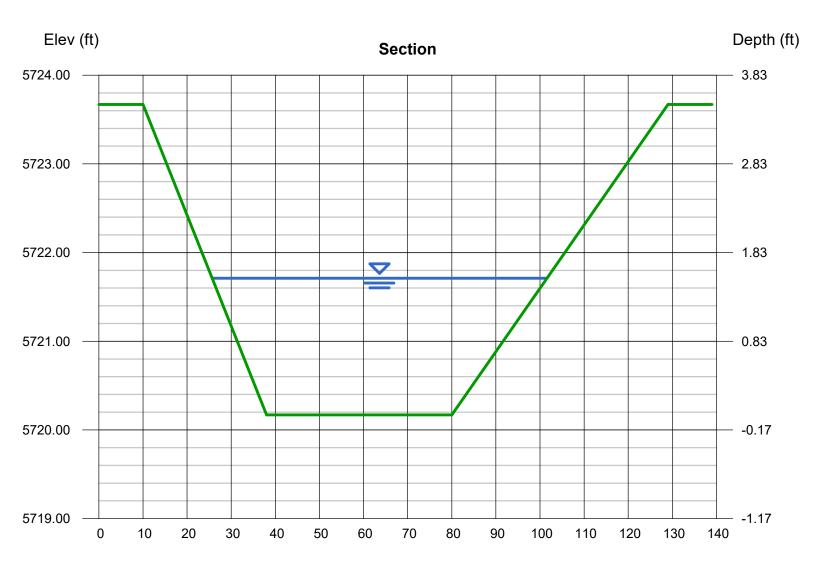
Bottom Width (ft) = 42.00 Side Slopes (z:1) = 8.00, 14.00 Total Depth (ft) = 3.50 Invert Elev (ft) = 5720.17

Slope (%) = 1.00 N-Value = 0.030

**Calculations** 

Compute by: Known Q Known Q (cfs) = 505.00 Highlighted

Depth (ft) = 1.54Q (cfs) = 505.00Area (sqft) = 90.77Velocity (ft/s) = 5.56 Wetted Perim (ft) = 76.03 Crit Depth, Yc (ft) = 1.45Top Width (ft) = 75.88 EGL (ft) = 2.02



Reach (ft)

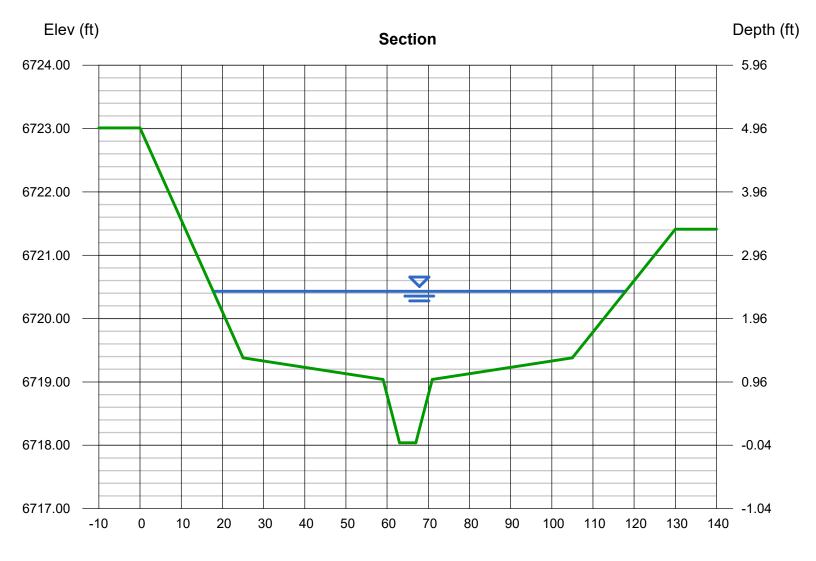
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# **Section 14**

User-defined		Highlighted	
Invert Elev (ft)	= 6718.04	Depth (ft)	= 2.39
Slope (%)	= 0.60	Q (cfs)	= 505.00
N-Value	= 0.030	Area (sqft)	= 118.25
		Velocity (ft/s)	= 4.27
Calculations		Wetted Perim (ft)	= 100.53
Compute by:	Known Q	Crit Depth, Yc (ft)	= 2.11
Known Q (cfs)	= 505.00	Top Width (ft)	= 100.17
, ,		EGL (ft)	= 2.67

(Sta, EI, n)-(Sta, EI, n)... (0.00, 6723.01)-(25.00, 6719.38, 0.030)-(59.00, 6719.04, 0.030)-(63.00, 6718.04, 0.030)-(67.00, 6718.04, 0.030)-(71.00, 6719.04, 0.030)-(105.00, 6719.38, 0.030) -(130.00, 6721.41, 0.030)



Sta (ft)

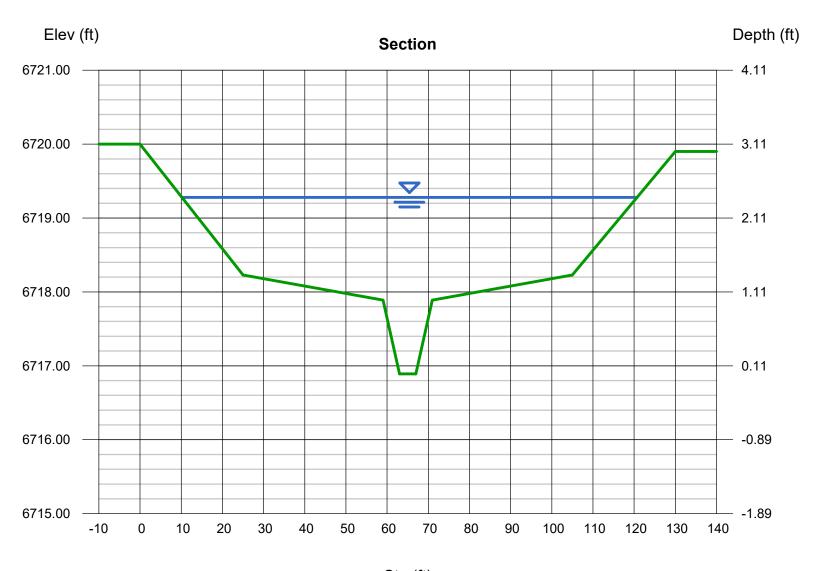
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Tuesday, Dec 21 2021

# **Section 15**

User-defined		Highlighted	
Invert Elev (ft)	= 6716.89	Depth (ft)	= 2.39
Slope (%)	= 0.60	Q (cfs)	= 505.00
N-Value	= 0.030	Area (sqft)	= 123.70
		Velocity (ft/s)	= 4.08
Calculations		Wetted Perim (ft)	= 110.88
Compute by:	Known Q	Crit Depth, Yc (ft)	= 2.11
Known Q (cfs)	= 505.00	Top Width (ft)	= 110.56
		EGL (ft)	= 2.65

(Sta, EI, n)-(Sta, EI, n)... (0.00, 6720.00)-(25.00, 6718.23, 0.030)-(59.00, 6717.89, 0.030)-(63.00, 6716.89, 0.030)-(67.00, 6716.89, 0.030)-(71.00, 6717.89, 0.030)-(105.00, 6718.23, 0.030) -(130.00, 6719.90, 0.030)



Sta (ft)

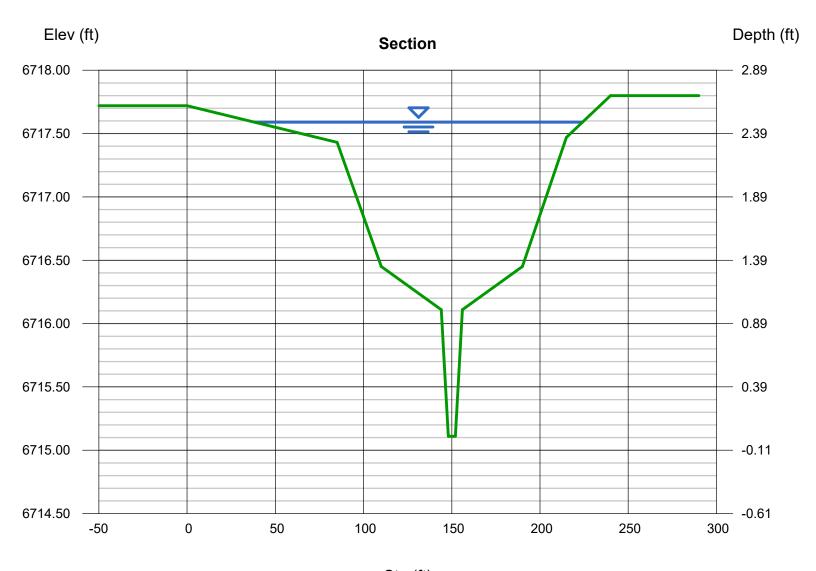
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Tuesday, Dec 21 2021

# **Section 16**

User-defined		Highlighted	
Invert Elev (ft)	= 6715.11	Depth (ft)	= 2.48
Slope (%)	= 0.60	Q (cfs)	= 505.00
N-Value	= 0.030	Area (sqft)	= 151.09
		Velocity (ft/s)	= 3.34
Calculations		Wetted Perim (ft)	= 186.16
Compute by:	Known Q	Crit Depth, Yc (ft)	= 2.10
Known Q (cfs)	= 505.00	Top Width (ft)	= 185.87
, ,		EGL (ft)	= 2.65

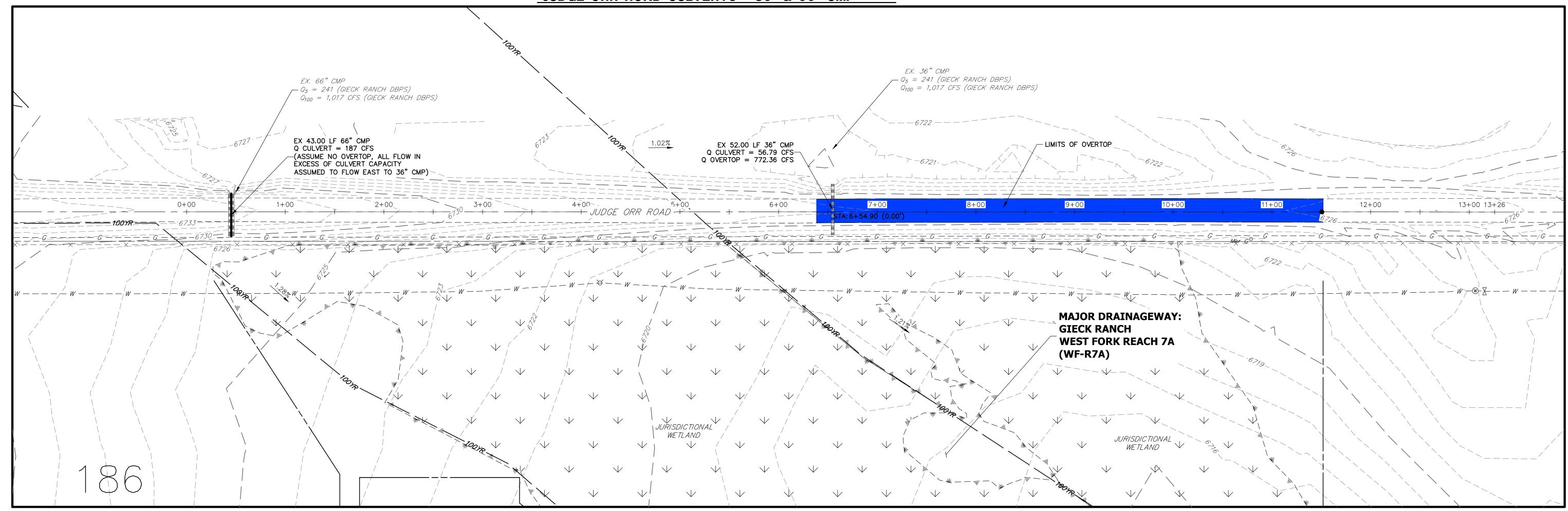
(Sta, El, n)-(Sta, El, n)... (0.00, 6717.72)-(85.00, 6717.43, 0.030)-(110.00, 6716.45, 0.030)-(144.00, 6716.11, 0.030)-(148.00, 6715.11, 0.030)-(152.00, 6715.11, 0.030)-(156.00, 6716.11, 0.030)-(156.00, 6716.11, 0.030)-(156.00, 6715.11, 0.030)-(1 -(190.00, 6716.45, 0.030)-(215.00, 6717.47, 0.030)-(240.00, 6717.80, 0.030)



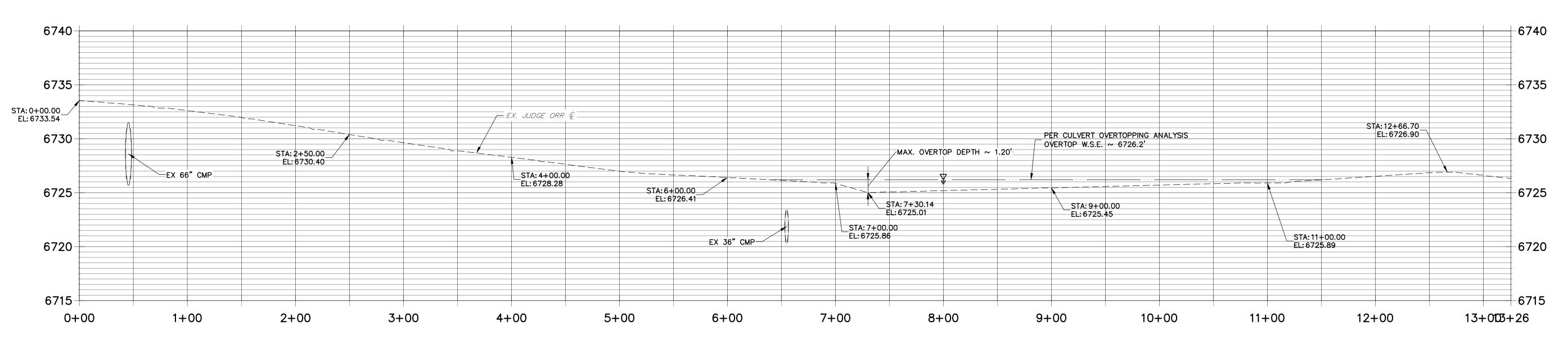
Sta (ft)

# SADDLEHORN RANCH

JUDGE ORR ROAD CULVERTS - 36" & 66" CMP



# JUDGE ORR ROAD WEST & EAST CULVERT ROAD PROFILE PROFILE STA 0+00.00 TO 13+25.72



SADDLEHORN RANCH EX CULVERT OVERTOPPING 2514200 11/27/19 SHEET 2 OF 2



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# GIECK RANCH DRAINAGE BASIN PLANNING STUDY El Paso County, Colorado

# **Volume 1 – Final Report**

October 1, 2007 Revised: February 10, 2010

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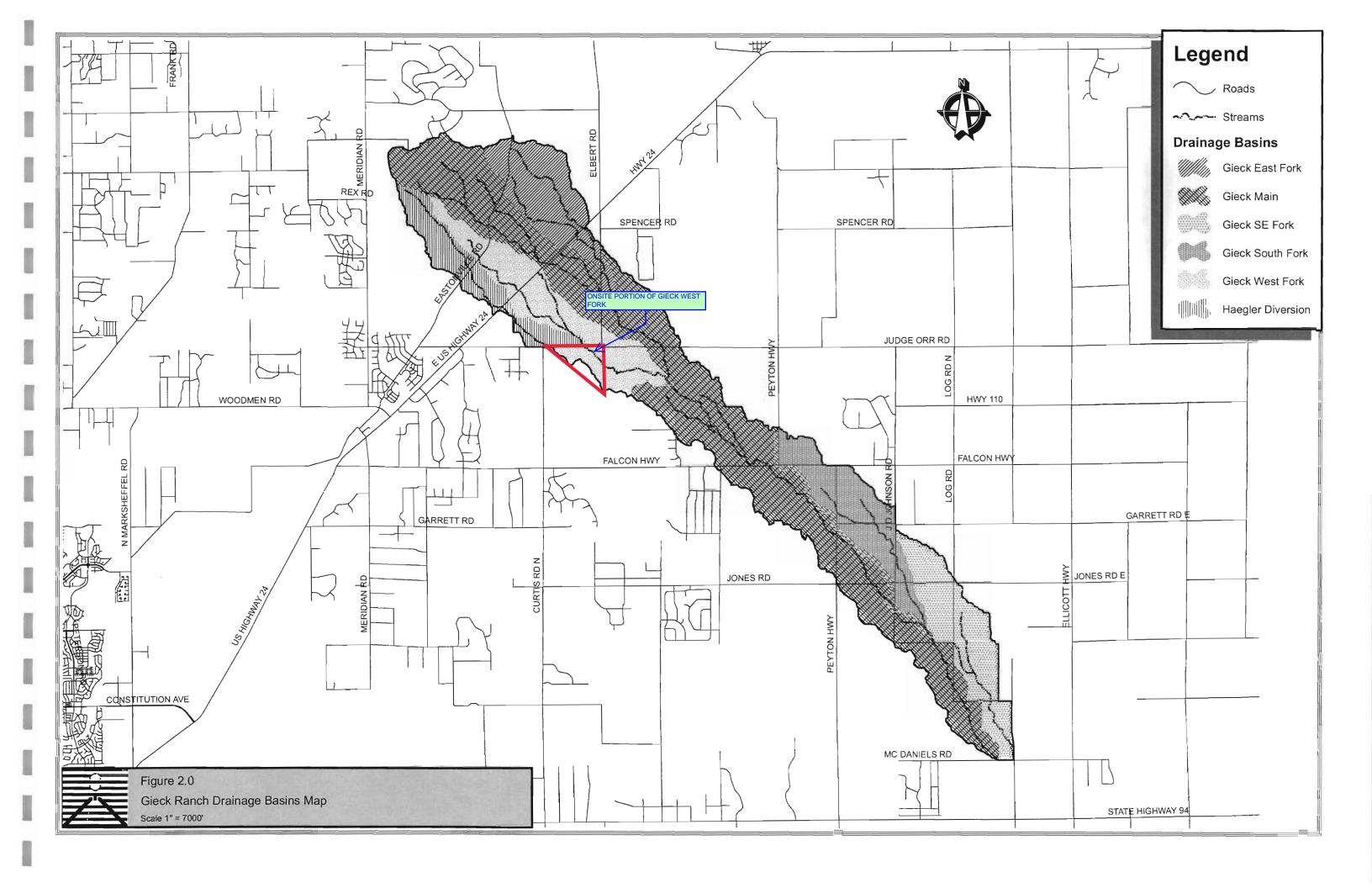


Table 6.4: Summary of Flows at Selected Design Points – 100-year Storm Event

	Summary of Flows at Science Design Forms 100 y		Accumulative	Existing	Future	%	Existing	Future	%
Design		Hydrologic	Accumulative	Existing Peak Flow	Peak Flow	Difference	Volume	Volume	Difference
Point ID	Design Point Location	Element	(mi <sup>2</sup> )	(cfs)	(cfs)	Peak Flow	(ac-ft)	(ac-ft)	Volume
1	Haegler Diversion at Eastonville Road	HD-J2	0.8	431	1060	146%	77	96	25%
2	West Fork at Eastonville Road	WF-J1	0.3	146	389	166%	29	39	33%
3	Main Channel at Eastonville Road	MS-J4	1.3	730	1233	69%	112	135	20%
4	Haegler Diversion at Highway 24	HD-J4	1.3	521	1223	135%	97	121	24%
5	West Fork at Highway 24	WF-J3	0.4	224	605	170%	49	62	26%
6	Main Channel at Highway 24 CONTRIBUTING ACREAGE TO WE	MS-J6	2.5	997	1896	90%	194	225	16%
7	East Fork at Highway 24  R7A @ JUDGE ORR ROAD CROSSING	EF-J4	1.2	1054	1113	6%	124	126	1%
8	Main Channel at Elbert Road	MS-J7	3.0	1010	1896	88%	220	253	15%
9	Fast Fork at Filhert Road	FF-16	2.1	1120	1172	5%	183	187	2%
10	West Fork at Judge Orr Road	WF-J6	1.5	1017	2213	117%	244	291	19%
11	Confluence of East Fork and Main Channel	MS-J9	5.7	1817	3068	69%	429	467	9%
12	Main Channel at Judge Orr Road	MS-J11	6.7	1968	3383	72%	487	564	16%
13	Confluence of West Fork and Main Channel	MS-J12	11.2	2732	6104	123%	805	993	23%
14	Main Channel at Falcon Highway	MS-J16	13.4	3045	6784	123%	936	1191	27%
15	Main Channel at Peyton Highway	MS-J19	15.1	3200	6946	117%	1012	1269	25%
16	Main Channel at Jones Road	MS-J20	15.6	3250	7056	117%	1040	1308	26%
17	South Fork at Jones Road	SF-J4	1.3	454	454	0%	133	133	0%
18	Confluence of South Fork and Main Channel	MS-J22	17.9	3650	7392	103%	1210	1489	23%
19	Southeast Fork at McDaniels Road	SE-J3	2.4	547	546	0%	210	210	0%
20	Main Channel at McDaniels Road	MS-J29	19.6	3791	7525	99%	1293	1597	23%
21	Total Combined Outfall	SE-J3 plus MS-J29	22.0	4326	7687	78%	1503	1807	20%

The 100-year storm event future undetained peak flow is estimated to increase by 78% over the existing peak flow while the future volume of runoff is estimated to increase by 20%.

During the hydrologic analysis it was observed that the Black Squirrel Creek lies very close to the eastern boundary of the Gieck Ranch Basin from Falcon Highway downstream to Log Road. It is possible that flow from Black Squirrel Creek could spill into the Gieck Ranch Basin during extreme storm events. The flows in Black Squirrel Creek in this area are expected to be more than 5,000 cfs for the 100-year event. If the Black Squirrel Creek were to overflow its' banks and flow into the Gieck Ranch Basin it could increase the flows shown in the above tables. Possible improvements to address this potential problem include channel improvements to increase the Black Squirrel Creek conveyance in this area or constructing berms on the east bank to prevent overflow.

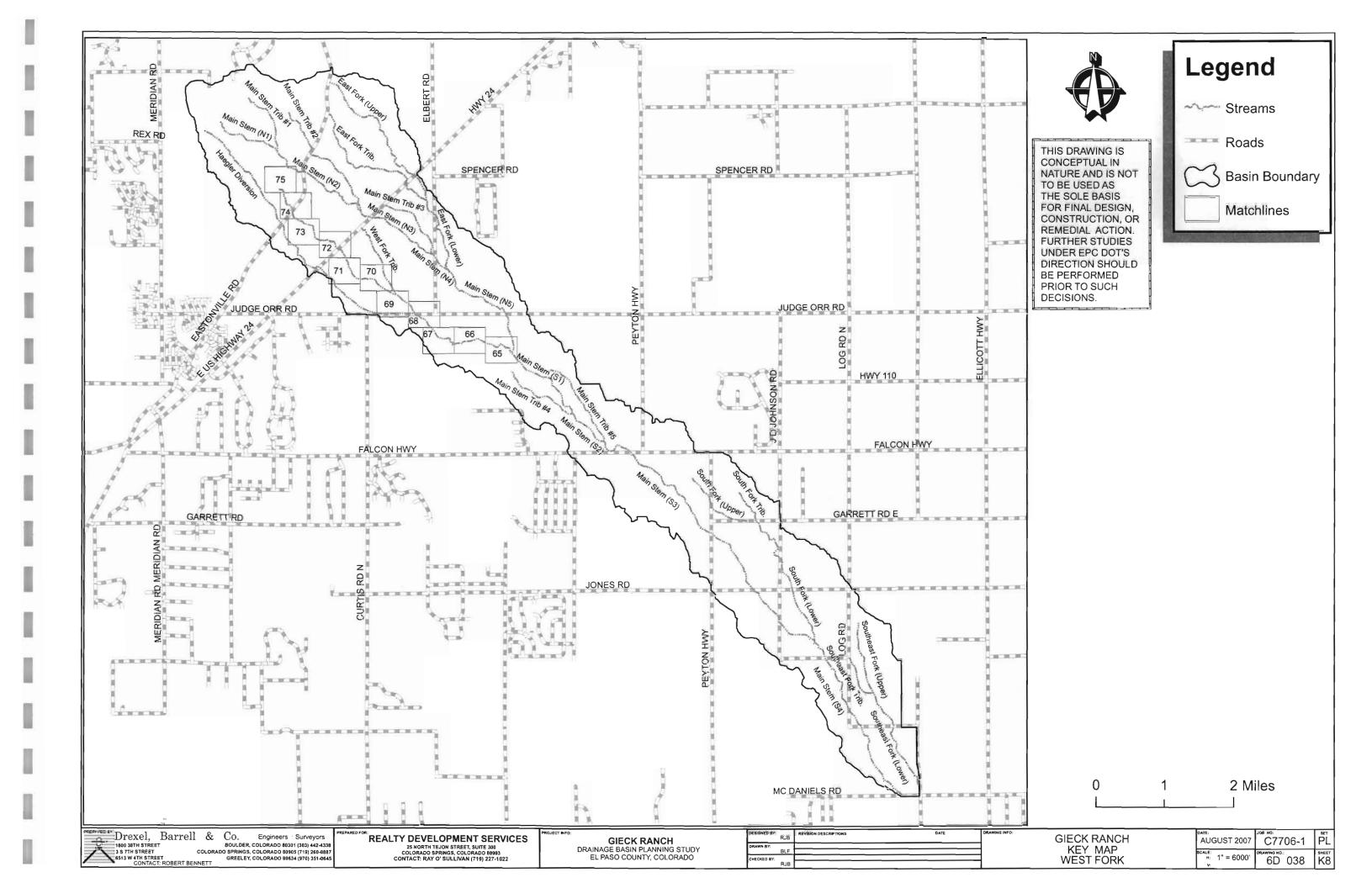
35	Elbert Road south of structure 34	24" CMP	Good	100%	Y	
36	Elbert Road at Main Channel	2 - 48" CMP	Good	19%	N	3 - 12' x 4' CB
37	Elbert Road south of structure 36	24" CMP	Poor	55%	Y	
		6711 -: 0511				
88	Judge Orr Road at West Fork	CMP	Good	20%	N	4 - 12' x 5' CE
39	Judge Orr Road east of structure 38	36" CMP	Good	100%	Y	
10	Judge Orr Road west of structure 41	24" CMP	Poor	90%	Y	
11	Judge Orr Road at Main Channel	Bridge	Good	100%	Y	
12	Falcon Hwy at Main Channel	Bridge	<u>G</u> ood	57%	N	85' Span
13	Peyton Road at headwaters of South Fork	24" CMP	Fair	75%	Y	
14	Peyton Road at Main Channel	4 - 24" RCP	Good	2%	N	5 - 12' x 7' CE
15	Peyton Road south of structure 44	36" CMP	Poor	100%	Y	
16	Peyton Road south of structure 45	24" CMP	Good	100%	Y	
<b>1</b> 7	East Garrett Road west of structure 48	24" CMP	Poor	100%	Y	
18	East Garrett Road at South Fork	48" CMP	Good	14%	N	2 - 5' x 4' CB
19	J.D. Johnson Road at South Fork	4 - 42" RCP	Good	63%	N	2 - 12' x 4' CF
50	J.D. Johnson Road south of structure 49	30" CMP	Fair	56%	N	36" CMP
51	J.D. Johnson Road south of structure 50	30" CMP	Fair	100%	Y	
52	Jones Road at Main Channel	60" CMP	Fair	4%	N	6 - 12' x 7' CF
53	J.D. Johnson Road at Jones Road	30" CMP	Fair	55%	Y	
54	Jones Road east of J.D. Johnson Road	30" CMP	Good	73%	Y	
55	Jones Road at South Fork	36" CMP	Good	6%	N	2 - 7' x 5' CB
56	Jones Road east of structure 55	30" CMP	Fair	67%	Y	
57	J.D. Johnson Road at Main Channel US of structure 58	3 - 60" RCP	Good	14%	N	85' Span
58	J.D. Johnson Road at Main Channel	30" CMP	Good	1%	N	120' Span
59	J.D. Johnson Road and Log Road	24" CMP	Fair	23%	N	2 - 6' x 3' CB
		48" CMP				
50	Main Channel at private driveway	(est.)	Unknown	2%	<u>N.E.</u>	
51	Log Road at Main Channel	Bridge	Good	36%	N	120' Span
52	M.D. (ID. 1 (M.) Cl.	30" x 48"		10/	3.7	10010
1	McDaniel Road at Main Channel	Oval CMP	Good	1%	N	120' Span

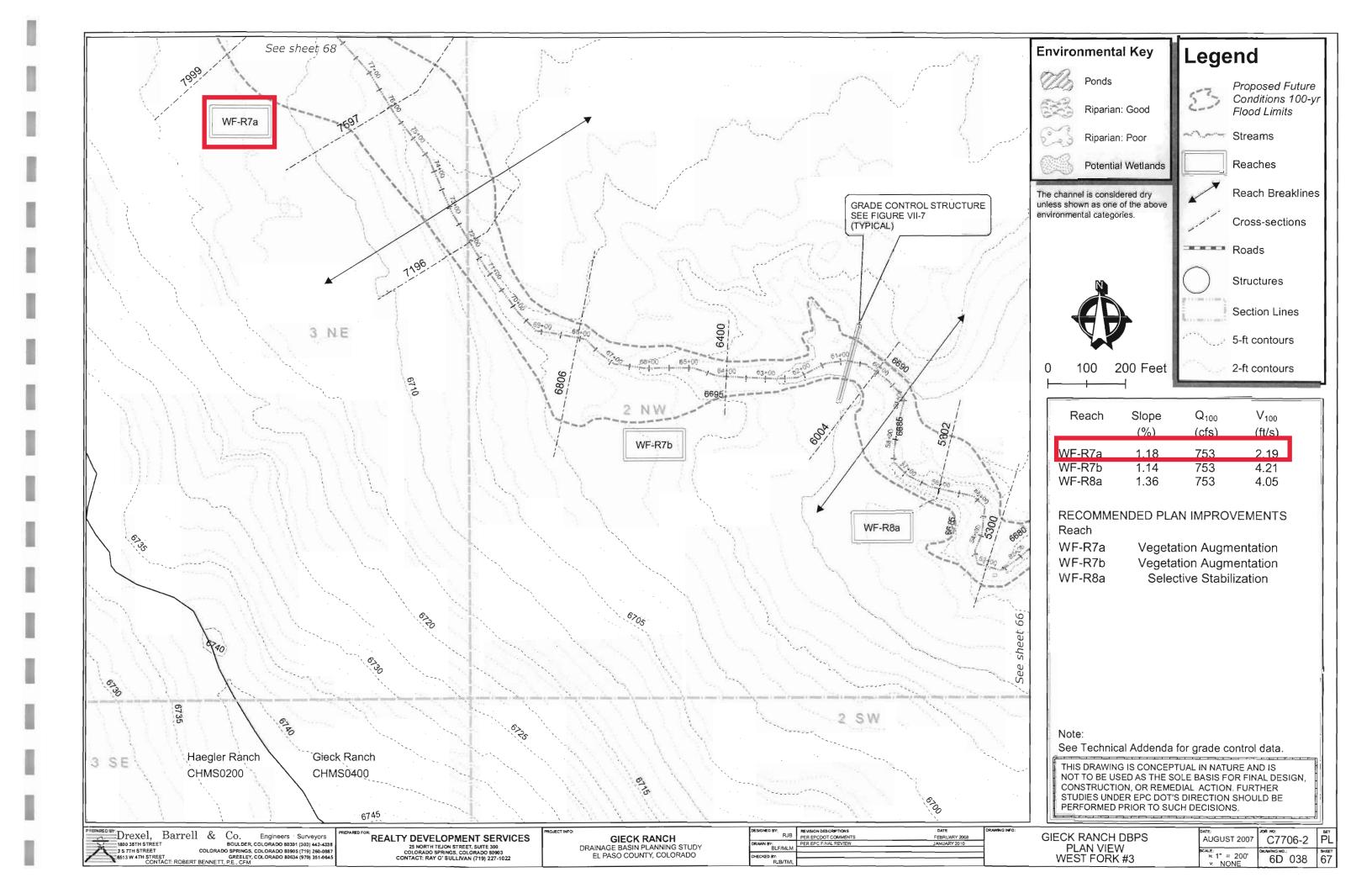
<sup>\*</sup> Road over-topping not included

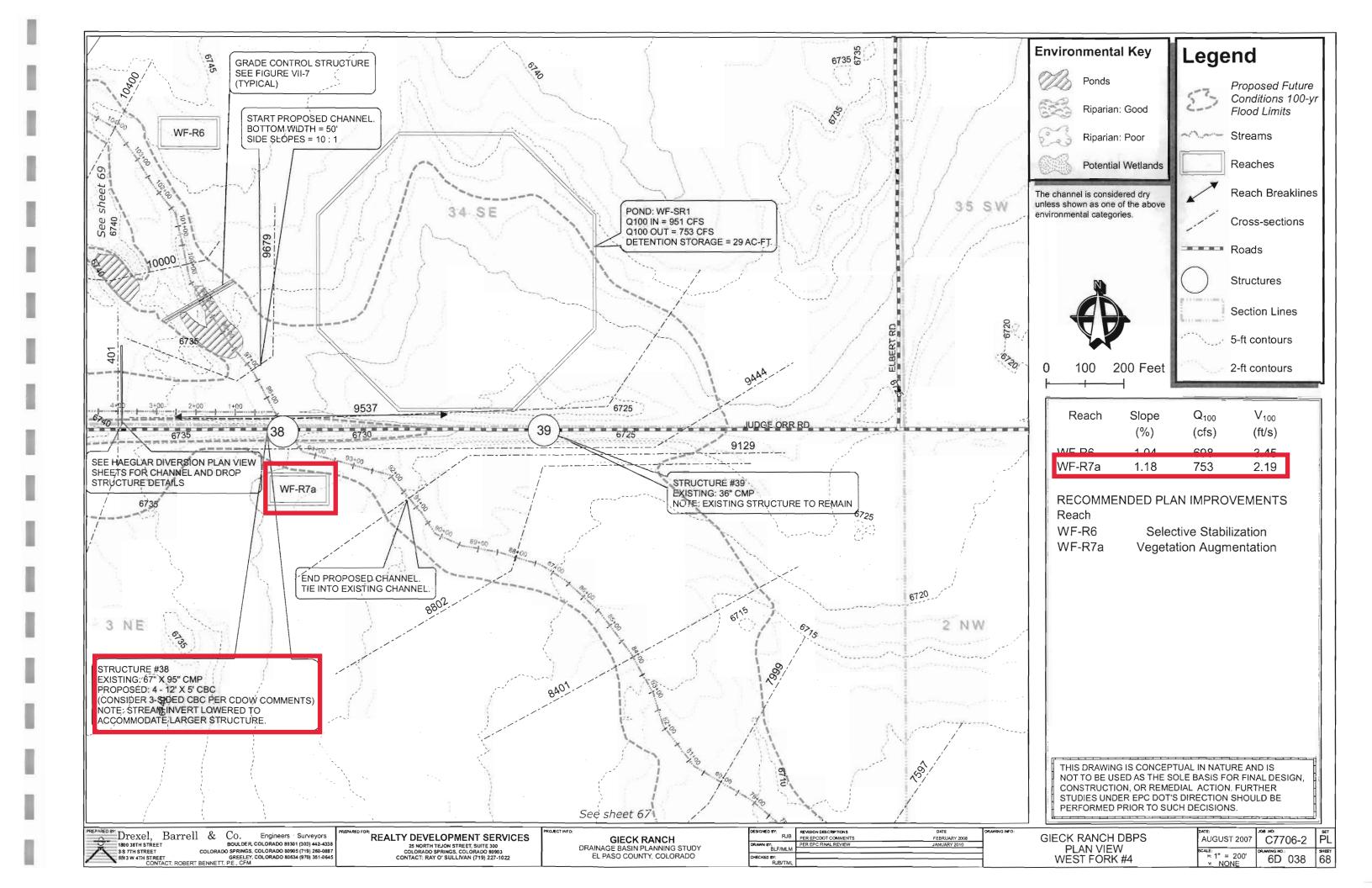
<sup>\*\*</sup> Allowable road over-topping included in adequacy analysis

<sup>\*\*\*</sup> Based on proposed (with selected drainage basin plan) flows

N.E. Not Evaluated, not EPCDOT responsibility

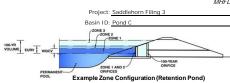






#### DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



Example Zone Configuration (Re

Matarchad	Information

or since in itemation		
Selected BMP Type =	EDB	
Watershed Area =	96.84	acres
Watershed Length =	5,370	ft
Watershed Length to Centroid =	1,383	ft
Watershed Slope =	0.012	ft/ft
Watershed Imperviousness =	14.60%	percent
Percentage Hydrologic Soil Group A =	93.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	7.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-br Rainfall Denths =	User Innut	

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) =	0.737	acre-feet				
Excess Urban Runoff Volume (EURV) =	1.159	acre-feet				
2-yr Runoff Volume (P1 = 1.19 in.) =	0.711	acre-feet				
5-yr Runoff Volume (P1 = 1.5 in.) =	1.074	acre-feet				
10-yr Runoff Volume (P1 = 1.75 in.) =	1.450	acre-feet				
25-yr Runoff Volume (P1 = 2 in.) =	3.279	acre-feet				
50-yr Runoff Volume (P1 = 2.25 in.) =	4.653	acre-feet				
100-yr Runoff Volume (P1 = 2.52 in.) =	6.705	acre-feet				
500-yr Runoff Volume (P1 = 3.14 in.) =	11.187	acre-feet				
Approximate 2-yr Detention Volume =	0.724	acre-feet				
Approximate 5-yr Detention Volume =	1.034	acre-feet				
Approximate 10-yr Detention Volume =	1.331	acre-feet				
Approximate 25-yr Detention Volume =	1.735	acre-feet				
Approximate 50-yr Detention Volume =	2.136	acre-feet				
Approximate 100-yr Detention Volume =	3.064	acre-feet				

Optional User Overrides				
	acre-feet			
	acre-feet			
1.19	inches			
1.50	inches			
1.75	inches			
2.00	inches			
2.25	inches			
2.52	inches			
	inches			

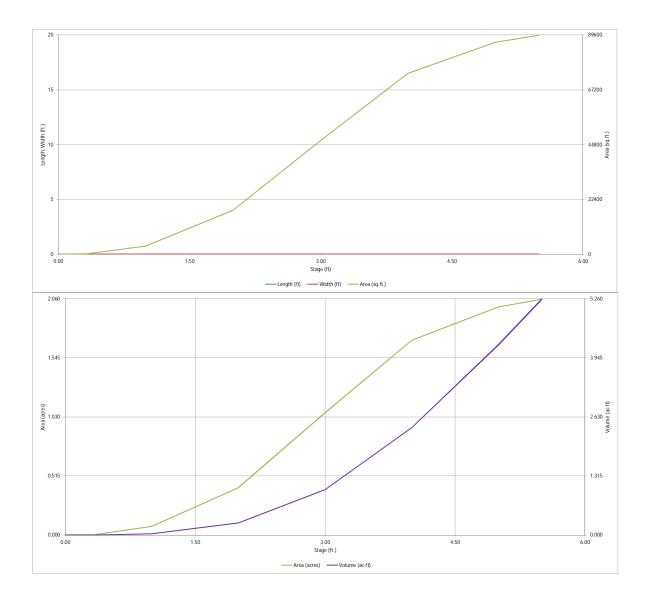
#### Define Zones and Basin Geometry

Jerine Zones and Basin Geometry		
Zone 1 Volume (WQCV) =	0.737	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.422	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.906	acre-feet
Total Detention Basin Volume =	3.064	acre-feet
Initial Surcharge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H <sub>total</sub> ) =	user	ft
Depth of Trickle Channel (H <sub>TC</sub> ) =	user	ft
Slope of Trickle Channel (S <sub>TC</sub> ) =	user	ft/ft
Slopes of Main Basin Sides (Smain) =	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 $(H_{FLOOR})$ =	user	ft
Length of Basin Floor $(L_{FLOOR})$ =	user	ft
Width of Basin Floor $(W_{FLOOR}) =$	user	ft
Area of Basin Floor $(A_{FLOOR}) =$		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 $(A_{MAIN}) =$		ft <sup>2</sup>
Volume of Main Basin ( $V_{MAIN}$ ) =	user	ft <sup>3</sup>
Calculated Total Basin Volume ( $V_{total}$ ) =	user	acre-feet

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Optional Override Area (ft <sup>2</sup> )	Area (acre)	Volume (ft 3)	Volume (ac-ft)
Top of Micropool		0.00				32	0.001		
6711		0.33				50	0.001	14	0.000
6712		1.00				3,260	0.075	1,122	0.026
6713		2.00	1			17,980	0.413	11,742	0.270
6714		3.00				46,439	1.066	43,952	1.009
6715		4.00				73,964	1.698	104,153	2.391
6716		5.00				86,681	1.990	184,476	4.235
6716.5		5.50				89,520	2.055	228,526	5.246
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M#FD-Detention\_w4 04\_Pond C.xlsm, Basin 12/14/2021, 2:54 PM



M#FD-Detention\_w4 04\_Pond C.xlsm, Basin 12/14/2021, 2:54 PM

MHFD-Detention, Version 4.04 (February 2021)

Project: Saddlehorn Filling 3

Basin I D: Pond C

TOO-YEAR ORIFICE

PERMANENT ORIFICE

POOL

Example Zone Configuration (Retention Pond)

	Estimated	Estimated	
_	Stage (ft)	Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.73	0.737	Orifice Plate
Zone 2 (EURV)	3.14	0.422	Orifice Plate
Zone 3 (100-year)	4.39	1.906	Weir&Pipe (Restrict)
•	Total (all zones)	3.064	

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

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

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

Invert of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)

Depth at top of Zone using Orifice Plate = 3.14 ft (relative to basin bottom at Stage = 0 ft)

Orifice Plate: Orifice Vertical Spacing = N/A inches

Orifice Plate: Orifice Area per Row = 2.44 sq. inches (diameter = 1-3/4 inches)

 $\begin{tabular}{ll} & & & & & & & & & \\ & & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & \\ & & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & \\ & & & \\ &$ 

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	0.91	1.82					
Orifice Area (sq. inches)	2.44	2.44	2.44					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

	Calculated Parameters for Vertical Orifice					
	Not Selected	Not Selected				
Vertical Orifice Area =	N/A	N/A	ft <sup>2</sup>			
ertical Orifice Centroid =	N/A	N/A	fee			

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

	Zone 3 weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.17	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet C
Overflow Grate Type =	Type C Grate	Type C Grate	
Debris Clogging % =	0%	N/A	%

pe)	Calculated Parameters for Overflow Weir				
	Zone 3 Weir	Not Selected			
t) Height of Grate Upper Edge, H <sub>t</sub> =	3.17	N/A	feet		
Overflow Weir Slope Length =	5.00	N/A	feet		
Grate Open Area / 100-yr Orifice Area =	4.25	N/A			
Overflow Grate Open Area w/o Debris =	20.88	N/A	ft <sup>2</sup>		
Overflow Grate Open Area w/ Debris =	20.88	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 =	0.39	N/A	ft (distan
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	30.00		inches

nce below basin bottom at Stage = 0 ft)
Outlet Orifice Area =
Outlet Orifice Centroid =
Half-Central Angle of Restrictor Plate on Pipe =

Zone 3 Restrictor Not Selected

4.91
N/A
ft²
feet
1.25
N/A
radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

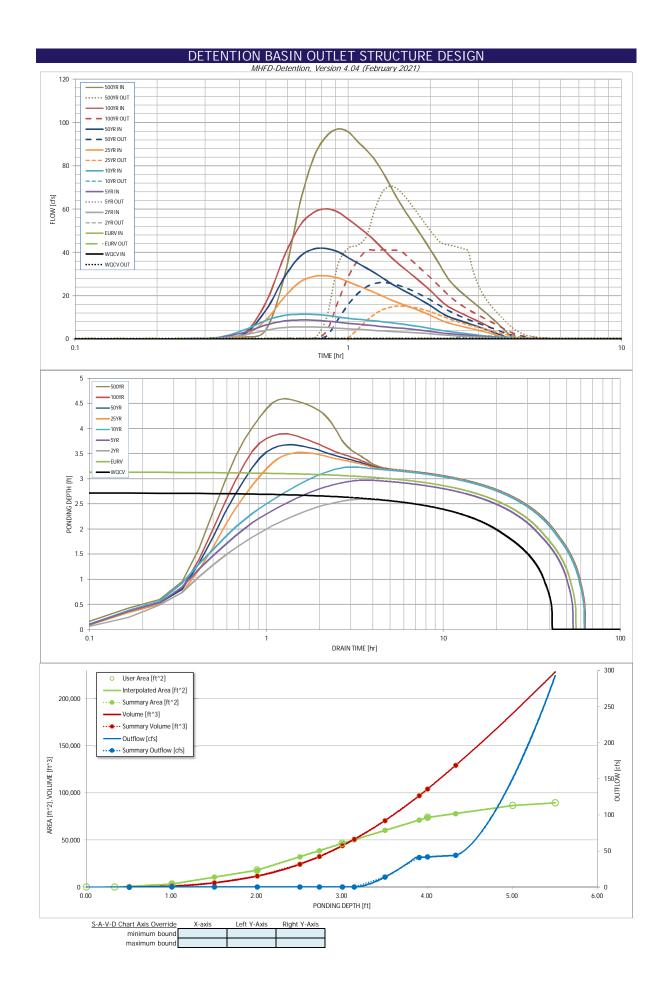
Spillway Invert Stage=	4.33	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	60.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

	Calculated Paramet	ers for Spillway
Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =	2.06	acres
sin Volume at Top of Freeboard =	5.25	acre-ft

Routed Hydrograph Results	The user can over	ride the default CUHF	hydrographs and i	runoff volumes by en	tering new values in l	the Inflow Hydrogra <sub>l</sub>	ohs table (Columns V	V through AF).	
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.737	1.159	0.711	1.074	1.450	3.279	4.653	6.705	11.187
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.711	1.074	1.450	3.279	4.653	6.705	11.187
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.6	1.0	1.4	17.2	29.1	46.2	81.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.01	0.18	0.30	0.48	0.84
Peak Inflow Q (cfs) =	N/A	N/A	5.7	8.8	11.5	29.2	41.8	60.2	97.1
Peak Outflow Q (cfs) =	0.3	0.4	0.3	0.3	1.5	15.3	26.2	41.2	70.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	1.1	0.9	0.9	0.9	0.9
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.7	1.2	2.0	2.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	51	38	49	57	53	50	46	39
Time to Drain 99% of Inflow Volume (hours) =	40	54	40	52	60	58	57	55	52
Maximum Ponding Depth (ft) =	2.73	3.14	2.59	2.97	3.23	3.52	3.68	3.90	4.60
Area at Maximum Ponding Depth (acres) =	0.89	1.15	0.80	1.05	1.21	1.39	1.49	1.63	1.87

Ва

Maximum Volume Stored (acre-ft) =



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.

			ated inflow riyur							OLULD
	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04
	0:15:00	0.00	0.00	0.10	0.17	0.21	0.14	0.19	0.18	0.30
	0:20:00	0.00	0.00	0.49	0.68	0.82	0.53	0.64	0.66	0.91
	0:25:00	0.00	0.00	1.97	3.17	4.25	1.80	2.42	2.78	4.35
	0:30:00	0.00	0.00	4.09	6.54	8.67	8.92	13.39	17.00	28.89
	0:35:00	0.00	0.00	5.34	8.37	10.93	19.40	28.58	38.34	63.01
	0:40:00	0.00	0.00	5.67	8.81	11.51	26.43	38.22	52.58	84.28
	0:45:00	0.00	0.00	5.63	8.71	11.43	28.97	41.67	58.62	93.78
	0:50:00	0.00	0.00	5.41	8.36	10.97	29.22	41.84	60.17	97.06
	0:55:00	0.00	0.00	5.09	7.81	10.24	28.29	40.33	58.73	95.68
	1:00:00	0.00	0.00	4.78	7.31	9.62	26.48	37.63	55.34	91.22
	1:05:00	0.00	0.00	4.53	6.90	9.18	24.70	35.08	52.05	87.27
	1:10:00	0.00	0.00	4.30	6.53	8.80	23.10	32.81	48.89	82.89
	1:15:00	0.00	0.00	4.05	6.16	8.46	21.54	30.61	45.46	77.40
	1:20:00	0.00	0.00	3.80	5.77	8.05	19.95	28.35	41.94	71.50
	1:25:00	0.00	0.00	3.60	5.48	7.67	18.40	26.11	38.52	65.69
	1:30:00	0.00	0.00	3.45	5.23	7.28	17.12	24.29	35.66	60.79
	1:35:00	0.00	0.00	3.29	4.98	6.89	16.01	22.68	33.19	56.44
	1:40:00	0.00	0.00	3.14	4.72	6.50	14.98	21.19	30.91	52.44
	1:45:00	0.00	0.00	2.98	4.45	6.11	13.97	19.72	28.72	48.62
	1:50:00	0.00	0.00	2.83	4.16	5.72	12.98	18.28	26.58	44.92
	1:55:00	0.00	0.00	2.66	3.88	5.34	12.00	16.85	24.45	41.27
	2:00:00	0.00	0.00	2.46	3.59	4.94	11.02	15.43	22.36	37.68
	2:05:00	0.00	0.00	2.25	3.28	4.51	10.01	13.99	20.25	34.12
	2:10:00	0.00	0.00	2.04	2.97	4.09	8.98	12.52	18.13	30.57
	2:15:00	0.00	0.00	1.88	2.75	3.78	8.07	11.25	16.28	27.54
	2:20:00	0.00	0.00	1.75	2.56	3.53	7.40	10.34	14.92	25.29
	2:25:00 2:30:00	0.00	0.00	1.63	2.39	3.28	6.89	9.63	13.86	23.44
	2:35:00	0.00	0.00	1.52	2.22	3.05	6.43	9.00	12.92	21.80
	2:40:00	0.00	0.00	1.41	2.06 1.91	2.83	6.01 5.60	8.41	12.06 11.24	20.29
	2:45:00	0.00	0.00	1.20	1.77	2.41	5.20	7.83 7.27	10.44	18.86 17.49
	2:50:00	0.00	0.00	1.11	1.62	2.41	4.81	6.73	9.67	16.20
	2:55:00	0.00	0.00	1.02	1.49	2.03	4.44	6.20	8.92	14.95
	3:00:00	0.00	0.00	0.93	1.36	1.85	4.07	5.67	8.18	13.71
	3:05:00	0.00	0.00	0.84	1.23	1.67	3.70	5.16	7.44	12.48
	3:10:00	0.00	0.00	0.75	1.10	1.50	3.33	4.64	6.71	11.26
	3:15:00	0.00	0.00	0.67	0.97	1.33	2.97	4.13	5.97	10.03
	3:20:00	0.00	0.00	0.59	0.85	1.17	2.61	3.62	5.24	8.81
	3:25:00	0.00	0.00	0.51	0.73	1.00	2.25	3.11	4.51	7.60
	3:30:00	0.00	0.00	0.43	0.61	0.84	1.89	2.61	3.79	6.38
	3:35:00	0.00	0.00	0.35	0.49	0.68	1.54	2.10	3.06	5.17
	3:40:00	0.00	0.00	0.27	0.38	0.53	1.19	1.60	2.34	3.96
	3:45:00	0.00	0.00	0.20	0.27	0.39	0.85	1.12	1.63	2.78
	3:50:00	0.00	0.00	0.16	0.21	0.30	0.53	0.66	0.96	1.70
	3:55:00	0.00	0.00	0.13	0.17	0.25	0.33	0.41	0.58	1.10
	4:00:00	0.00	0.00	0.11	0.15	0.21	0.23	0.29	0.39	0.75
	4:05:00	0.00	0.00	0.10	0.13	0.18	0.18	0.22	0.27	0.52
	4:10:00 4:15:00	0.00	0.00	0.08	0.11	0.16 0.13	0.14 0.11	0.17 0.14	0.20 0.14	0.35 0.24
	4:13:00	0.00	0.00	0.06	0.09	0.13	0.09	0.14	0.14	0.24
	4:25:00	0.00	0.00	0.05	0.06	0.08	0.07	0.08	0.07	0.10
	4:30:00	0.00	0.00	0.04	0.05	0.07	0.06	0.07	0.06	0.08
	4:35:00	0.00	0.00	0.03	0.04	0.05	0.05	0.05	0.05	0.06
	4:40:00 4:45:00	0.00	0.00	0.03	0.03	0.04	0.04	0.04	0.04	0.05 0.04
	4:50:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	4:55:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	5:00:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	5:05:00 5:10:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	5:10:00	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 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

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically. The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

g	<u>'</u>	,					
Stage - Storage	Stage	Area	Area	Volume	Volume	Total	
Description		re. 21	[]	rs. 3a	F== 641	Outflow	
· ·	[ft]	[ft²]	[acres]	[ft <sup>3</sup> ]	[ac-ft]	[cfs]	_
	0.50	864	0.020	91	0.002	0.06	For
		3,260	0.075	1,122	0.026	0.11	stag
	1.00						chai
	1.50	10,620	0.244	4,592	0.105	0.16	fron
	2.00	17,980	0.413	11,742	0.270	0.24	She
	2.50	32,209	0.739	24,289	0.558	0.30	
WQCV	2.73	38,755	0.890	32,450	0.745	0.32	Also
	3.00	46,439	1.066	43,952	1.009	0.35	outl
FUDV		50,292	1.155	50,723	1.164	0.36	ove
EURV	3.14						whe
	3.50	60,201	1.382	70,612	1.621	13.83	+-
100-YR	3.90	71,211	1.635	96,894	2.224	41.21	_
	4.00	73,964	1.698	104,153	2.391	41.88	
Spillway	4.33	78,161	1.794	129,254	2.967	44.03	
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							-
							_
							7
							-
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For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

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

# POND C FOREBAY VOLUME REQUIREMENTS

Equation 3-1  $WQCV = a(0.91I^3 - 1.19I^2 + 0.781I)$ a=1 (40 hour drain time)

Equation 3-3 V=(WQCV/12)A

PROPOSED FOREBAY A= 80.46 Acres V= 0.611 FUTURE FOREBAY A= 16.38 Acres V= 0.103

3% OF WQCV

FOREBAY TOTAL VOLUME= .03(V)

VOLUME REQUIRED FOR PROPOSED FOREBAY =0.018 AC-FT798 CFVOLUME REQUIRED FOR FUTURE FOREBAY =0.003 AC-FT134 CF

VOLUME PROVIDED FOR PROPOSED FOREBAY = 0.023 AC-FT 993 CF

Q<sub>100</sub> DISCHARGES 2% OF Q<sub>100</sub>

 $Q_{100}$  PROPOSED FOREBAY= .02\*50.0 CFS= 1.00 CFS  $Q_{100}$  FUTURE FOREBAY= .02\*14.3 CFS= 0.29 CFS

# **Weir Report**

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

Monday, Dec 13 2021

# **Pond C Forebay 1 Notch**

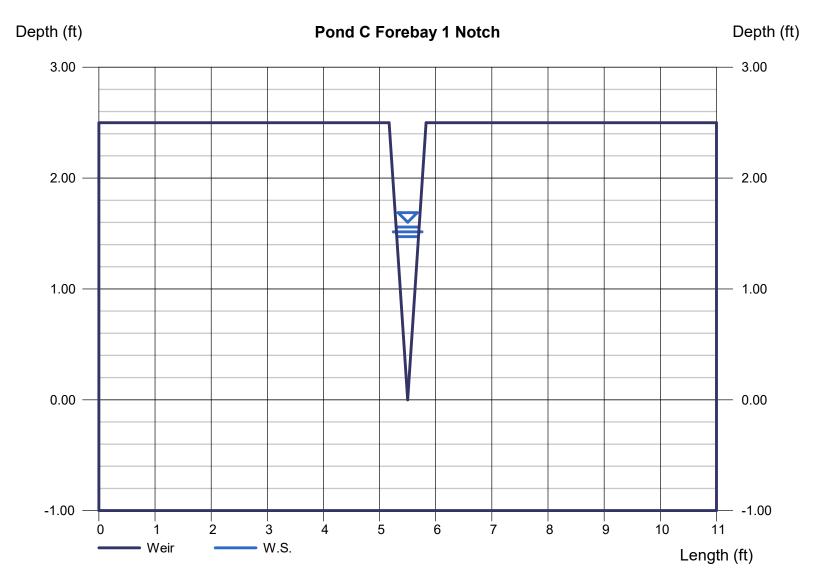
V-Notch Weir	
Crest	= Sharp
Angle (Deg)	= 15
Total Depth (ft)	= 2.50

**Calculations** 

Weir Coeff. Cw = 0.33Compute by: Known Q Known Q (cfs) = 1.00

# Highlighted

Depth (ft) = 1.56 Q (cfs) = 1.000 Area (sqft) = 0.32 Velocity (ft/s) = 3.13 Top Width (ft) = 0.41



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

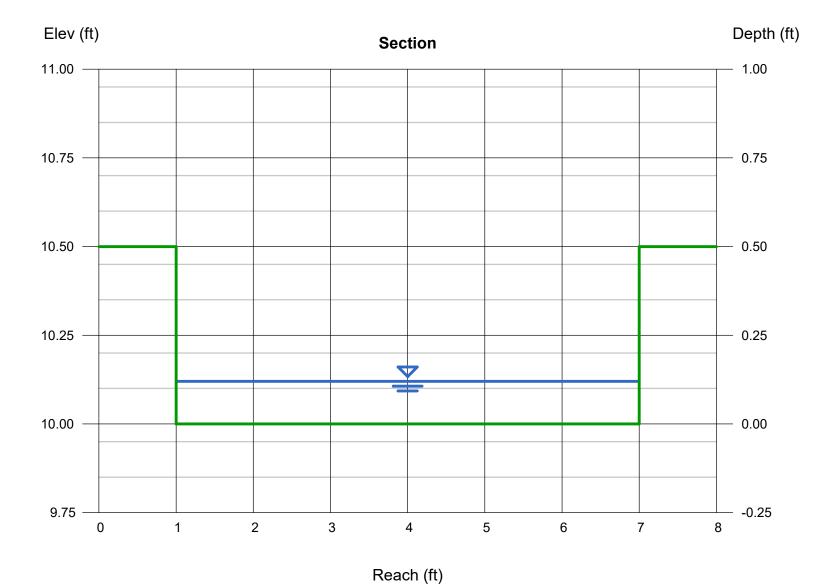
= 1.29

Monday, Dec 13 2021

# **Pond C Trickle Channel**

Known Q (cfs)

	Highlighted	
= 6.00	Depth (ft)	= 0.12
= 0.50	Q (cfs)	= 1.290
	Area (sqft)	= 0.72
= 10.00	Velocity (ft/s)	= 1.79
= 0.50	Wetted Perim (ft)	= 6.24
= 0.013	Crit Depth, Yc (ft)	= 0.12
	Top Width (ft)	= 6.00
	EGL (ft)	= 0.17
Known Q		
	= 0.50 = 10.00 = 0.50 = 0.013	= 6.00 = 0.50  Depth (ft) Q (cfs) Area (sqft) Velocity (ft/s) = 0.50 Wetted Perim (ft) Crit Depth, Yc (ft) Top Width (ft) EGL (ft)



# **Weir Report**

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

Tuesday, Dec 14 2021

# **Pond C Spillway**

Tra	pezo	oidal	Weir
	P 1		

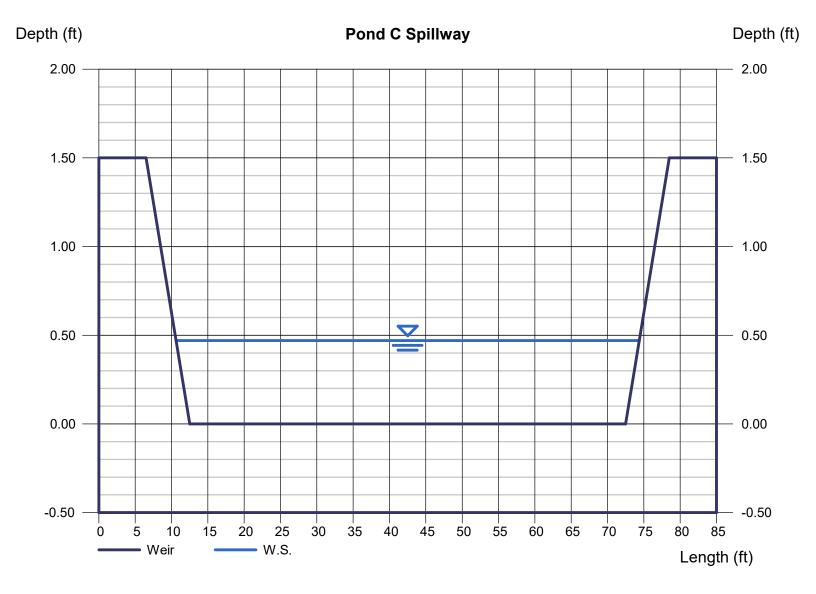
Crest = Sharp Bottom Length (ft) = 60.00 Total Depth (ft) = 1.50 Side Slope (z:1) = 4.00

#### **Calculations**

Weir Coeff. Cw = 3.10Compute by: Known Q Known Q (cfs) = 60.20

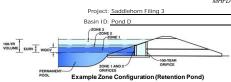
## Highlighted

Depth (ft) = 0.47 Q (cfs) = 60.20 Area (sqft) = 29.08 Velocity (ft/s) = 2.07 Top Width (ft) = 63.76



#### DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



Watershed Information

ateranea information		
Selected BMP Type =	EDB	
Watershed Area =	78.02	acres
Watershed Length =	3,473	ft
Watershed Length to Centroid =	970	ft
Watershed Slope =	0.012	ft/ft
Watershed Imperviousness =	15.40%	percent
Percentage Hydrologic Soil Group A =	70.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	30.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

the embedded Colorado Urban Hydro	graph Proced	lure.
Water Quality Capture Volume (WQCV) =	0.619	acre-feet
Excess Urban Runoff Volume (EURV) =	1.007	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.755	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.188	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	2.116	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	3.929	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	5.225	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	7.358	acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	11.183	acre-feet
Approximate 2-yr Detention Volume =	0.683	acre-feet
Approximate 5-yr Detention Volume =	1.098	acre-feet
Approximate 10-yr Detention Volume =	1.393	acre-feet
Approximate 25-yr Detention Volume =	1.747	acre-feet
Approximate 50-yr Detention Volume =	2.024	acre-feet
Approximate 100-yr Detention Volume =	2.808	acre-feet

Optional User Overrides					
	acre-feet				
	acre-feet				
1.19	inches				
1.50	inches				
1.75	inches				
2.00	inches				
2.25	inches				
2.52	inches				
	inches				

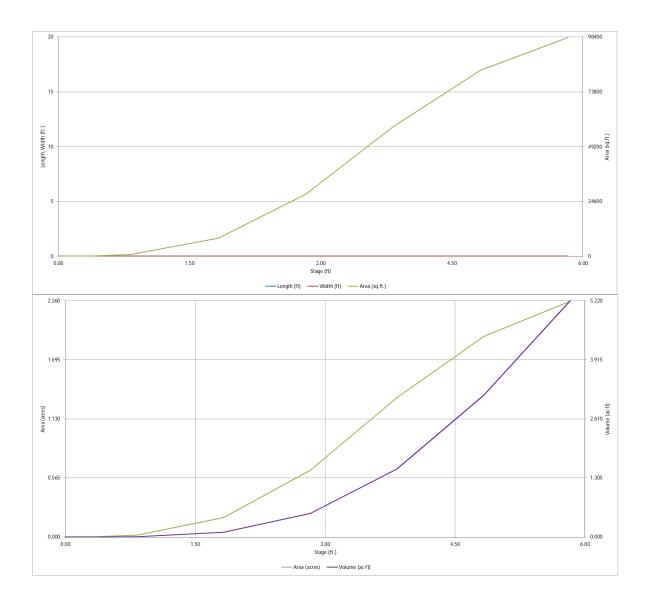
Define Zones and Basin Geometry

		Jenne Zones and basin decinent
acre-f	0.619	Zone 1 Volume (WQCV) =
acre-f	0.388	Zone 2 Volume (EURV - Zone 1) =
acre-f	1.800	Zone 3 Volume (100-year - Zones 1 & 2) =
acre-f	2.808	Total Detention Basin Volume =
ft <sup>3</sup>	user	Initial Surcharge Volume (ISV) =
ft	user	Initial Surcharge Depth (ISD) =
ft	user	Total Available Detention Depth (H <sub>total</sub> ) =
ft	user	Depth of Trickle Channel (H <sub>TC</sub> ) =
ft/ft	user	Slope of Trickle Channel (S <sub>TC</sub> ) =
H:V	user	Slopes of Main Basin Sides (Smain) =
	user	Basin Length-to-Width Ratio (R <sub>L/W</sub> ) =

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 (LFLOOR) =	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 (Vtotal) =	user	acre-feet

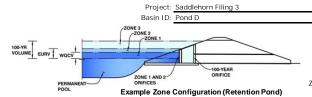
			1.							
ĺ	Depth Increment =		ft Optional				Optional			
	Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft 2)	Override Area (ft <sup>2</sup> )	Area (acre)	Volume (ft 3)	Volume (ac-ft)
.17	Top of Micropool		0.00				32	0.001		
	6709.5		0.33				50	0.001	14	0.000
	6710 6711		0.83				699 8,089	0.016	201 4,595	0.005
	6712		2.83				27,770	0.638	22,524	0.103
	6713		3.83				58,037	1.332	65,427	1.502
	6714		4.83				83,546	1.918	136,219	3.127
	6715		5.83				98,172	2.254	227,078	5.213
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MHFD-Detention\_v4 04\_Pond D.xism, Basin 12/14/2021, 3:08 PM



M#FD-Detention\_w4 04\_Pond D.xlsm, Basin 12/14/2021, 3:08 PM

MHFD-Detention, Version 4.04 (February 2021)



	Estimated	Estimated	
	Stage (ft)	Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.98	0.619	Orifice Plate
Zone 2 (EURV)	3.42	0.388	Circular Orifice
Zone 3 (100-year)	4.66	1.800	Weir&Pipe (Restrict)
•	Total (all zones)	2.808	

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

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

Calculated Parameters for Underdrain Underdrain Orifice Area N/A Underdrain Orifice Centroid = N/A

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

Invert of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft) Depth at top of Zone using Orifice Plate = 3.42 ft (relative to basin bottom at Stage = 0 ft) Orifice Plate: Orifice Vertical Spacing 13.70 inches Orifice Plate: Orifice Area per Row = 2.05 sq. inches (diameter = 1-5/8 inches)

Calculated Parameters for Plate WQ Orifice Area per Row 1 424F-02 Elliptical Half-Width N/A Elliptical Slot Centroid N/A feet Elliptical Slot Area: N/A

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.14	2.28					
Orifice Area (sq. inches)	2.05	2.05	2.05					

	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 Circular	Not Selected	
Invert of Vertical Orifice =	2.98	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.42	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	0.38	N/A	inches

	Calculated Paramet	ers for Vertical Orific	e
	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.00	N/A	ft <sup>2</sup>
'ertical 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 OR Rectangular/Trapezoida) (and No Outlet Pip

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.42	N/A	ft (relative to basin bottom at St
Overflow Weir Front Edge Length =	10.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	0%	N/A	%

lo Outlet Pipe)		Calculated Parameters for Overflow Weir			
		Zone 3 Weir	Not Selected		
Stage = 0 ft)	Height of Grate Upper Edge, $H_t =$	3.42	N/A	feet	
	Overflow Weir Slope Length =	5.00	N/A	feet	
Grat	e Open Area / 100-yr Orifice Area =	4.92	N/A		
Over	rflow Grate Open Area w/o Debris =	34.80	N/A	ft <sup>2</sup>	
Ove	erflow Grate Open Area w/ Debris =	34.80	N/A	ft <sup>2</sup>	
	•				

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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 =	0.40	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pine Diameter -	36.00	N/A	inches

inches

	Calculated Parameter	Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate					
		Zone 3 Restrictor	Not Selected				
it Stage = 0 ft)	Outlet Orifice Area =	7.07	N/A	ft <sup>2</sup>			
	Outlet Orifice Centroid =	1.50	N/A	feet			
Half-Central Angle	of Restrictor Plate on Pipe =	3.14	N/A	radia			

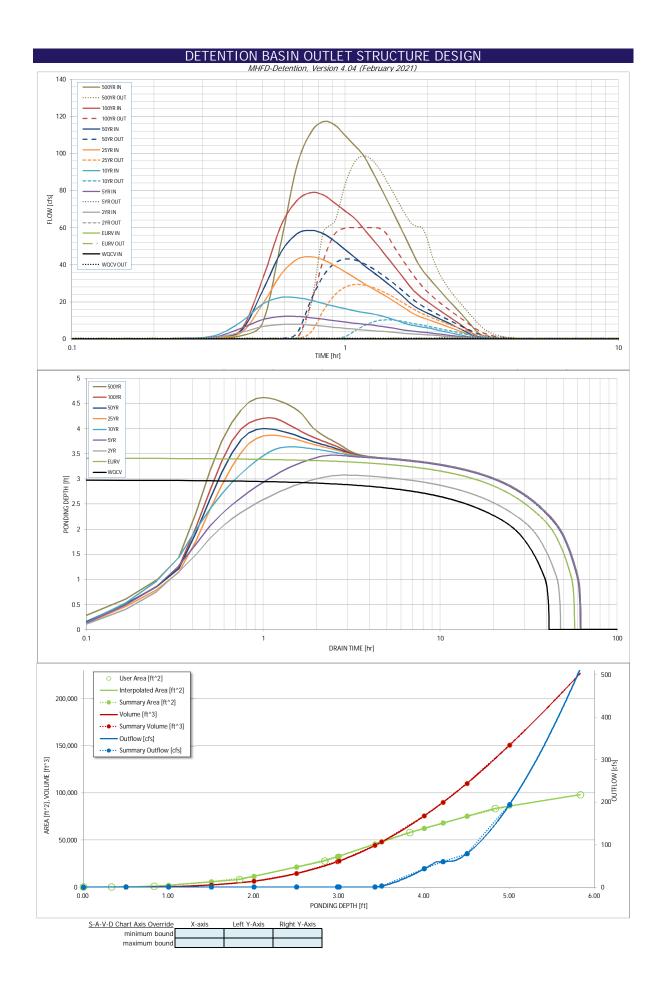
Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.33	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	75.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

36.00

	Calculated Paramet	ers for Spilli
Spillway Design Flow Depth=	0.49	feet
Stage at Top of Freeboard =	5.82	feet
Basin Area at Top of Freeboard =	2.25	acres
Basin Volume at Top of Freeboard =	5.19	acre-ft

Routed Hydrograph Results Design Storm Return Period WOCV FURV 5 Year 50 Year 100 Yea 500 Year One-Hour Rainfall Depth (in) N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 3.14 CUHP Runoff Volume (acre-ft) 0.619 1.188 3.929 5.225 7.358 Inflow Hydrograph Volume (acre-ft) N/A N/A 0.755 1.188 2.116 3.929 5.225 7.358 11.183 CUHP Predevelopment Peak Q (cfs) N/A N/A 0.9 2.0 11.4 32.5 46.1 66.0 103.2 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A Predevelopment Unit Peak Flow, q (cfs/acre) 0.59 N/A N/A 0.01 0.03 0.15 0.42 0.85 1.32 Peak Inflow Q (cfs) N/A N/A 7.9 22.4 44.2 78.8 Peak Outflow Q (cfs) 43.1 98.7 0.3 0.3 0.3 1.4 10.3 29.3 60.1 Ratio Peak Outflow to Predevelopment Q N/A N/A N/A 0.7 0.9 0.9 0.9 0.9 1.0 Structure Controlling Flow Plate Overflow Weir 1 Vertical Orifice 1 Overflow Weir 1 Overflow Weir 1 Overflow Weir 1 Overflow Weir 1 Outlet Plate Spillway Max Velocity through Grate 1 (fps) N/A N/A N/A 0.0 0.8 1.8 Max Velocity through Grate 2 (fps) N/A N/A N/A N/A N/A N/A N/A N/A N/A Time to Drain 97% of Inflow Volume (hours) 53 44 56 54 49 47 42 35 38 Time to Drain 99% of Inflow Volume (hours) 40 56 46 60 58 56 55 50 Maximum Ponding Depth (ft) 2 98 3 42 3.07 3 47 3 64 3.87 4 00 4.62 Area at Maximum Ponding Depth (acres) 1.79 0.74 1.05 0.80 1.08 1.20 1.35 1.43 1.55 Maximum Volume Stored (acre-ft)



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.

ĺ	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
	0:00:00									
5.00 min	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	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.07
	0:20:00	0.00	0.00	0.78	1.07	1.80	0.23	0.96	1.01	1.78
	0:25:00	0.00	0.00	3.62	5.77	9.24	3.35	4.42	5.02	8.89
	0:30:00	0.00	0.00	6.66	10.45	18.82	18.82	26.04	32.56	52.15
	0:35:00	0.00	0.00	7.84	12.08	22.42	34.80	46.75	61.06	93.07
	0:40:00	0.00	0.00	7.93	12.12	22.20	42.88	56.63	74.53	111.26
	0:45:00	0.00	0.00	7.48	11.45	20.90	44.25	58.54	78.84	117.15
	0:50:00	0.00	0.00	6.83	10.62	19.13	42.61	56.69	77.56	115.33
	0:55:00 1:00:00	0.00	0.00	6.26	9.86	17.62	39.50	52.70 48.27	73.29	109.78
	1:05:00	0.00	0.00	5.76 5.28	9.14 8.47	16.34 15.15	36.17 33.11	44.11	68.97 65.06	104.24 99.07
	1:10:00	0.00	0.00	4.89	7.99	14.25	30.04	39.97	59.68	91.26
	1:15:00	0.00	0.00	4.55	7.50	13.58	27.49	36.59	54.41	83.33
	1:20:00	0.00	0.00	4.22	6.95	12.74	25.14	33.49	49.45	75.69
	1:25:00	0.00	0.00	3.89	6.38	11.68	22.87	30.48	44.61	68.20
	1:30:00	0.00	0.00	3.56	5.81	10.53	20.61	27.48	40.05	61.16
	1:35:00	0.00	0.00	3.24	5.25	9.39	18.42	24.52	35.69	54.45
	1:40:00 1:45:00	0.00	0.00	2.93	4.70	8.31	16.26	21.61	31.44	47.94
	1:50:00	0.00	0.00	2.69	4.26 3.96	7.48 6.91	14.20 12.64	18.83 16.78	27.41 24.37	41.84 37.36
	1:55:00	0.00	0.00	2.39	3.70	6.44	11.50	15.25	22.06	33.85
	2:00:00	0.00	0.00	2.23	3.45	5.96	10.59	13.99	20.09	30.81
	2:05:00	0.00	0.00	2.04	3.15	5.44	9.68	12.77	18.25	27.94
	2:10:00	0.00	0.00	1.84	2.84	4.90	8.78	11.58	16.49	25.21
	2:15:00	0.00	0.00	1.65	2.54	4.37	7.91	10.44	14.82	22.61
	2:20:00	0.00	0.00	1.46	2.24	3.86	7.07	9.32	13.24	20.17
	2:25:00	0.00	0.00	1.28	1.96	3.37	6.25	8.23	11.74	17.88
	2:30:00	0.00	0.00	1.11 0.94	1.70	2.90 2.45	5.45 4.66	7.17 6.12	10.28 8.83	15.64 13.43
	2:40:00	0.00	0.00	0.74	1.19	2.43	3.88	5.09	7.40	11.24
	2:45:00	0.00	0.00	0.62	0.95	1.60	3.12	4.07	5.97	9.05
	2:50:00	0.00	0.00	0.47	0.72	1.19	2.36	3.06	4.55	6.89
	2:55:00	0.00	0.00	0.33	0.50	0.82	1.62	2.08	3.16	4.80
	3:00:00	0.00	0.00	0.25	0.39	0.60	0.98	1.26	2.00	3.10
	3:05:00	0.00	0.00	0.20	0.32	0.50	0.63	0.81	1.31	2.10
	3:10:00 3:15:00	0.00	0.00	0.17 0.15	0.26	0.41	0.43	0.56 0.41	0.89	1.46
	3:20:00	0.00	0.00	0.13	0.22	0.34	0.32	0.41	0.41	0.67
	3:25:00	0.00	0.00	0.11	0.15	0.22	0.19	0.23	0.28	0.44
	3:30:00	0.00	0.00	0.09	0.12	0.17	0.15	0.18	0.18	0.28
	3:35:00	0.00	0.00	0.07	0.09	0.13	0.11	0.14	0.12	0.19
	3:40:00	0.00	0.00	0.06	0.07	0.10	0.09	0.10	0.09	0.14
	3:45:00	0.00	0.00	0.05	0.06	0.08	0.07	0.08	0.07	0.11
	3:50:00	0.00	0.00	0.04	0.05	0.06	0.05	0.06	0.06	0.09
	3:55:00 4:00:00	0.00	0.00	0.03	0.03	0.04	0.04	0.05	0.04	0.07
	4:05:00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.03
	4:10:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.02
	4:15:00 4:20:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	4:20:00	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 4:40:00	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
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00 5:00:00	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
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00 5:20:00	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
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00 5:40:00	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
	5:50:00	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

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically. The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

0.00 32 0.001 0 0.000 0.00 For be stages 1.00 1.00 1.955 0.045 426 0.010 0.07 from the stages 1.50 5.650 0.130 2.328 0.053 0.13 Sheet 2.00 11.435 0.263 6.254 0.144 0.16 2.50 21.275 0.488 14.432 0.331 0.22 Also in WQCV 2.98 32.310 0.742 27.030 0.621 0.27 outlets 2.00 32.915 0.756 27.682 0.635 0.27 overfice 2.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00	Stage - Storage	Stage	Area	Area	Volume	Volume	Total Outflow	
0.50 271 0.006 41 0.001 0.05 stages stages 1.00 1.955 0.045 426 0.010 0.07 chang from t 1.50 5.650 0.130 2.328 0.053 0.13 Sheet 2.00 11,435 0.263 6.254 0.144 0.16 2.50 21,275 0.488 14,432 0.331 0.22 Also if where 3.00 32,915 0.756 27,682 0.635 0.27 overflag where 3.350 48,049 1.103 47,923 1.100 2.50 4.00 62,374 1.432 75,662 1.737 43.04 100-YR 4.22 67,986 1.561 90,002 2.066 60.12 4.50 75,128 1.725 110,038 2.526 78.64	Description	[ft]	[ft <sup>2</sup> ]	[acres]	[ft <sup>3</sup> ]	[ac-ft]		
0.50         271         0.006         41         0.001         0.05         stages           1.00         1,955         0.045         426         0.010         0.07         chang from the chang from the chang from the chang from the chang from the change f		0.00	32	0.001	0	0.000	0.00	For bes
1.00         1,955         0.045         426         0.010         0.07         chang from t from t sheet           1.50         5,650         0.130         2,328         0.053         0.13         Sheet           2.00         11,435         0.263         6,254         0.144         0.16         Sheet           2.50         21,275         0.488         14,432         0.331         0.22         Also ir           WQCV         2.98         32,310         0.742         27,030         0.621         0.27         outlet           3.00         32,915         0.756         27,682         0.635         0.27         overfix           EURV         3.42         45,628         1.047         44,176         1.014         0.31         where           4.00         62,374         1.432         75,662         1.737         43.04           100-YR         4.22         67,986         1.561         90,002         2.066         60.12           4.50         75,128         1.725         110,038         2.526         78.64			271	0.006	41	0.001	0.05	stages
1.50 5,680 0.130 2,328 0.053 0.13 Sheet  2.00 11,435 0.263 6,254 0.144 0.16  2.50 21,275 0.488 14,432 0.331 0.22 Also ir  WQCV 2,98 32,310 0.742 27,030 0.621 0.27 outlet  3.00 32,915 0.756 27,682 0.635 0.27 overflow  EURV 3.42 45,628 1.047 44,176 1.014 0.31 where  3.50 48,049 1.103 47,923 1.100 2.50  4.00 62,374 1.432 75,662 1.737 43.04  100-YR 4.22 67,986 1.561 90,002 2.066 60.12  4.50 75,128 1.725 110,038 2.526 78.64			1,955	0.045	426	0.010	0.07	change
2.00 11,435 0.263 6.254 0.144 0.16 2.50 21,275 0.488 14,432 0.331 0.22 Also ir  WQCV 2.98 32,310 0.742 27,030 0.621 0.27 outlet: 3.00 32,915 0.756 27,682 0.635 0.27 overfic  EURV 3.42 45,628 1.047 44,176 1.014 0.31  3.50 48,049 1.103 44,923 1.100 2.50 4.00 62,374 1.432 75,662 1.737 43.04 100-YR 4.22 67,986 1.561 90,002 2.066 60.12 4.50 75,128 1.725 110,038 2.526 78.64			5,650	0.130	2,328	0.053	0.13	Sheet 'I
WQCV         2.98         32,310         0.742         27,030         0.621         0.27         outlets overflow o		2.00						_
3.00 32,915 0.756 27,682 0.635 0.27 overflow there  EURV 3.42 45,628 1.047 44,176 1.014 0.31  3.50 48,049 1.103 47,923 1.100 2.50  4.00 62,374 1.432 75,662 1.737 43.04  100-YR 4.22 67,986 1.561 90,002 2.066 60.12  4.50 75,128 1.725 110,038 2.526 78.64								Also inc
EURV 3.42 45,628 1.047 44,176 1.1014 0.31 Where 3.50 48,049 1.103 47,923 1.100 2.50 4.00 62,374 1.432 75,662 1.737 43.04 100-YR 4.22 67,986 1.561 90,002 2.066 60.12 4.50 75,128 1.725 110,038 2.526 78.64	WQCV							
3.50 48,049 1.103 47,923 1.100 2.50 4.00 62,374 1.432 75,662 1.737 43.04 100-YR 4.22 67,986 1.561 90,002 2.066 60.12 4.50 75,128 1.725 110,038 2.526 78.64	FUDV							where a
4.00     62,374     1.432     75,662     1.737     43.04       100-YR     4.22     67,986     1.561     90,002     2.066     60.12       4.50     75,128     1.725     110,038     2.526     78.64	EURV							
100-YR 4.22 67,986 1.561 90,002 2.066 60.12 4.50 75,128 1.725 110,038 2.526 78.64								
4.50 75,128 1.725 110,038 2.526 78.64	100-YR							
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For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

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

# POND D FOREBAY VOLUME REQUIREMENTS

WQCV=  $a(0.91I^3-1.19I^2+0.781I)$ a=1 (40 hour drain time) Equation 3-1

Proposed Forebay WQCV= 0.080158 I = .124Future Forebay I=.147 WQCV= 0.091836

> Equation 3-3 V=(WQCV/12)A

Proposed Forebay A= 40.72 Acres V= 0.272 Future Forebay A= 33.94 Acres V= 0.260

3% OF WQCV

FOREBAY TOTAL VOLUME= .03(V)

VOLUME REQUIRED FOR PROPOSED FOREBAY= 0.008 AC-FT 355 CF **VOLUME REQUIRED FOR FUTURE FOREBAY =** 339 CF 0.008 AC-FT

VOLUME PROVIDED FOR PROPOSED FOREBAY = 0.015 AC-FT 642 CF

Q<sub>100</sub> Discharges 2% OF Q<sub>100</sub>

Q<sub>100</sub> Proposed Forebay 1= .02\*51.7 CFS= 1.03 CFS Q<sub>100</sub> Future Forebay= .02\*37.3 CFS= 0.75 CFS

# **Weir Report**

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

Wednesday, Mar 2 2022

# **Pond D Forebay 1 Notch**

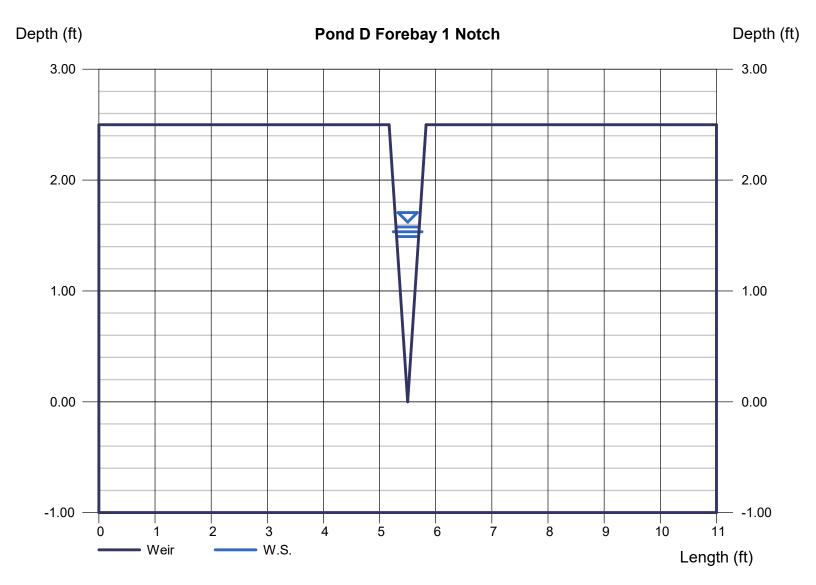
V-Notch Weir	
Crest	= Sharp
Angle (Deg)	= 15
Total Depth (ft)	= 2.50

**Calculations** 

Weir Coeff. Cw = 0.33 Compute by: Known Q Known Q (cfs) = 1.03

# Highlighted

Depth (ft) = 1.58 Q (cfs) = 1.030 Area (sqft) = 0.33 Velocity (ft/s) = 3.15 Top Width (ft) = 0.42



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

Monday, Dec 13 2021

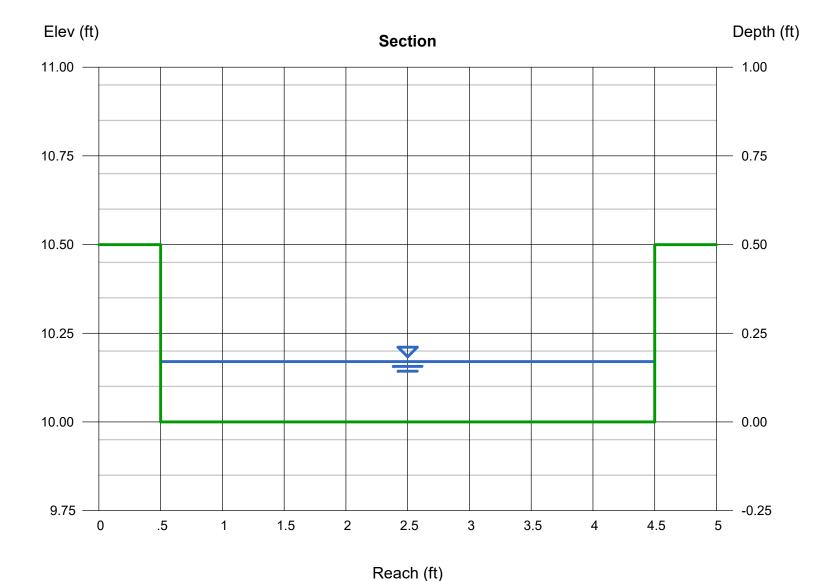
## **Pond D Trickle Channel**

Rectangular Bottom Width (ft) Total Depth (ft)	= 4.00 = 0.50
Invert Elev (ft)	= 10.00
Slope (%)	= 0.50
N-Value	= 0.013

Compute by: Known Q Known Q (cfs) = 1.52

**Calculations** 





# **Weir Report**

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

Tuesday, Dec 14 2021

# **Pond D Spillway**

Trapezoidal Weir	,
------------------	---

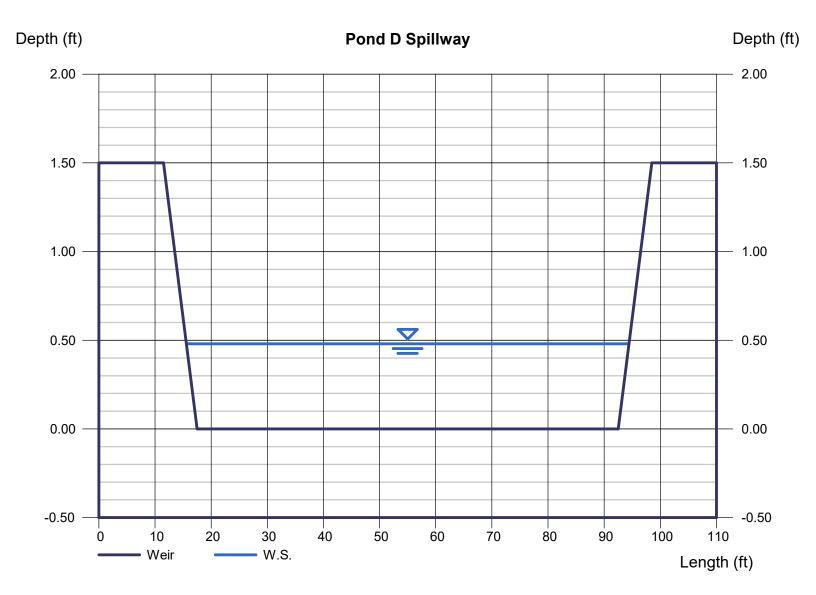
Crest = Sharp Bottom Length (ft) = 75.00 Total Depth (ft) = 1.50 Side Slope (z:1) = 4.00

#### **Calculations**

Weir Coeff. Cw = 3.10 Compute by: Known Q Known Q (cfs) = 78.80

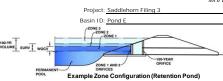
## Highlighted

Depth (ft) = 0.48 Q (cfs) = 78.80 Area (sqft) = 36.92 Velocity (ft/s) = 2.13 Top Width (ft) = 78.84



#### DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



#### Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	18.37	acres
Watershed Length =	1,810	ft
Watershed Length to Centroid =	803	ft
Watershed Slope =	0.012	ft/ft
Watershed Imperviousness =	8.10%	percent
Percentage Hydrologic Soil Group A =	83.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	17.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1 br Painfall Donths -	Hear Input	

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

the embedded Colorado Urban Hydrograph Procedure.							
Water Quality Capture Volume (WQCV) =	0.086	acre-feet					
Excess Urban Runoff Volume (EURV) =	0.106	acre-feet					
2-yr Runoff Volume (P1 = 1.19 in.) =	0.065	acre-feet					
5-yr Runoff Volume (P1 = 1.5 in.) =	0.106	acre-feet					
10-yr Runoff Volume (P1 = 1.75 in.) =	0.204	acre-feet					
25-yr Runoff Volume (P1 = 2 in.) =	0.592	acre-feet					
50-yr Runoff Volume (P1 = 2.25 in.) =	0.859	acre-feet					
100-yr Runoff Volume (P1 = 2.52 in.) =	1.292	acre-feet					
500-yr Runoff Volume (P1 = 3.14 in.) =	2.174	acre-feet					
Approximate 2-yr Detention Volume =	0.067	acre-feet					
Approximate 5-yr Detention Volume =	0.113	acre-feet					
Approximate 10-yr Detention Volume =	0.153	acre-feet					
Approximate 25-yr Detention Volume =	0.199	acre-feet					
Approximate 50-yr Detention Volume =	0.254	acre-feet					
Approximate 100-yr Detention Volume =	0.419	acre-feet					

	Optional User Overrides								
t		acre-feet							
t		acre-feet							
t	1.19	inches							
t	1.50	inches							
t	1.75	inches							
t	2.00	inches							
t	2.25	inches							
t	2.52	inches							
t		inches							

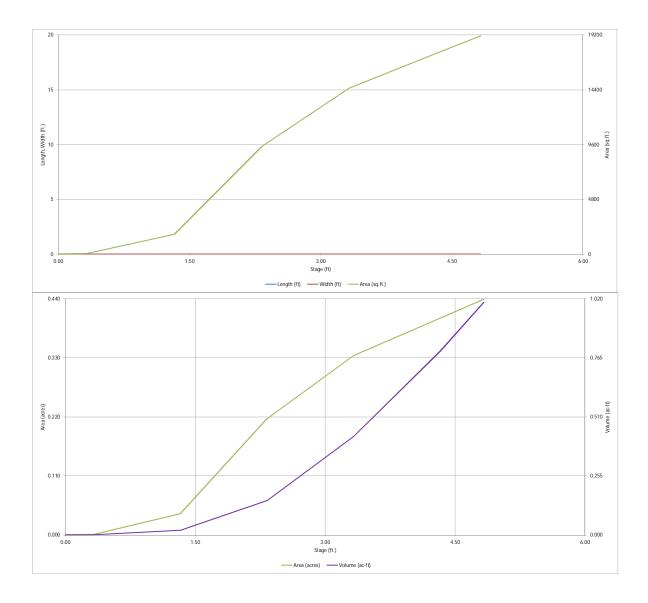
#### Define Zones and Basin Geometry

Jerine Zones and Basin Geometry		
Zone 1 Volume (WQCV) =	0.086	acre-fe
Zone 2 Volume (EURV - Zone 1) =	0.021	acre-fe
Zone 3 Volume (100-year - Zones 1 & 2) =	0.313	acre-fe
Total Detention Basin Volume =	0.419	acre-fe
Initial Surcharge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H <sub>total</sub> ) =	user	ft
Depth of Trickle Channel (H <sub>TC</sub> ) =	user	ft
Slope of Trickle Channel (S <sub>TC</sub> ) =	user	ft/ft
Slopes of Main Basin Sides (Smain) =	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 (LFLOOR) =	user	ft
Width of Basin Floor $(W_{FLOOR}) =$		ft
Area of Basin Floor $(A_{FLOOR})$ =		ft <sup>2</sup>
Volume of Basin Floor ( $V_{FLOOR}$ ) =	user	ft <sup>3</sup>
Depth of Main Basin (H <sub>MAIN</sub> ) =	user	ft
Length of Main Basin $(L_{MAIN})$ =	user	ft
Width of Main Basin ( $W_{MAIN}$ ) =	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

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Optional Override Area (ft <sup>2</sup> )	Area (acre)	Volume (ft 3)	Volume (ac-ft)
6720.67	Top of Micropool		0.00				32	0.001		
	6721		0.33				50	0.001	14	0.000
	6722		1.33				1,723	0.040	900	0.021
	6723		2.33				9,446	0.217	6,484	0.149
	6724		3.33				14,566	0.334	18,490	0.424
	6725		4.33				17,600	0.404	34,573	0.794
	6725.5		4.83				19,121	0.439	43,754	1.004
Overrides										
cre-feet										
cre-feet iches										
iches										
iches										
ches										
ches										
iches										
ches										
						-				
										-

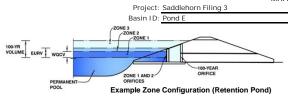
MHFD-Detention\_v4 04\_Pond E.xlsm, Basin 12/13/2021, 10:16 AM



M#FD-Detention\_w4 04\_Pond Extern, Basin 12/13/2021, 10:16 AM

#### DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.00	0.086	Orifice Plate
Zone 2 (EURV)	2.12	0.021	Orifice Plate
Zone 3 (100-year)	3.32	0.313	Weir&Pipe (Restrict)
•	Total (all zones)	0.419	

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 Underdra				
Underdrain Orifice Area =	N/A	ft <sup>2</sup>			
Jnderdrain 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) Calculated Parameters for Plate ft (relative to basin bottom at Stage = 0 ft) WQ Orifice Area per Row Invert of Lowest Orifice = 0.00 2 153F-03 ft<sup>2</sup> Depth at top of Zone using Orifice Plate = 2 12 ft (relative to basin bottom at Stage = 0 ft) Elliptical Half-Width N/A feet Orifice Plate: Orifice Vertical Spacing : N/A inches Elliptical Slot Centroid = N/A feet Orifice Plate: Orifice Area per Row = 0.31 sq. inches (diameter = 5/8 inch) Elliptical Slot Area = N/A

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) Calculated Parameters for Vertical Orifice Not Selected Not Selected Not Selected Not Selected Invert of Vertical Orifice N/A N/A ft (relative to basin bottom at Stage = 0 ft) Vertical Orifice Area N/A N/A Depth at top of Zone using Vertical Orifice : N/A N/A ft (relative to basin bottom at Stage = 0 ft) Vertical Orifice Centroid = N/A Vertical Orifice Diameter =

User Input: Overflow Weir (Dropbox with Flat or	Calculated Parameters for Overflow Weir					
	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected	i
Overflow Weir Front Edge Height, Ho =	2.30	N/A	ft (relative to basin bottom at Stage = 0 ft) Height of Grate Upper Edge, $H_t$ =	3.55	N/A	feet
Overflow Weir Front Edge Length =	5.00	N/A	feet Overflow Weir Slope Length =	5.15	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V Grate Open Area / 100-yr Orifice Area =	10.15	N/A	i
Horiz. Length of Weir Sides =	5.00	N/A	feet Overflow Grate Open Area w/o Debris =	17.94	N/A	ft <sup>2</sup>
Overflow Grate Type =	Type C Grate	N/A	Overflow Grate Open Area w/ Debris =	17.94	N/A	ft <sup>2</sup>
Debris Clogging % =	0%	N/A	%			

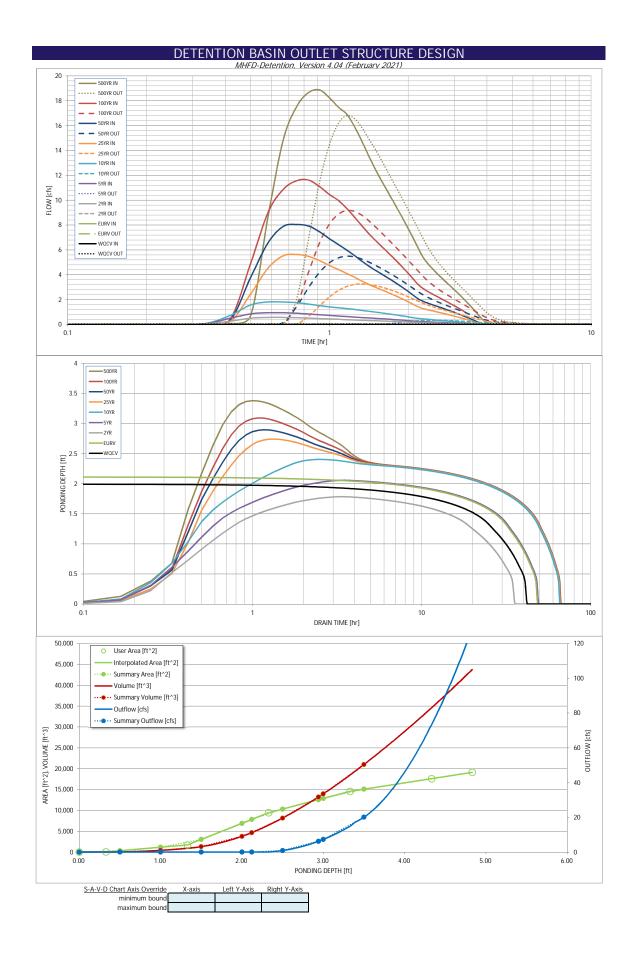
User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.15	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77	N/A	ft <sup>2</sup>
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.75	N/A	feet
Restrictor Plate Height Above Pipe Invert =	18.00		inches Half-Central Angle	of Restrictor Plate on Pipe =	3.14	N/A	radians

Calculated Parameters for Spillway User Input: Emergency Spillway (Rectangular or Trapezoidal) Spillway Design Flow Depth= Spillway Invert Stage= 3.33 ft (relative to basin bottom at Stage = 0 ft) 0.38 feet Spillway Crest Length = 15.00 Stage at Top of Freeboard = 4.71 feet Spillway End Slopes 4.00 H:V Basin Area at Top of Freeboard = 0.43 acres Freeboard above Max Water Surface = Basin Volume at Top of Freeboard = acre-ft

Routed Hydrograph Results	The user can over	ride the default CUI	HP hydrographs and	l runoff volumes by	v entering new value	es in the Inflow Hya	rographs table (Col	umns W through Ai	5).
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.086	0.106	0.065	0.106	0.204	0.592	0.859	1.292	2.174
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.065	0.106	0.204	0.592	0.859	1.292	2.174
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.9	4.6	7.0	10.5	17.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.05	0.25	0.38	0.57	0.96
Peak Inflow Q (cfs) =	N/A	N/A	0.6	1.0	1.8	5.6	8.0	11.6	18.9
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.3	3.3	5.5	9.2	16.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.4	0.7	0.8	0.9	0.9
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.3	0.5	0.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	44	32	44	58	51	47	42	32
Time to Drain 99% of Inflow Volume (hours) =	40	46	34	47	62	59	57	54	49
Maximum Ponding Depth (ft) =	2.00	2.12	1.78	2.06	2.40	2.74	2.90	3.09	3.38
Area at Maximum Ponding Depth (acres) =	0.16	0.18	0.12	0.17	0.23	0.27	0.28	0.31	0.34
Maximum Volume Stored (acre-ft) =	0.087	0.107	0.056	0.095	0.164	0.248	0.289	0.348	0.438



# DETENTION BASIN OUTLET STRUCTURE DESIGN Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]		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	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	0:20:00	0.00	0.00	0.04	0.06	0.07	0.04	0.05	0.06	0.07
	0:25:00	0.00	0.00	0.27	0.50	0.72	0.23	0.34	0.41	0.72
	0:30:00	0.00	0.00	0.51 0.57	0.86	1.57 1.81	2.46 4.55	3.79 6.58	4.91 9.03	8.73 14.87
	0:40:00	0.00	0.00	0.57	0.95	1.81	5.53	7.89	10.87	17.53
	0:45:00	0.00	0.00	0.55	0.91	1.75	5.64	8.05	11.57	18.66
	0:50:00	0.00	0.00	0.52	0.85	1.64	5.48	7.92	11.61	18.87
	0:55:00	0.00	0.00	0.48	0.78	1.52	5.14	7.46	11.09	18.24
	1:00:00	0.00	0.00	0.45	0.73	1.42	4.75 4.42	6.90	10.46 9.97	17.47 16.90
	1:10:00	0.00	0.00	0.42	0.64	1.28	4.42	5.98	9.32	15.88
	1:15:00	0.00	0.00	0.37	0.60	1.21	3.80	5.54	8.62	14.71
	1:20:00	0.00	0.00	0.34	0.56	1.14	3.49	5.08	7.92	13.52
	1:25:00	0.00	0.00	0.32	0.53	1.06	3.22	4.69	7.30	12.46
	1:30:00	0.00	0.00	0.31	0.50	1.00	2.99	4.36	6.76	11.55
	1:40:00	0.00	0.00	0.29	0.47	0.93	2.79	4.06 3.77	6.28 5.83	9.94
	1:45:00	0.00	0.00	0.26	0.41	0.81	2.41	3.49	5.40	9.19
	1:50:00	0.00	0.00	0.24	0.38	0.74	2.22	3.22	4.97	8.45
	1:55:00	0.00	0.00	0.22	0.35	0.68	2.03	2.94	4.54	7.72
	2:00:00	0.00	0.00	0.20	0.31	0.62	1.84	2.66	4.12	7.01
	2:10:00	0.00	0.00	0.18 0.16	0.28	0.55 0.50	1.65 1.46	2.38	3.70 3.29	6.31 5.61
	2:15:00	0.00	0.00	0.15	0.24	0.47	1.32	1.92	2.99	5.12
	2:20:00	0.00	0.00	0.14	0.22	0.44	1.23	1.78	2.77	4.73
	2:25:00	0.00	0.00	0.13	0.21	0.41	1.15	1.67	2.57	4.40
	2:30:00	0.00	0.00	0.12	0.20	0.38	1.08	1.56	2.40	4.09
	2:35:00	0.00	0.00	0.12 0.11	0.18	0.35	1.01 0.94	1.46	2.24	3.81 3.54
	2:45:00	0.00	0.00	0.10	0.16	0.30	0.87	1.27	1.94	3.28
	2:50:00	0.00	0.00	0.09	0.14	0.28	0.81	1.17	1.80	3.04
	2:55:00	0.00	0.00	0.08	0.13	0.25	0.74	1.07	1.65	2.80
	3:00:00 3:05:00	0.00	0.00	80.0	0.12	0.23	0.68	0.98	1.51	2.57
	3:10:00	0.00	0.00	0.07	0.11	0.21	0.61	0.89	1.37	2.33
	3:15:00	0.00	0.00	0.05	0.08	0.16	0.48	0.70	1.09	1.85
	3:20:00	0.00	0.00	0.04	0.07	0.14	0.42	0.60	0.95	1.62
	3:25:00	0.00	0.00	0.04	0.06	0.11	0.35	0.51	0.81	1.38
	3:30:00 3:35:00	0.00	0.00	0.03	0.05	0.09	0.29	0.42	0.67	1.14 0.91
	3:40:00	0.00	0.00	0.02	0.03	0.07	0.16	0.32	0.39	0.67
	3:45:00	0.00	0.00	0.01	0.01	0.03	0.10	0.14	0.25	0.44
	3:50:00	0.00	0.00	0.01	0.01	0.02	0.05	0.07	0.14	0.27
	3:55:00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.08	0.17
	4:00:00 4:05:00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.05	0.11
	4:10:00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04
	4:15:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
	4:20:00 4:25:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	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 4:40:00	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
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00 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 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 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 5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

# DETENTION BASIN OUTLET STRUCTURE DESIGN MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

	Chann	0	A	Makima	Maliana	Total	7
Stage - Storage	Stage	Area	Area	Volume	Volume	Outflow	
Description	[ft]	[ft <sup>2</sup> ]	[acres]	[ft <sup>3</sup> ]	[ac-ft]	[cfs]	
	0.00	32	0.001	0	0.000	0.00	For best results, include the
		334	0.008			0.01	stages of all grade slope
	0.50			46	0.001		changes (e.g. ISV and Floor)
	1.00	1,171	0.027	423	0.010	0.02	from the S-A-V table on
	1.50	3,036	0.070	1,304	0.030	0.03	Sheet 'Basin'.
WQCV	2.00	6,897	0.158	3,788	0.087	0.04	Sheet Basiii.
EURV	2.12	7,824	0.180	4,671	0.107	0.04	Also include the inverts of all
LONG	2.50	10,316	0.237	8,164	0.187	0.91	outlets (e.g. vertical orifice,
							overflow grate, and spillway,
100-YR	2.94	12,569	0.289	13,199	0.303	6.22	where applicable).
	3.00	12,876	0.296	13,962	0.321	7.30	where арріпсавіе).
	3.50	15,082	0.346	21,011	0.482	20.07	1
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		1	1	1	1	1	†
							4

## POND E FOREBAY VOLUME REQUIREMENTS

Equation 3-1  $WQCV = a(0.91I^3 - 1.19I^2 + 0.781I)$ a=1 (40 hour drain time)

Equation 3-3 V=(WQCV/12)A

Forebay 1 A= 17.69 Acres V= 0.083

3% OF WQCV FOREBAY TOTAL VOLUME= .03(V)

VOLUME REQUIRED FOR FOREBAY 1 = 0.002 AC-FT 109 CF

VOLUME PROVIDED FOR FOREBAY 1 = 0.005 AC-FT 230 CF

Q<sub>100</sub> Discharges 2% OF Q<sub>100</sub>

 $Q_{100}$  Forebay 1= .02\*12.6 CFS= 0.25 CFS

# **Weir Report**

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

Monday, Dec 13 2021

## **Pond E Forebay Notch**

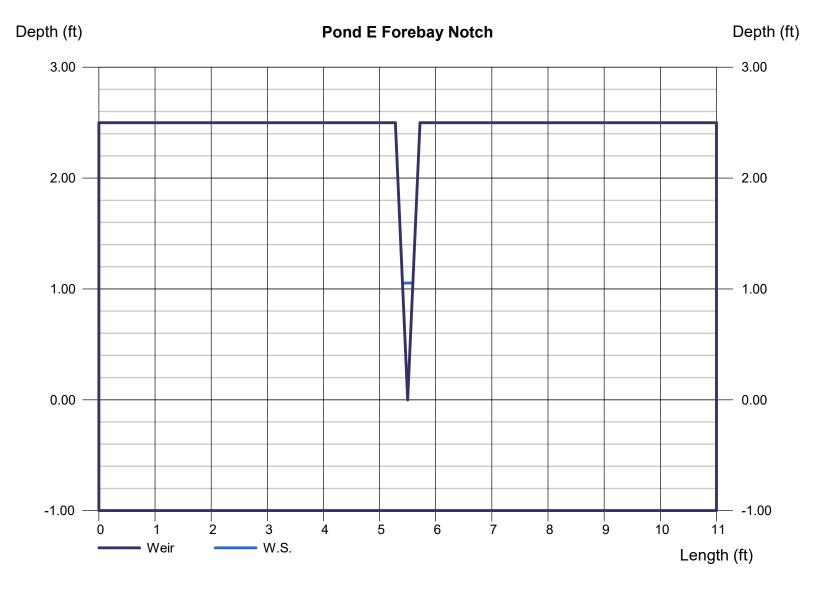
V-Notch Weir	
Crest	= Sharp
Angle (Deg)	= 10
Total Depth (ft)	= 2.50

**Calculations** 

Weir Coeff. Cw = 0.22Compute by: Known Q Known Q (cfs) = 0.25

# Highlighted

Depth (ft) = 1.05 Q (cfs) = 0.250 Area (sqft) = 0.10 Velocity (ft/s) = 2.58 Top Width (ft) = 0.18



# **Channel Report**

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

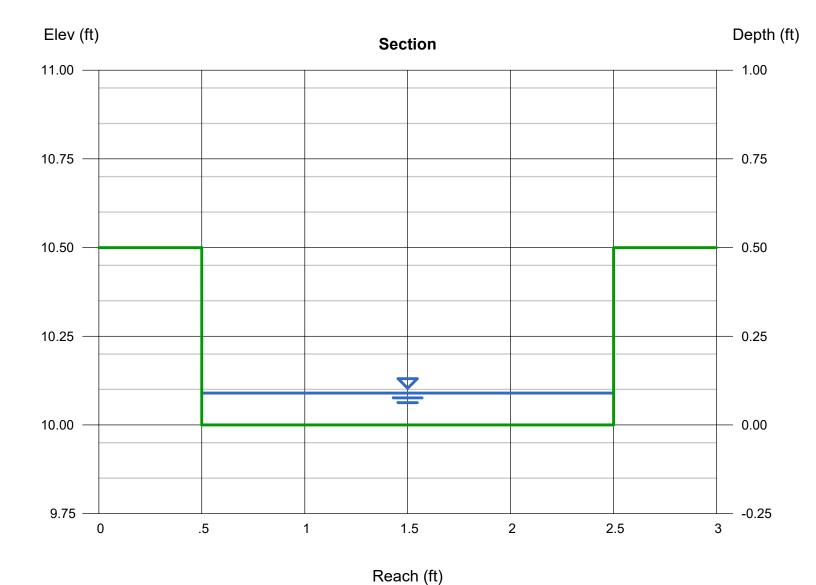
= 0.25

Monday, Dec 13 2021

#### **Pond E Trickle Channel**

Known Q (cfs)

	Highlighted	
= 2.00	Depth (ft)	= 0.09
= 0.50	Q (cfs)	= 0.250
	Area (sqft)	= 0.18
= 10.00	Velocity (ft/s)	= 1.39
= 0.50	Wetted Perim (ft)	= 2.18
= 0.013	Crit Depth, Yc (ft)	= 0.08
	Top Width (ft)	= 2.00
	EGL (ft)	= 0.12
Known Q		
	= 0.50 = 10.00 = 0.50 = 0.013	= 2.00 Depth (ft) = 0.50 Q (cfs) Area (sqft)  = 10.00 Velocity (ft/s) = 0.50 Wetted Perim (ft) = 0.013 Crit Depth, Yc (ft) Top Width (ft) EGL (ft)



# **Weir Report**

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

Monday, Dec 13 2021

#### **Pond E Spillway**

Tra			

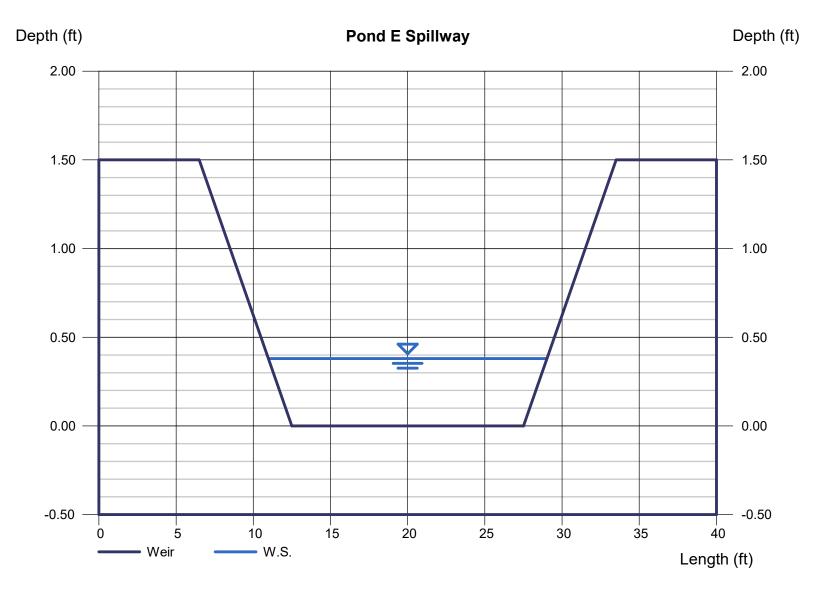
Crest = Sharp
Bottom Length (ft) = 15.00
Total Depth (ft) = 1.50
Side Slope (z:1) = 4.00

#### **Calculations**

Weir Coeff. Cw = 3.10 Compute by: Known Q Known Q (cfs) = 11.60

#### Highlighted

Depth (ft) = 0.38 Q (cfs) = 11.60 Area (sqft) = 6.28 Velocity (ft/s) = 1.85 Top Width (ft) = 18.04



**User Defined** 

**User Defined** 

Workhook Protected

Worksheet Protected

**User Defined** 

**User Defined** 

Stormwater Facility Name: Saddlehorn Filing 3 - Pond C

Facility Location & Jurisdiction: El Paso County - Saddlehorn Ranch Metropolitan District

#### **User Input: Watershed Characteristics**

Watershed Slope =	0.012	ft/ft
Watershed Length =	5370	ft
Watershed Area =	96.84	acres
Watershed Imperviousness =	14.6%	percent
Percentage Hydrologic Soil Group A =	93.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	7.0%	percent

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

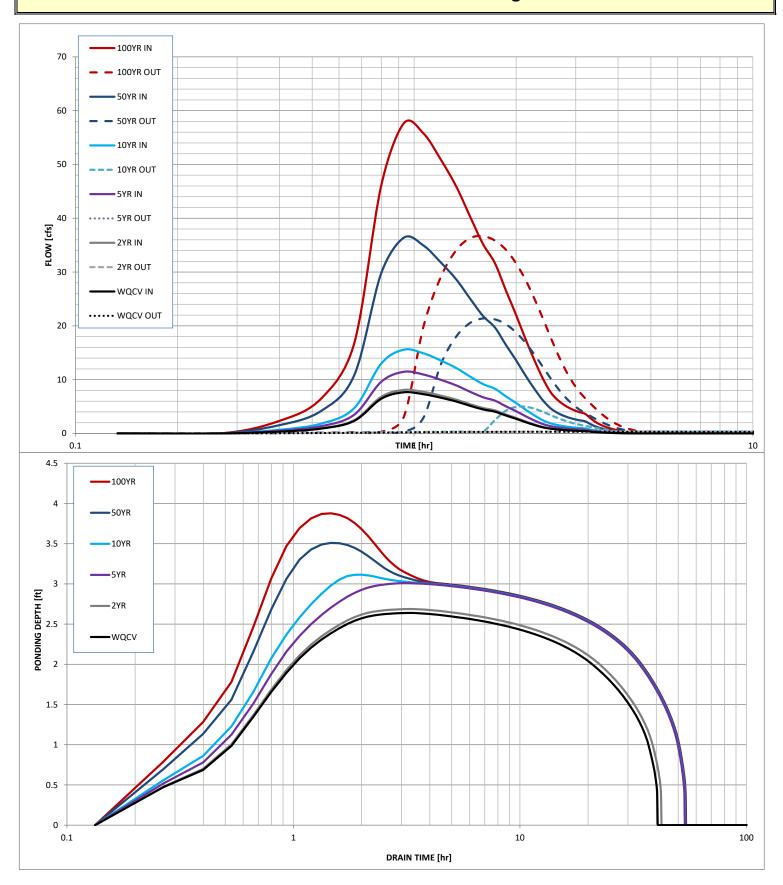
Area [ft^2] Discharge [cfs] Stage [ft] Stage [ft] 0.00 32 0.00 0.00 0.33 50 0.33 0.05 1.00 3,260 1.00 0.11 2.00 17,980 2.00 0.24 3.00 46,439 3.00 0.35 4.00 73,964 4.00 41.88 5.00 86,681 5.00 237.69 5.50 89,520 5.50 408.05

After completing and printing this worksheet to a pdf, go to: <a href="https://maperture.digitaldataservices.com/gvh/?viewer=cswdif">https://maperture.digitaldataservices.com/gvh/?viewer=cswdif</a> create a new stormwater facility, and attach the pdf of this worksheet to that record.

**Routed Hydrograph Results** 

	Routed Hydro	graph Results					_
Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.737	0.780	1.110	1.513	3.577	5.724	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.736	0.779	1.109	1.513	3.577	5.722	acre-ft
Time to Drain 97% of Inflow Volume =	37.4	38.9	49.0	48.1	43.7	39.8	hours
Time to Drain 99% of Inflow Volume =	39.3	40.9	51.6	51.2	49.4	47.7	hours
Maximum Ponding Depth =	2.64	2.69	3.01	3.11	3.51	3.88	ft
Maximum Ponded Area =	0.83	0.86	1.07	1.13	1.38	1.62	acres
Maximum Volume Stored =	0.662	0.702	1.014	1.127	1.624	2.180	acre-ft

SDI\_Pond C.xlsm, Design Data 4/13/2023, 1:51 PM



SDI\_Pond C.xlsm, Design Data 4/13/2023, 1:51 PM

Workhook Protected

Worksheet Protected

Stormwater Facility Name: Saddlehorn Ranch Filing 3 - Pond D

Facility Location & Jurisdiction: El Paso County - Saddlehorn Ranch Metropolitan District

#### **User Input: Watershed Characteristics**

Watershed Slope =	0.012	ft/ft
Watershed Length =	3473	ft
Watershed Area =	78.02	acres
Watershed Imperviousness =	15.4%	percent
Percentage Hydrologic Soil Group A =	70.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	30.0%	percent
		1"

Location for 1-hr Rainfall Depths (use dropdown):

User Input extstyle

WQCV Treatment Method = Extended Detention

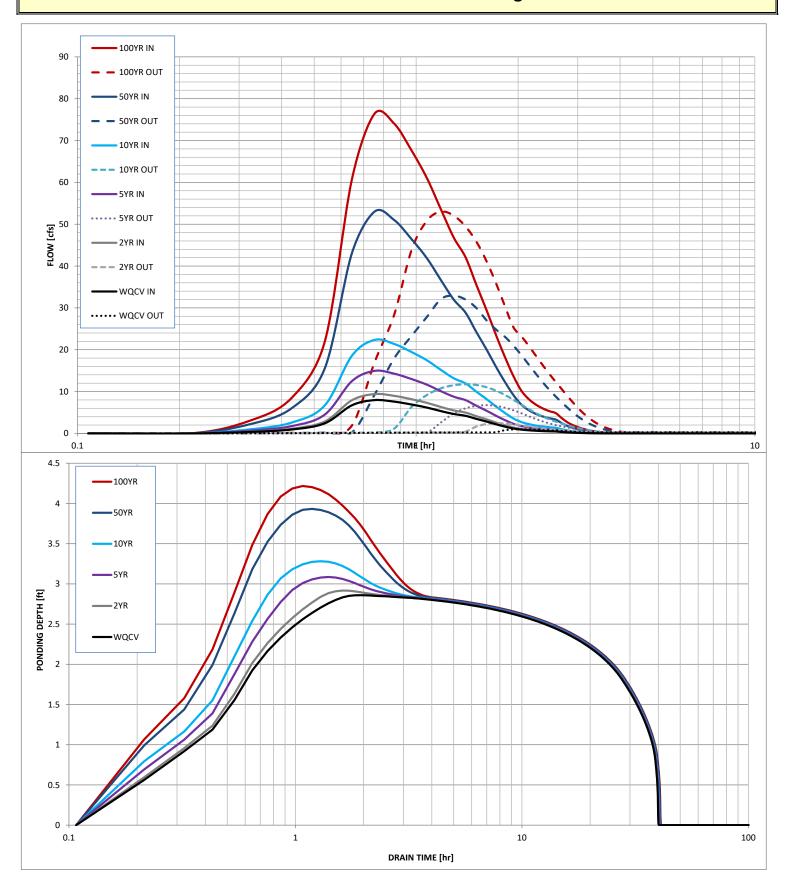
**User Defined User Defined User Defined User Defined** Area [ft^2] Discharge [cfs] Stage [ft] Stage [ft] 0.00 32 0.00 0.00 0.04 0.33 50 0.33 0.83 699 0.83 0.06 1.83 8,089 1.83 0.15 27,770 2.83 2.83 0.26 3.83 58,037 3.83 25.71 4.33 70,791 4.33 61.17 4.83 83,546 4.83 146.98 5.83 98,172 5.83 513.83

After completing and printing this worksheet to a pdf, go to: <a href="https://maperture.digitaldataservices.com/gvh/?viewer=cswdif">https://maperture.digitaldataservices.com/gvh/?viewer=cswdif</a> create a new stormwater facility, and attach the pdf of this worksheet to that record.

**Routed Hydrograph Results** 

	Routeu Hyuro	grapii Kesuits					_
Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.619	0.733	1.170	1.758	4.226	6.144	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.619	0.733	1.170	1.758	4.226	6.142	acre-ft
Time to Drain 97% of Inflow Volume =	36.5	36.0	34.5	32.7	26.5	22.5	hours
Time to Drain 99% of Inflow Volume =	38.5	38.3	37.8	37.0	34.2	32.4	hours
Maximum Ponding Depth =	2.86	2.92	3.09	3.28	3.93	4.22	ft
Maximum Ponded Area =	0.65	0.70	0.81	0.95	1.39	1.56	acres
Maximum Volume Stored =	0.533	0.573	0.701	0.872	1.637	2.055	acre-ft

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SDI\_Pond D.xlsm, Design Data 4/13/2023, 1:54 PM

Workhook Protected

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Stormwater Facility Name: Saddlehorn Ranch Filing 3 - Pond E

Facility Location & Jurisdiction: El Paso County - Saddlehorn Ranch Metropolitan District

#### **User Input: Watershed Characteristics**

Watershed Slope =	0.012	ft/ft
Watershed Length =	1810	ft
Watershed Area =	18.37	acres
Watershed Imperviousness =	8.1%	percent
Percentage Hydrologic Soil Group A =	83.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	17.0%	percent

Location for 1-hr Rainfall Depths (use dropdown):

User Input extstyle

WQCV Treatment Method = Extended Detention

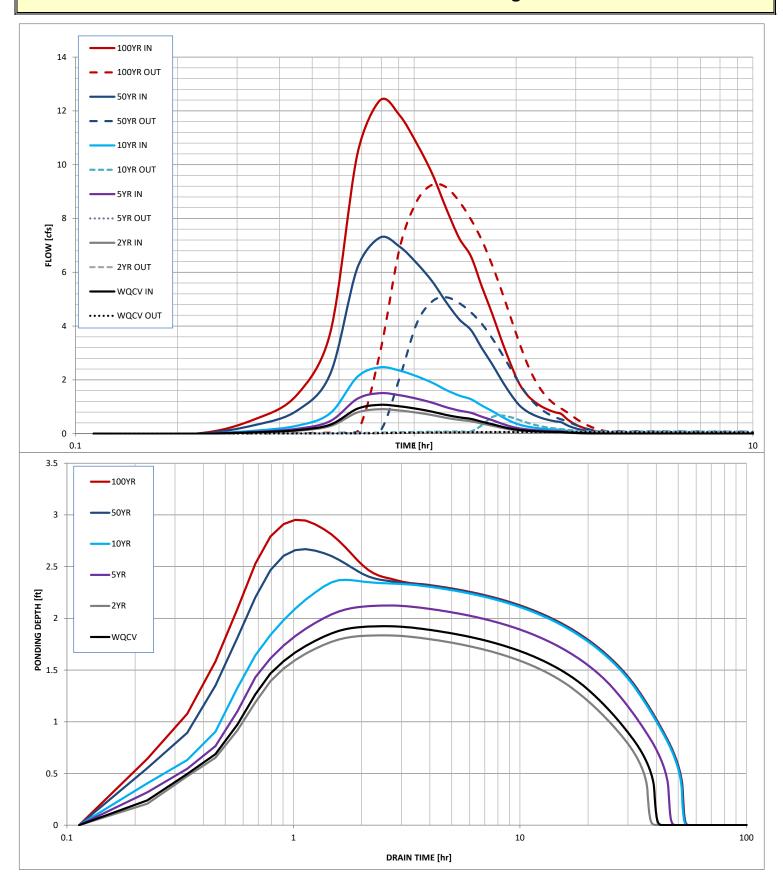
User Defined	User Defined	User Defined	User Defined
Stage [ft]	Area [ft^2]	Stage [ft]	Discharge [cfs]
0.00	32	0.00	0.00
0.33	50	0.33	0.01
0.83	887	0.83	0.01
1.33	1,723	1.33	0.02
2.33	9,446	2.33	0.09
3.33	14,566	3.33	14.90
3.83	16,083	3.83	35.11
4.33	17,600	4.33	73.11
4.83	19,121	4.83	128.58

After completing and printing this worksheet to a pdf, go to: <a href="https://maperture.digitaldataservices.com/gvh/?viewer=cswdif">https://maperture.digitaldataservices.com/gvh/?viewer=cswdif</a> create a new stormwater facility, and attach the pdf of this worksheet to that record.

**Routed Hydrograph Results** 

	Routeu Hyuro	grapii Kesuits					_
Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.086	0.073	0.121	0.199	0.596	1.019	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.085	0.072	0.120	0.199	0.596	1.019	acre-ft
Time to Drain 97% of Inflow Volume =	35.7	33.6	40.3	43.9	34.3	28.1	hours
Time to Drain 99% of Inflow Volume =	38.3	35.9	43.8	49.1	44.3	40.2	hours
Maximum Ponding Depth =	1.92	1.84	2.12	2.37	2.67	2.95	ft
Maximum Ponded Area =	0.14	0.13	0.18	0.22	0.26	0.29	acres
Maximum Volume Stored =	0.075	0.063	0.107	0.157	0.228	0.305	acre-ft

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Chapter 12 Storage

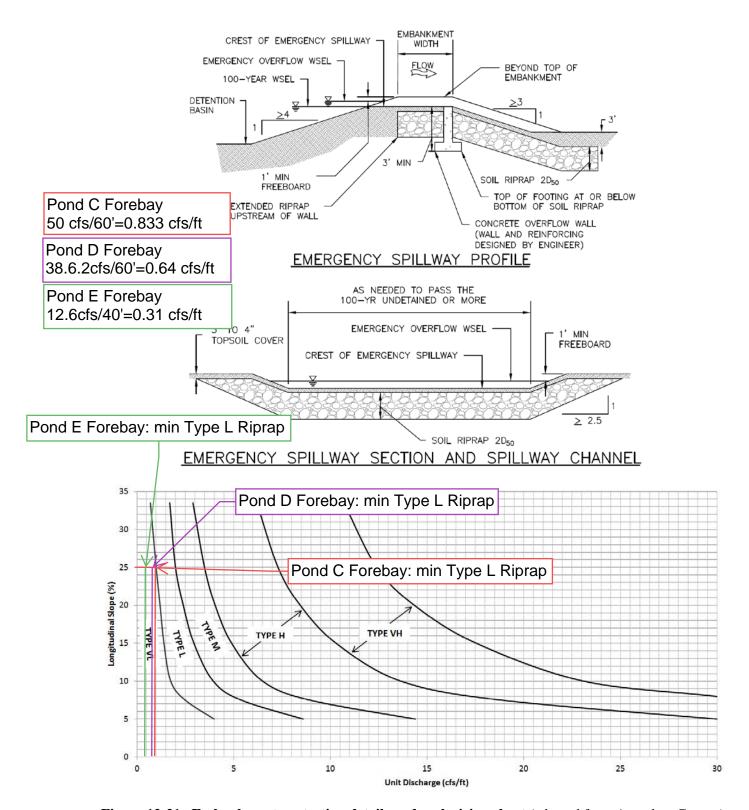


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

Chapter 12 Storage

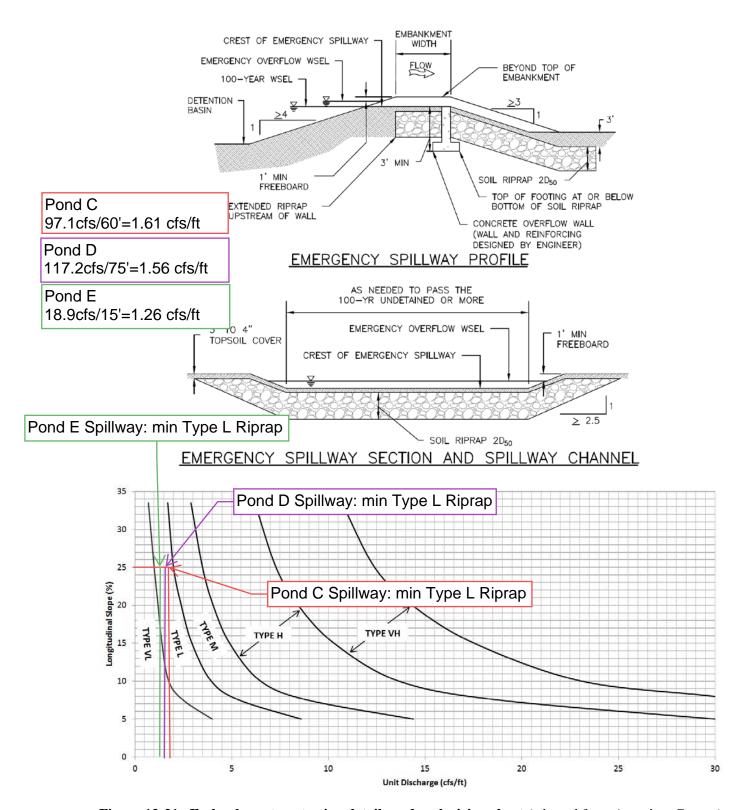


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

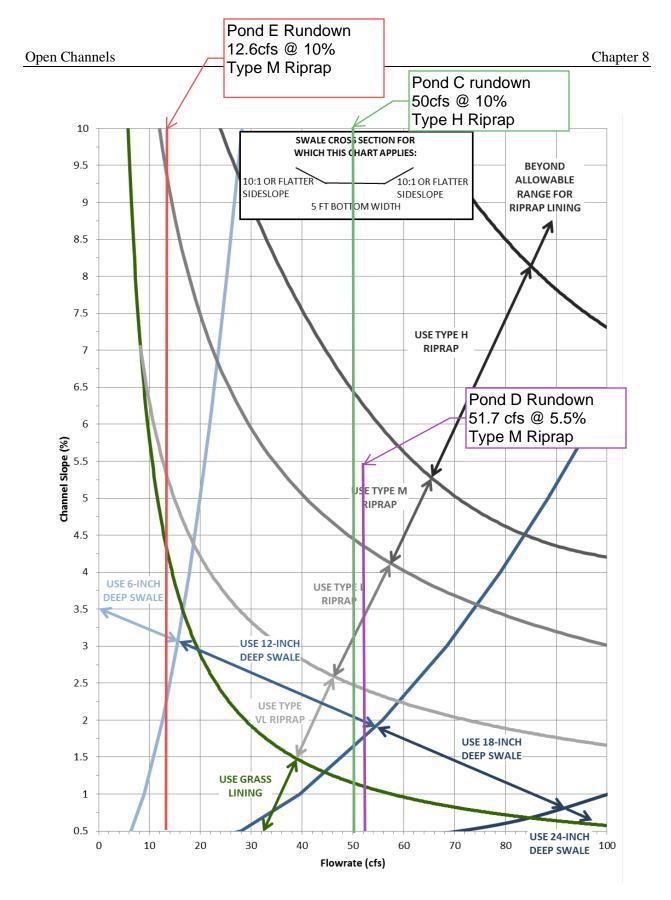
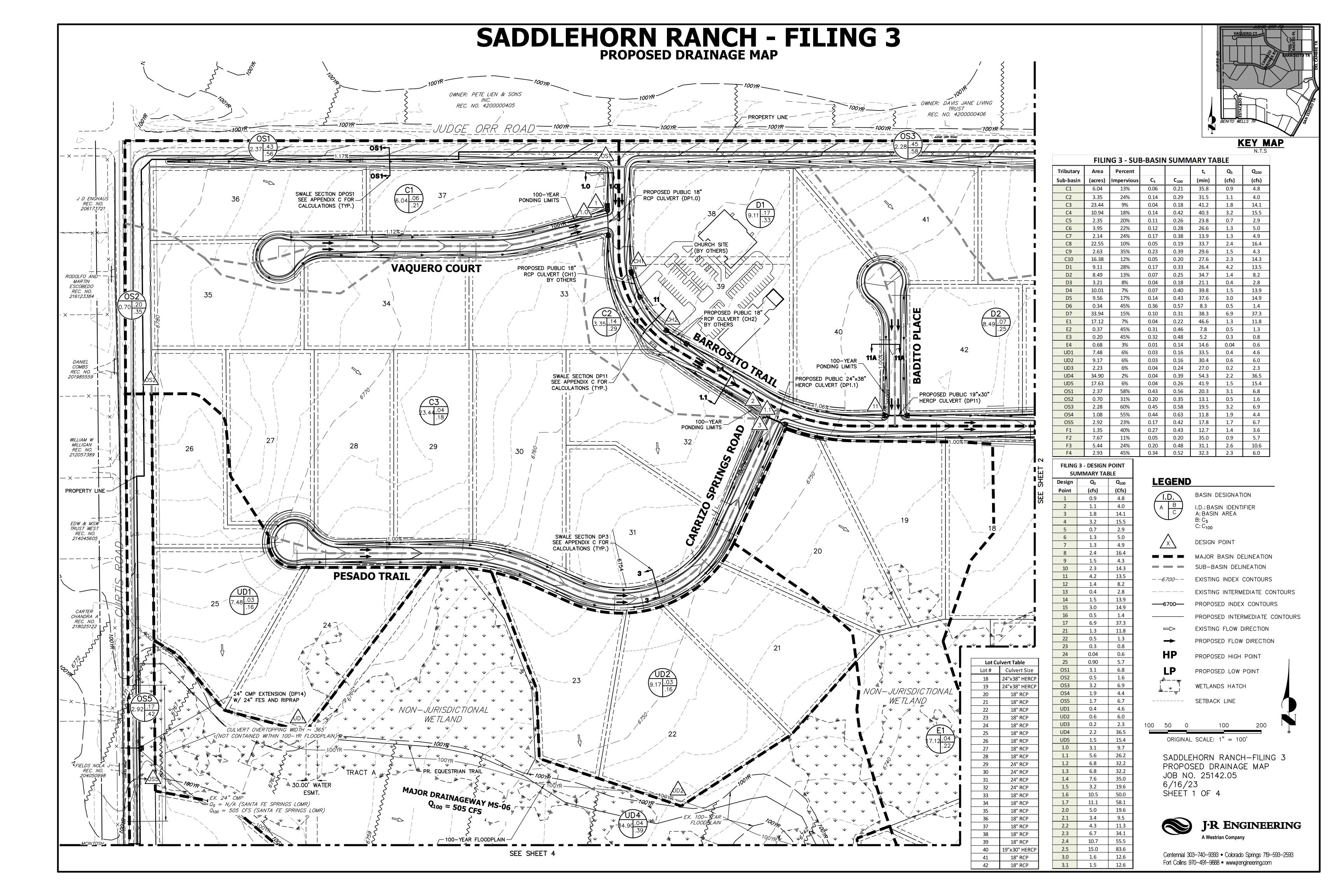
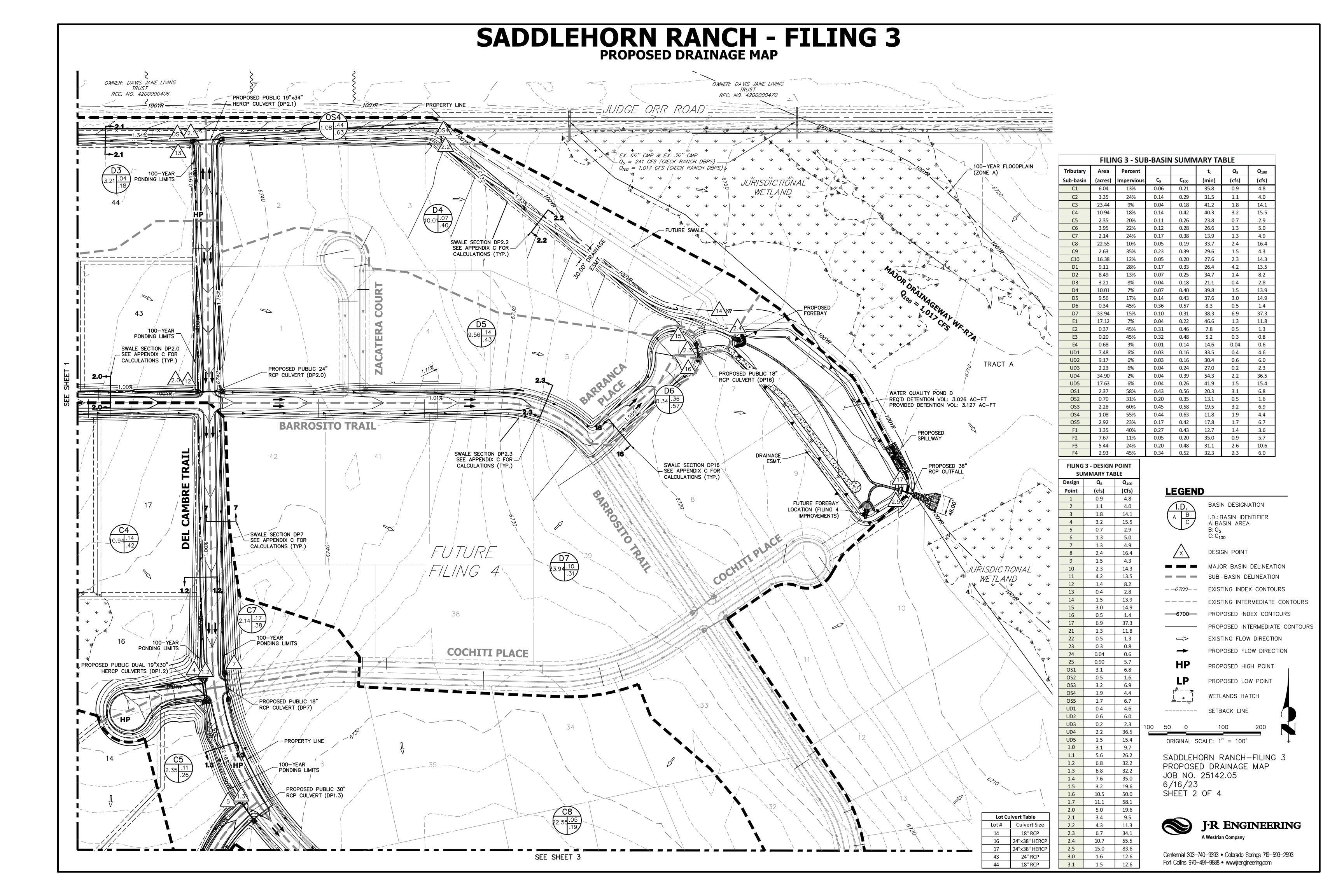
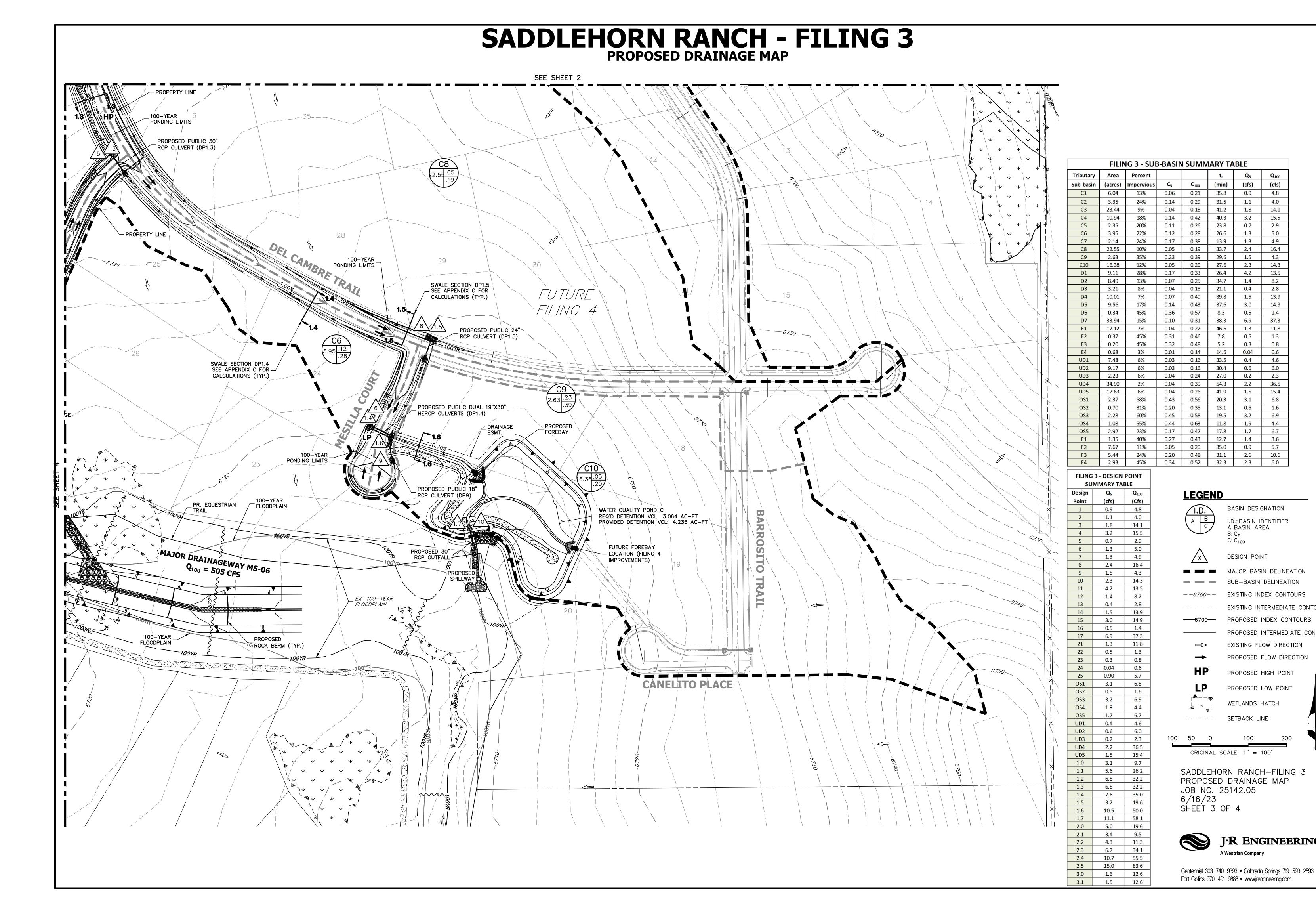


Figure 8-25. Swale stability chart: greater than 4-foot bottom width and 10:1 (or flatter) side slopes (Note: Riprap classifications refer to gradation for riprap used in soil riprap or void-filled riprap. See Figure 8-34 for gradations.) (Source: Muller Engineering Company)







BASIN DESIGNATION

A: BASIN AREA

DESIGN POINT

C: C<sub>100</sub>

I.D.: BASIN IDENTIFIER

MAJOR BASIN DELINEATION

SUB-BASIN DELINEATION

EXISTING INDEX CONTOURS

PROPOSED INDEX CONTOURS

EXISTING FLOW DIRECTION

PROPOSED HIGH POINT

PROPOSED LOW POINT

WETLANDS HATCH

SETBACK LINE

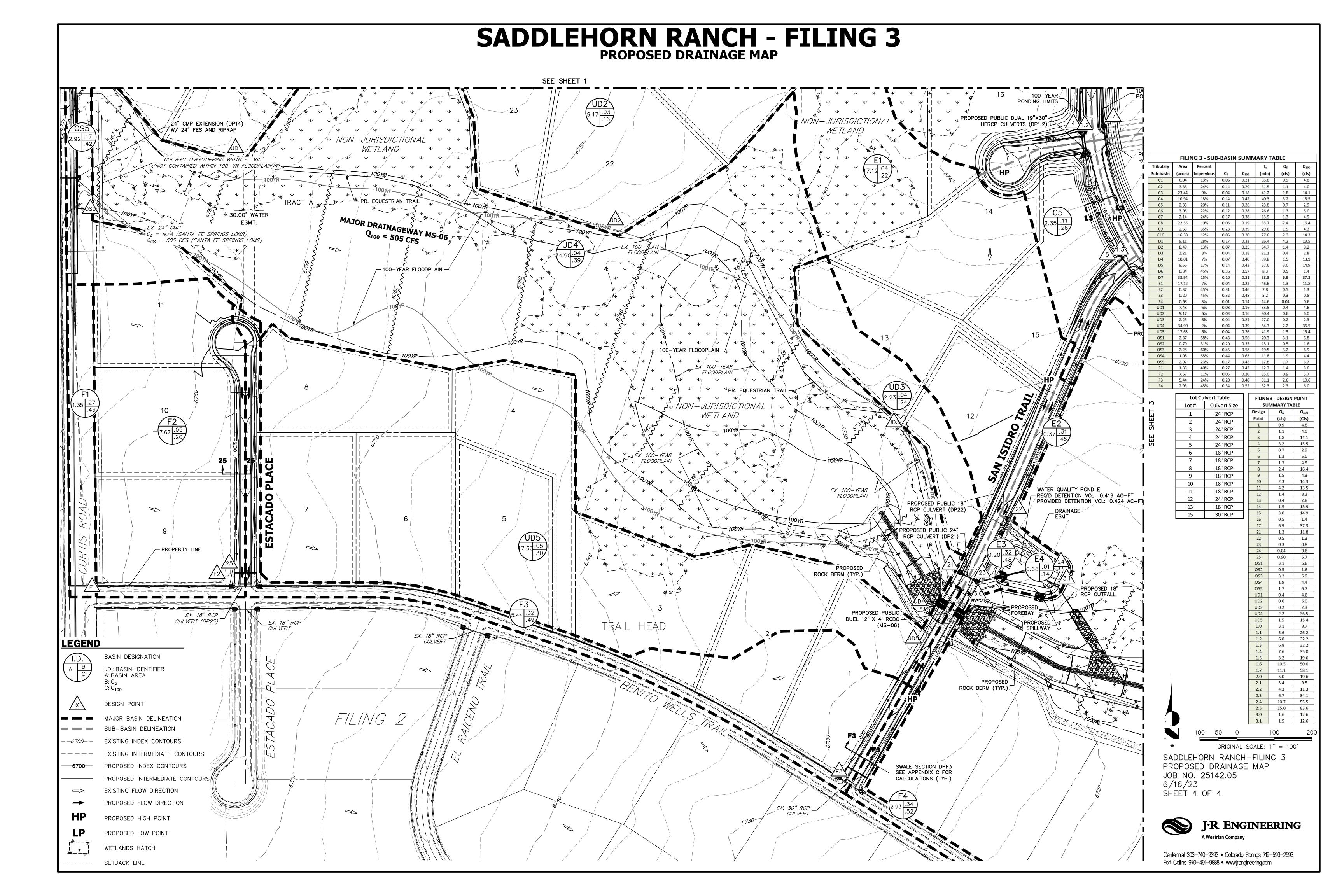
PROPOSED FLOW DIRECTION

J·R ENGINEERING

A Westrian Company

EXISTING INTERMEDIATE CONTOURS

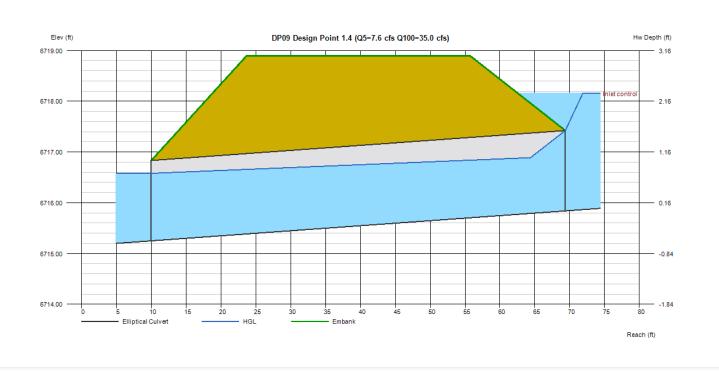
PROPOSED INTERMEDIATE CONTOURS



Tuesday, Dec 21 2021

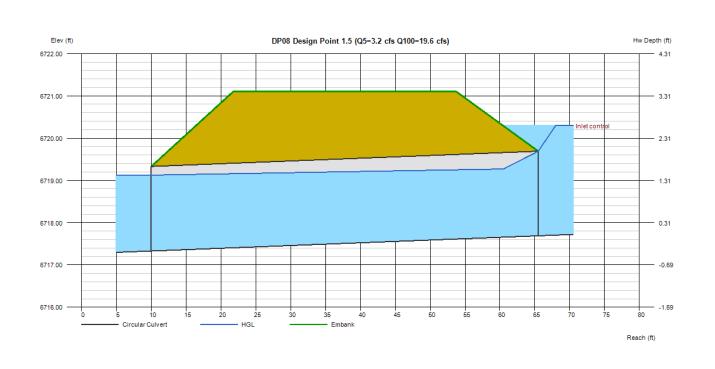
# DP09 Design Point 1.4 (Q5=7.6 cfs Q100=35.0 cfs)

Invert Elev Dn (ft)	= 6715.25	Calculations	
Pipe Length (ft)	= 59.38	Qmin (cfs)	= 7.60
Slope (%)	= 0.99	Qmax (cfs)	= 35.00
Invert Elev Up (ft)	= 6715.84	Tailwater Élev (ft)	= (dc+D)/2
Rise (in)	= 19.0	, ,	,
Shape	= Elliptical	Highlighted	
Span (in)	= 30.0	Qtotal (cfs)	= 35.00
No. Barrels	= 2	Qpipe (cfs)	= 35.00
n-Value	= 0.012		= 0.00
Culvert Type	= Horizontal Ellipse Concrete	Veloc Dn (ft/s)	= 6.02
Culvert Entrance	= Square edge w/headwall (H)	Veloc Up (ft/s)	= 7.51
Coeff. K,M,c,Y,k	= 0.01, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 6716.58
		HGL Up (ft)	= 6716.92
Embankment		Hw Elev (ft)	= 6718.15
Top Elevation (ft)	= 6718.90	Hw/D (ft)	= 1.46
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00	-	
Shape Span (in) No. Barrels n-Value Culvert Type Culvert Entrance Coeff. K,M,c,Y,k  Embankment Top Elevation (ft) Top Width (ft)	= Elliptical = 30.0 = 2 = 0.012 = Horizontal Ellipse Concrete = Square edge w/headwall (H) = 0.01, 2, 0.0398, 0.67, 0.5 = 6718.90 = 32.00	Qpipe (cfs) Qovertop (cfs) Veloc Dn (ft/s) Veloc Up (ft/s) HGL Dn (ft) HGL Up (ft) Hw Elev (ft) Hw/D (ft)	= 35.00 = 0.00 = 6.02 = 7.51 = 6716.58 = 6716.92 = 6718.15 = 1.46

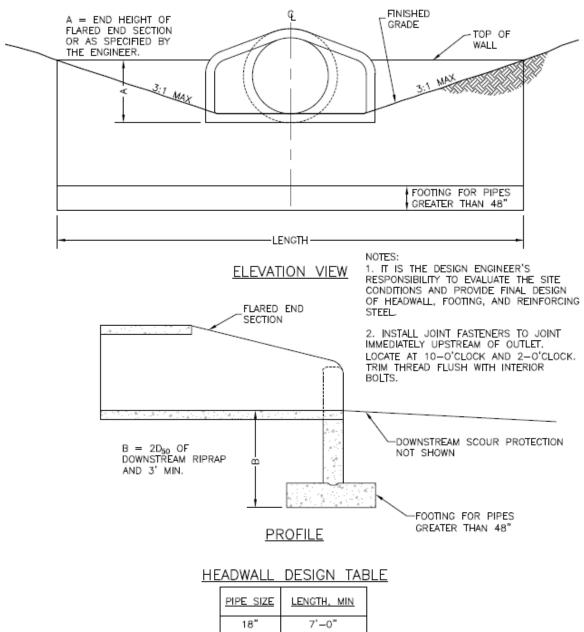


# DP08 Design Point 1.5 (Q5=3.2 cfs Q100=19.6 cfs)

Invert Elev Dn (ft)	= 6717.33	Calculations	
Pipe Length (ft)	= 55.50	Qmin (cfs)	= 3.20
Slope (%)	= 0.65	Qmax (cfs)	= 19.60
Invert Elev Up (ft)	= 6717.69	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 24.0		
Shape	= Circular	Highlighted	
Span (in)	= 24.0	Qtotal (cfs)	= 19.60
No. Barrels	= 1	Qpipe (cfs)	= 19.60
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	<ul><li>Circular Concrete</li></ul>	Veloc Dn (ft/s)	= 6.59
Culvert Entrance	<ul><li>= Groove end projecting (C)</li></ul>	Veloc Up (ft/s)	= 7.30
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2	HGL Dn (ft)	= 6719.13
		HGL Up (ft)	= 6719.28
Embankment		Hw Elev (ft)	= 6720.30
Top Elevation (ft)	= 6721.10	Hw/D (ft)	= 1.30
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 20.00		

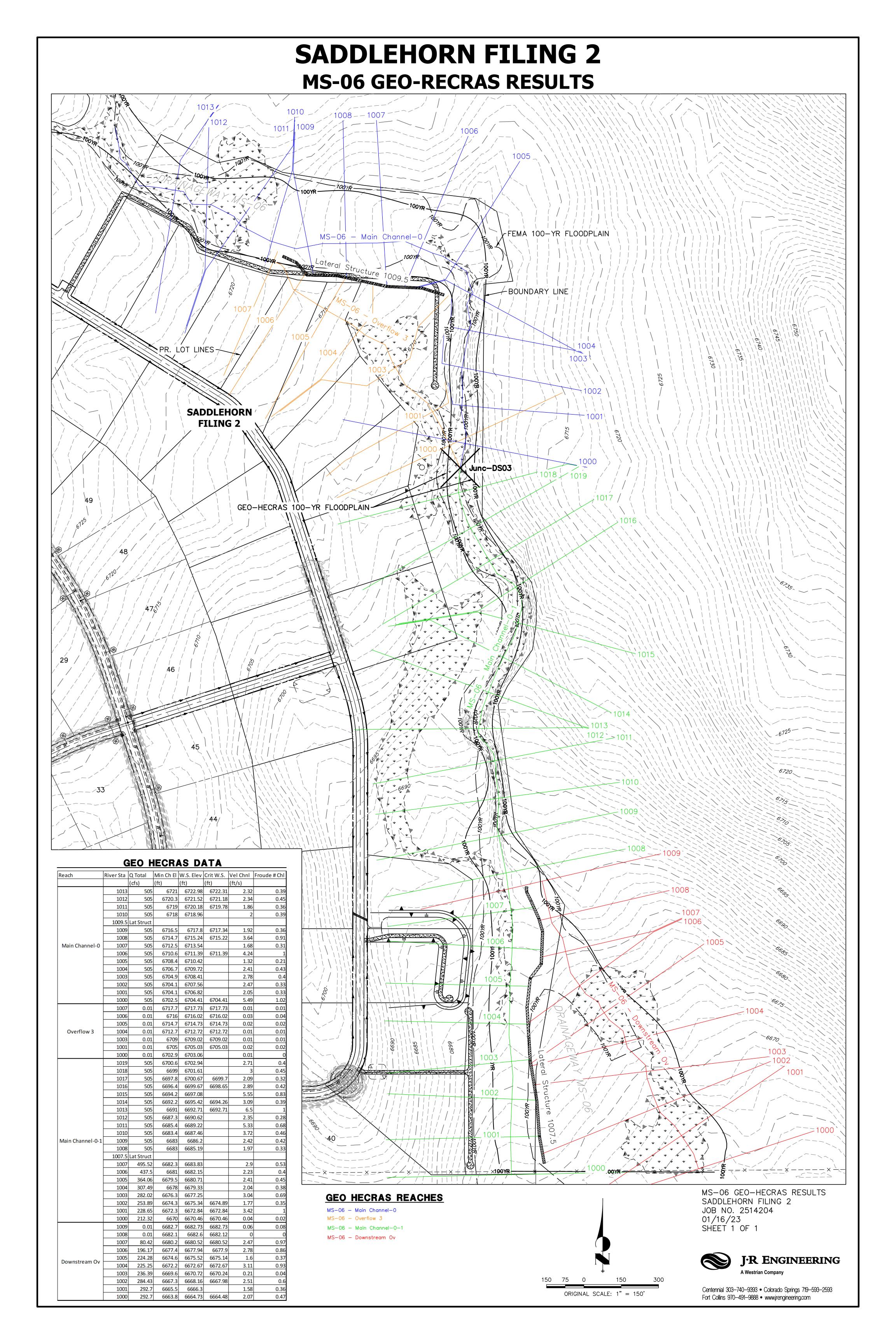


Hydraulic Structures Chapter 9



PIPE SIZE	LENGTH, MIN
18"	7'-0"
24"	8'-0"
30"	10'-0"
36"	12'-6"
42"	15'-9"
48"	17'-6"
54"	19'-6"
60"	21'-6"
66"	22'-6"
72"	24'-0"

Figure 9-29. Flared end section (FES) headwall concept



Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan	Hydr Depth
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)	(ft)
Main Channel-0	1014	100 yr	505.00	6721.50	6723.80		6724.00	0.002891	3.61	139.94	116.54	0.58	0.22	1.20
Main Channel-0	1013	100 yr	505.00	6721.00	6722.98	6722.31	6723.07	0.007902	2.32	217.55	200.88	0.39	0.53	1.08
Main Channel-0	1012	100 yr	505.00	6720.30	6721.52	6721.18	6721.61	0.011583	2.34	221.16	303.86	0.45	0.59	0.73
Main Channel-0	1011	100 yr	505.00	6719.00	6720.18	6719.78	6720.23	0.007171	1.86	280.35	393.62	0.36	0.37	0.71
Main Channel-0	1010	100 yr	505.00	6718.00	6718.96		6719.02	0.008246	2.00	256.25	332.21	0.39	0.43	0.77
Main Channel-0	1009.5		Lat Struct											
Main Channel-0	1009	100 yr	505.00	6716.50	6717.80	6717.34	6717.86	0.007267	1.92	266.02	329.30	0.36	0.39	0.81
Main Channel-0	1008	100 yr	505.00	6714.70	6715.24	6715.22	6715.45	0.054239	3.64	139.41	304.56	0.91	1.69	0.46
Main Channel-0	1007	100 yr	505.00	6712.50	6713.54		6713.58	0.005047	1.68	306.71	366.97	0.31	0.29	0.84
Main Channel-0	1006	100 yr	505.00	6710.60	6711.39	6711.39	6711.67	0.063578	4.24	119.11	214.06	1.00	2.22	0.56
Main Channel-0	1005	100 yr	505.00	6708.40	6710.42		6710.45	0.002217	1.32	382.27	353,43	0.21	0.17	1.08
Main Channel-0	1004	100 yr	505.00	6706.70	6709.72		6709.81	0.009820	2.41	209.21	214.32	0.43	0.60	0.98
Main Channel-0	1003	100 yr	505.00	6704.90	6708.41		6708.53	0.007229	2.78	181.66	119.49	0.40	0.68	1.52
Main Channel-0	1002	100 yr	505.00	6704.10	6707.56		6707.66	0.004579	2.47	204.77	114.46	0.33	0.51	1.79
Main Channel-0	1001	100 yr	505.00	6704.10	6706.82		6706.89	0.005420	2.05	246.08	205.82	0.33	0.40	
Main Channel-0	1000	100 yr	505.00	6702.50	6704.41	6704.41	6704.88	0.056085	5.49	92.02	101.57	1.02	3.17	0.91
Overflow 3	1007	100 yr	0.01	6717.70	6717.73	6717.73	6717.73	0.000010	0.01	1.62	70.54	0.01	0.00	0.02
Overflow 3	1006	100 yr	0.01	6716.00	6716.02	6716.02	6716.02	0.000282	0.03	0.32	15.35	0.04	0.00	0.02
Overflow 3	1005	100 yr	0.01	6714.70	6714.73	6714.73	6714.73	0.000072	0.02	0.67	35.03	0.02	0.00	0.02
Overflow 3	1004	100 yr	0.01	6712.70	6712.72	6712.72	6712.72	0.000015	0.01	1.44	74.63	0.01	0.00	
Overflow 3	1003	100 yr	0.01	6709.00	6709.02	6709.02	6709.02	0.000013	0.01	1.07	53.13	0.01	0.00	0.02
Overflow 3	1001	100 yr	0.01	6705.00	6705.02	6705.03	6705.03	0.000103	0.02	0.47	19.16	0.02	0.00	0.02
Overflow 3	1000	100 yr	0.01	6702.90	6703.06	0703.03	6703.06	0.000103	0.02	1.35	14.20	0.02	0.00	0.10
Main Channel-0-1	1019	100 yr	505.00	6700.60	6702.94		6703.05	0.007686	2.71	186.12	133.11	0.40	0.67	1.40
Main Channel-0-1	1018	100 yr	505.00	6699.00	6701.61		6701.75	0.007688	3.00	168.56	121.49	0.40	0.82	1.40
Main Channel-0-1	1017	100 yr	505.00	6697.80	6700.67	6699.70	6700.74	0.009409	2.09	241.29	178.67	0.43	0.40	1.35
Main Channel-0-1	1017	100 yr	505.00	6696.40	6699.67	6698.65	6699.80	0.004788	2.89	174.95	119.90	0.42	0.40	1.46
Main Channel-0-1	1015	100 yr	505.00	6694.20	6697.08	0090.00	6697.56	0.008234	5.55	90.95	64.93	0.42	2.81	1.40
Main Channel-0-1	1013	100 yr	505.00	6692.20	6695.42	6694.26	6695.56	0.032246	3.09	163.60	85.75	0.39	0.78	1.40
Main Channel-0-1	1014	100 yr	505.00	6691.00	6692.71	6692.71	6693.37	0.048628	6.50	77.64	59.48	1.00	3.95	1.31
Main Channel-0-1	1013	100 yr	505.00	6687.30	6690.62	0092.71	6690.70	0.048028	2.35	215.12	101.03	0.28	0.44	2.13
Main Channel-0-1	1012	100 yr	505.00	6685.40	6689.22		6689.66	0.003297	5.33	94.80	49.06	0.28	2.33	1.93
Main Channel-0-1	1010	100 yr	505.00	6683.40	6687.46		6687.68	0.019635	3.72	135.84	66.04	0.46	1.11	2.06
Main Channel-0-1	1009	100 yr	505.00	6683.00	6686.20		6686.29	0.008729	2.42	214.68	238.49	0.46	0.59	0.90
Main Channel-0-1	1009	-	505.00		6685.19			0.005416	1.97	258.32	242.87	0.42	0.38	1.06
		100 yr		6683.00	0000.19		6685.25	0.005416	1.97	256.32	242.01	0.33	0.36	1.06
Main Channel-0-1 Main Channel-0-1	1007.5	100 yr	Lat Struct 495.52	6682.30	6683.83		6683.96	0.015299	2.90	170.62	184.08	0.53	0.88	0.93
												0.53		
Main Channel-0-1	1006	100 yr	437.50	6681.00	6682.15		6682.23	0.008346	2.23	196.24	199.56		0.51	0.98
Main Channel-0-1 Main Channel-0-1	1005	100 yr 100 yr	364.06 307.49	6679.50 6678.00	6680.71 6679.33		6680.80 6679.39	0.011063 0.007656	2.41	151.00 151.03	168.54 164.90	0.45 0.38	0.62	0.90
Main Channel-0-1	1004		282.02				6677.40	0.007656	3.04	92.71	152.48	0.69	1.11	0.92
		100 yr		6676.30	6677.25									
Main Channel-0-1	1002	100 yr	253.89	6674.30	6675.34	6674.89	6675.39	0.006976	1.77	143.71	181.22	0.35	0.34	0.79
Main Channel-0-1	1001	100 yr	228.65	6672.30	6672.84	6672.84	6673.03	0.072944	3.42	66.87	182.58	1.00	1.66	0.37
Main Channel-0-1	1000	100 yr	212.32	6670.00	6670.46	6670.46	6670.46	0.000021	0.04	848.73	536.15	0.02	0.00	1.58
Downstream Ov	1009	100 yr	0.01	6682.70	6682.73	6682.73	6682.73	0.001427	0.06	0.16	9.47	0.08	0.00	0.02
Downstream Ov	1008	100 yr	0.01	6682.10	6682.60	6682.12	6682.60	0.000000	0.00	36.84	116.11	0.00	0.00	0.32
Downstream Ov	1007	100 yr	80.42	6680.20	6680.52	6680.52	6680.62	0.083611	2.47	32.52	160.20	0.97	1.06	0.20
Downstream Ov	1006	100 yr	196.17	6677.40	6678.05		6678.12	0.025914	2.07	94.87	253.99	0.60	0.60	0.37
Downstream Ov	1005	100 yr	224.28	6674.60	6675.42	6675.14	6675.48	0.013081	1.89	118.53	217.09	0.45	0.45	0.55
Downstream Ov	1004	100 yr	225.25	6672.20	6672.80	6672.65	6672.88	0.023526	2.26	100.02	224.82	0.59	0.68	0.44
Downstream Ov	1003	100 yr	236.39	6669.60	6670.57	6670.25	6670.62	0.010463	1.78	133.13	228.33	0.41	0.38	0.58
Downstream Ov	1002	100 yr	284.43	6667.30	6668.16	6667.98	6668.26	0.023487	2.51	113.35	210.84	0.60	0.79	0.54
Downstream Ov	1001	100 yr	292.70	6665.50	6666.30		6666.34	0.007891	1.58	187.58	345.81	0.36	0.30	0.54
Downstream Ov	1000	100 yr	292.70	6663.80	6664.73	6664.48	6664.79	0.013917	2.07	142.83	254.26	0.47	0.52	0.56

Highlighted cross sections shall be further analyzed in the Saddlehorn Filing No. 3
Final Drainage Report and CDs.

# APPENDIX F DRAINAGE MAPS & PLANS

