FINAL DRAINAGE REPORT
FOR
SADDLEHORN RANCH – FILING 2

Prepared For:
ROI Property Group, LLC
2495 Rigdon Street
Napa, CA 94558
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June 4, 2021
Project No. 25142.04

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

El Paso County PCD File No.:
SF-21-033

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.

____ _________________________

Mike Bramlett, Colorado P.E. # 32314 Date
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:

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

Business Name: ROI Property Group, LLC

By: ____________________________________

Title: ____________________________________
Address: 2495 Rigdon Street
Napa, CA 94558

El Paso County:

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

____ _________________________

Jennifer Irvine, P.E. Date
County Engineer/ ECM Administrator

Conditions:

Change to Joshua Palmer, P.E.

CONTENTS

PURPOSE

This document is the Final Drainage report for Filing 2 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 2, known as "Filing 2" from herein, is a parcel of land located in Section 3 and 10, Township 13 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. Saddlehorn Ranch is an 824 acre, rural, single family-development. Filing 2 is 176 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 2 is bound by future filings to the North and East while it is bound by Curtis Road to the West and to the South by Saddlehorn Filing 1. A vicinity map is presented in Appendix A.

Currently, there are two major Drainageway that will receive flows from Filing 2: Haegler Ranch Tributary 6 (T-6) 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.

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

Description of Property

Filing 2 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, Filing 2 slopes from northwest to southeast and the existing drainageways follows this topography.

Per a NRCS web soil survey of the area, Filing 2 is made up of Type A and D soils. Type A soils cover roughly 79% of Filing 2 while Type D soils cover 21% of Filing 2. 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 2 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 2 will occur in Zone X. The FIRM Map has been presented in Appendix A.

DRAINAGE BASINS AND SUB-BASINS

Existing Major Basin Descriptions

Filing 2 lies within Haegler Ranch Drainage Basin based on the "*Haegler Ranch Drainage Basin Planning Study*" prepared by URS Corporation in May 2009.

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.

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 120 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 for Saddlehorn Filing 3, berming will be provided that will protect proposed lots from overtopping flows.

The *Haegler Ranch DBPS* evaluated two detention alternatives for the drainage basin: region and sub regional. In the regional approach, it is recommended the existing 36" CMP be upsized to a 60" RCP. In the sub-regional approach, this culvert is recommended to be left in its existing condition.

The existing 36" CMP culvert will not be upsized within the context of this report and development. The culvert is owned by El Paso County and timing of improvements, if any, will be controlled by the County.

provide the analyisis - the channel is being platted in this filing

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. All MS-06 channel improvements will be proposed with the Filing 3 improvements. Per the Haegler Ranch DBPS sub-regional detention alternative, channel and culvert improvements are only proposed through proposed developments, or where the existing conditions are undersized. For the Filing 2 development, no existing conditions are undersized for the development and the proposed Pond F prevents any negative impacts to the drainageway. Discussions with the county during the preliminary planning phase also determined that the proposed MS-06 improvements would be constructed with the San Isidro culvert crossing improvements, and with the Saddlehorn Filing 3 and Filing 5 developments. All Drainageway T-6 improvements have been proposed with the Filing 1 improvements. See recommended channel improvement sheets from the *Haegler Ranch DBPS* 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. However, based on the *Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch,* Filing 2 will utilize an on-site full spectrum water quality and detention pond instead. This full spectrum detention pond will limit developed discharge into the MS-06 Drainageway 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.

Of the three drainageways that were evaluated in the LOMR, Haegler Ranch Tributary 3 and 4 run adjacent to Filing 2. Within the boundary of the proposed development, Haegler Ranch Tributary 3 is synonymous with MS-06 and Haegler Ranch Tributary 4 is synonymous with T-6 from the *Haegler Ranch DBPS*. The purpose of the LOMR was to revise the flood hazard depicted in the current Flood Insurance Study. Per the LOMR, an existing 100-year flow of 130 cfs crosses onto Filing 1 in Haegler Ranch Tributary 4. The off-site flow of 130 cfs carried within Tributary 4 was used to design the 84" RCP culvert and associated channel improvements outlined in the Filing 1 report. The off-site flow of 505 cfs carried with Tributary 3 through the site will be used to design the culvert crossing at San Isidro Trail with Filing 3.

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 Geick Ranch DBPS:	Per Sante Fe Springs LOMR:
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 2: Major Drainageway – Ex. 100-Year Flow Comparison

Major Drainageways: 100-Year Flow Comparison				
Drainageway Name	Contributing Area (sq. mi.)	Q_{100} Per Haegler Ranch DBPS:	Q_{100} Per Geick Ranch DBPS:	Q_{100} Per Sante Fe Springs LOMR:
MS-06 @ Curtis Road	1.05	590 cfs	N/A*	505 cfs
T-6 @ Curtis Road	0.39	120 cfs	N/A*	130 cfs

*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 the associated full spectrum water quality pond were established. As it pertains to Filing 2, one full spectrum water quality pond is recommended. Roadside ditches and local street culverts will be utilized to capture and convey Filing 2's runoff to the water quality pond. The proposed water quality pond will discharge into Drainageway MS-06 at less than historic rates.

All improvements to the Drainageway T-6, were proposed with the Filing 1 improvements. These improvements included an 84" reinforced concrete pipe (RCP) culvert at the crossing of Del Cerro Trail and Drainageway T-6, in addition to channel improvements up and downstream of the culvert. These culvert and channel improvements were designed to ensure a no-rise scenario in the floodplain.

Existing Sub-basin Drainage

On-site, existing sub-basin drainage patterns are generally from northwest to southeast by way of Drainageway T-6 and MS-06. On-site areas flow directly into these drainageways which also bypass off-site flows through the site.

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 has been provided in Appendix E.

Proposed Sub-basin Drainage

The proposed Filing 2 basin delineation is as follows;

Basin F consists of Sub-Basins F1-F10 combining for a total of 93.35 acres. In its existing condition, Basin F is rolling rangeland and runoff generally flows southeast 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 ditches and conveyed along Benito Wells Trail to Pond F. Pond F will be a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway MS-06.

Basin G consists of Sub-basins G1-G2 combining for a total of 18.8 acres. In its existing condition, Basin G is rolling rangeland and runoff generally flows south and east to Drainageway MS-06. In the proposed condition, Basin G will be rural 2.5 acre lots and paved roadway. Sub-basins G1 & G2 are tributary to Pond G, which was part of the Filing 1 improvements. In the *Final Drainage Report for Saddlehorn – Filing 1*, Sub-basins G1 and G2 were referenced as F-G1 & F-G2. These were analyzed as developed basins within the context of the Filing 1 report to adequately size ditches, culverts, and water quality pond for the fully developed future condition. Runoff from this basin will be collected in road side ditches and conveyed south along El Raiceno Trail and west along Carranza Trail to Pond G. Pond G is a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway T-6.

Basin UD consists of Sub-basins UD1-UD5 combining for a total of 92.13 acres. In their existing condition, these basins are rolling rangeland. Runoff from Basin UD1generally flows south and east to Drainageway T-6. Basins UD2, UD4, & UD5 generally flow south and east to Drainageway MS-06. Basin UD-3 represents Drainageway MS-06 and the runoff generated along the Filing 2 boundary. In the proposed condition, Basins UD1, UD2, UD4, and UD5 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-OS3 combining for a total of 2.77 acres of offsite area. In their existing condition, these basins are paved roadway (Curtis Road) and undeveloped area. In the proposed condition, Basin OS1 and OS3 will be improved with 8' of pavement width and the stretch of Curtis Road within basin OS2 will be improved with a deceleration lane for access to Filing 2. Basin OS1-OS2 will follow existing drainage patterns and will flow on-site prior to being captured in a roadside swale and conveyed to Pond F prior to being released into Drainageway MS-06. Basin OS3 will not be detained in Pond F due to its location relative to Pond F, as well as Section I.7.1.C.1.a of the ECM – Stormwater Quality Policy and Procedures states that up to 20%, not exceeding 1 acre, of the development site area can be excluded from permanent stormwater quality. The improvements along Curtis Road would add 42,240 ft^2 over the length of one mile and therefore meet the exclusion present in Section I.7.1.B.2.

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

Basin F runoff along with runoff from Sub-Basins OS1 and OS2 will be captured in roadside ditches and conveyed to the proposed full spectrum water quality and detention pond. This full spectrum pond will release treated flows at less than historic rates to minimize adverse impacts downstream. Pond F will discharge into Major Drainageway MS-06.

See Table 3 below for proposed Filing 2 pond parameters.

Table 3: Pond Summary

Tributary Sub-Basin	Pond Name	Tributary Acres	WQ Volume (ac-ft)	Total Detention Volume (ac-ft)	Provided Volume (ac-ft)	Maximum 100-Year Discharge (cfs)
F	POND F	95.54	0.684	2.911	3.011	38.5

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.

Urban Drainage and Flood Control District's UD-Detention, Version 4.04 workbook was used for 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

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. The runoff quantities, street grades, and the USDCM Manual's UD-Inlet spread sheet were utilized to determine the size of storm drain inlets and street capacities. 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 2 runoff to a full spectrum water quality and detention pond (Pond F) via roadside ditches and local street culverts. Pond F was designed to release at less than historic rates to minimize adverse impacts downstream.

All improvements aforementioned to Drainageway MS-06 shall be proposed with the Saddlehorn Filing 3 improvements. All improvements aforementioned to Drainageway T-6 have been proposed with the Saddlehorn Filing 1 Improvements. Outfall protection from Pond F is the only improvement to Drainageway MS-06 proposed with the Filing 2 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 2 utilizes roadside ditches with culvert crossings throughout. These roadside ditches direct the on-site development flows to the proposed detention pond within the project that releases at or below historic rates into Drainageway MS-06. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impact to downstream Drainageway MS-06 is anticipated.

Step 3, Provide WQCV: Runoff from this development is treated through capture and slow release of the WQCV in a full spectrum water quality and detention pond that is 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 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. Complete pond and outlet structure designs 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. The Erosion Control Plan for Filing 2 is 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 824 Acre Metropolitan No. 1. Vegetation in the natural and improved portions of Drainageway T-6 with the Filing 1 improvements is the responsibility of 824 Acre Metropolitan District No. 1. This includes all mowing, seeding and weed control activities. An Inspection & Maintenance Plan is submitted concurrently 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 2 Platted Acres: 176.85 ac
Total Filing 2 Impervious Acres = 17.7 ac (176.85 ac x 10%)

Filing 2 Fee Totals (Prior to Reductions):

Bridge Fees
$ 1,640/ac x 17.7 ac = $29,028

Drainage Fees
$11,113/ac x 17.7 ac = $196,700

Filing 2 Drainage Fee Reduction: 25% Reduction for Low Density Lots: $196,700 x 25% = $49,175

Filing 2 Fee Totals (After Reductions):

Bridge Fees
$ 1,640/ac x 17.7 ac = $29,028

Drainage Fees
$196,700 - $49,175 = $145,858

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 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 and is in accordance with the PDR/MDDP for Saddlehorn Ranch.

REFERENCES:

1. City of Colorado Springs Drainage Criteria Manual Volume 1, City of Colorado Springs, CO, May 2014.

2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.

3. Master Development Drainage Plan and Preliminary Drainage Report for Saddlehorn Ranch, JR Engineering, May 2020.

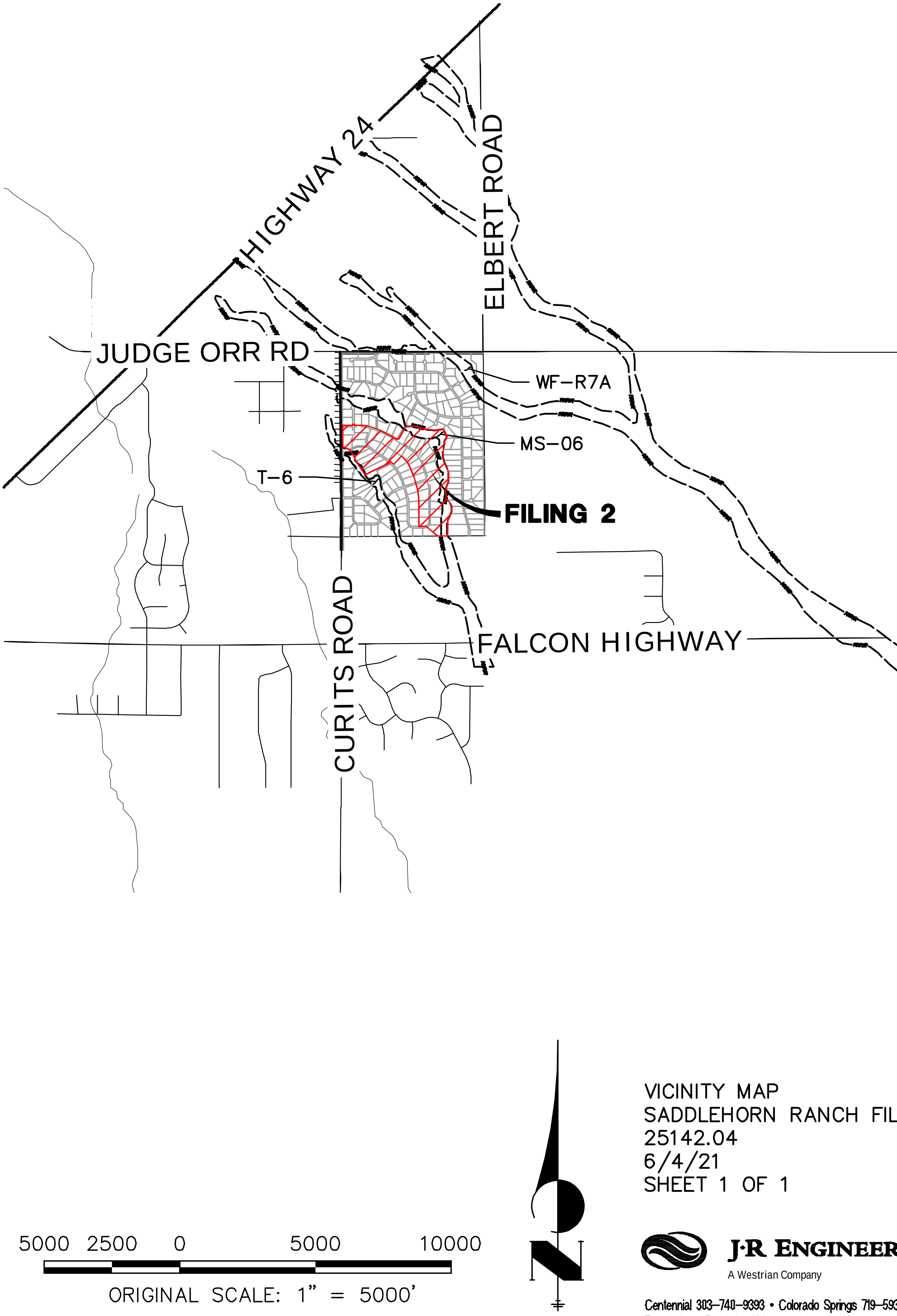
4. Haegler Ranch Drainage Basin Planning Study, URS Corporation, May 2009.

5. The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR, Federal Emergency Management Agency, October 20, 2004.

6. Final Drainage Report for Saddlehorn Ranch – Filing 1, JR Engineering, May 7, 2020

APPENDIX A

FIGURES AND EXHIBITS



VICINITY MAP
SADDLEHORN RANCH FILING 2
25142.04
6/4/21
SHEET 1 OF 1

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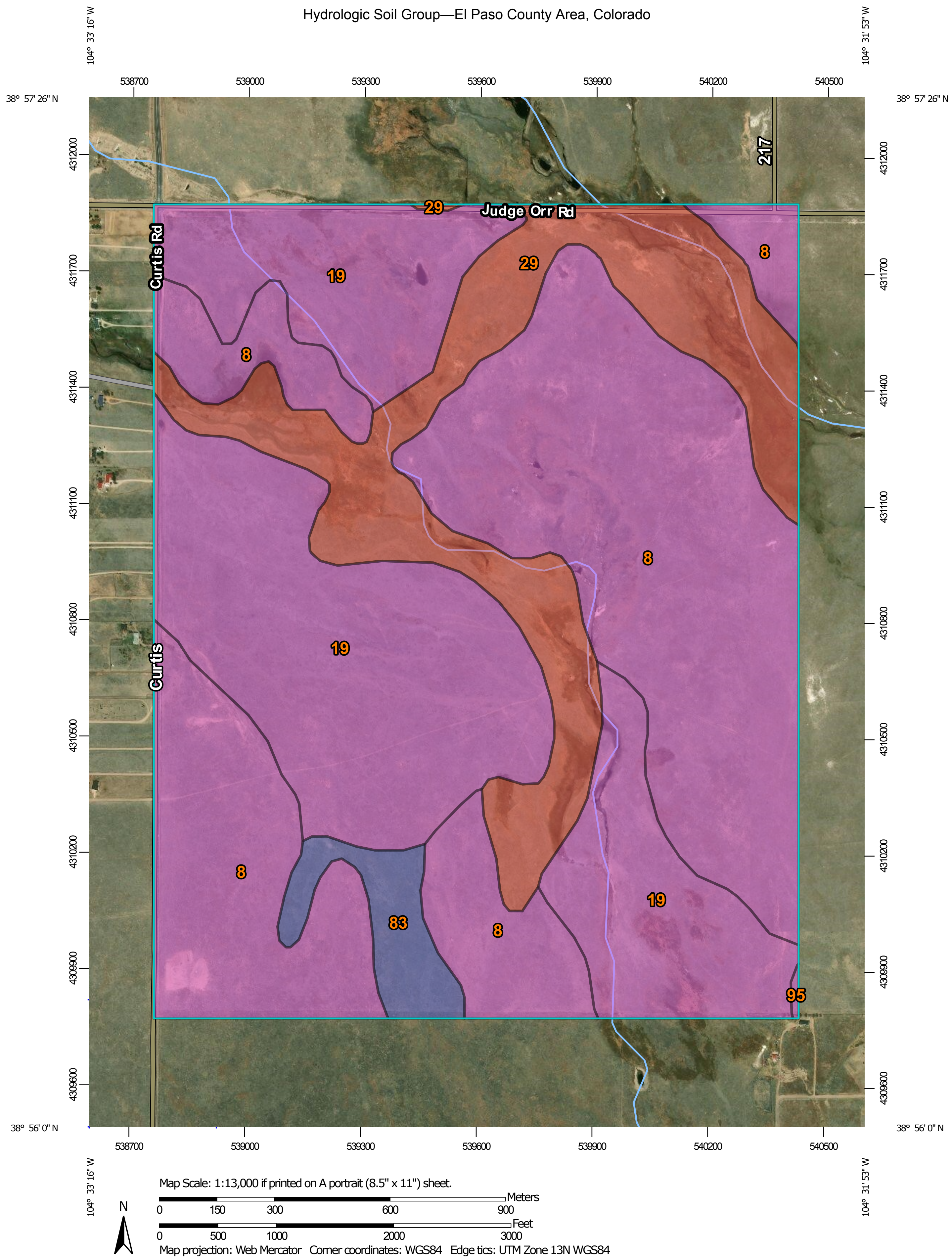


104° 33' 16" W
104° 31' 53" W
38° 57' 26" N
38° 56' 0" N
538700
539000
539300
539600
539900
540200
540500
4312000
4311700
4311400
4311100
4310800
4310500
4310200
4309900
4309600
Judge Orr Rd
Curtis Rd
Curtis
217
29
19
8
83
95
Map Scale: 1:13,000 if printed on A portrait (8.5" x 11") sheet.
Meters
0 150 300 600 900
Feet
0 500 1000 2000 3000
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, Sep 10, 2018

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

Date(s) aerial images were photographed: May 22, 2016—Aug 17, 2017

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	388.3	44.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	307.3	35.3%
29	Fluvaquentic Haplaquolls, nearly level	D	150.0	17.2%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	24.6	2.8%
95	Truckton loamy sand, 1 to 9 percent slopes	A	0.6	0.1%
Totals for Area of Interest			**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 floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

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

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

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

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, 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 and may appear outside of the floodplain.

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

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

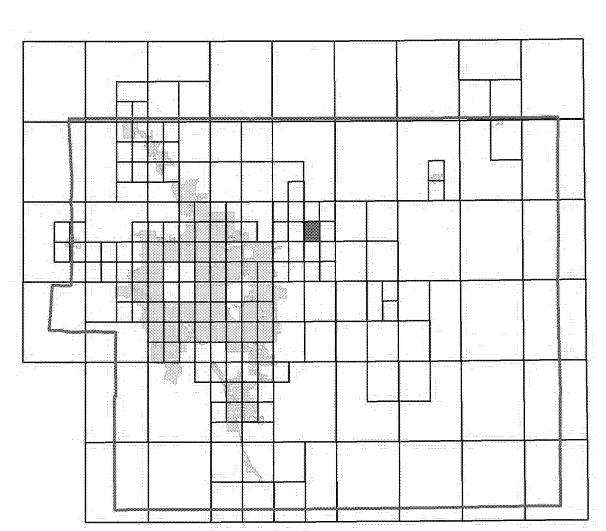
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this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

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

El Paso County Vertical Datum Offset Table

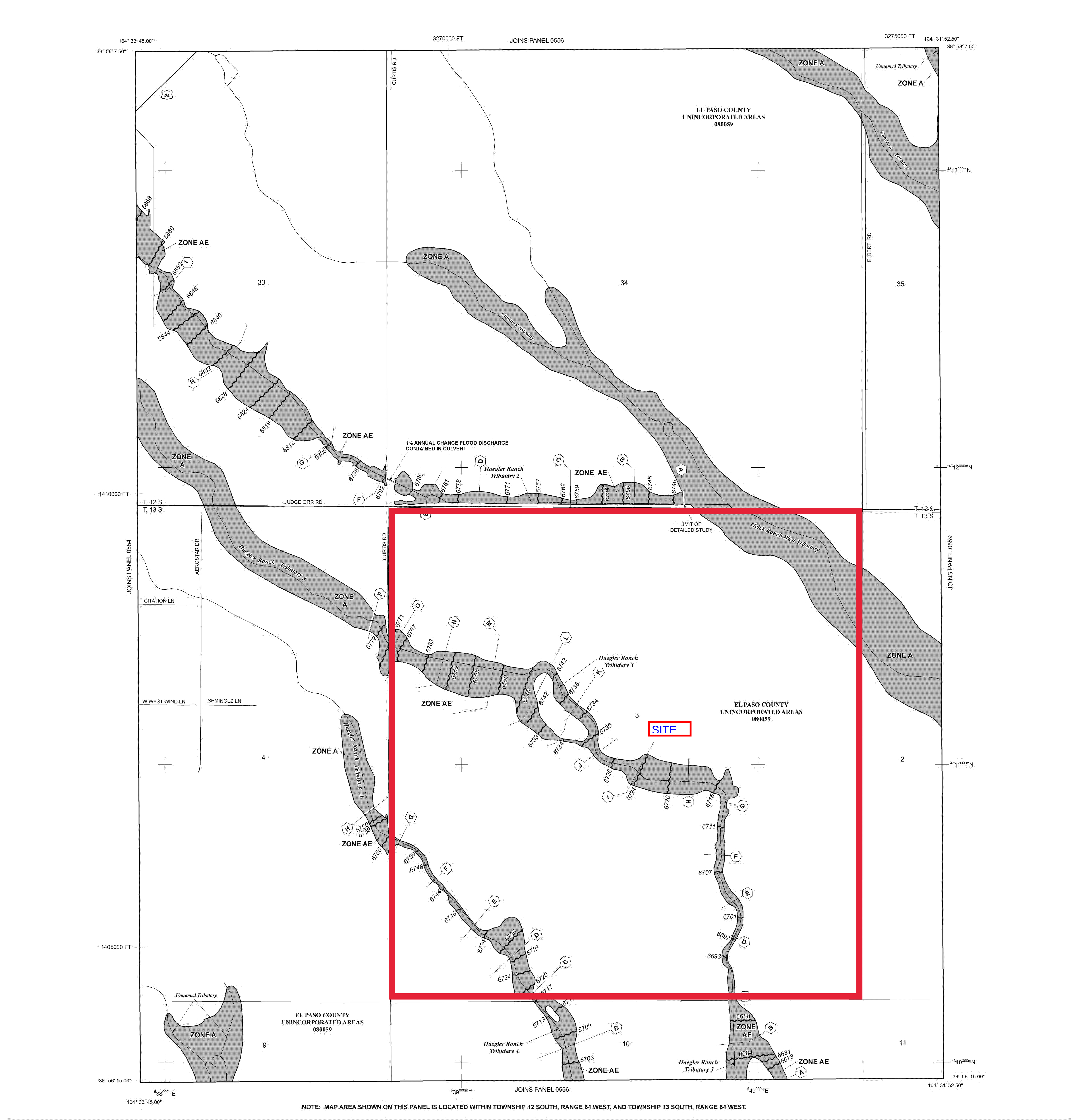
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



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

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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST, AND TOWNSHIP 13 SOUTH, RANGE 64 WEST.

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

(A)——(A) Cross section line
(23)- - - -(23) Transect line
97° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N 1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 × Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0558G

NATIONAL FLOOD INSURANCE PROGRAM

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

PANEL 558 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0558	G

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

MAP NUMBER
08041C0558G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

2021 Financial Assurance Estimate Form
(with pre-plat construction)

Updated: 12/22/2020

PROJECT INFORMATION		
Saddlehorn Ranch Filing 2 Improvements	1/2/2022	SF-21-033
Project Name	Date	PCD File No.

Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction) % Complete	Remaining	
SECTION 1 - GRADING AND EROSION CONTROL (Construction and Permanent BMPs)								
* Earthwork								*
less than 1,000; $5,300 min		CY	$ 8.00	=	$ -		$ -	*
1,000-5,000; $8,000 min		CY	$ 6.00	=	$ -		$ -	*
5,001-20,000; $30,000 min		CY	$ 5.00	=	$ -		$ -	*
20,001-50,000; $100,000 min		CY	$ 3.50	=	$ -		$ -	*
50,001-200,000; $175,000 min	50,633	CY	$ 2.50	=	$ 175,000.00		$ 175,000.00	*
greater than 200,000; $500,000 min		CY	$ 2.00	=	$ -		$ -	*
* Permanent Seeding (inc. noxious weed mgmnt.)	6	AC	$ 828.00	=	$ 5,266.08		$ 5,266.08	*
* Mulching	6	AC	$ 777.00	=	$ 4,662.00		$ 4,662.00	*
* Permanent Erosion Control Blanket	0	SY	$ 6.00	=	$ -		$ -	*
* Permanent Pond/BMP Construction	See Below	CY	$ -	=			$ -	*
* Permanent Pond/BMP (provide engineer's estimate)		EA		=	$ -		$ -	*
*30" RCP	44	LF	$ 100.00	=	$ 4,400.00		$ 4,400.00	*
*Detention Outlet Structure	1	EA	$ 5,000.00	=	$ 5,000.00		$ 5,000.00	
*Concrete/Riprap Forebay	1	EA	$ 3,000.00	=	$ 3,000.00		$ 3,000.00	
*Concrete Trickle Channel	330	CY	$ 95.00	=	$ 31,350.00		$ 31,350.00	
*Detention Emergency Spillway	1	EA	$ 4,000.00		$ 4,000.00		$ 4,000.00	
*Drainageway riprap, d50 size from 6" to 24"	694	Tons	$ 83.00		$ 57,602.00		$ 57,602.00	
*30" - Flared End Section (FES)	1	EA	$ 600.00	=	$ 600.00		$ 600.00	
*Permanent WQ Feature (EDB)	1	EA	$ 5,000.00		$ 5,000.00		$ 5,000.00	
*Gravel Maintenance Access Road	1,046	SY	$ 45.00		$ 47,070.00		$ 47,070.00	
					$ -		$ -	
Construction Markers	8,102	LF	$ 3.00	=	$ 24,306.00		$ 24,306.00	
Temporary Erosion Control Blanket	3,642	SY	$ 3.00	=	$ 10,926.00		$ 10,926.00	
Vehicle Tracking Control	2	EA	$ 2,453.00	=	$ 4,906.00		$ 4,906.00	
Silt Fence	11,010	LF	$ 2.60	=	$ 28,626.00		$ 28,626.00	
Temporary Seeding	13	AC	$ 650.00	=	$ 8,450.00		$ 8,450.00	
Temporary Mulch	13	AC	$ 777.00	=	$ 10,101.00		$ 10,101.00	
Erosion Bales	0	EA	$ 26.00	=	$ -		$ -	
Erosion Logs/Straw Waddle	0	LF	$ 5.00	=	$ -		$ -	
Rock Check Dams	36	EA	$ 518.00	=	$ 18,648.00		$ 18,648.00	
Inlet Protection	17	EA	$ 173.00	=	$ 2,941.00		$ 2,941.00	
Sediment Basin	1	EA	$ 1,824.00	=	$ 1,824.00		$ 1,824.00	
Concrete Washout Basin	1	EA	$ 932.00	=	$ 932.00		$ 932.00	
Safety Fence	50	LF	$ 5.00	=	$ 250.00		$ 250.00	
[insert items not listed but part of construction plans]					$ -		$ -	
								*
MAINTENANCE (35% of Construction BMPs)				=	$ 30,661.40		$ 30,661.40	*
* - Subject to defect warranty financial assurance. A minimum of 20% shall			**Section 1 Subtotal**	=	$ 485,521.48		$ 485,521.48	*
SECTION 2 - PUBLIC IMPROVEMENTS *								*
ROADWAY IMPROVEMENTS								*
								*
Mobilization/Construction Traffic Control	1	LS	$ 50,000.00	=	$ 50,000.00		$ 50,000.00	*
Removal of Asphalt (Full Depth)	210	SY	$ 10.00		$ 2,100.00		$ 2,100.00	*
Removal of Asphalt (Planing-4")	837	SY	$ 5.00		$ 4,185.00		$ 4,185.00	*
Removal of Striping	7,534	LF	$ 1.00		$ 7,534.00		$ 7,534.00	*
Removal of Fencing	1,096	LF	$ 5.00		$ 5,480.00		$ 5,480.00	*
Aggregate Base Course (135 lbs/cf)	5,080	Tons	$ 29.00	=	$ 147,320.00		$ 147,320.00	*
Aggregate Base Course (135 lbs/cf)		CY	$ 52.00		$ -		$ -	*
Asphalt Pavement (3" thick)		SY	$ 14.50		$ -		$ -	*
Asphalt Pavement (4" thick)		SY	$ 20.00		$ -		$ -	*
Asphalt Pavement (6" thick)		SY	$ 30.00		$ -		$ -	*
Asphalt Pavement (147 lbs/cf) _" thick	20,805	Tons	$ 91.00	=	$ 1,893,255.00		$ 1,893,255.00	*
Raised Median, Paved		SF	$ 8.30	=	$ -		$ -	*
Regulatory Sign/Advisory Sign	7	EA	$ 311.00	=	$ 2,177.00		$ 2,177.00	*
Guide/Street Name Sign	13	EA	$ 250.00	=	$ 3,250.00		$ 3,250.00	*
Epoxy Pavement Marking	4,122	SF	$ 14.00	=	$ 57,708.00		$ 57,708.00	*
Thermoplastic Pavement Marking	87	SF	$ 24.00	=	$ 2,097.60		$ 2,097.60	*
Barricade - Type 3	8	EA	$ 207.00	=	$ 1,656.00		$ 1,656.00	*
Delineator - Type I		EA	$ 25.00	=	$ -		$ -	*
Curb and Gutter, Type A (6" Vertical)		LF	$ 31.00	=	$ -		$ -	*

PROJECT INFORMATION		
Saddlehorn Ranch Filing 2 Improvements	1/2/2022	SF-21-033
Project Name	Date	PCD File No.

Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction) % Complete	Remaining	
Curb and Gutter, Type B (Median)		LF	$ 31.00	=	$ -		$ -	*
Curb and Gutter, Type C (Ramp)		LF	$ 31.00	=	$ -		$ -	*
4" Sidewalk (common areas only)		SY	$ 50.00	=	$ -		$ -	*
5" Sidewalk		SY	$ 62.00	=	$ -		$ -	*
6" Sidewalk		SY	$ 75.00	=	$ -		$ -	*
8" Sidewalk		SY	$ 99.00		$ -		$ -	*
Pedestrian Ramp		EA	$ 1,190.00	=	$ -		$ -	*
Cross Pan, local (8" thick, 6' wide to include return)		LF	$ 63.00	=	$ -		$ -	*
Cross Pan, collector (9" thick, 8' wide to include return)		LF	$ 95.00		$ -		$ -	*
Curb Chase		EA	$ 1,532.00	=	$ -		$ -	
Guardrail Type 3 (W-Beam)		LF	$ 51.00	=	$ -		$ -	*
Guardrail Type 7 (Concrete)		LF	$ 75.00	=	$ -		$ -	*
Guardrail Impact Attenuator		EA	$ 3,899.00	=	$ -		$ -	*
Sound Barrier Fence (CMU block, 6' high)		LF	$ 81.00		$ -		$ -	*
Sound Barrier Fence (panels, 6' high)		LF	$ 83.00	=	$ -		$ -	*
Electrical Conduit, Size =		LF	$ 17.00	=	$ -		$ -	*
Traffic Signal, complete intersection		EA	$ 439,875	=	$ -		$ -	*
Traffic Signal, complete intersection		EA	$ 439,875	=	$ -		$ -	*
[insert items not listed but part of construction plans]				=	$ -		$ -	*
STORM DRAIN IMPROVEMENTS								*
Concrete Box Culvert (M Standard), Size (W x H)		LF		=	$ -		$ -	*
18" Reinforced Concrete Pipe	223	LF	$ 67.00	=	$ 14,941.00		$ 14,941.00	*
24" Reinforced Concrete Pipe	123	LF	$ 81.00	=	$ 9,963.00		$ 9,963.00	*
19" x 30" Horizontal Elliptical Reinforced Concrete Pipe	68	LF	$ 100.00	=	$ 6,800.00		$ 6,800.00	*
54" Corrugated Steel Pipe		LF	$ 269.00	=	$ -		$ -	
30" Corrugated Steel Pipe	16	LF	$ 100.00	=	$ 1,600.00		$ 1,600.00	
60" Corrugated Steel Pipe		LF	$ 290.00	=	$ -		$ -	*
66" Corrugated Steel Pipe		LF	$ 352.00	=	$ -		$ -	*
72" Corrugated Steel Pipe		LF	$ 414.00	=	$ -		$ -	*
18" - Flared End Section (FES)	6	EA	$ 402.00		$ 2,412.00		$ 2,412.00	*
18" - Flared End Section (FES)	8	EA	$ 402.00		$ 3,216.00		$ 3,216.00	*
24" - Flared End Section (FES)	4	EA	$ 486.00		$ 1,944.00		$ 1,944.00	*
19" x 30" - Flared End Section (FES)	2	EA	$ 600.00		$ 1,200.00		$ 1,200.00	*
30" - Flared End Section (FES)	2	EA	$ 600.00		$ 1,200.00		$ 1,200.00	*
Flared End Section (FES) CSP Size = 30" (unit cost = 6x pipe unit cost)	1	EA	$ 600.00	=	$ 600.00		$ 600.00	*
End Treatment- Headwall		EA		=	$ -		$ -	*
End Treatment- Wingwall		EA		=	$ -		$ -	*
End Treatment - Cutoff Wall		EA		=	$ -		$ -	*
Curb Inlet (Type R) L=5', Depth < 5'		EA	$ 5,736.00	=	$ -		$ -	*
Curb Inlet (Type R) L=5', 5' ≤ Depth < 10'		EA	$ 7,440.00	=	$ -		$ -	*
Curb Inlet (Type R) L =5', 10' ≤ Depth < 15'		EA	$ 8,637.00	=	$ -		$ -	*
Curb Inlet (Type R) L =10', Depth < 5'		EA	$ 7,894.00	=	$ -		$ -	*
Curb Inlet (Type R) L =10', 5' ≤ Depth < 10'		EA	$ 8,136.00	=	$ -		$ -	*
Curb Inlet (Type R) L =10', 10' ≤ Depth < 15'		EA	$ 10,185.00	=	$ -		$ -	*
Curb Inlet (Type R) L =15', Depth < 5'		EA	$ 10,265.00	=	$ -		$ -	*
Curb Inlet (Type R) L =15', 5' ≤ Depth < 10'		EA	$ 11,005.00	=	$ -		$ -	*
Curb Inlet (Type R) L =15', 10' ≤ Depth < 15'		EA	$ 12,034.00	=	$ -		$ -	*
Curb Inlet (Type R) L =20', Depth < 5'		EA	$ 10,940.00	=	$ -		$ -	*
Curb Inlet (Type R) L =20', 5' ≤ Depth < 10'		EA	$ 12,075.00	=	$ -		$ -	*
Grated Inlet (Type C), Depth < 5'		EA	$ 4,802.00	=	$ -		$ -	
Grated Inlet (Type D), Depth < 5'		EA	$ 5,932.00	=	$ -		$ -	*
Storm Sewer Manhole, Box Base		EA	$ 12,034.00	=	$ -		$ -	
Storm Sewer Manhole, Slab Base		EA	$ 6,619.00	=	$ -		$ -	
Geotextile (Erosion Control)		SY	$ 6.20	=	$ -		$ -	
Rip Rap, d50 size from 6" to 24"	476	Tons	$ 83.00	=	$ 39,508.00		$ 39,508.00	
Rip Rap, Grouted		Tons	$ 98.00	=	$ -		$ -	
Drainage Channel Lining, Concrete		CY	$ 590.00	=	$ -		$ -	
Drainage Channel Lining, Rip Rap		CY	$ 116.00	=	$ -		$ -	
Drainage Channel Lining, Grass		AC		=	$ -		$ -	
Drainage Channel Lining, Other Stabilization				=	$ -		$ -	
				=	$ -		$ -	
[insert items not listed but part of construction plans]				=	$ -		$ -	
* - Subject to defect warranty financial assurance. A minimum of 20% shall			**Section 2 Subtotal**	=	$ 2,266,446.60		$ 2,266,446.60	

PROJECT INFORMATION		
Saddlehorn Ranch Filing 2 Improvements	1/2/2022	SF-21-033
Project Name	Date	PCD File No.

Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction) % Complete	Remaining
SECTION 3 - COMMON DEVELOPMENT IMPROVEMENTS (Private or District and NOT Maintained by EPC)**							
ROADWAY IMPROVEMENTS							
				=	$ -		$ -
				=	$ -		$ -
STORM DRAIN IMPROVEMENTS (Exception: Permanent Pond/BMP shall be itemized under Section 1)							
				=	$ -		$ -
				=	$ -		$ -
				=	$ -		$ -
WATER SYSTEM IMPROVEMENTS							
Water Main Pipe (PVC), Size 8"	6,800	LF	$ 66.00	=	$ 448,800.00		$ 448,800.00
Water Main Pipe (PVC), Size 12"	1,696	LF	$ 100.00		$ 169,600.00		$ 169,600.00
Water Main Pipe (PVC), Size 6"	243	LF	$ 66.00		$ 16,038.00		$ 16,038.00
Water Main Pipe (Ductile Iron), Size 8"		LF	$ 78.00	=	$ -		$ -
					$ -		$ -
Gate Valves, 8"	22	EA	$ 1,923.00	=	$ 42,306.00		$ 42,306.00
Gate Valves, 12"	6	EA	$ 2,900.00		$ 17,400.00		$ 17,400.00
Fire Hydrant Assembly, w/ all valves	18	EA	$ 6,828.00	=	$ 122,904.00		$ 122,904.00
Water Service Line Installation, inc. tap and valves	42	EA	$ 1,370.00	=	$ 57,540.00		$ 57,540.00
Fire Cistern Installation, complete		EA		=	$ -		$ -
				=	$ -		$ -
[insert items not listed but part of construction plans]				=	$ -		$ -
SANITARY SEWER IMPROVEMENTS							
Sewer Main Pipe (PVC), Size 8"		LF	$ 66.00	=	$ -		$ -
Sanitary Sewer Manhole, Depth < 15 feet		EA	$ 4,540.00	=	$ -		$ -
Sanitary Service Line Installation, complete		EA	$ 1,451.00	=	$ -		$ -
Sanitary Sewer Lift Station, complete		EA		=	$ -		$ -
				=	$ -		$ -
[insert items not listed but part of construction plans]				=	$ -		$ -
LANDSCAPING IMPROVEMENTS (For subdivision specific condition of approval, or PUD)							
		EA		=	$ -		$ -
		EA		=	$ -		$ -
		EA		=	$ -		$ -
		EA		=	$ -		$ -
		EA		=	$ -		$ -
** - Section 3 is not subject to defect warranty requirements			**Section 3 Subtotal**	=	$ 874,588.00		$ 874,588.00
AS-BUILT PLANS (Public Improvements inc. Permanent 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 Construction Financial Assurance $ 3,646,556.08

(Sum of all section subtotals plus as-builts and pond/BMP certification)

Total Remaining Construction Financial Assurance (with Pre-Plat Construction) $ 3,646,556.08

(Sum of all section totals less credit for items complete plus as-builts and pond/BMP certification)

Total Defect Warranty Financial Assurance $ 490,274.94

(20% of all items identified as (*). To be collateralized at time of preliminary acceptance)

Approvals

I hereby certify that this is an accurate and complete estimate of costs for the work as shown on the Grading and Erosion Control Plan and Construction Drawings associated with the Project.

Engineer (P.E. Seal Required)

Approved by Owner / Applicant

Date

Approved by El Paso County Engineer / ECM Administrator

Date

APPENDIX B

HYDROLOGIC CALCULATIONS

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Saddlehorn Ranch
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.04
Calculated By: AAM
Checked By: TBD
Date: 6/4/21

		Paved Roads			2.5 Acre Rural Lots			Lawns			Basins Total
Basin ID	Total Area (ac)	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	Weighted % Imp.
F1	4.93	45%	0.97	8.9%	6.2%	3.96	5.0%	2%	0.00	0.0%	13.8%
F2	3.77	45%	1.44	17.2%	6.2%	2.33	3.8%	2%	0.00	0.0%	21.0%
F3	33.31	45%	2.99	4.0%	6.2%	30.32	5.6%	2%	0.00	0.0%	9.7%
F4	14.38	45%	0.80	2.5%	6.2%	13.58	5.9%	2%	0.00	0.0%	8.4%
F5	19.25	45%	2.66	6.2%	6.2%	16.59	5.3%	2%	0.00	0.0%	11.6%
F6	7.67	45%	0.98	5.7%	6.2%	6.69	5.4%	2%	0.00	0.0%	11.2%
F7	2.37	45%	2.37	45.0%	6.2%	0.00	0.0%	2%	0.00	0.0%	45.0%
F8	2.93	45%	2.93	45.0%	6.2%	0.00	0.0%	2%	0.00	0.0%	45.0%
F9	0.87	45%	0.87	45.0%	6.2%	0.00	0.0%	2%	0.00	0.0%	45.0%
F10	3.87	45%	0.00	0.0%	6.2%	2.20	3.5%	2%	1.67	0.9%	4.4%
G1	17.59	45%	1.35	3.5%	6.2%	16.24	5.7%	2%	0.00	0.0%	9.2%
G2	1.21	45%	1.21	45.0%	6.2%	0.00	0.0%	2%	0.00	0.0%	45.0%
UD1	16.50	45%	0.00	0.0%	6.2%	16.50	6.2%	2%	0.00	0.0%	6.2%
UD2	23.67	45%	0.00	0.0%	6.2%	23.67	6.2%	2%	0.00	0.0%	6.2%
UD3	44.34	45%	0.00	0.0%	6.2%	0.00	0.0%	2%	44.34	2.0%	2.0%
UD4	1.80	45%	0.00	0.0%	6.2%	1.80	6.2%	2%	0.00	0.0%	6.2%
UD5	5.82	45%	0.00	0.0%	6.2%	5.82	6.2%	2%	0.00	0.0%	6.2%
OS1	1.35	100%	0.53	39.3%	6.2%	0.00	0.0%	2%	0.82	1.2%	40.5%
OS2	0.84	100%	0.42	50.0%	6.2%	0.00	0.0%	2%	0.42	1.0%	51.0%
OS3	0.58	100%	0.18	31.0%	6.2%	0.00	0.0%	2%	0.40	1.4%	32.4%
TOTAL	207.05										9.2%

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

2.5 Acre Rural Lots - Comp. % Impervious Calculation			
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. % Impervious 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
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.04
Calculated By: AAM
Checked By: TBD
Date: 6/4/21

Basin ID	Total Area (ac)	Basins Total Weighted % Imp.	Hydrologic Soil Group			Hydrologic Soil Group			Minor Coefficients			Major Coefficients			Basins Total Weighted C_5	Basins Total Weighted C_{100}
			Area A (ac)	Area B (ac)	Area C/D (ac)	% A (ac)	% B (ac)	% C/D (ac)	$C_{5,A}$	$C_{5,B}$	$C_{5,C/D}$	$C_{100,A}$	$C_{100,B}$	$C_{100,C/D}$		
F1	4.93	13.8%	4.93	0.00	0.00	100%	0%	0%	0.07	0.10	0.15	0.22	0.49	0.54	0.07	0.22
F2	3.77	21.0%	3.77	0.00	0.00	100%	0%	0%	0.12	0.16	0.21	0.27	0.52	0.57	0.12	0.27
F3	33.31	9.7%	32.92	0.00	0.39	99%	0%	1%	0.04	0.07	0.11	0.19	0.47	0.52	0.04	0.19
F4	14.38	8.4%	14.38	0.00	0.00	100%	0%	0%	0.04	0.06	0.10	0.17	0.47	0.52	0.04	0.17
F5	19.25	11.6%	10.03	0.00	9.22	52%	0%	48%	0.05	0.08	0.13	0.20	0.48	0.53	0.09	0.36
F6	7.67	11.2%	7.67	0.00	0.00	100%	0%	0%	0.05	0.08	0.13	0.20	0.48	0.53	0.05	0.20
F7	2.37	45.0%	2.00	0.00	0.37	84%	0%	16%	0.31	0.36	0.40	0.46	0.64	0.67	0.32	0.49
F8	2.93	45.0%	2.12	0.00	0.81	72%	0%	28%	0.31	0.36	0.40	0.46	0.64	0.67	0.34	0.52
F9	0.87	45.0%	0.87	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
F10	3.87	4.4%	3.87	0.00	0.00	100%	0%	0%	0.02	0.03	0.07	0.14	0.45	0.50	0.02	0.14
UD1	16.50	6.2%	16.50	0.00	0.00	100%	0%	0%	0.03	0.04	0.09	0.16	0.46	0.51	0.03	0.16
UD2	23.67	6.2%	15.82	0.00	7.85	67%	0%	33%	0.03	0.04	0.09	0.16	0.46	0.51	0.05	0.27
UD3	44.34	2.0%	20.64	0.00	23.70	47%	0%	53%	0.01	0.01	0.05	0.13	0.44	0.49	0.03	0.32
UD4	1.80	6.2%	1.56	0.00	0.24	87%	0%	13%	0.03	0.04	0.09	0.16	0.46	0.51	0.03	0.20
UD5	5.82	6.2%	5.82	0.00	0.00	100%	0%	0%	0.03	0.04	0.09	0.16	0.46	0.51	0.03	0.16
G1	17.59	9.2%	17.59	0.00	0.00	100%	0%	0%	0.04	0.06	0.11	0.18	0.47	0.52	0.04	0.18
G2	1.21	45.0%	1.21	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
OS1	1.35	40.5%	1.35	0.00	0.00	100%	0%	0%	0.27	0.32	0.37	0.43	0.62	0.65	0.27	0.43

OS2	0.84	51.0%	0.84	0.00	0.00	100%	0%	0%	0.36	0.41	0.45	0.51	0.67	0.69	0.36	0.51
OS3	0.58	32.4%	0.58	0.00	0.00	100%	0%	0%	0.20	0.25	0.30	0.36	0.58	0.62	0.20	0.36
TOTAL	207.05	9.2%	164.47	0.00	42.58	79%	0%	21%	---	---	---	---	---	---	0.06	0.25

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

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

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
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.04
Calculated By: AAM
Checked By: TBD
Date: 6/4/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
F1	4.93	A	14%	0.07	0.22	300	1.7%	26.9	546	0.5%	15.0	1.1	8.6	35.4	846.0	35.4	35.4
F2	3.77	A	21%	0.12	0.27	300	1.4%	27.7	249	1.0%	15.0	1.5	2.8	30.4	549.0	25.9	25.9
F3	33.31	A	10%	0.04	0.19	300	1.3%	30.6	2488	1.5%	15.0	1.8	22.5	53.1	2788.0	56.9	53.1
F4	14.38	A	8%	0.04	0.17	300	2.1%	26.0	583	1.7%	15.0	2.0	5.0	31.0	883.0	31.9	31.0
F5	19.25	A	12%	0.09	0.36	300	1.7%	26.5	1524	1.1%	15.0	1.6	16.1	42.6	1824.0	46.8	42.6
F6	7.67	A	11%	0.05	0.20	300	1.7%	27.5	690	1.0%	15.0	1.5	7.7	35.2	990.0	35.0	35.0
F7	2.37	A	45%	0.32	0.49	48	2.0%	7.7	2354	1.4%	15.0	1.8	22.1	29.8	2402.0	40.0	29.8
F8	2.93	A	45%	0.34	0.52	12	22.0%	1.7	3016	1.2%	15.0	1.6	30.6	32.3	3028.0	48.3	32.3
F9	0.87	A	45%	0.31	0.46	12	22.0%	1.8	946	1.2%	15.0	1.6	9.6	11.4	958.0	27.8	11.4
F10	3.87	A	4%	0.02	0.14	139	4.4%	14.2	489	0.5%	20.0	1.4	5.8	19.9	628.0	37.2	19.9
UD1	16.50	A	6%	0.03	0.16	118	1.8%	17.4	819	1.8%	7.0	0.9	14.5	31.9	937.0	35.3	31.9
UD2	23.67	A	6%	0.05	0.27	300	1.3%	30.2	209	1.3%	7.0	0.8	4.4	34.6	509.0	28.0	28.0
UD3	44.34	A	2%	0.03	0.32	290	1.6%	28.0	4562	1.2%	15.0	1.7	46.1	74.1	4852.0	100.1	74.1
UD4	1.80	A	6%	0.03	0.20	300	1.0%	33.4	144	1.0%	7.0	0.7	3.4	36.8	444.0	27.4	27.4
UD5	5.82	A	6%	0.03	0.16	300	4.1%	21.1	126	4.1%	7.0	1.4	1.5	22.6	426.0	26.0	22.6
G1	17.59	A	9%	0.04	0.18	300	1.5%	29.0	1399	1.1%	15.0	1.6	14.8	43.8	1699.0	46.1	43.8
G2	1.21	A	45%	0.31	0.46	12	22.0%	1.8	1378	1.1%	15.0	1.6	14.6	16.4	1390.0	32.7	16.4

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Saddlehorn Ranch
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.04
Calculated By: AAM
Checked By: TBD
Date: 6/4/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					tc CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
OS1	1.35	A	40%	0.27	0.43	55	3.4%	7.4	754	0.5%	15.0	1.1	11.8	19.3	809.0	31.2	19.3
OS2	0.84	A	51%	0.36	0.51	55	3.9%	6.3	491	0.5%	15.0	1.1	7.7	14.0	546.0	24.5	14.0
OS3	0.58	A	32%	0.20	0.36	174	3.2%	14.5	73	1.7%	7.0	0.9	1.3	15.9	247.0	21.2	15.9

NOTES:

$$t_c = t_i + t_t$$

Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$

Equation 6-3

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

Table 6-2. NRCS Conveyance factors, K

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	15
Paved areas and shallow paved swales	20

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

Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Equation 6-5

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.

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

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

Project Name: Saddlehorn Ranch
Project No.: 25142.04
Calculated By: AAM
Checked By: TBD
Date: 6/4/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	OS2	OS2	0.84	0.36	14.0	0.31	3.62	1.1					1.1	0.31	1.85					379	2.7	2.3	Roadside Swale Swale conveyance to DP 1.0
	1	F1	4.93	0.07	35.4	0.34	2.23	0.8					0.8	0.34	0.50					0	1.4	0.0	Roadside Swale Swale conveyance to DP 1.0
	1.0								35.4	0.65	2.23	1.5	1.5	0.65	1.4					564	2.4	4.0	Sum of DP OS2 and DP 1 Swale conveyance to DP 1.1
	2	F2	3.77	0.12	25.9	0.44	2.70	1.2					1.2	0.44	1.0					0	2.0	0.0	Roadside Swale Swale conveyance to DP 1.1
	1.1								39.4	1.09	2.07	2.3	2.3	1.09	1.5					2922	2.4	19.9	Sum of DP 1.0 and DP 2 Swale conveyance to DP 1.2
	3	F3	33.31	0.04	53.1	1.49	1.63	2.4					2.4	1.49	1.5					0	2.4	0.0	Roadside Swale Swale conveyance to DP 1.2
	4	F4	14.38	0.04	31.0	0.52	2.43	1.3					1.3	0.52	1.6					0	2.5	0.0	Roadside Swale Swale conveyance to DP 1.2
	1.2								59.3	3.10	1.46	4.5	4.5	3.10	1.0					1003	2.0	8.4	Sum of DP 1.1, DP 3, and DP 4 Swale conveyance to DP 1.3
	5	F5	19.25	0.09	42.6	1.75	1.95	3.4					3.4	1.75	1.0					0	2.0	0.0	Roadside Swale Swale conveyance to DP 1.3
	1.3								67.6	4.85	1.26	6.1				6.1	4.85	0.5	24	62	4.7	0.2	Sum of DP 1.2 and DP 5 Culvert conveyance to DP 1.6
	OS1	OS1	1.35	0.27	19.3	0.37	3.15	1.2					1.2	0.37	1.8					379	2.7	2.4	Roadside Swale Swale conveyance to DP 1.4
	6	F6	7.67	0.05	35.0	0.40	2.25	0.9					0.9	0.40	1.0					0	2.0	0.0	Roadside Swale Swale conveyance to DP 1.4
	1.4								35.0	0.77	2.25	1.7	1.7	0.77	1.4					1672	2.4	11.8	Sum of DP OS1 and DP 6 Swale conveyance to DP 1.5
	7	F7	2.37	0.32	29.8	0.77	2.49	1.9					1.9	0.77	1.4					0	2.4	0.0	Roadside Swale Swale conveyance to DP 1.5
	1.5								46.8	1.54	1.82	2.8	2.8	1.54	1.4					2987	2.4	21.0	Sum of DP 1.4 and DP 7 Swale conveyance to DP 1.6
	8	F8	2.93	0.34	32.3	0.98	2.37	2.3					2.3	0.98	1.3					0	2.3	0.0	Roadside Swale Swale conveyance to DP 1.6
	9	F9	0.87	0.31	11.4	0.27	3.94	1.1					1.1	0.27	1.3					86	2.3	0.6	Roadside Swale Swale conveyance to DP 1.6
	1.6								67.8	7.64	1.26	9.6	9.6	7.64	1.4					489	2.4	3.4	Sum of DP 1.3, DP 1.5, DP 8, and DP 9 Pond conveyance to DP 1.7
	10	F10	3.87	0.02	19.9	0.06	3.10	0.2					0.2	0.06	1.0					0	2.0	0.0	Proposed Pond F Pond conveyance to DP 1.7
	1.7								67.8	7.70	1.26	9.7											Sum of DP 1.6 and DP 10 Outlet structure release into Drainageway MS-06
	11	G1	17.59	0.04	43.8	0.72	1.91	1.4															Roadside Swale Swale conveyance to DP 11, Ultimately outfall into the existing Pond G
	12	G2	1.21	0.31	16.4	0.38	3.39	1.3															Roadside Swale Swale conveyance to DP 12, Ultimately outfall into the existing Pond G

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

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

Project Name: Saddlehorn Ranch
Project No.: 25142.04
Calculated By: AAM
Checked By: TBD
Date: 6/4/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	13	UD1	16.50	0.03	31.9	0.41	2.39	1.0															Overland Flow Sheet flow into Drainageway T-6
	14	UD2	23.67	0.05	28.0	1.07	2.58	2.8															Overland Flow Sheet flow into Drainageway MS-06
	15	UD3	44.34	0.03	74.1	1.33	1.13	1.5															Overland Flow Sheet flow into Drainageway MS-06
	16	UD4	1.80	0.03	27.4	0.06	2.62	0.2															Overland Flow Sheet flow into Drainageway MS-06
	17	UD5	5.82	0.03	22.6	0.15	2.91	0.4															Overland Flow Sheet flow into Drainageway MS-06
	OS3	OS3	0.58	0.20	15.9	0.12	3.44	0.4															Overland Flow Sheet flow into Drainageway T-6

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

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

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

Project Name: Saddlehorn Ranch
Project No.: 25142.04
Calculated By: AAM
Checked By: TBD
Date: 6/4/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	OS2	OS2	0.84	0.51	14.0	0.43	6.08	2.6					2.6	0.43	1.85					379	2.7	2.3	Roadside Swale Swale conveyance to DP 1.0
	1	F1	4.93	0.22	35.4	1.07	3.75	4.0					4.0	1.07	0.50					0	1.4	0.0	Roadside Swale Swale conveyance to DP 1.0
	1.0								35.4	1.50	3.75	5.6	5.6	1.50	1.4					564	2.4	4.0	Sum of DP OS2 and DP 1 Swale conveyance to DP 1.1
	2	F2	3.77	0.27	25.9	1.03	4.53	4.7					4.7	1.03	1.0					0	2.0	0.0	Roadside Swale Swale conveyance to DP 1.1
	1.1								39.4	2.53	3.48	8.8	8.8	2.53	1.5					2922	2.4	19.9	Sum of DP 1.0 and DP 2 Swale conveyance to DP 1.2
	3	F3	33.31	0.19	53.1	6.33	2.73	17.3					17.3	6.33	1.5					0	2.4	0.0	Roadside Swale Swale conveyance to DP 1.2
	4	F4	14.38	0.17	31.0	2.52	4.08	10.3					10.3	2.52	1.6					0	2.5	0.0	Roadside Swale Swale conveyance to DP 1.2
	1.2								59.3	11.38	2.45	27.9	27.9	11.38	1.0					1003	2.0	8.4	Sum of DP 1.1, DP 3, and DP 4 Swale conveyance to DP 1.3
	5	F5	19.25	0.36	42.6	6.90	3.28	22.6					22.6	6.90	1.0					0	2.0	0.0	Roadside Swale Swale conveyance to DP 1.3
	1.3								67.6	18.28	2.12	38.7				38.7	18.28	0.5	24	62	12.3	0.1	Sum of DP 1.2 and DP 5 Culvert conveyance to DP 1.6
	OS1	OS1	1.35	0.43	19.3	0.58	5.28	3.1					3.1	0.58	1.8					379	2.7	2.4	Roadside Swale Swale conveyance to DP 1.4
	6	F6	7.67	0.20	35.0	1.51	3.78	5.7					5.7	1.51	1.0					0	2.0	0.0	Roadside Swale Swale conveyance to DP 1.4
	1.4								35.0	2.09	3.78	7.9	7.9	2.09	1.4					1672	2.4	11.8	Sum of DP OS1 and DP 6 Swale conveyance to DP 1.5
	7	F7	2.37	0.49	29.8	1.17	4.18	4.9					4.9	1.17	1.4					0	2.4	0.0	Roadside Swale Swale conveyance to DP 1.5
	1.5								46.8	3.26	3.05	9.9	9.9	3.26	1.4					2987	2.4	21.0	Sum of DP 1.4 and DP 7 Swale conveyance to DP 1.6
	8	F8	2.93	0.52	32.3	1.52	3.98	6.0					6.0	1.52	1.3					0	2.3	0.0	Roadside Swale Swale conveyance to DP 1.6
	9	F9	0.87	0.46	11.4	0.40	6.61	2.6					2.6	0.40	1.3					86	2.3	0.6	Roadside Swale Swale conveyance to DP 1.6
	1.6								67.8	23.46	2.11	49.5	49.5	23.46	1.4					489	2.4	3.4	Sum of DP 1.3, DP 1.5, DP 8, and DP 9 Pond conveyance to DP 1.7
	10	F10	3.87	0.14	19.9	0.56	5.20	2.9					2.9	0.56	1.0					0	2.0	0.0	Proposed Pond F Pond conveyance to DP 1.7
	1.7								67.8	24.02	2.11	50.7											Sum of DP 1.6 and DP 10 Outlet structure release into Drainageway MS-06
	11	G1	17.59	0.18	43.8	3.20	3.21	10.3															Roadside Swale Swale conveyance to DP 11, Ultimately outfall into the existing Pond G
	12	G2	1.21	0.46	16.4	0.56	5.69	3.2															Roadside Swale Swale conveyance to DP 12, Ultimately outfall into the existing Pond G

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

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

Project Name: Saddlehorn Ranch
Project No.: 25142.04
Calculated By: AAM
Checked By: TBD
Date: 6/4/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	13	UD1	16.50	0.16	31.9	2.61	4.01	10.5															Overland Flow Sheet flow into Drainageway T-6
	14	UD2	23.67	0.27	28.0	6.50	4.33	28.2															Overland Flow Sheet flow into Drainageway MS-06
	15	UD3	44.34	0.32	74.1	14.26	1.89	26.9															Overland Flow Sheet flow into Drainageway MS-06
	16	UD4	1.80	0.20	27.4	0.37	4.39	1.6															Overland Flow Sheet flow into Drainageway MS-06
	17	UD5	5.82	0.16	22.6	0.92	4.88	4.5															Overland Flow Sheet flow into Drainageway MS-06
	OS3	OS3	0.58	0.36	15.9	0.21	5.77	1.2															Overland Flow Sheet flow into Drainageway T-6

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

APPENDIX C

HYDRAULIC CALCULATIONS

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Thursday, Dec 2 2021

DP01 Design Point 1.0 (Q5=1.5 cfs Q100=5.6 cfs)

Invert Elev Dn (ft)	= 6750.42
Pipe Length (ft)	= 56.00
Slope (%)	= 0.50
Invert Elev Up (ft)	= 6750.70
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

Embankment

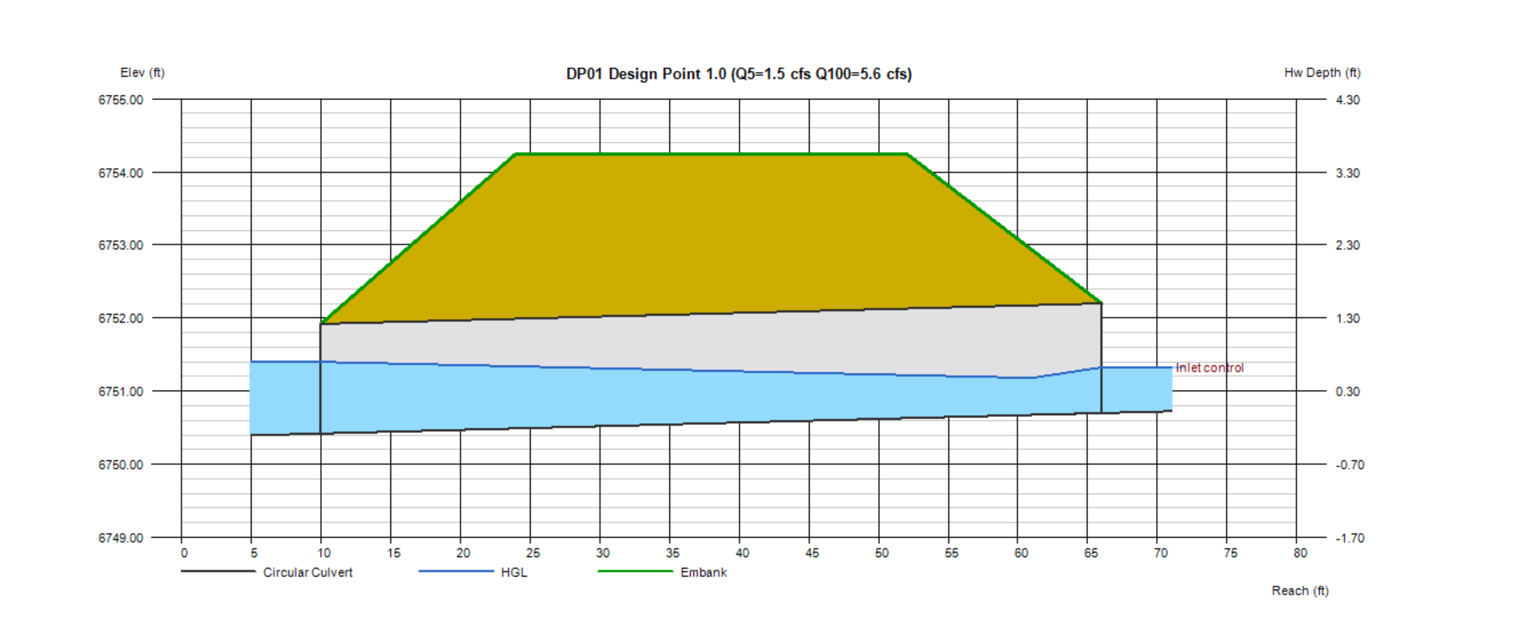
Top Elevation (ft)	= 6754.25
Top Width (ft)	= 28.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 1.50
Qmax (cfs)	= 5.60
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 1.50
Qpipe (cfs)	= 1.50
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 1.23
Veloc Up (ft/s)	= 3.27
HGL Dn (ft)	= 6751.40
HGL Up (ft)	= 6751.16
Hw Elev (ft)	= 6751.33
Hw/D (ft)	= 0.42
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Dec 2 2021

DP02 Design Point 1.1 (Q5=2.3 cfs Q100=8.8 cfs)

Invert Elev Dn (ft)	=	6740.39
Pipe Length (ft)	=	63.00
Slope (%)	=	0.98
Invert Elev Up (ft)	=	6741.01
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

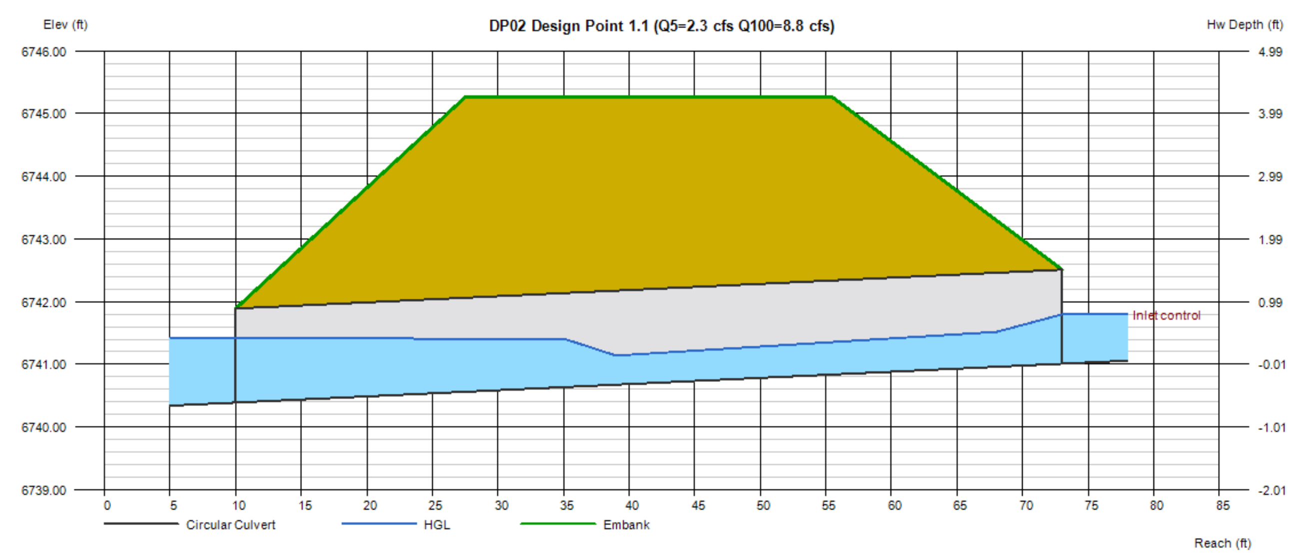
Top Elevation (ft)	=	6745.26
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2.30
Qmax (cfs)	=	8.80
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	2.30
Qpipe (cfs)	=	2.30
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.77
Veloc Up (ft/s)	=	3.71
HGL Dn (ft)	=	6741.43
HGL Up (ft)	=	6741.58
Hw Elev (ft)	=	6741.80
Hw/D (ft)	=	0.52
Flow Regime	=	Inlet Control



Culvert Report

DP03 Design Point 1.2 (Q5=4.5 cfs Q100=27.9 cfs)

Invert Elev Dn (ft)	= 6697.50
Pipe Length (ft)	= 63.00
Slope (%)	= 0.63
Invert Elev Up (ft)	= 6697.90
Rise (in)	= 30.0
Shape	= Circular
Span (in)	= 30.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

Embankment

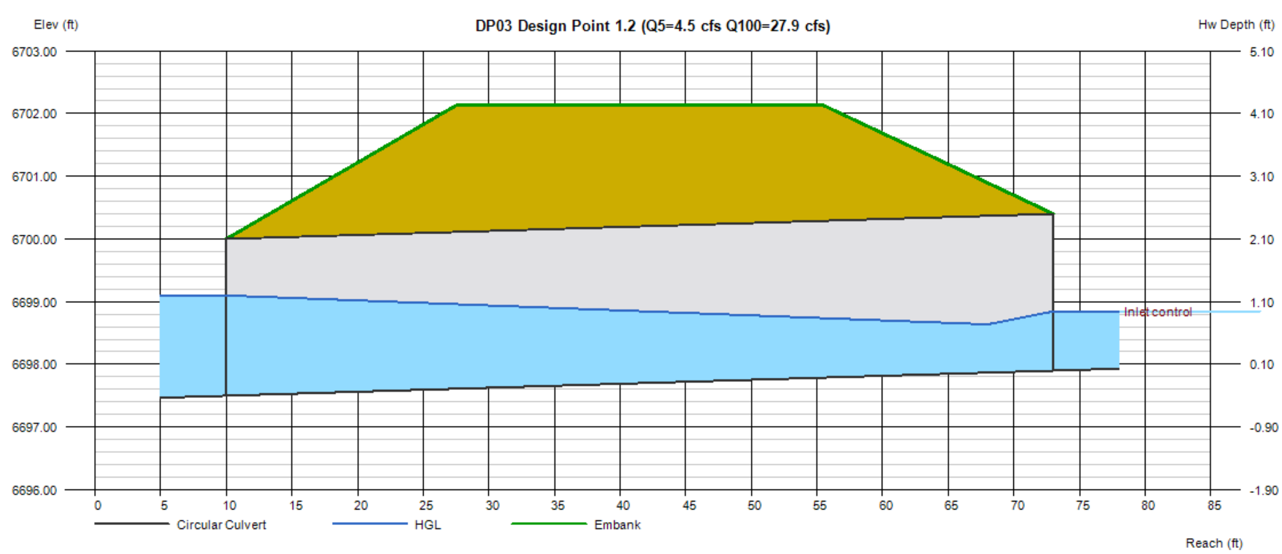
Top Elevation (ft)	= 6702.13
Top Width (ft)	= 28.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 4.50
Qmax (cfs)	= 27.90
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 4.50
Qpipe (cfs)	= 4.50
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 1.36
Veloc Up (ft/s)	= 4.01
HGL Dn (ft)	= 6699.10
HGL Up (ft)	= 6698.60
Hw Elev (ft)	= 6698.84
Hw/D (ft)	= 0.38
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Dec 2 2021

DP06 Design Point 1.3 (Q5=6.1 cfs Q100=38.7 cfs)

Invert Elev Dn (ft)	=	6686.49
Pipe Length (ft)	=	61.50
Slope (%)	=	0.29
Invert Elev Up (ft)	=	6686.67
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

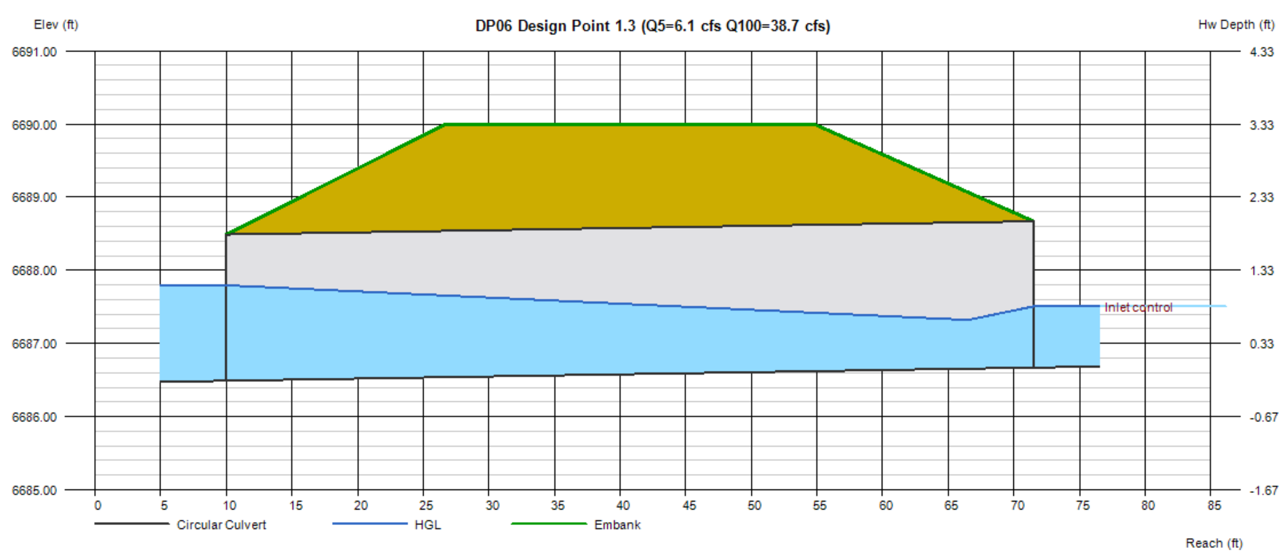
Top Elevation (ft)	=	6690.00
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	6.10
Qmax (cfs)	=	38.70
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	6.10
Qpipe (cfs)	=	6.10
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.41
Veloc Up (ft/s)	=	3.77
HGL Dn (ft)	=	6687.80
HGL Up (ft)	=	6687.28
Hw Elev (ft)	=	6687.51
Hw/D (ft)	=	0.42
Flow Regime	=	Inlet Control



Culvert Report

DP04 Design Point 1.4 (Q5=1.7 cfs Q100=7.9 cfs)

Invert Elev Dn (ft)	=	6750.98
Pipe Length (ft)	=	68.00
Slope (%)	=	1.40
Invert Elev Up (ft)	=	6751.93
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

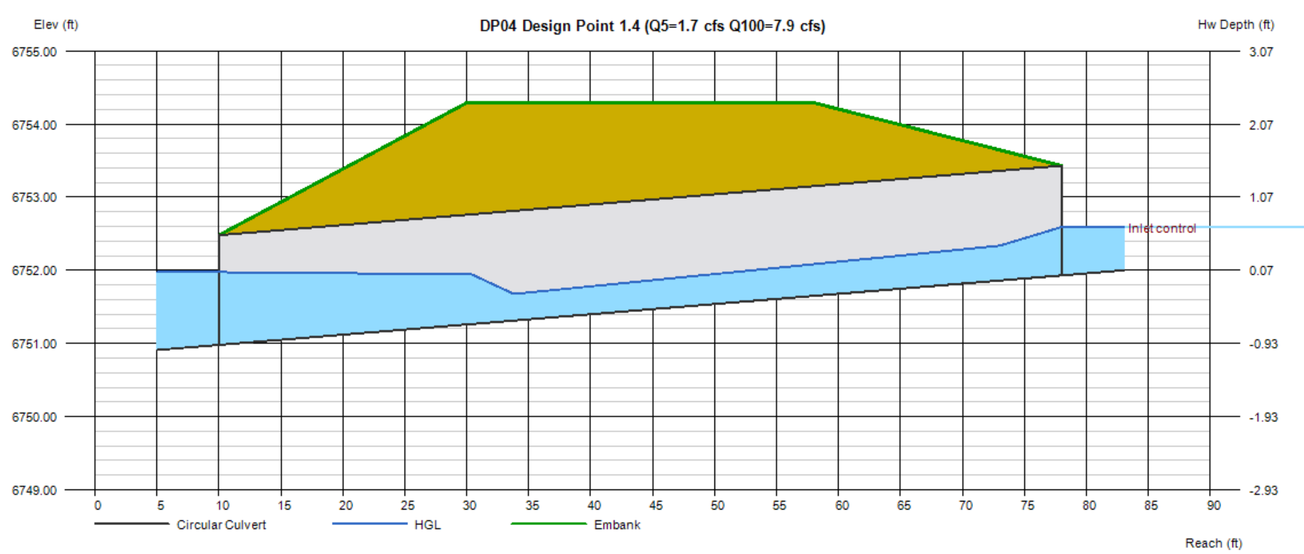
Top Elevation (ft)	=	6754.29
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	1.70
Qmax (cfs)	=	7.90
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	1.70
Qpipe (cfs)	=	1.70
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.37
Veloc Up (ft/s)	=	3.39
HGL Dn (ft)	=	6751.98
HGL Up (ft)	=	6752.42
Hw Elev (ft)	=	6752.59
Hw/D (ft)	=	0.44
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Dec 20 2021

DP05 Design Point 1.5 (Q5=2.8 cfs Q100=9.9 cfs)

Invert Elev Dn (ft)	=	6724.66
Pipe Length (ft)	=	68.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	6725.34
Rise (in)	=	19.0
Shape	=	Elliptical
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Horizontal Ellipse Concrete
Culvert Entrance	=	Square edge w/headwall (H)
Coeff. K,M,c,Y,k	=	0.01, 2, 0.0398, 0.67, 0.5

Embankment

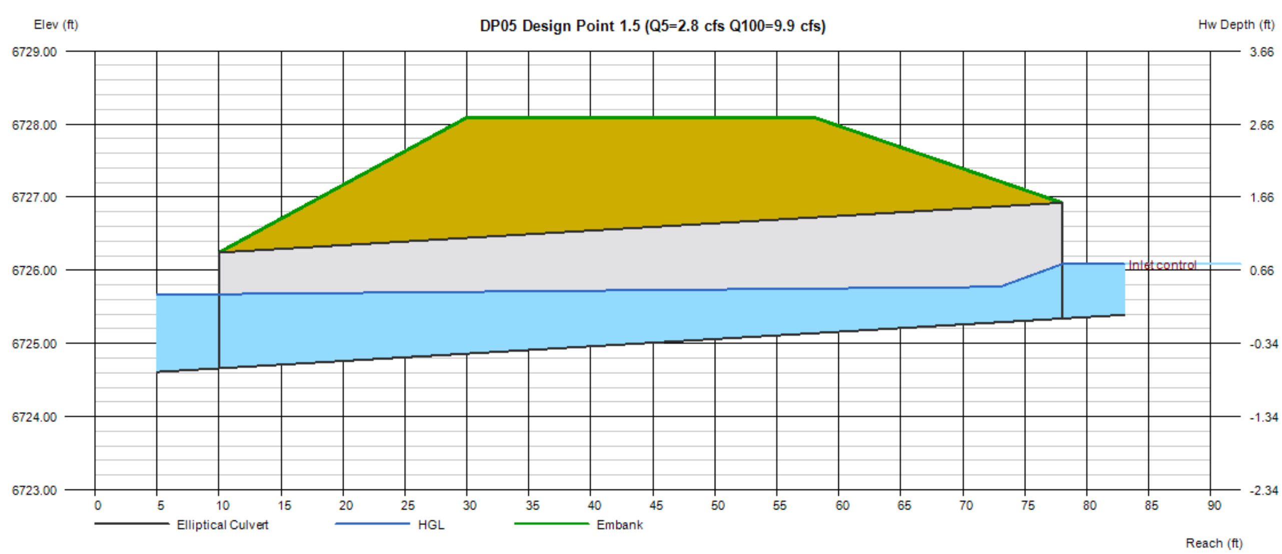
Top Elevation (ft)	=	6728.09
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2.80
Qmax (cfs)	=	9.90
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	2.80
Qpipe (cfs)	=	2.80
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.29
Veloc Up (ft/s)	=	4.39
HGL Dn (ft)	=	6725.67
HGL Up (ft)	=	6725.78
Hw Elev (ft)	=	6726.08
Hw/D (ft)	=	0.47
Flow Regime	=	Inlet Control



Culvert Report

DP07 Design Point 9 (Q5=1.1 cfs Q100=2.6 cfs)

Invert Elev Dn (ft)	= 6686.99
Pipe Length (ft)	= 36.00
Slope (%)	= 0.86
Invert Elev Up (ft)	= 6687.30
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

Embankment

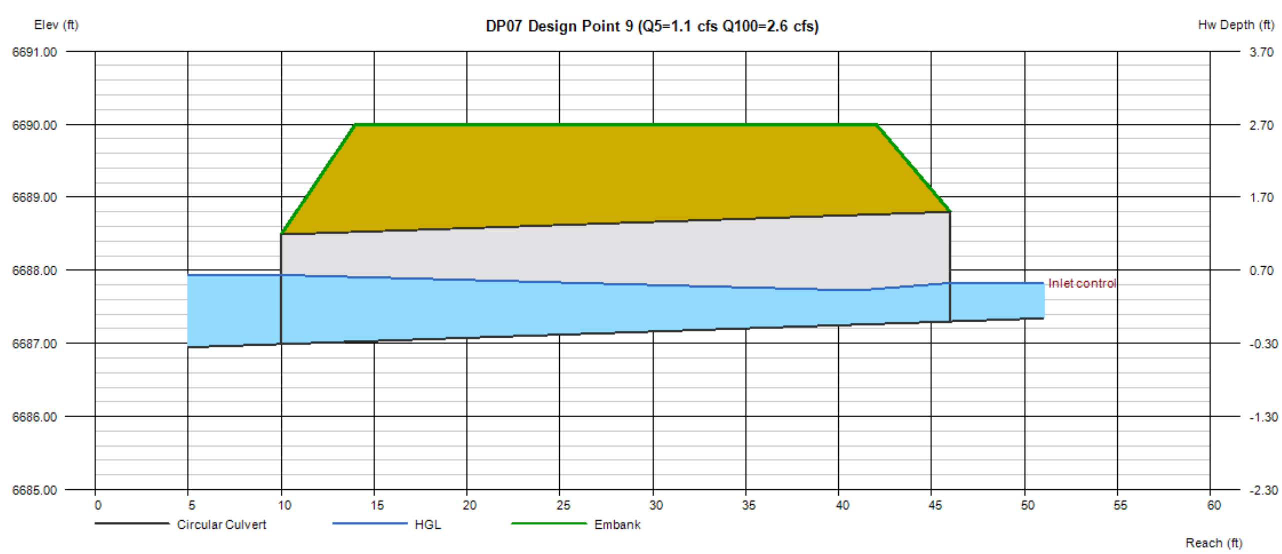
Top Elevation (ft)	= 6690.00
Top Width (ft)	= 28.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 1.10
Qmax (cfs)	= 2.60
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 1.10
Qpipe (cfs)	= 1.10
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 0.94
Veloc Up (ft/s)	= 3.00
HGL Dn (ft)	= 6687.94
HGL Up (ft)	= 6687.69
Hw Elev (ft)	= 6687.83
Hw/D (ft)	= 0.35
Flow Regime	= Inlet Control



PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Saddlehorn Ranch
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.04
Calculated By: AAM
Checked By: TBD
Date: 6/4/21

	STORM DRAIN SYSTEM			
	DESIGN POINT 1.0	DESIGN POINT 1.1	DESIGN POINT 1.2	Notes
Q_{100} (cfs):	5.6	8.8	27.9	Flows are the greater of proposed vs. future
Conduit	Pipe	Pipe	Pipe	
D_c , Pipe Diameter (in):	18	18	30	
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):	0.98	1.04	1.60	If unknown, use Y_t/D_c (or H)=0.4
Y_t/Dc or Y_t/H	0.65	0.69	0.64	
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	2.03	3.19	2.82	
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]:	1.40	2.05	3.33	
Required Riprap Size:	L	L	L	Fig. 9-38 or Fig. 9-36
d_{50} (in):	9	9	9	
Expansion Factor, $1/(2 \tan\theta)$:	6.75	6.75	6.75	Read from Fig. 9-35 or 9-36
θ:	0.07	0.07	0.07	
Erosive Soils?	No	No	No	
Area of Flow, A_t (ft^2):	0.80	1.26	3.99	$A_t=Q/V$
Length of Protection, L_p (ft):	-4.6	-2.0	-0.1	$L=(1/(2 \tan \theta))(At/Yt - D)$
Min Length (ft)	4.5	4.5	7.5	Min L=3D or 3H
Max Length (ft)	15.0	15.0	25.0	Max L=10D or 10H
Min Bottom Width, T (ft):	0.8	1.2	2.5	$T=2*(L_p*\tan\theta)+W$
Design Length (ft)	4.5	4.5	7.5	
Design Width (ft)	0.8	1.2	2.5	
Riprap Depth (in)	18	18	18	Depth=2(d_{50})
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
* For use when the flow in the culvert is supercritical (and less than full).

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision:	Saddlehorn Ranch	Project Name:	Saddlehorn Ranch
Location:	El Paso County	Project No.:	25142.04
		Calculated By:	AAM
		Checked By:	TBD
		Date:	6/4/21

	STORM DRAIN SYSTEM			Notes
	DESIGN POINT 1.3	DESIGN POINT 1.4	DESIGN POINT 1.5	
Q_{100} (cfs):	38.7	7.9	9.9	Flows are the greater of proposed vs. future
Conduit	Pipe	Pipe	Pipe	
D_c, Pipe Diameter (in):	24	18	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):	1.31	1.00	1.01	If unknown, use Y_t/D_c (or H)=0.4
Y_t/Dc or Y_t/H	0.66	0.67	0.51	
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	6.84	2.87	1.75	
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]:	6.27	1.93	2.19	
Required Riprap Size:	L	L	L	Fig. 9-38 or Fig. 9-36
d_{50} (in):	9	9	9	
Expansion Factor, $1/(2\tan\theta)$:	3.75	6.75	6.75	Read from Fig. 9-35 or 9-36
θ:	0.13	0.07	0.07	
Erosive Soils?	No	No	No	
Area of Flow, A_t (ft^2):	5.53	1.13	1.41	$A_t=Q/V$
Length of Protection, L_p (ft):	8.3	-2.5	-4.0	$L=(1/(2\tan\theta))(At/Yt - D)$
Min Length (ft)	6.0	4.5	6.0	Min L=3D or 3H
Max Length (ft)	20.0	15.0	20.0	Max L=10D or 10H
Min Bottom Width, T (ft):	4.2	1.1	1.4	$T=2*(L_p*\tan\theta)+W$
Design Length (ft)	9.0	4.5	6.0	
Design Width (ft)	4.2	1.1	1.4	
Riprap Depth (in)	18	18	18	Depth=$2(d_{50})$
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

* For use when the flow in the culvert is supercritical (and less than full).

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision:	Saddlehorn Ranch	Project Name:	Saddlehorn Ranch
Location:	El Paso County	Project No.:	25142.04
		Calculated By:	AAM
		Checked By:	TBD
		Date:	6/4/21

	STORM DRAIN SYSTEM			Notes
	DESIGN POINT 9	DESIGN POINT	DESIGN POINT	
Q_{100} (cfs):	2.6			Flows are the greater of proposed vs. future
Conduit	Pipe			
D_c, Pipe Diameter (in):	18			
W, Box Width (ft):	N/A			
H, Box Height (ft):	N/A			
Y_t, Tailwater Depth (ft):	0.95			If unknown, use Y_t/D_c (or H)=0.4
Y_t/Dc or Y_t/H	0.63			
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	0.94			
Supercritical?	No			
Y_n, Normal Depth (ft) [Supercritical]:	0.00			
D_a, H_a (in) [Supercritical]:	N/A			$D_a=(D_c+Y_n)/2$
Riprap d_{50} (in) [Supercritical]:	N/A			
Riprap d_{50} (in) [Subcritical]:	0.68			
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
θ:	0.07			
Erosive Soils?	No			
Area of Flow, A_t (ft^2):	0.37			$A_t=Q/V$
Length of Protection, L_p (ft):	-7.5			$L=(1/(2\tan\theta))(At/Yt - D)$
Min Length (ft)	4.5			Min L=3D or 3H
Max Length (ft)	15.0			Max L=10D or 10H
Min Bottom Width, T (ft):	0.4			$T=2*(L_p*\tan\theta)+W$
Design Length (ft)	4.5			
Design Width (ft)	0.4			
Riprap Depth (in)	18			Depth=$2(d_{50})$
Type II Bedding Depth (in)*	6			*Not used if Soil Riprap
Cutoff Wall	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
* For use when the flow in the culvert is supercritical (and less than full).

Channel Report

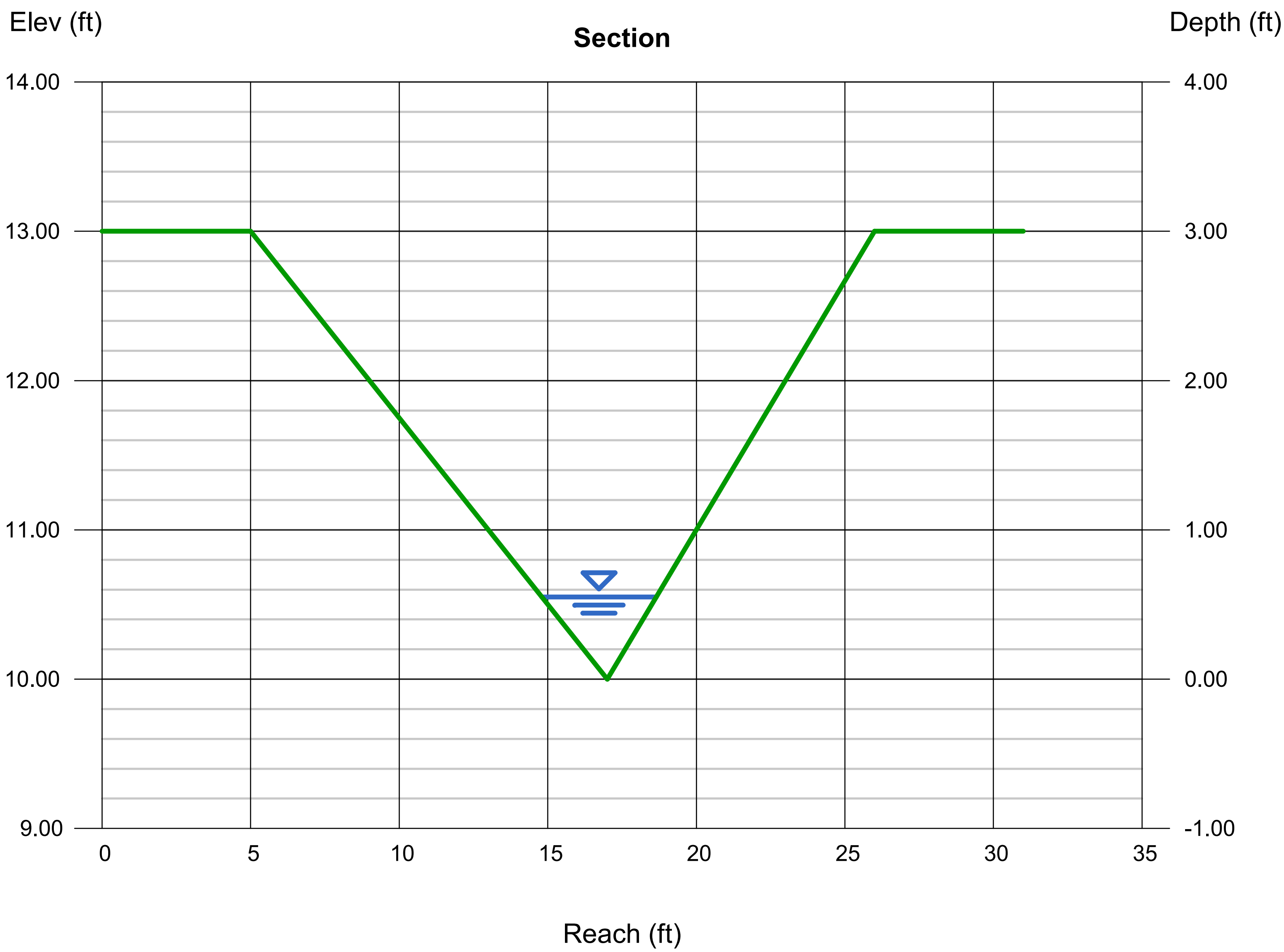
DP 1.0 Swale (5-Year) (FR: 0.39)

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

Invert Elev (ft) = 10.00
Slope (%) = 0.50
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cfs) = 1.50

Highlighted
Depth (ft) = 0.55
Q (cfs) = 1.500
Area (sqft) = 1.06
Velocity (ft/s) = 1.42
Wetted Perim (ft) = 4.01
Crit Depth, Yc (ft) = 0.41
Top Width (ft) = 3.85
EGL (ft) = 0.58



Channel Report

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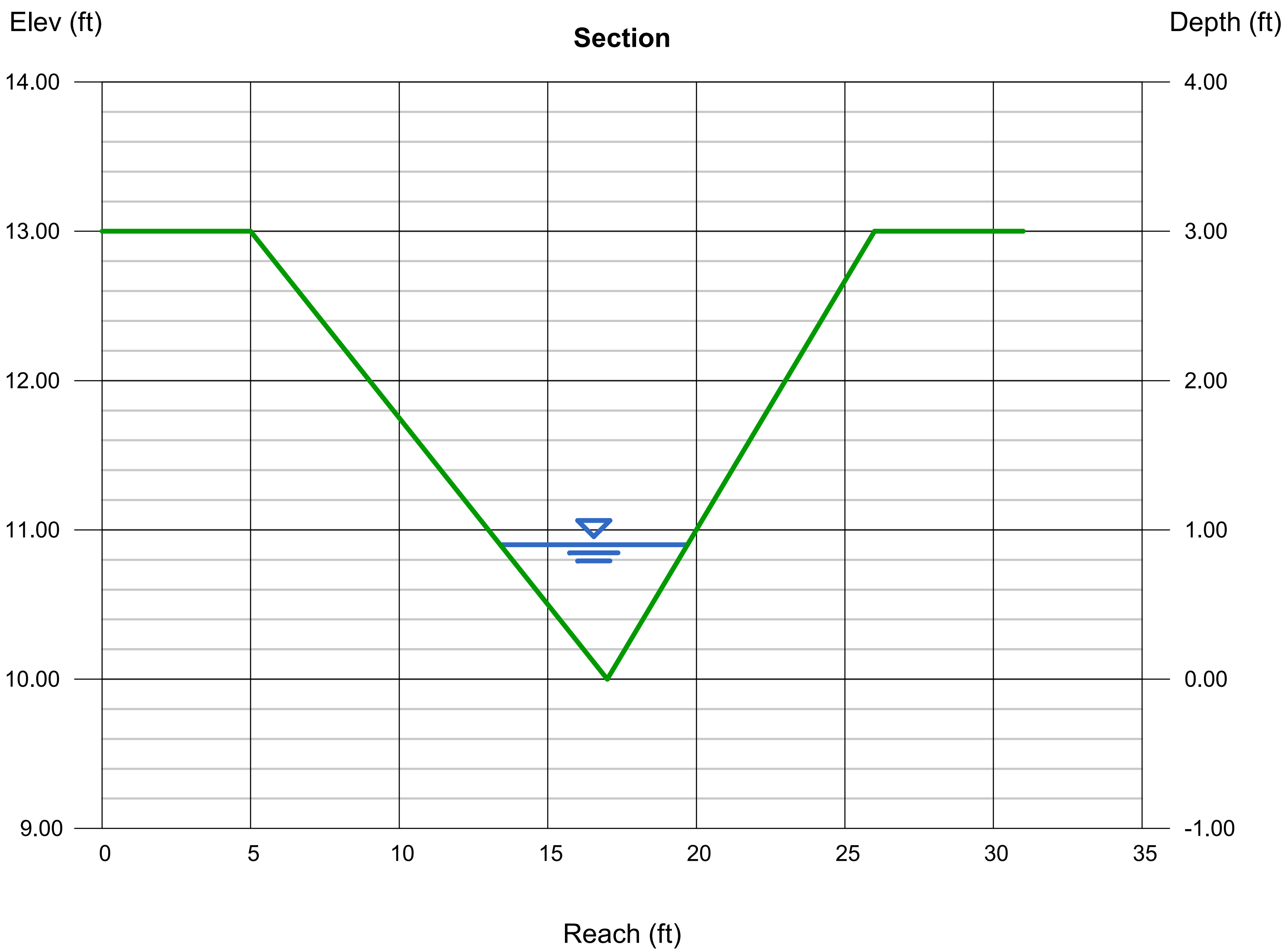
DP 1.0 Swale (100-Year) (FR: 0.42)

Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 3.00	Depth (ft)	= 0.90
Total Depth (ft)	= 3.00	Q (cfs)	= 5.600
		Area (sqft)	= 2.83
Invert Elev (ft)	= 10.00	Velocity (ft/s)	= 1.98
Slope (%)	= 0.50	Wetted Perim (ft)	= 6.56
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.70
		Top Width (ft)	= 6.30
Calculations		EGL (ft)	= 0.96
Compute by:	Known Q		
Known Q (cfs)	= 5.60		



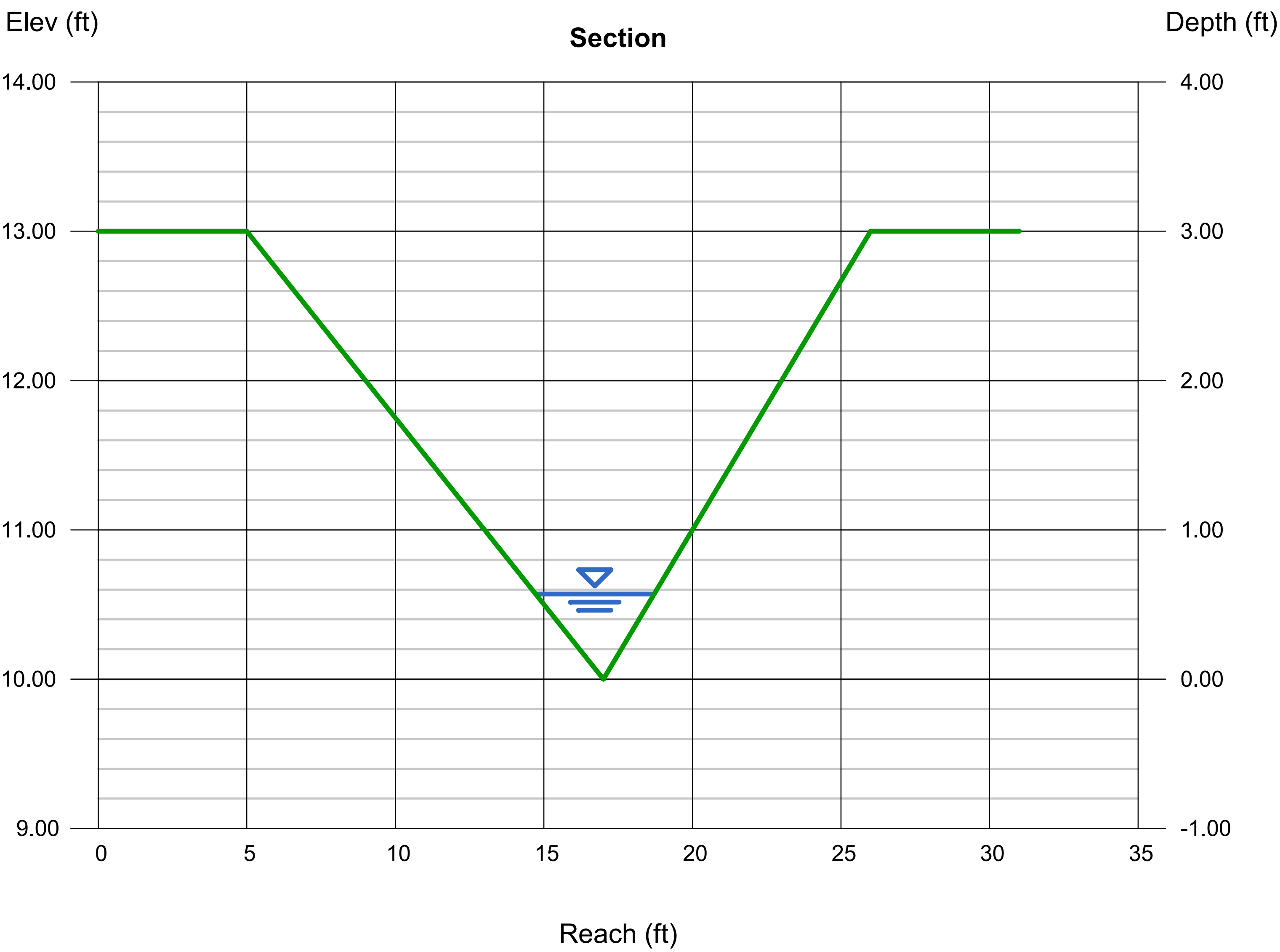
Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Dec 14 2021

DP 1.1 Swale (5-Year) (FR: 0.51)

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)	= 2.30

Highlighted	
Depth (ft)	= 0.57
Q (cfs)	= 2.300
Area (sqft)	= 1.14
Velocity (ft/s)	= 2.02
Wetted Perim (ft)	= 4.15
Crit Depth, Yc (ft)	= 0.49
Top Width (ft)	= 3.99
EGL (ft)	= 0.63



Channel Report

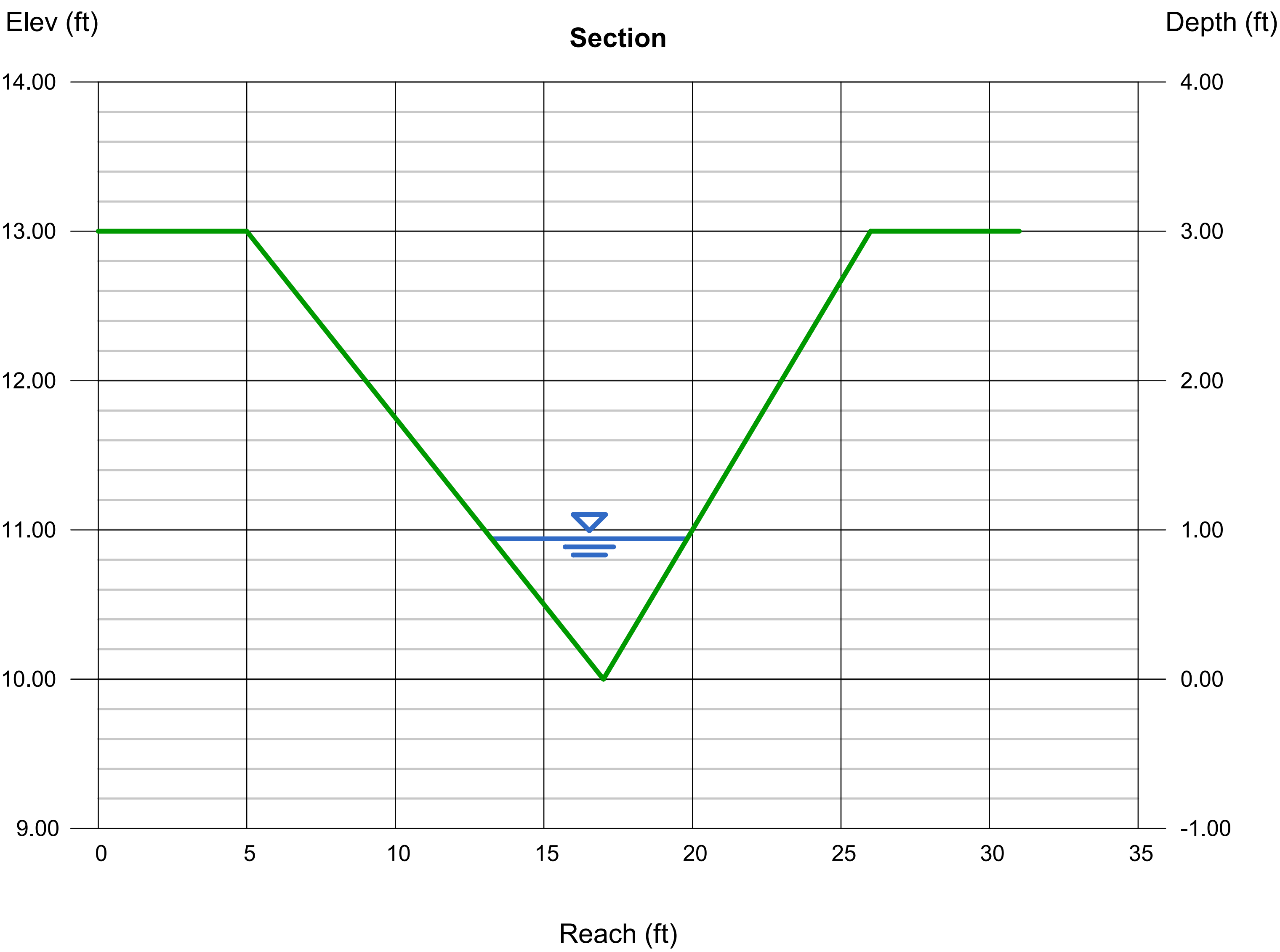
DP 1.1 Swale (100-Year) (FR: 0.55)

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) = 8.80

Highlighted
Depth (ft) = 0.94
Q (cfs) = 8.800
Area (sqft) = 3.09
Velocity (ft/s) = 2.85
Wetted Perim (ft) = 6.85
Crit Depth, Yc (ft) = 0.83
Top Width (ft) = 6.58
EGL (ft) = 1.07



Channel Report

DP 1.2 Swale (5-Year) (FR: 0.59)

Triangular

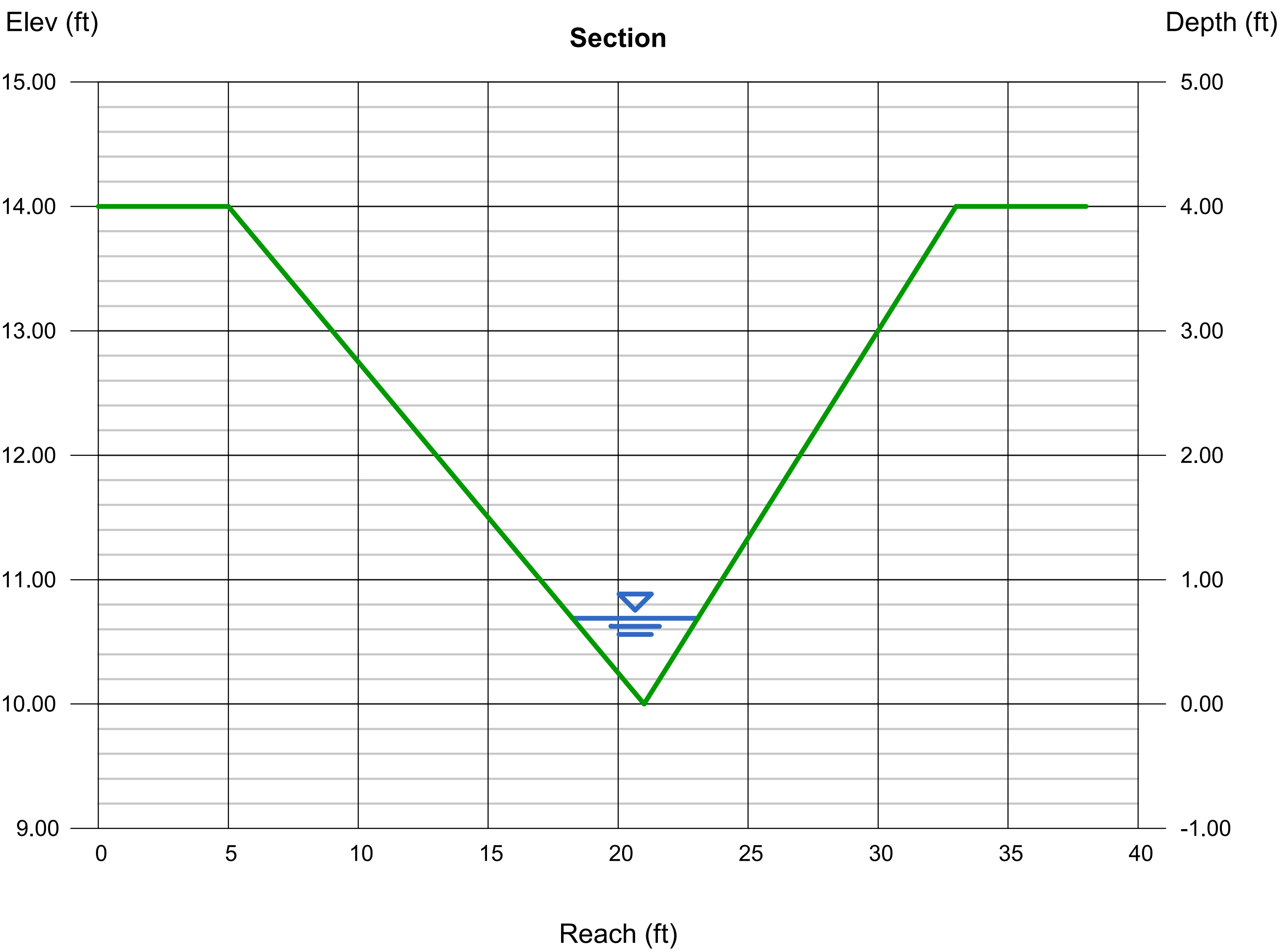
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.35
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.50

Highlighted

Depth (ft)	= 0.69
Q (cfs)	= 4.500
Area (sqft)	= 1.67
Velocity (ft/s)	= 2.70
Wetted Perim (ft)	= 5.03
Crit Depth, Yc (ft)	= 0.64
Top Width (ft)	= 4.83
EGL (ft)	= 0.80



Channel Report

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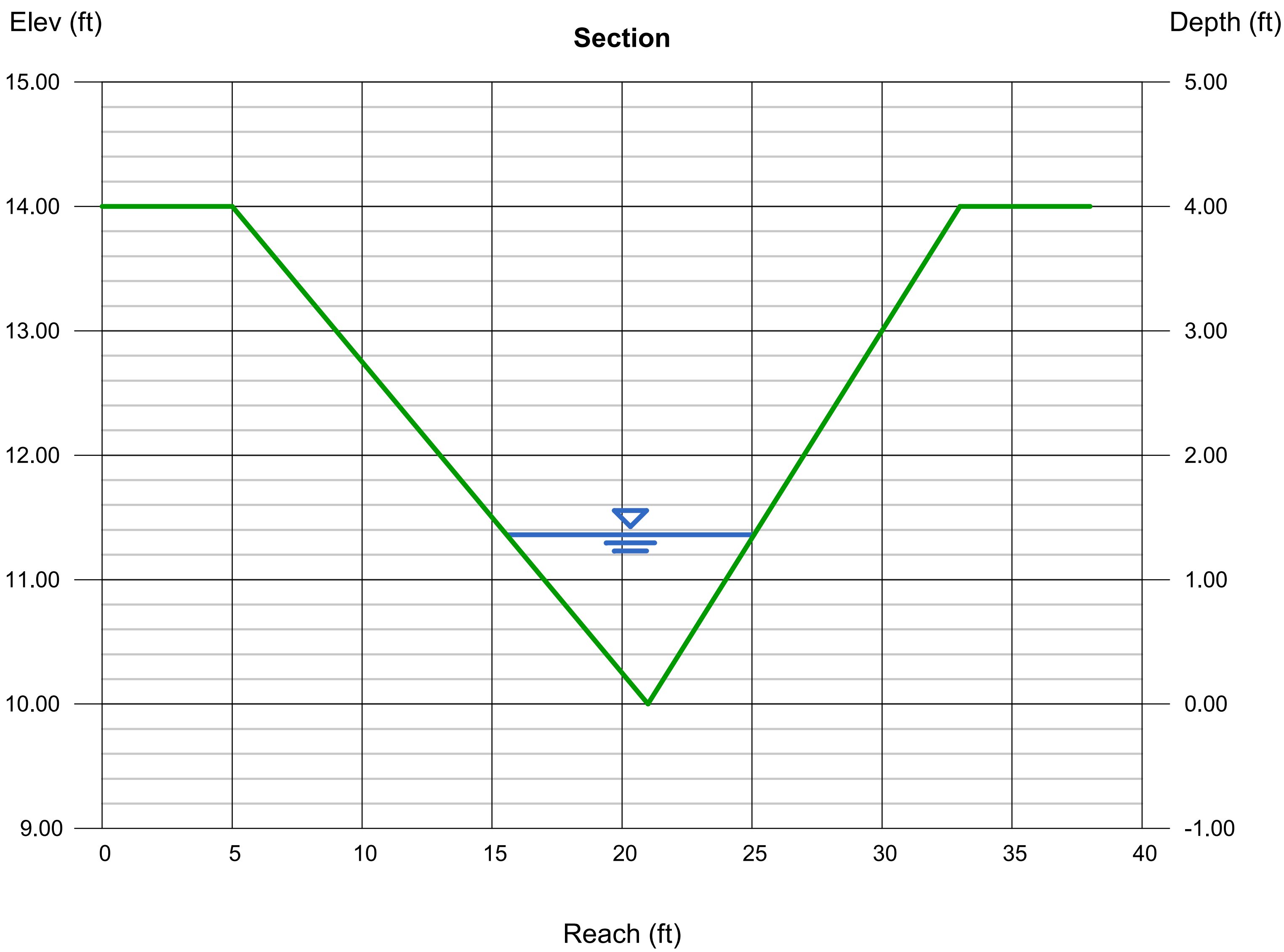
DP 1.2 Swale (100-Year) (FR: 0.66)

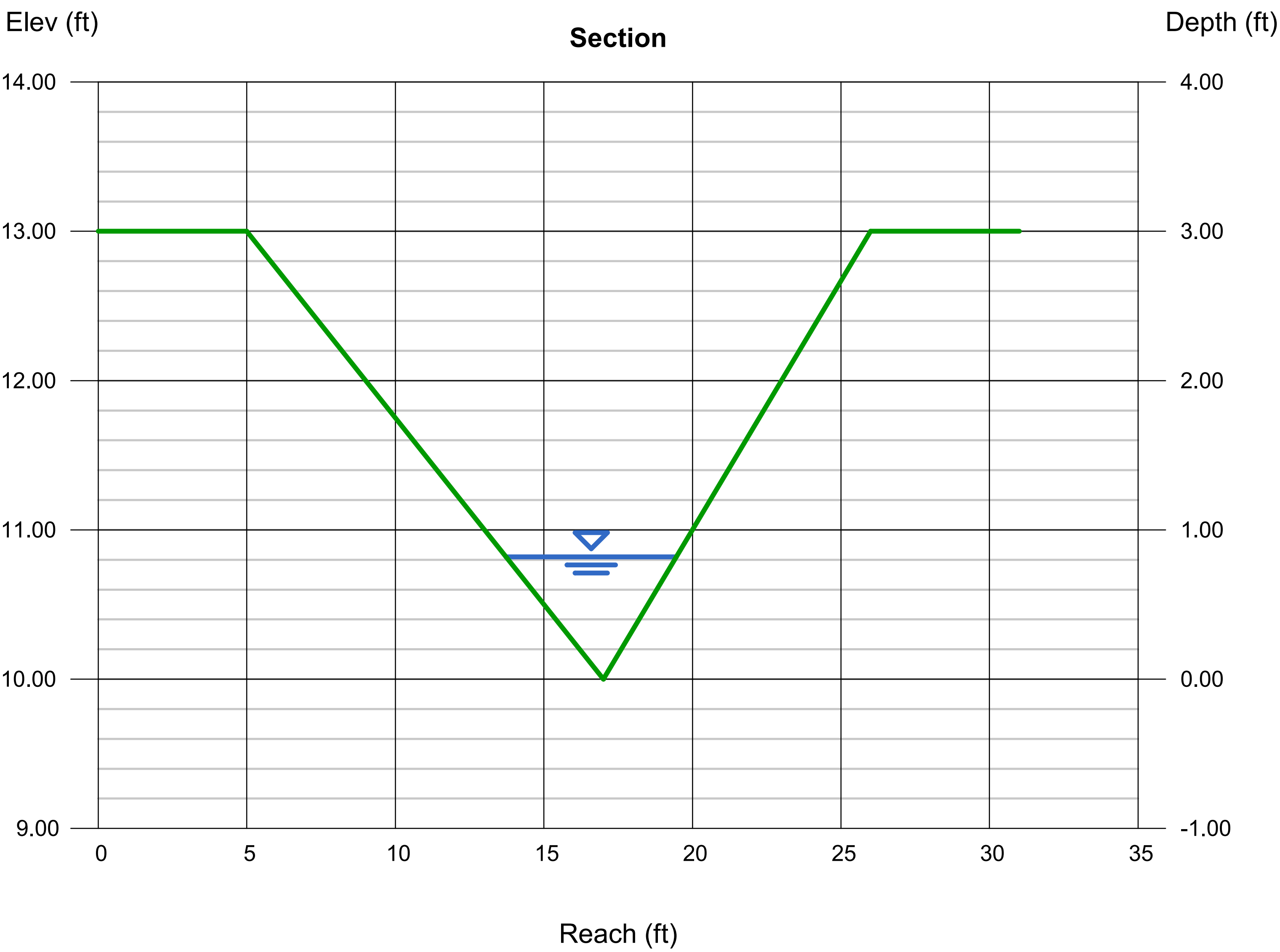
Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 3.00	Depth (ft)	= 1.36
Total Depth (ft)	= 4.00	Q (cfs)	= 27.90
		Area (sqft)	= 6.47
Invert Elev (ft)	= 10.00	Velocity (ft/s)	= 4.31
Slope (%)	= 1.35	Wetted Perim (ft)	= 9.91
N-Value	= 0.030	Crit Depth, Yc (ft)	= 1.32
		Top Width (ft)	= 9.52
Calculations		EGL (ft)	= 1.65
Compute by:	Known Q		
Known Q (cfs)	= 27.90		



Channel Report

DP 1.3 Swale (5-Year) (FR: 0.54)

Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 3.00	Depth (ft)	= 0.82
Total Depth (ft)	= 3.00	Q (cfs)	= 6.100
		Area (sqft)	= 2.35
Invert Elev (ft)	= 10.00	Velocity (ft/s)	= 2.59
Slope (%)	= 1.00	Wetted Perim (ft)	= 5.97
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.72
		Top Width (ft)	= 5.74
Calculations		EGL (ft)	= 0.92
Compute by:	Known Q		
Known Q (cfs)	= 6.10		



Channel Report

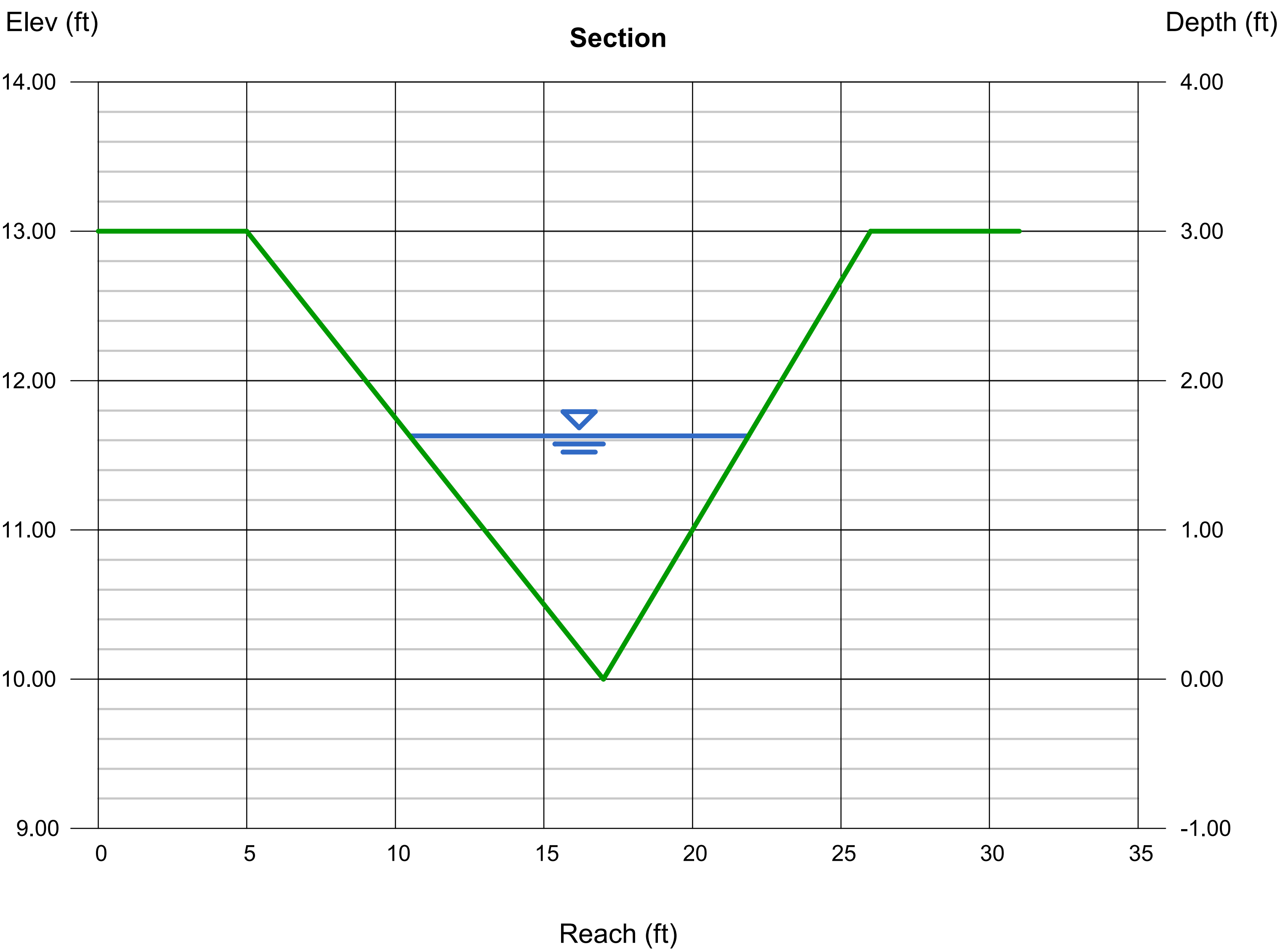
DP 1.3 Swale (100-Year) (0.60)

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) = 38.70

Highlighted
Depth (ft) = 1.63
Q (cfs) = 38.70
Area (sqft) = 9.30
Velocity (ft/s) = 4.16
Wetted Perim (ft) = 11.88
Crit Depth, Yc (ft) = 1.51
Top Width (ft) = 11.41
EGL (ft) = 1.90



Channel Report

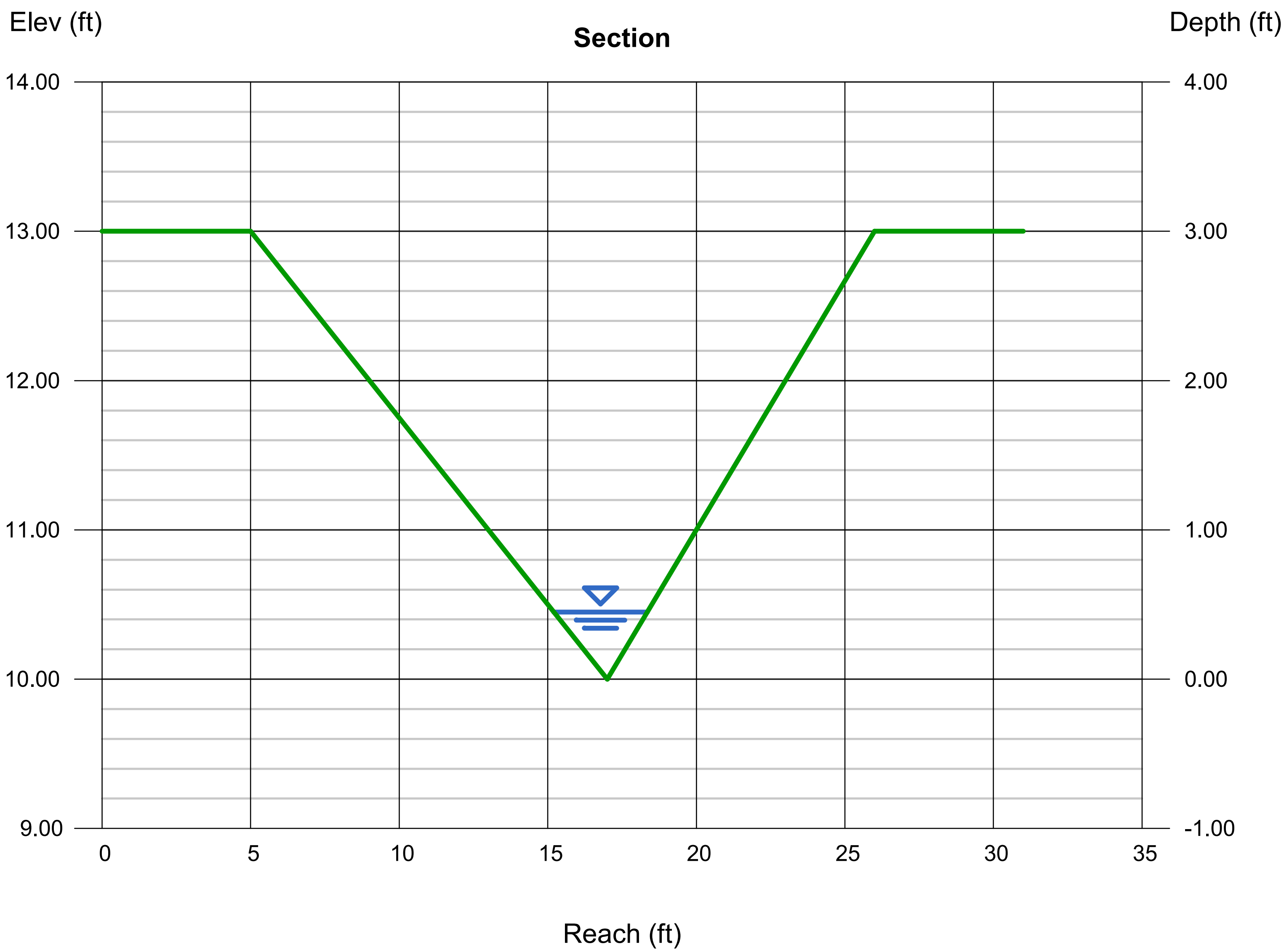
DP 1.4 Swale (5-Year) (FR: 0.64)

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

Invert Elev (ft) = 10.00
Slope (%) = 1.87
N-Value = 0.030

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

Highlighted
Depth (ft) = 0.45
Q (cfs) = 1.700
Area (sqft) = 0.71
Velocity (ft/s) = 2.40
Wetted Perim (ft) = 3.28
Crit Depth, Yc (ft) = 0.43
Top Width (ft) = 3.15
EGL (ft) = 0.54



Channel Report

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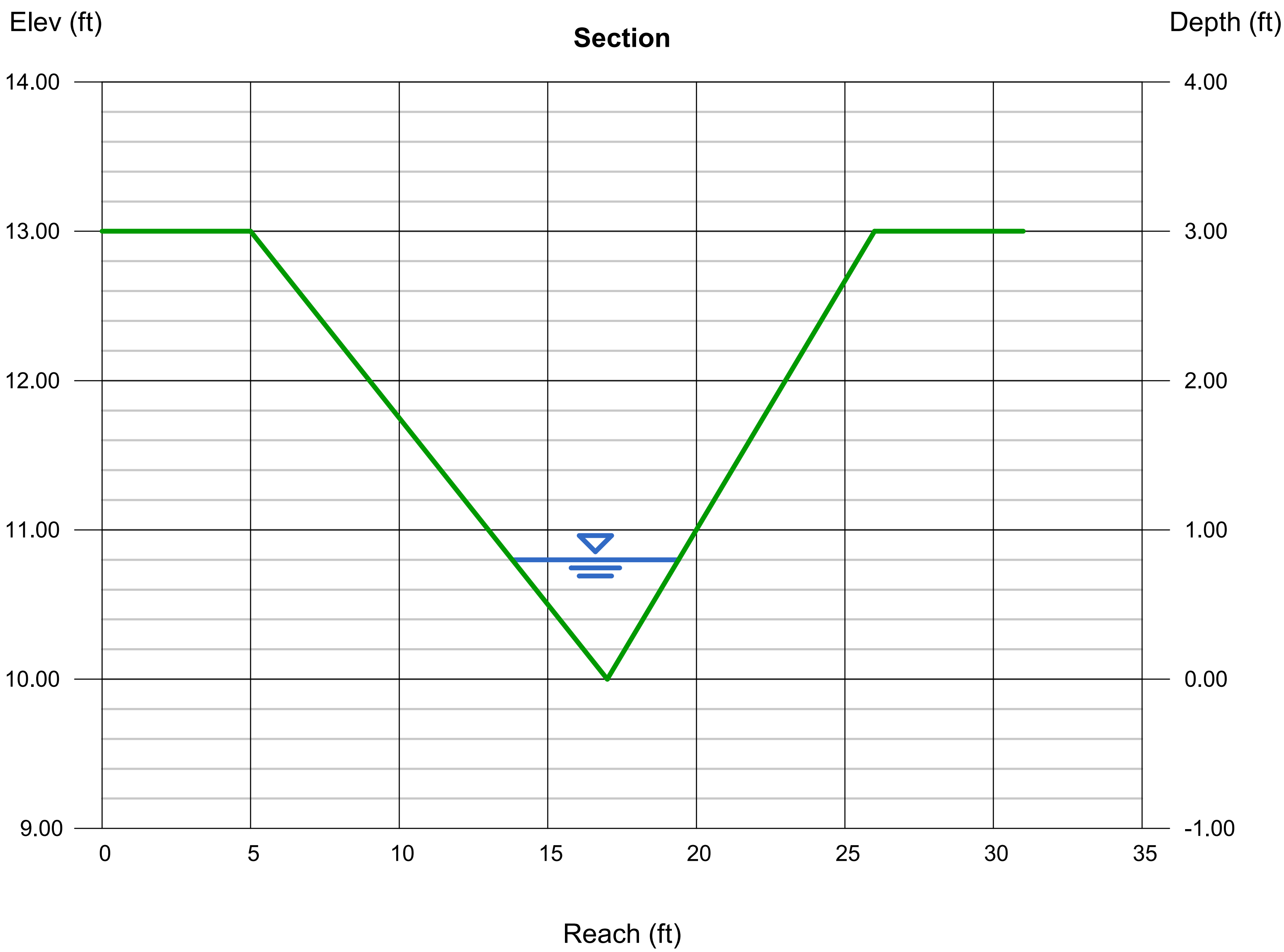
DP 1.4 Swale (100-Year) (FR: 0.70)

Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 3.00	Depth (ft)	= 0.80
Total Depth (ft)	= 3.00	Q (cfs)	= 7.900
		Area (sqft)	= 2.24
Invert Elev (ft)	= 10.00	Velocity (ft/s)	= 3.53
Slope (%)	= 1.87	Wetted Perim (ft)	= 5.83
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.80
		Top Width (ft)	= 5.60
Calculations		EGL (ft)	= 0.99
Compute by:	Known Q		
Known Q (cfs)	= 7.90		



Channel Report

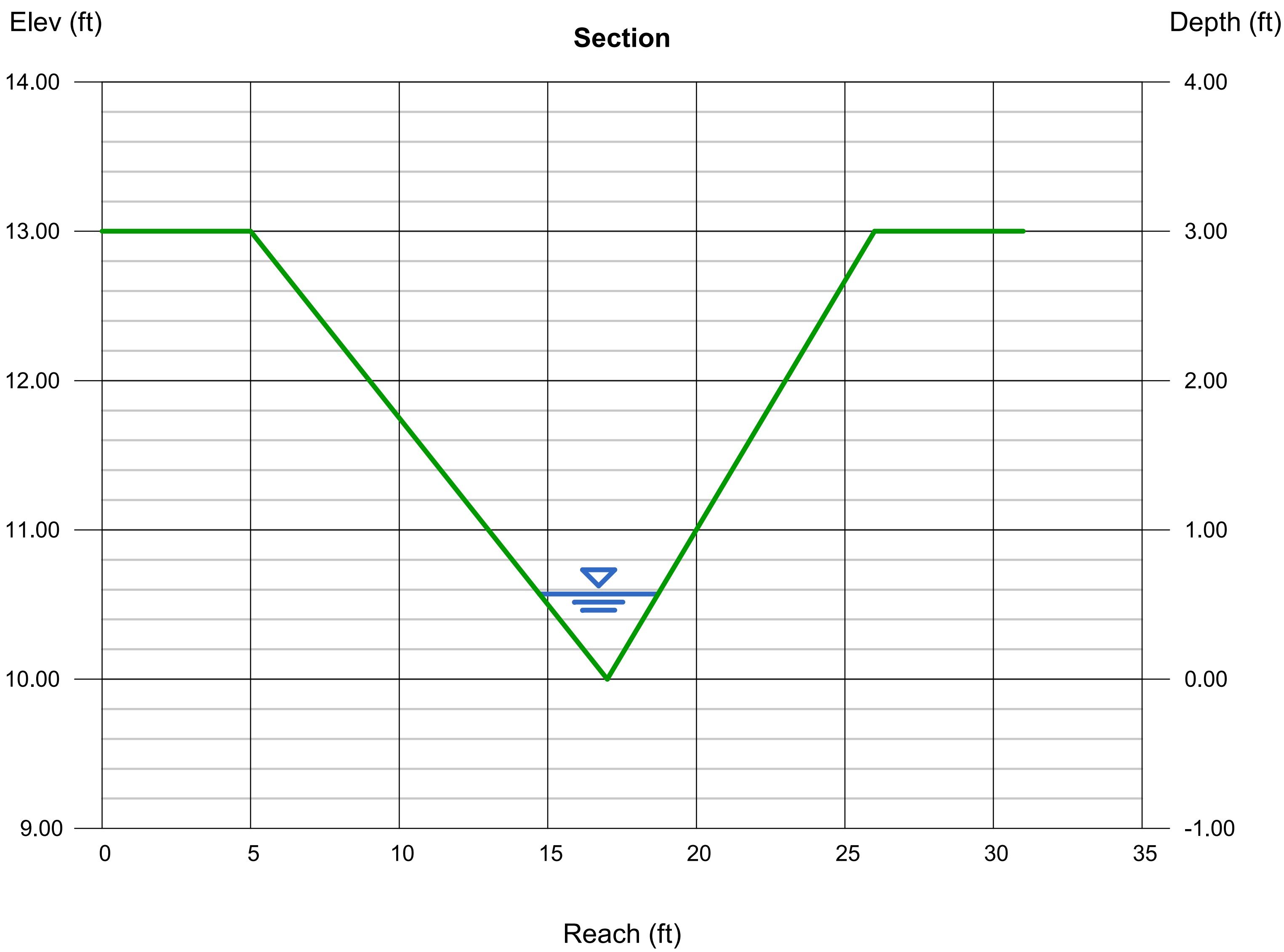
DP 1.5 Swale (5-Year) (FR: 0.59)

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

Invert Elev (ft) = 10.00
Slope (%) = 1.40
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cfs) = 2.80

Highlighted
Depth (ft) = 0.57
Q (cfs) = 2.800
Area (sqft) = 1.14
Velocity (ft/s) = 2.46
Wetted Perim (ft) = 4.15
Crit Depth, Yc (ft) = 0.53
Top Width (ft) = 3.99
EGL (ft) = 0.66



Channel Report

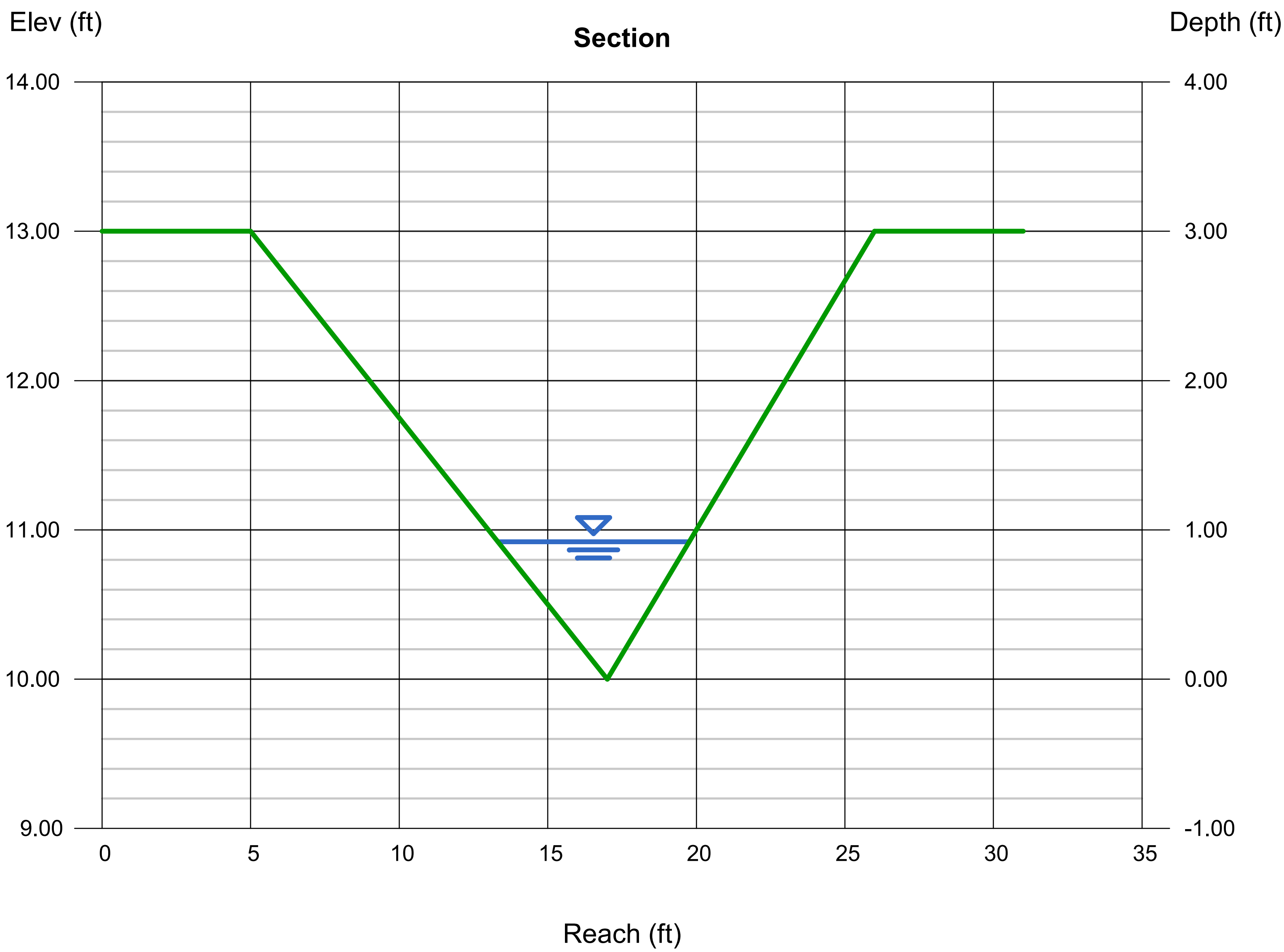
DP 1.5 Swale (100-Year) (FR: 0.63)

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

Invert Elev (ft) = 10.00
Slope (%) = 1.40
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cfs) = 9.90

Highlighted
Depth (ft) = 0.92
Q (cfs) = 9.900
Area (sqft) = 2.96
Velocity (ft/s) = 3.34
Wetted Perim (ft) = 6.70
Crit Depth, Yc (ft) = 0.87
Top Width (ft) = 6.44
EGL (ft) = 1.09

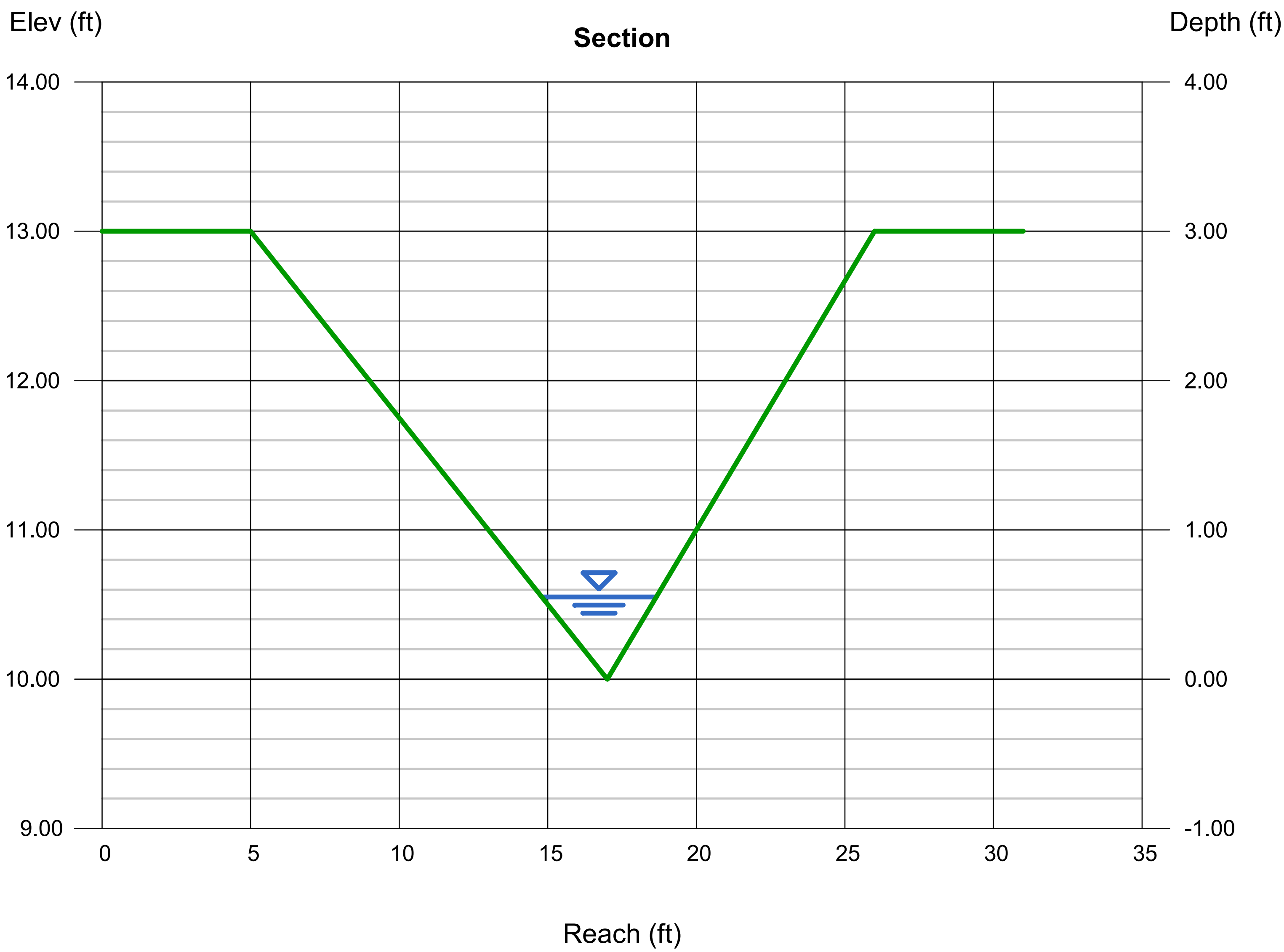


Channel Report

DP 8 Swale (5-Year) (FR: 0.55)

Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.22
N-Value	= 0.030
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 2.30

Highlighted	
Depth (ft)	= 0.55
Q (cfs)	= 2.300
Area (sqft)	= 1.06
Velocity (ft/s)	= 2.17
Wetted Perim (ft)	= 4.01
Crit Depth, Yc (ft)	= 0.49
Top Width (ft)	= 3.85
EGL (ft)	= 0.62



Channel Report

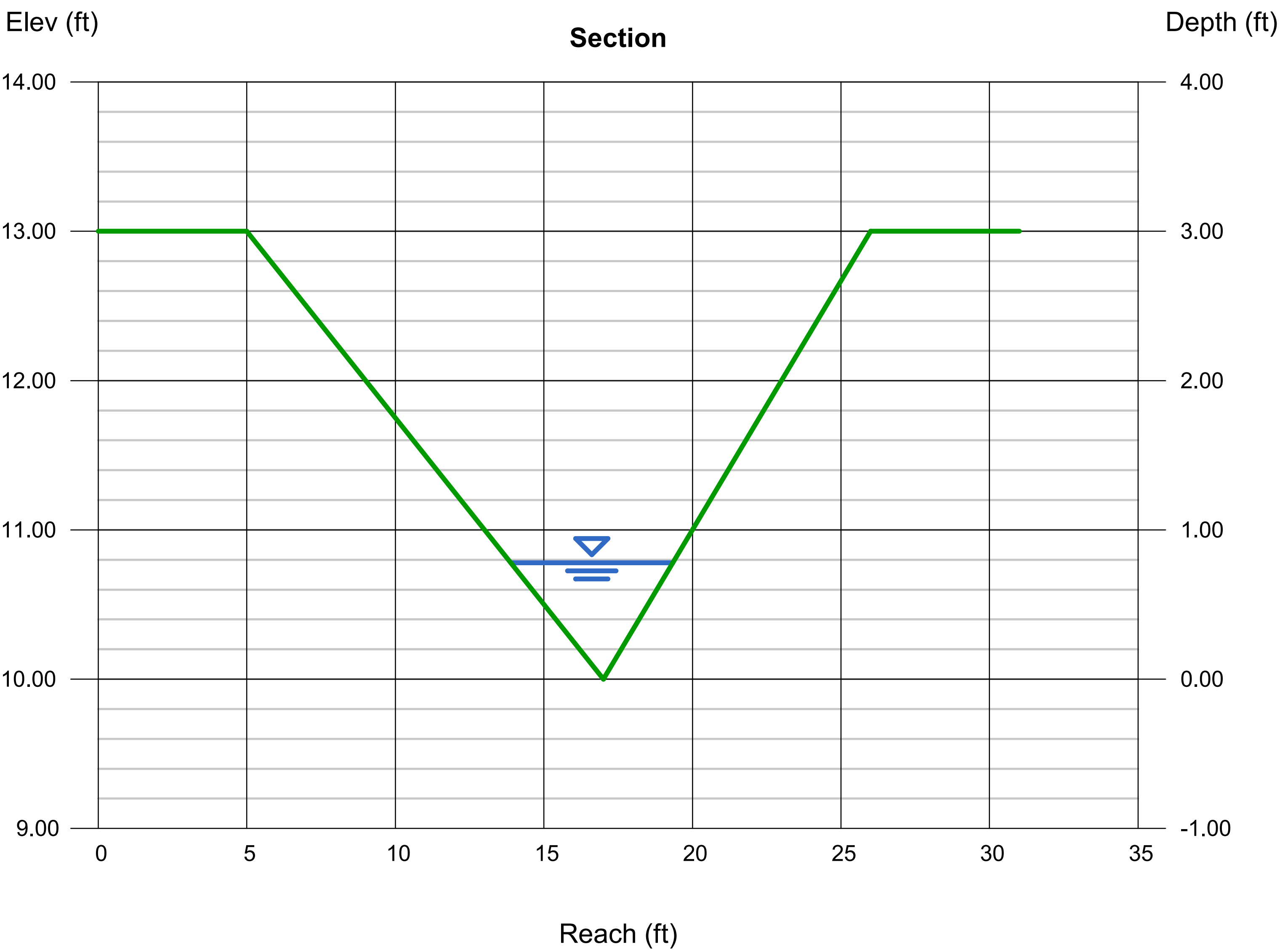
DP 8 Swale (100-Year) (FR: 0.59)

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

Invert Elev (ft) = 10.00
Slope (%) = 1.22
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cfs) = 6.00

Highlighted
Depth (ft) = 0.78
Q (cfs) = 6.000
Area (sqft) = 2.13
Velocity (ft/s) = 2.82
Wetted Perim (ft) = 5.68
Crit Depth, Yc (ft) = 0.72
Top Width (ft) = 5.46
EGL (ft) = 0.90



Channel Report

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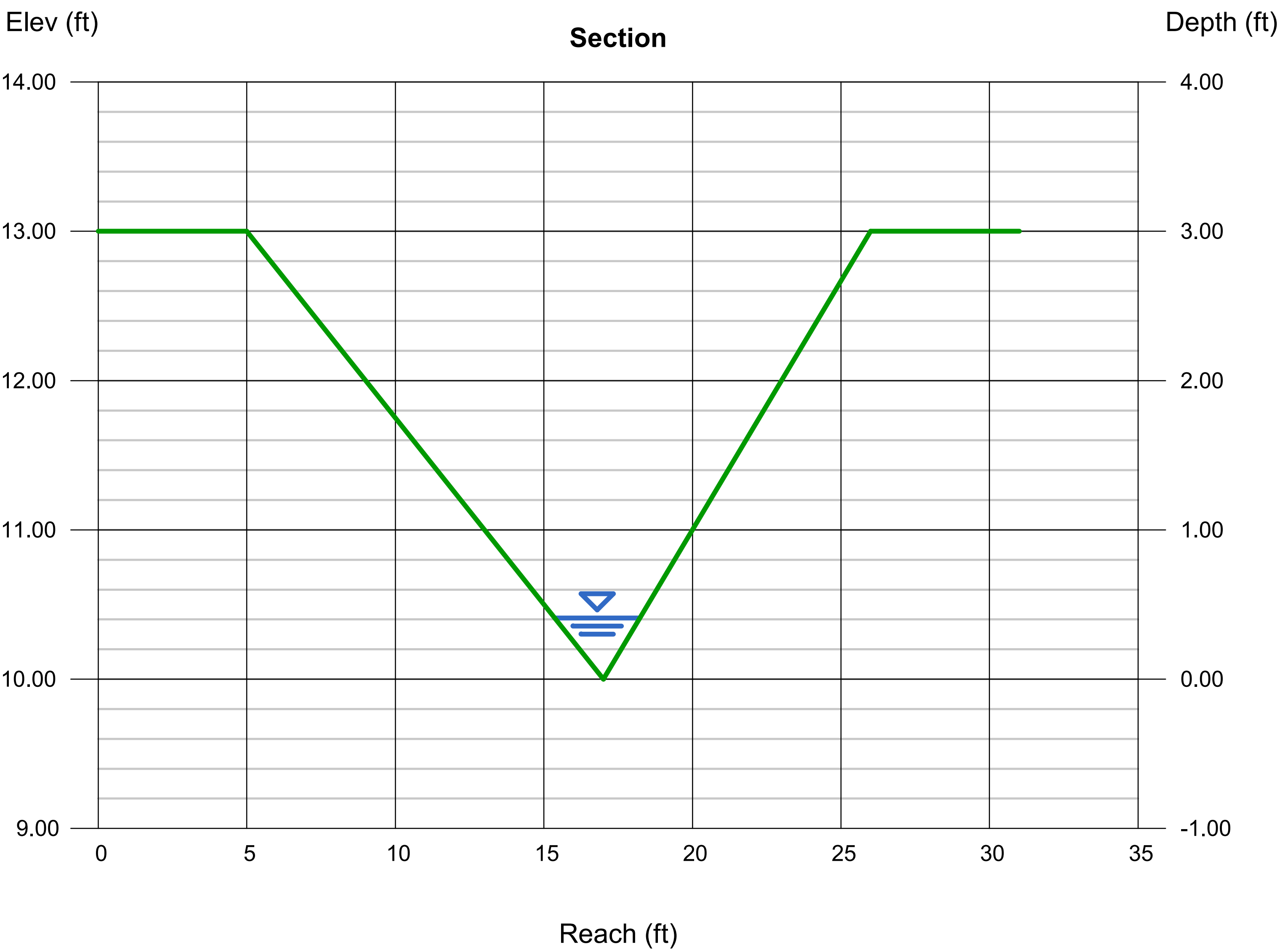
DP 9 Swale (5-Year) (FR: 0.54)

Triangular	
Side Slopes (z:1)	= 4.00, 3.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.30
N-Value	= 0.030
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 1.10

Highlighted	
Depth (ft)	= 0.41
Q (cfs)	= 1.100
Area (sqft)	= 0.59
Velocity (ft/s)	= 1.87
Wetted Perim (ft)	= 2.99
Crit Depth, Yc (ft)	= 0.37
Top Width (ft)	= 2.87
EGL (ft)	= 0.46



Channel Report

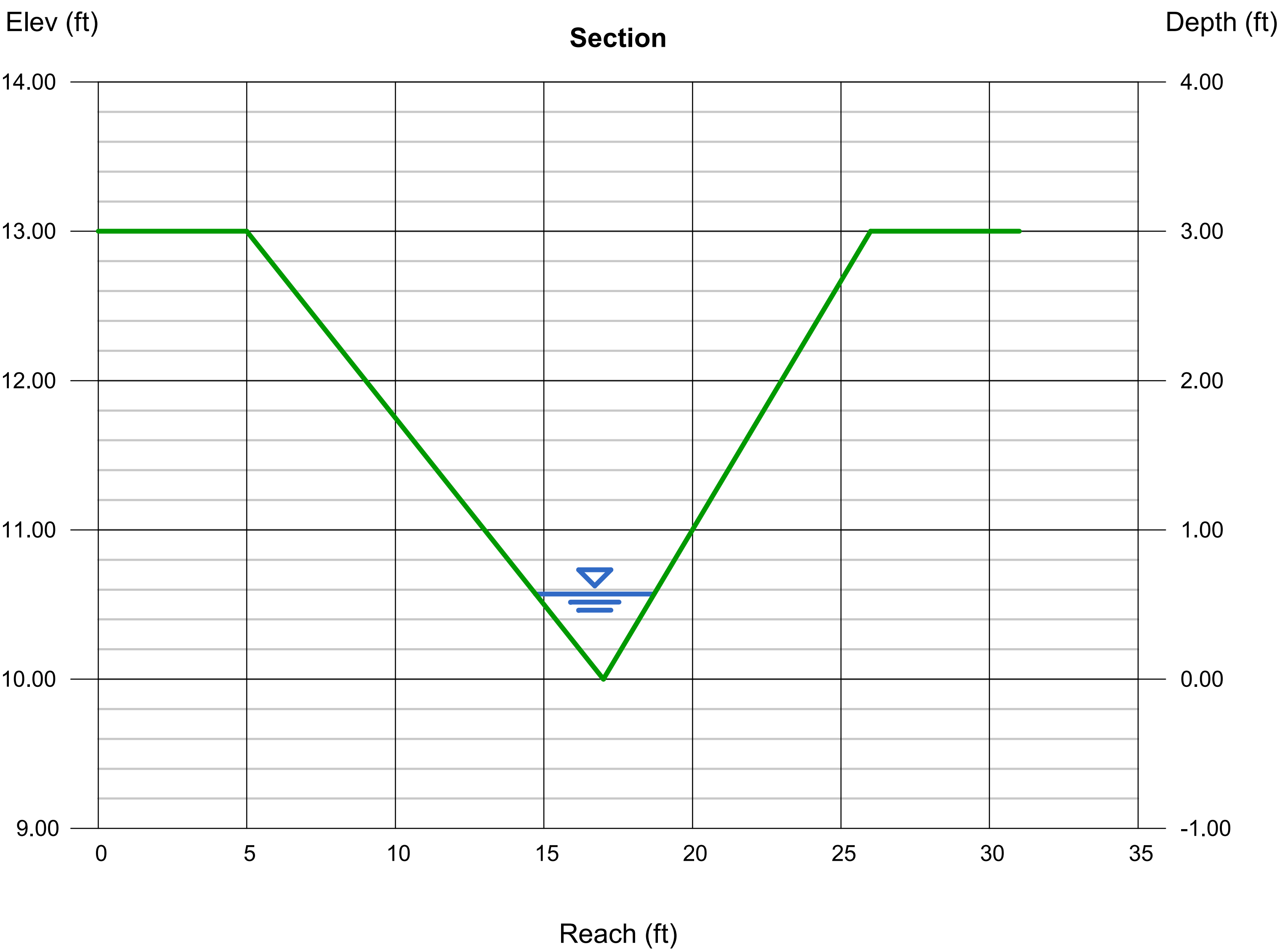
DP 9 Swale (100-Year) (FR: 0.57)

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

Invert Elev (ft) = 10.00
Slope (%) = 1.30
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cfs) = 2.60

Highlighted
Depth (ft) = 0.57
Q (cfs) = 2.600
Area (sqft) = 1.14
Velocity (ft/s) = 2.29
Wetted Perim (ft) = 4.15
Crit Depth, Yc (ft) = 0.51
Top Width (ft) = 3.99
EGL (ft) = 0.65



APPENDIX D

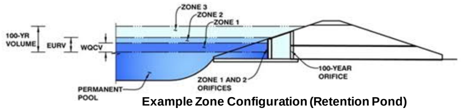
WATER QUALITY AND DETENTION CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Saddlehorn Filing 2

Basin ID: Pond F



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	95.54	acres
Watershed Length =	5,707	ft
Watershed Length to Centroid =	2,118	ft
Watershed Slope =	0.014	ft/ft
Watershed Imperviousness =	13.50%	percent
Percentage Hydrologic Soil Group A =	89.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	11.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.684	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.038	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.647	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.984	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.358	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.366	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.729	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	6.859	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	11.388	acre-feet		inches
Approximate 2-yr Detention Volume =	0.656	acre-feet		
Approximate 5-yr Detention Volume =	0.969	acre-feet		
Approximate 10-yr Detention Volume =	1.252	acre-feet		
Approximate 25-yr Detention Volume =	1.625	acre-feet		
Approximate 50-yr Detention Volume =	1.996	acre-feet		
Approximate 100-yr Detention Volume =	2.911	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.684	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.355	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.873	acre-feet
Total Detention Basin Volume =	2.911	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	36	0.001		
6681	--	0.33	--	--	--	50	0.001	14	0.000
6682	--	1.33	--	--	--	2,789	0.064	1,434	0.033
6683	--	2.33	--	--	--	15,282	0.351	10,469	0.240
6684	--	3.33	--	--	--	33,913	0.779	35,066	0.805
6685	--	4.33	--	--	--	49,906	1.146	76,976	1.767
6686	--	5.33	--	--	--	58,427	1.341	131,142	3.011
6687	--	6.33	--	--	--	67,707	1.554	194,209	4.458
6687.5	--	6.83	--	--	--	73,617	1.690	229,540	5.270
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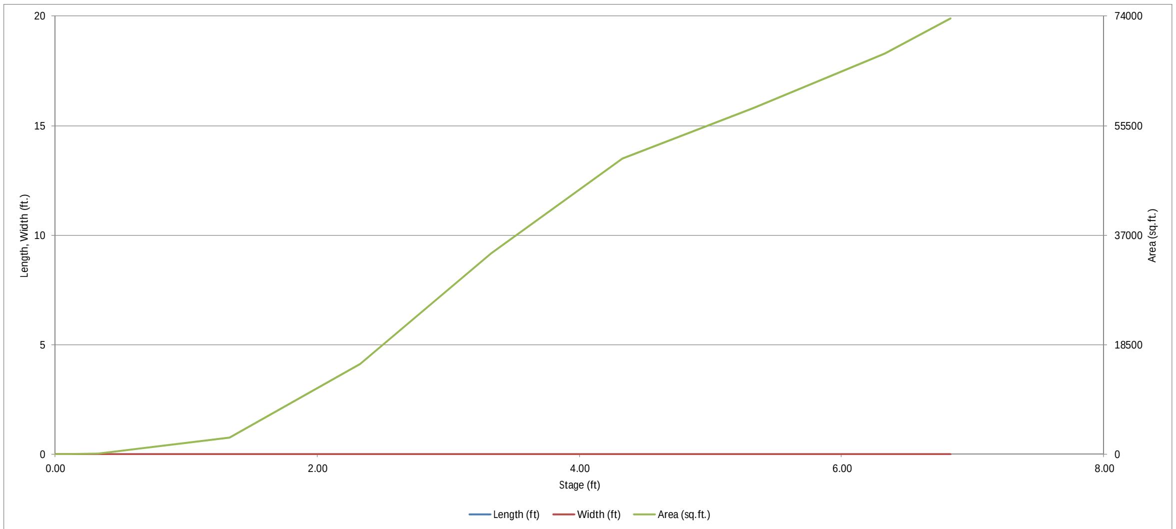
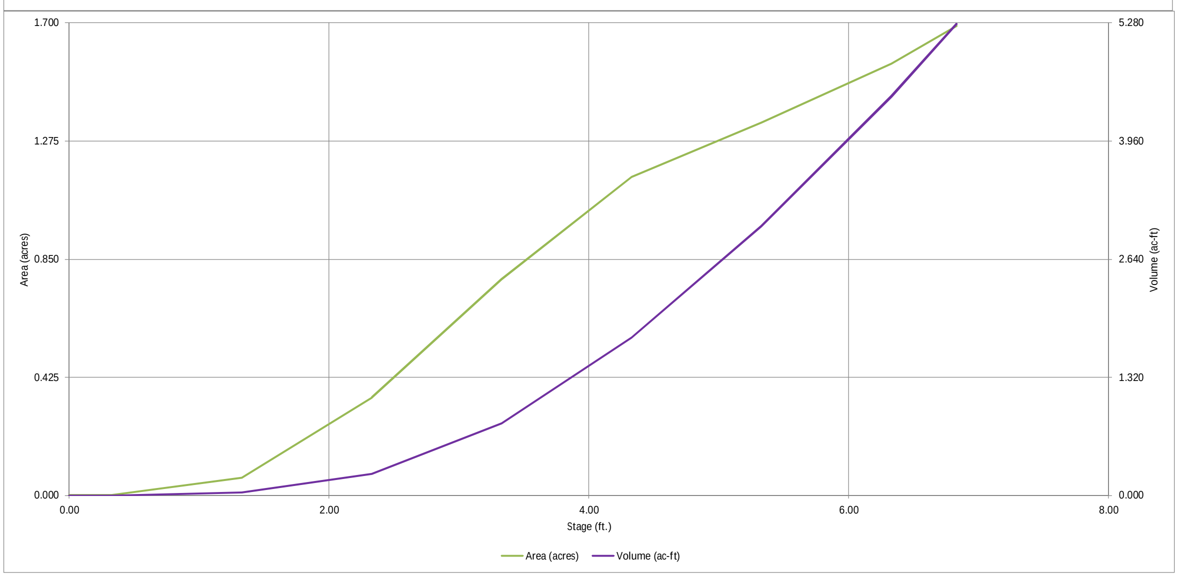
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



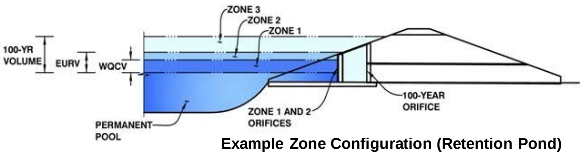


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Saddlehorn Filing 2

Basin ID: Pond F



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.17	0.684	Orifice Plate
Zone 2 (EURV)	3.62	0.355	Circular Orifice
Zone 3 (100-year)	5.26	1.873	Weir&Pipe (Restrict)
Total (all zones)		2.911	

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.17	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	12.70	inches
Orifice Plate: Orifice Area per Row =	2.03	sq. inches (diameter = 1-5/8 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.413E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.06	2.11	3.17				
Orifice Area (sq. inches)	2.03	2.03	2.03	0.11				

	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 =	3.17	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.62	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	0.38	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.00	N/A	ft^2
Vertical Orifice Centroid =	0.02	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.03	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
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.03	N/A	feet
Overflow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.96	N/A	
Overflow Grate Open Area w/o Debris =	20.88	N/A	ft^2
Overflow Grate Open Area w/ Debris =	20.88	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	4.21	N/A	ft^2
Outlet Orifice Centroid =	1.09	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.21	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.38	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	55.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.45	feet
Stage at Top of Freeboard =	6.83	feet
Basin Area at Top of Freeboard =	1.69	acres
Basin Volume at Top of Freeboard =	5.27	acre-ft

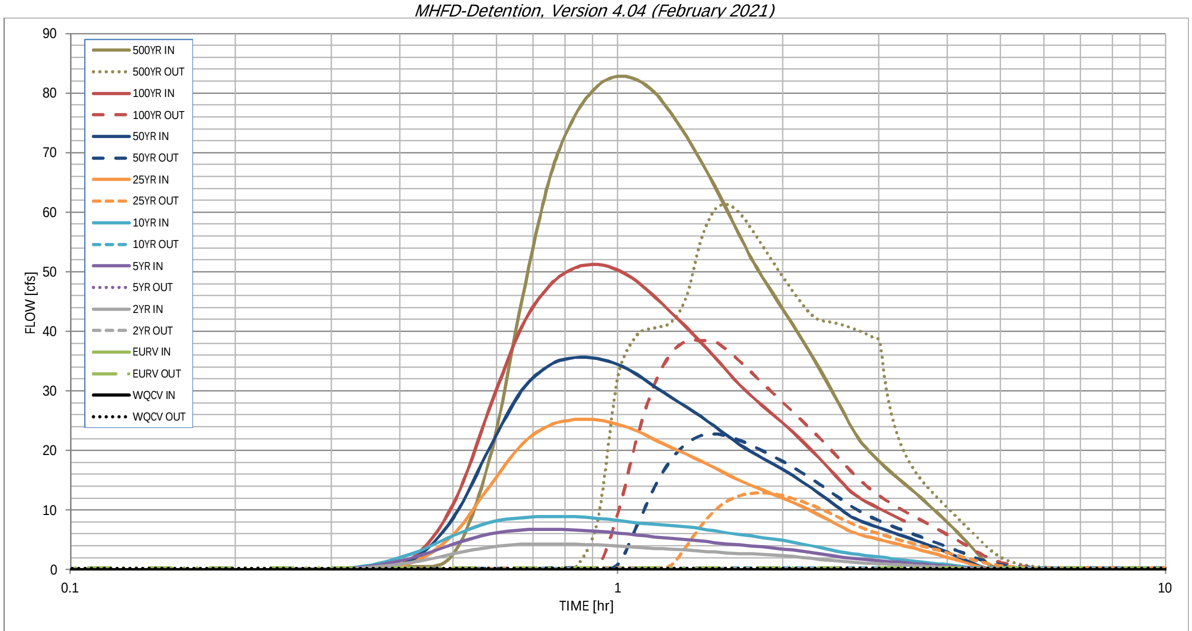
Routed Hydrograph Results

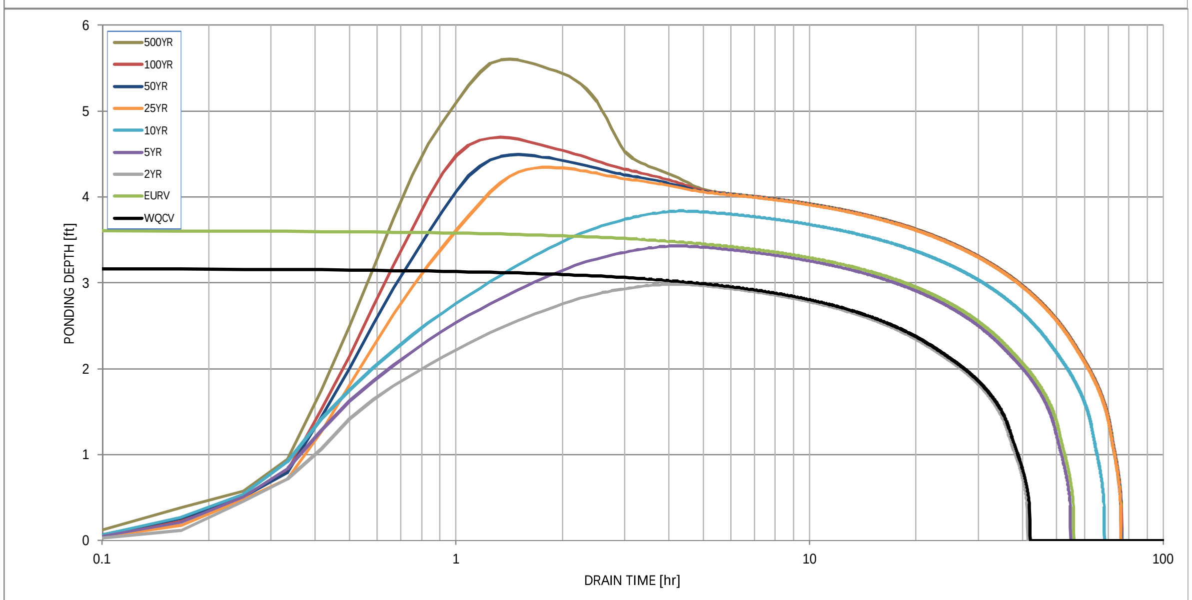
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

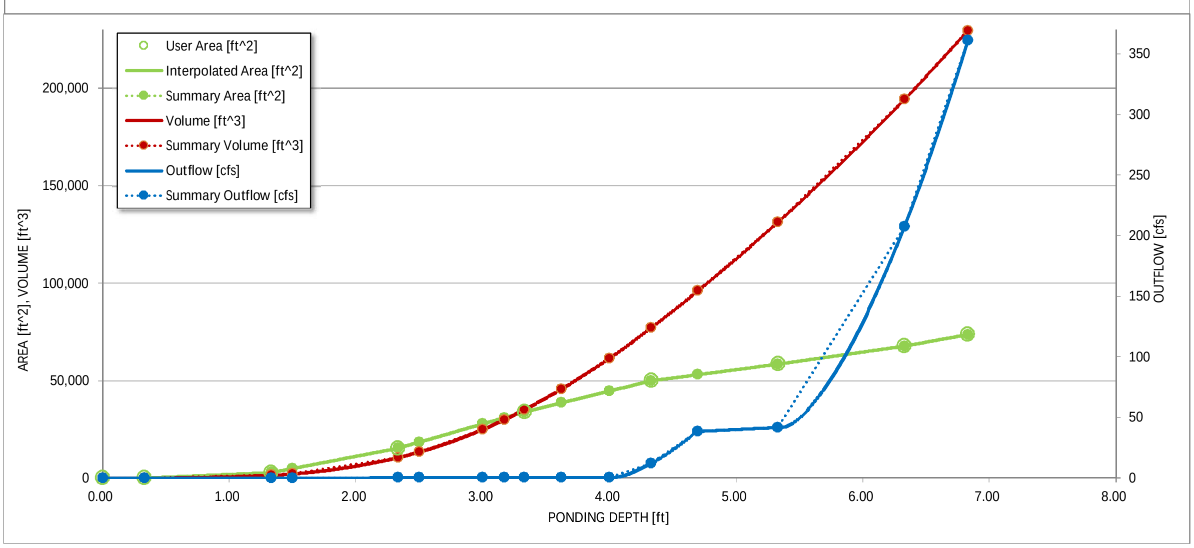
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.684	1.038	0.647	0.984	1.358	3.366	4.729	6.859	11.388
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.647	0.984	1.358	3.366	4.729	6.859	11.388
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.5	0.9	1.2	16.1	25.9	40.7	71.3
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	0.17	0.27	0.43	0.75
Peak Inflow Q (cfs) =	N/A	N/A	4.4	6.8	9.0	25.2	35.6	51.3	82.9
Peak Outflow Q (cfs) =	0.3	0.3	0.3	0.3	0.3	12.9	22.8	38.5	61.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.3	0.8	0.9	0.9	0.9
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Vertical Orifice 1	Vertical Orifice 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	N/A	0.6	1.1	1.8	2.0
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	50	62	64	61	57	50
Time to Drain 99% of Inflow Volume (hours) =	40	54	40	53	65	70	69	67	64
Maximum Ponding Depth (ft) =	3.17	3.62	2.99	3.43	3.84	4.35	4.49	4.70	5.61
Area at Maximum Ponding Depth (acres) =	0.71	0.89	0.63	0.82	0.96	1.15	1.18	1.22	1.40
Maximum Volume Stored (acre-ft) =	0.686	1.046	0.559	0.885	1.240	1.779	1.953	2.192	3.381

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	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	0.02
	0:15:00	0.00	0.00	0.05	0.09	0.11	0.08	0.10	0.09	0.16
	0:20:00	0.00	0.00	0.27	0.39	0.46	0.30	0.37	0.37	0.53
	0:25:00	0.00	0.00	1.18	1.91	2.58	1.10	1.47	1.68	2.65
	0:30:00	0.00	0.00	2.67	4.32	5.78	5.92	8.77	11.06	18.84
	0:35:00	0.00	0.00	3.83	6.06	7.99	14.15	20.62	27.30	45.14
	0:40:00	0.00	0.00	4.28	6.69	8.78	21.04	30.08	40.81	65.73
	0:45:00	0.00	0.00	4.36	6.79	8.98	24.27	34.38	47.75	76.17
	0:50:00	0.00	0.00	4.33	6.71	8.92	25.23	35.65	50.68	81.19
	0:55:00	0.00	0.00	4.21	6.51	8.67	25.15	35.49	51.26	82.88
	1:00:00	0.00	0.00	4.02	6.20	8.29	24.46	34.47	50.28	82.22
	1:05:00	0.00	0.00	3.80	5.83	7.87	23.30	32.79	48.42	80.15
	1:10:00	0.00	0.00	3.62	5.55	7.62	21.85	30.72	45.82	76.61
	1:15:00	0.00	0.00	3.47	5.32	7.44	20.56	28.95	43.22	72.76
	1:20:00	0.00	0.00	3.32	5.08	7.22	19.41	27.33	40.71	68.67
	1:25:00	0.00	0.00	3.16	4.84	6.91	18.30	25.75	38.22	64.49
	1:30:00	0.00	0.00	3.01	4.59	6.55	17.17	24.13	35.76	60.30
	1:35:00	0.00	0.00	2.87	4.37	6.21	16.05	22.53	33.34	56.16
	1:40:00	0.00	0.00	2.76	4.19	5.93	15.01	21.06	31.10	52.36
	1:45:00	0.00	0.00	2.67	4.02	5.68	14.16	19.86	29.24	49.20
	1:50:00	0.00	0.00	2.58	3.85	5.43	13.43	18.81	27.62	46.42
	1:55:00	0.00	0.00	2.48	3.68	5.19	12.74	17.81	26.10	43.78
	2:00:00	0.00	0.00	2.37	3.51	4.94	12.06	16.84	24.63	41.24
	2:05:00	0.00	0.00	2.24	3.32	4.67	11.36	15.85	23.16	38.73
	2:10:00	0.00	0.00	2.10	3.11	4.37	10.64	14.83	21.67	36.22
	2:15:00	0.00	0.00	1.95	2.89	4.06	9.91	13.81	20.19	33.74
	2:20:00	0.00	0.00	1.80	2.67	3.75	9.19	12.79	18.71	31.29
	2:25:00	0.00	0.00	1.66	2.45	3.44	8.46	11.77	17.25	28.85
	2:30:00	0.00	0.00	1.52	2.24	3.15	7.74	10.76	15.78	26.42
	2:35:00	0.00	0.00	1.39	2.05	2.89	7.04	9.77	14.35	24.04
	2:40:00	0.00	0.00	1.29	1.91	2.71	6.42	8.93	13.11	22.02
	2:45:00	0.00	0.00	1.22	1.81	2.56	5.99	8.34	12.20	20.52
	2:50:00	0.00	0.00	1.16	1.71	2.42	5.65	7.87	11.49	19.29
	2:55:00	0.00	0.00	1.09	1.62	2.28	5.36	7.46	10.86	18.20
	3:00:00	0.00	0.00	1.03	1.53	2.15	5.08	7.07	10.29	17.19
	3:05:00	0.00	0.00	0.97	1.44	2.02	4.81	6.70	9.73	16.24
	3:10:00	0.00	0.00	0.92	1.36	1.90	4.55	6.33	9.20	15.33
	3:15:00	0.00	0.00	0.86	1.28	1.78	4.29	5.97	8.69	14.47
	3:20:00	0.00	0.00	0.81	1.20	1.67	4.04	5.62	8.19	13.64
	3:25:00	0.00	0.00	0.75	1.12	1.56	3.79	5.28	7.69	12.82
	3:30:00	0.00	0.00	0.70	1.04	1.45	3.54	4.93	7.20	12.00
	3:35:00	0.00	0.00	0.65	0.96	1.35	3.30	4.59	6.70	11.18
	3:40:00	0.00	0.00	0.60	0.89	1.25	3.06	4.25	6.21	10.36
	3:45:00	0.00	0.00	0.55	0.82	1.14	2.81	3.91	5.72	9.54
	3:50:00	0.00	0.00	0.50	0.74	1.04	2.57	3.57	5.23	8.73
	3:55:00	0.00	0.00	0.46	0.67	0.94	2.33	3.23	4.74	7.92
	4:00:00	0.00	0.00	0.41	0.60	0.85	2.09	2.90	4.26	7.11
	4:05:00	0.00	0.00	0.36	0.53	0.75	1.85	2.56	3.77	6.30
	4:10:00	0.00	0.00	0.32	0.46	0.65	1.62	2.23	3.28	5.49
	4:15:00	0.00	0.00	0.27	0.39	0.56	1.38	1.89	2.80	4.68
	4:20:00	0.00	0.00	0.23	0.32	0.46	1.14	1.56	2.32	3.88
	4:25:00	0.00	0.00	0.18	0.26	0.37	0.91	1.23	1.83	3.07
	4:30:00	0.00	0.00	0.14	0.19	0.28	0.68	0.90	1.35	2.27
	4:35:00	0.00	0.00	0.10	0.13	0.20	0.45	0.58	0.89	1.50
	4:40:00	0.00	0.00	0.08	0.10	0.16	0.26	0.34	0.53	0.93
	4:45:00	0.00	0.00	0.07	0.09	0.14	0.17	0.21	0.33	0.62
	4:50:00	0.00	0.00	0.06	0.08	0.12	0.12	0.15	0.22	0.42
	4:55:00	0.00	0.00	0.05	0.07	0.10	0.09	0.12	0.15	0.28
	5:00:00	0.00	0.00	0.04	0.06	0.08	0.07	0.09	0.11	0.19
	5:05:00	0.00	0.00	0.04	0.05	0.07	0.06	0.07	0.08	0.12
	5:10:00	0.00	0.00	0.03	0.04	0.05	0.05	0.05	0.05	0.07
	5:15:00	0.00	0.00	0.03	0.03	0.04	0.04	0.04	0.04	0.05
	5:20:00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.04
	5:25:00	0.00	0.00	0.02	0.02	0.03	0.02	0.03	0.02	0.03
	5:30:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02
	5:35:00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.01	0.02
	5:40:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	5:45:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

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

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	36	0.001	0	0.000	0.00
	0.33	50	0.001	14	0.000	0.04
	1.33	2,789	0.064	1,434	0.033	0.11
	1.50	4,913	0.113	2,088	0.048	0.13
	2.33	15,282	0.351	10,469	0.240	0.21
	2.50	18,449	0.424	13,336	0.306	0.23
	3.00	27,765	0.637	24,890	0.571	0.28
WCQV	3.17	30,932	0.710	29,879	0.686	0.29
	3.33	33,913	0.779	35,066	0.805	0.30
EURV	3.62	38,551	0.885	45,574	1.046	0.33
	4.00	44,628	1.025	61,378	1.409	0.35
	4.33	49,906	1.146	76,976	1.767	12.02
100-YR	4.70	53,059	1.218	96,024	2.204	38.50
	5.33	58,427	1.341	131,142	3.011	41.73
	6.33	67,707	1.554	194,209	4.458	207.62
	6.83	73,617	1.690	229,540	5.270	360.96

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).

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision:	Saddlehorn Ranch	Project Name:	Saddlehorn Ranch
Location:	El Paso County	Project No.:	25142.04
		Calculated By:	AAM
		Checked By:	TBD
		Date:	6/4/21

	STORM DRAIN SYSTEM			
	DESIGN POINT 1.7	DESIGN POINT	DESIGN POINT	Notes
Q_{100} (cfs):	38.5			Flows are the greater of proposed vs. future
Conduit	Pipe			
D_c, Pipe Diameter (in):	30			
W, Box Width (ft):	N/A			
H, Box Height (ft):	N/A			
Y_t, Tailwater Depth (ft):	2.50			If unknown, use Y_t/D_c (or H)=0.4
Y_t/Dc or Y_t/H	1.00			
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	3.90			
Supercritical?	No			
Y_n, Normal Depth (ft) [Supercritical]:	0.00			
D_a, H_a (in) [Supercritical]:	N/A			$D_a=(D_c+Y_n)/2$
Riprap d_{50} (in) [Supercritical]:	N/A			
Riprap d_{50} (in) [Subcritical]:	2.69			
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
θ:	0.07			
Erosive Soils?	No			
Area of Flow, A_t (ft^2):	5.50			$A_t=Q/V$
Length of Protection, L_p (ft):	-2.0			$L=(1/(2\tan\theta))(At/Yt - D)$
Min Length (ft)	7.5			Min L=3D or 3H
Max Length (ft)	25.0			Max L=10D or 10H
Min Bottom Width, T (ft):	2.2			$T=2*(L_p*\tan\theta)+W$
Design Length (ft)	7.5			
Design Width (ft)	2.2			
Riprap Depth (in)	18			Depth=$2(d_{50})$
Type II Bedding Depth (in)*	6			*Not used if Soil Riprap
Cutoff Wall	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
* For use when the flow in the culvert is supercritical (and less than full).

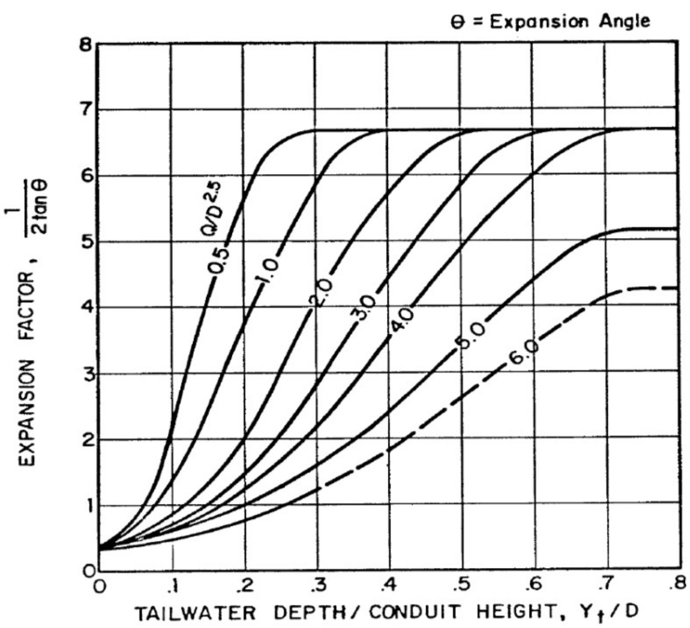


Figure 9-35. Expansion factor for circular conduits

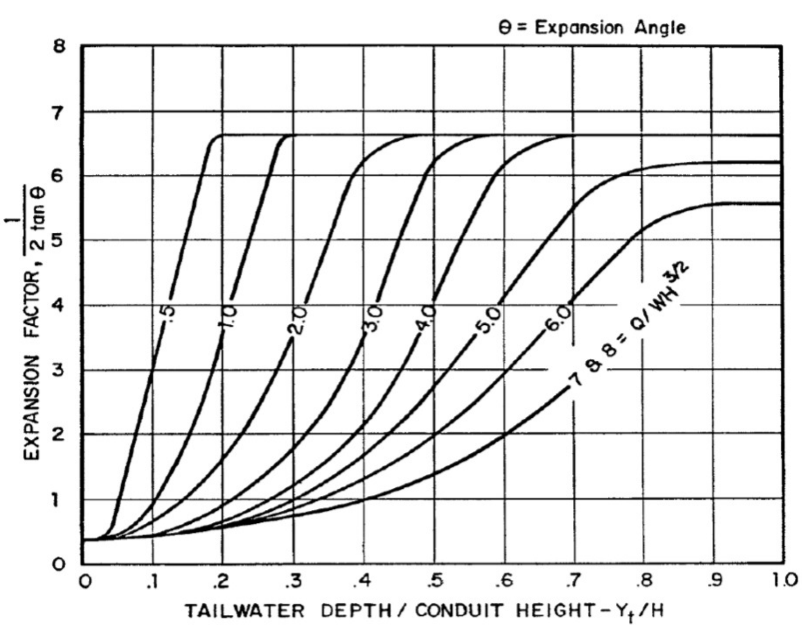


Figure 9-36. Expansion factor for rectangular conduits

FOREBAY VOLUME REQUIREMENTS

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

a=1 (40 hour drain time)

Forebay 1 $I=.135$ $WQCV=$ 0.085851

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

Forebay 1 A= 95.54 Acres V= 0.684

3% OF WQCV

FOREBAY TOTAL VOLUME= .03(V)

VOLUME REQUIRED FOR FOREBAY 1 =	0.021	AC-FT	893	CF
VOLUME PROVIDED FOR FOREBAY 1 =	0.037	AC-FT	1596	CF

Q_{100} Discharges 2% OF Q_{100}

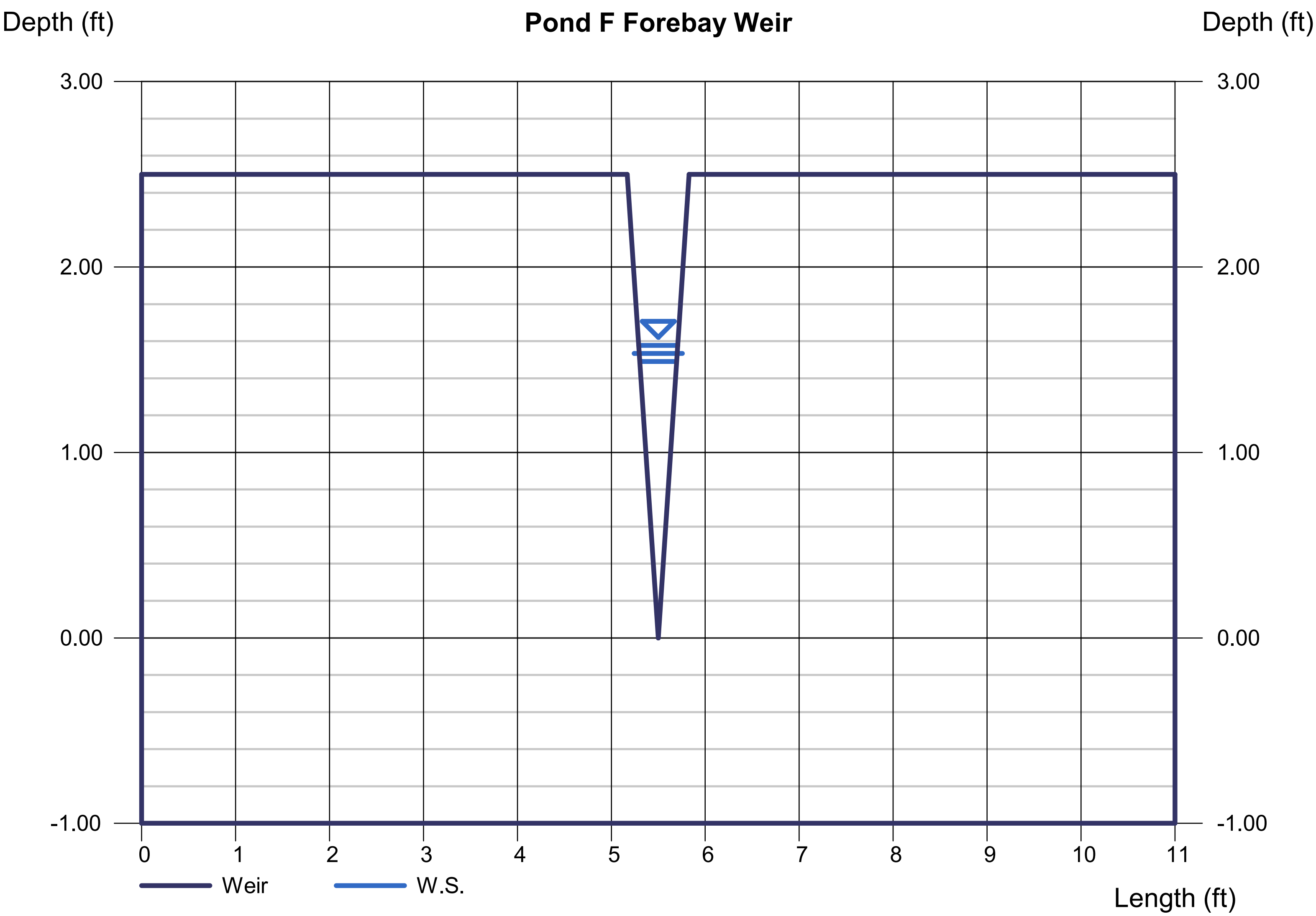
Q_{100} Forebay 1= .02*51.3 CFS= 1.03 CFS

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, May 25 2021

Pond F Forebay Weir

V-Notch Weir		**Highlighted**	
Crest	= Sharp	Depth (ft)	= 1.58
Angle (Deg)	= 15	Q (cfs)	= 1.030
Total Depth (ft)	= 2.50	Area (sqft)	= 0.33
		Velocity (ft/s)	= 3.15
Calculations		Top Width (ft)	= 0.42
Weir Coeff. Cw	= 0.33		
Compute by:	Known Q		
Known Q (cfs)	= 1.03		

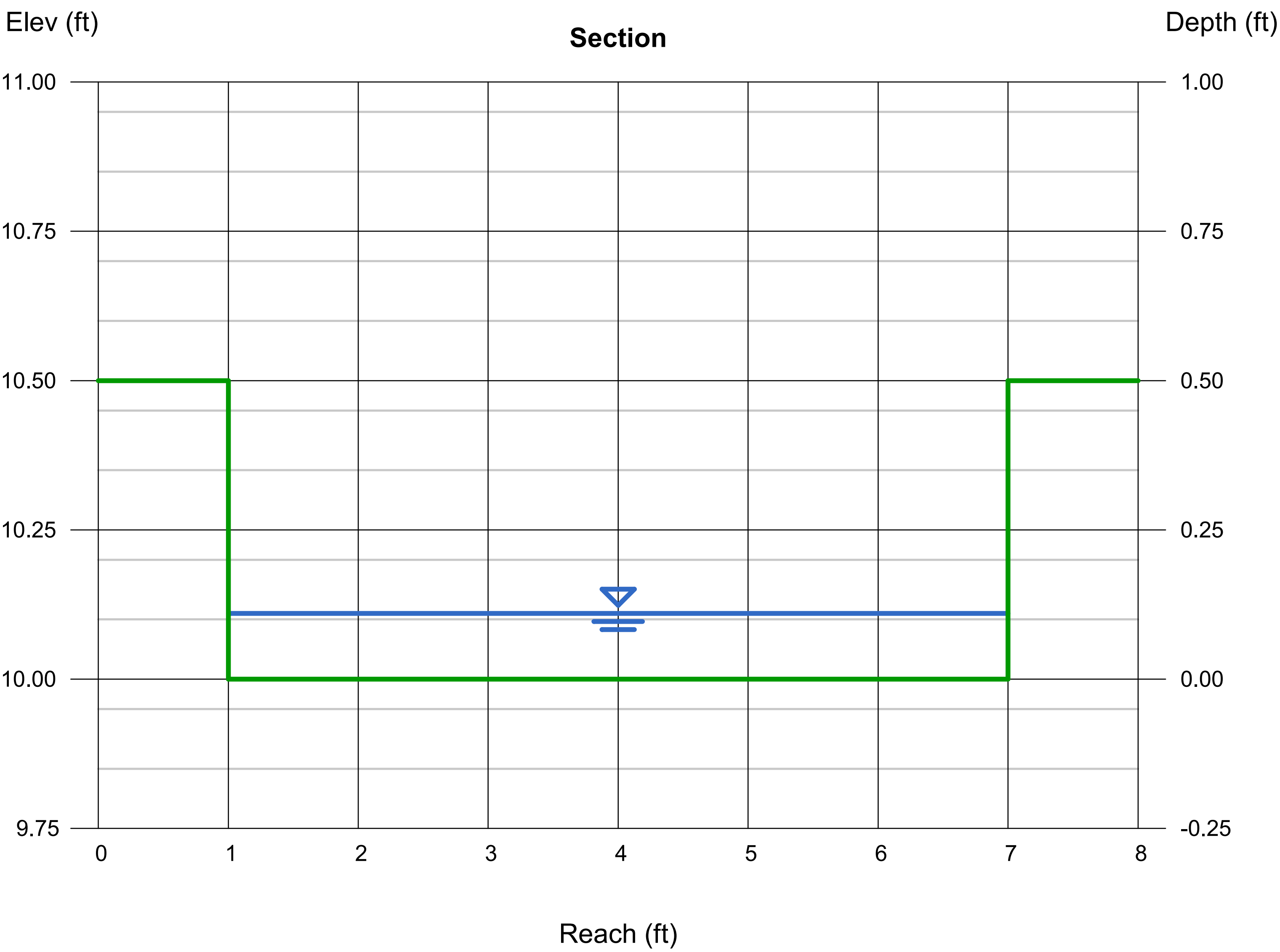


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 20 2021

Pond F Trickle Channel

Rectangular		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.11
Total Depth (ft)	= 0.50	Q (cfs)	= 1.030
		Area (sqft)	= 0.66
Invert Elev (ft)	= 10.00	Velocity (ft/s)	= 1.56
Slope (%)	= 0.50	Wetted Perim (ft)	= 6.22
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.10
		Top Width (ft)	= 6.00
Calculations		EGL (ft)	= 0.15
Compute by:	Known Q		
Known Q (cfs)	= 1.03		



Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 20 2021

Pond F Spillway

Trapezoidal Weir		**Highlighted**	
Crest	= Sharp	Depth (ft)	= 0.45
Bottom Length (ft)	= 55.00	Q (cfs)	= 51.30
Total Depth (ft)	= 1.45	Area (sqft)	= 25.56
Side Slope (z:1)	= 4.00	Velocity (ft/s)	= 2.01
		Top Width (ft)	= 58.60
Calculations			
Weir Coeff. Cw	= 3.10		
Compute by:	Known Q		
Known Q (cfs)	= 51.30		

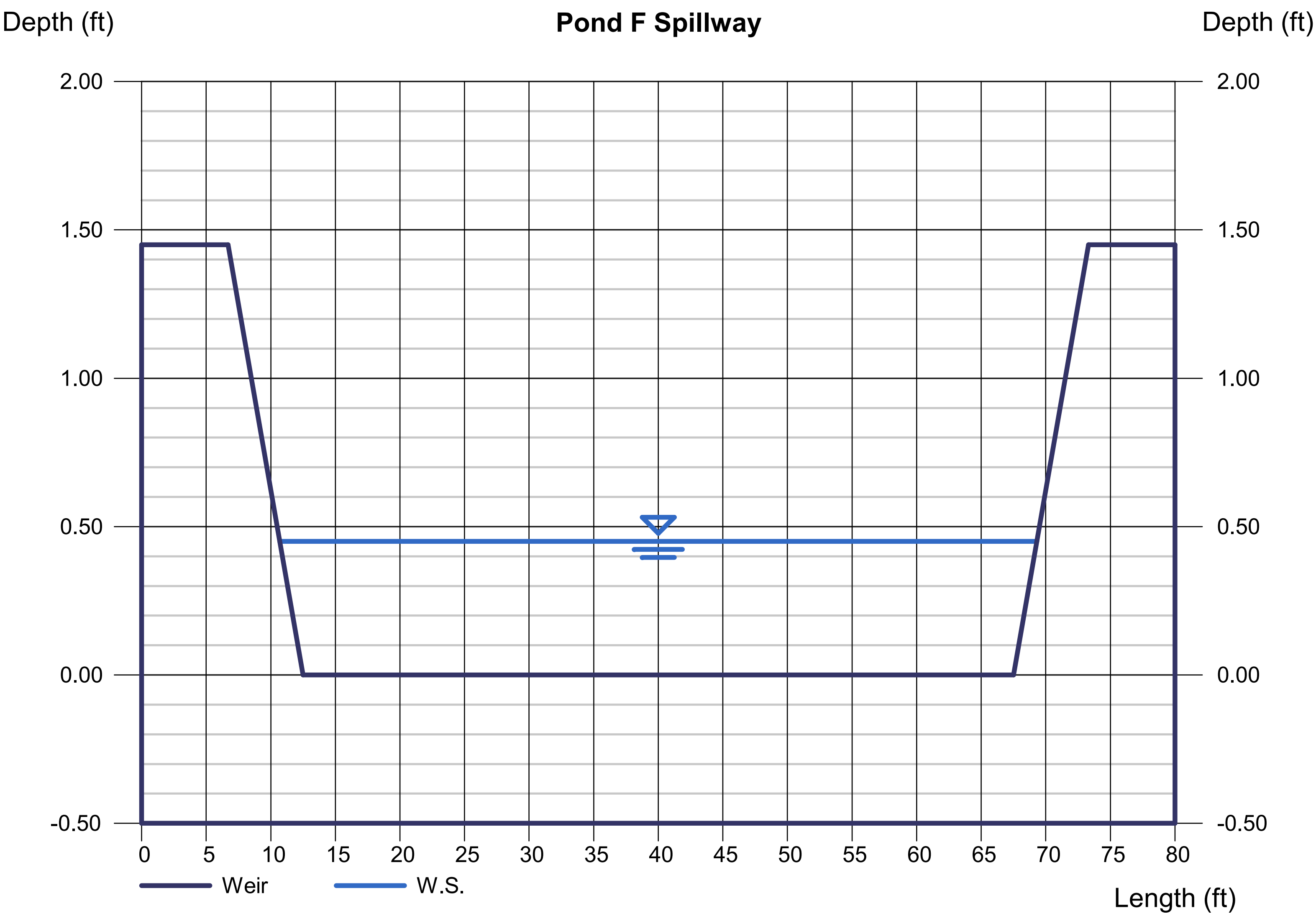


Figure 13-12c. Emergency Spillway Protection

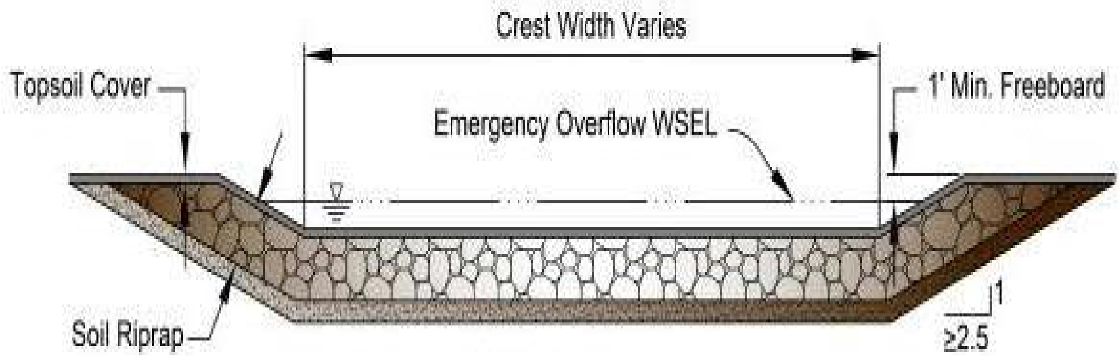
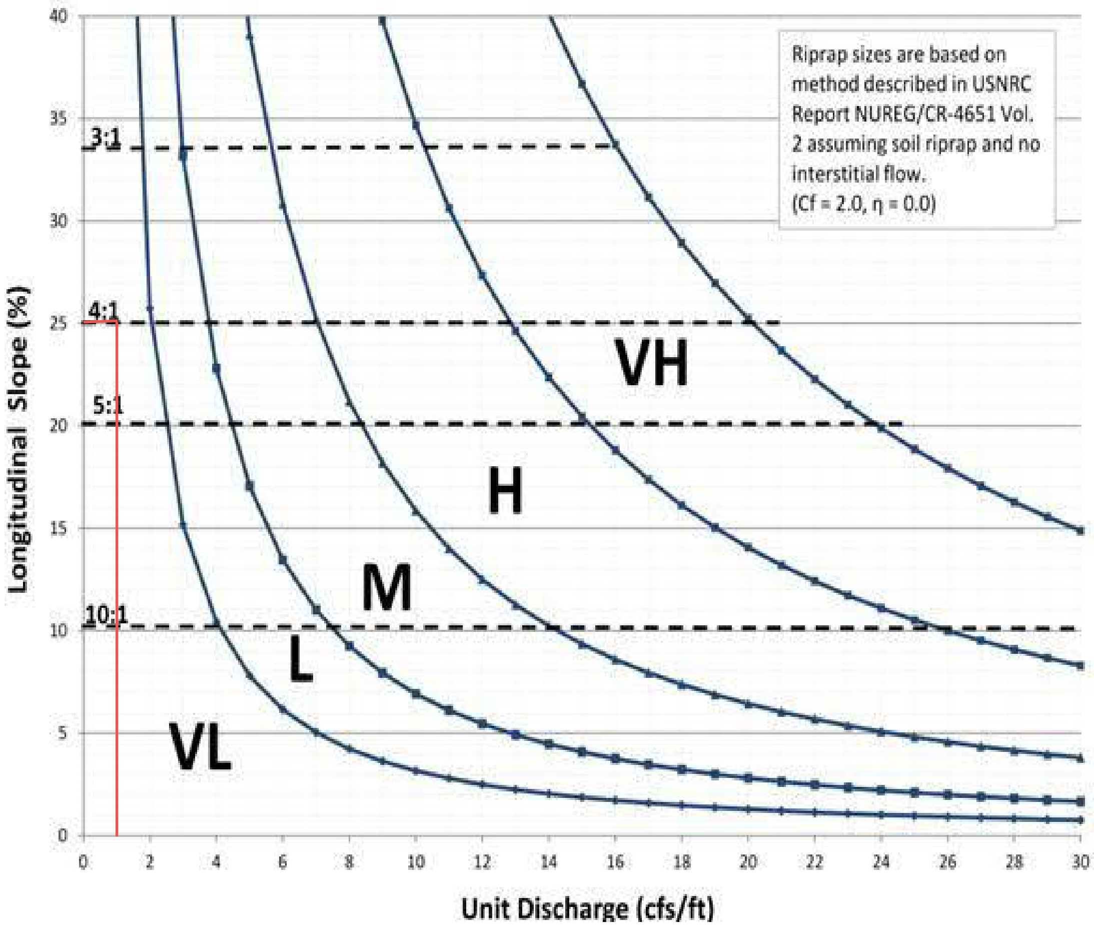


Figure 13-12d. Riprap Types for Emergency Spillway Protection



Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected   Worksheet Protected

Stormwater Facility Name: SADDLEHORN RANCH - FILING 2 - POND F

Facility Location & Jurisdiction: EL PASO COUNTY - SADDLEHORN RANCH METROPOLITAN DISTRICT

User Input: Watershed Characteristics

Watershed Slope =	0.014	ft/ft
Watershed Length =	5707	ft
Watershed Area =	95.54	acres
Watershed Imperviousness =	13.5%	percent
Percentage Hydrologic Soil Group A =	89.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	11.0%	percent

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

User Input

WQCV Treatment Method = Extended Detention

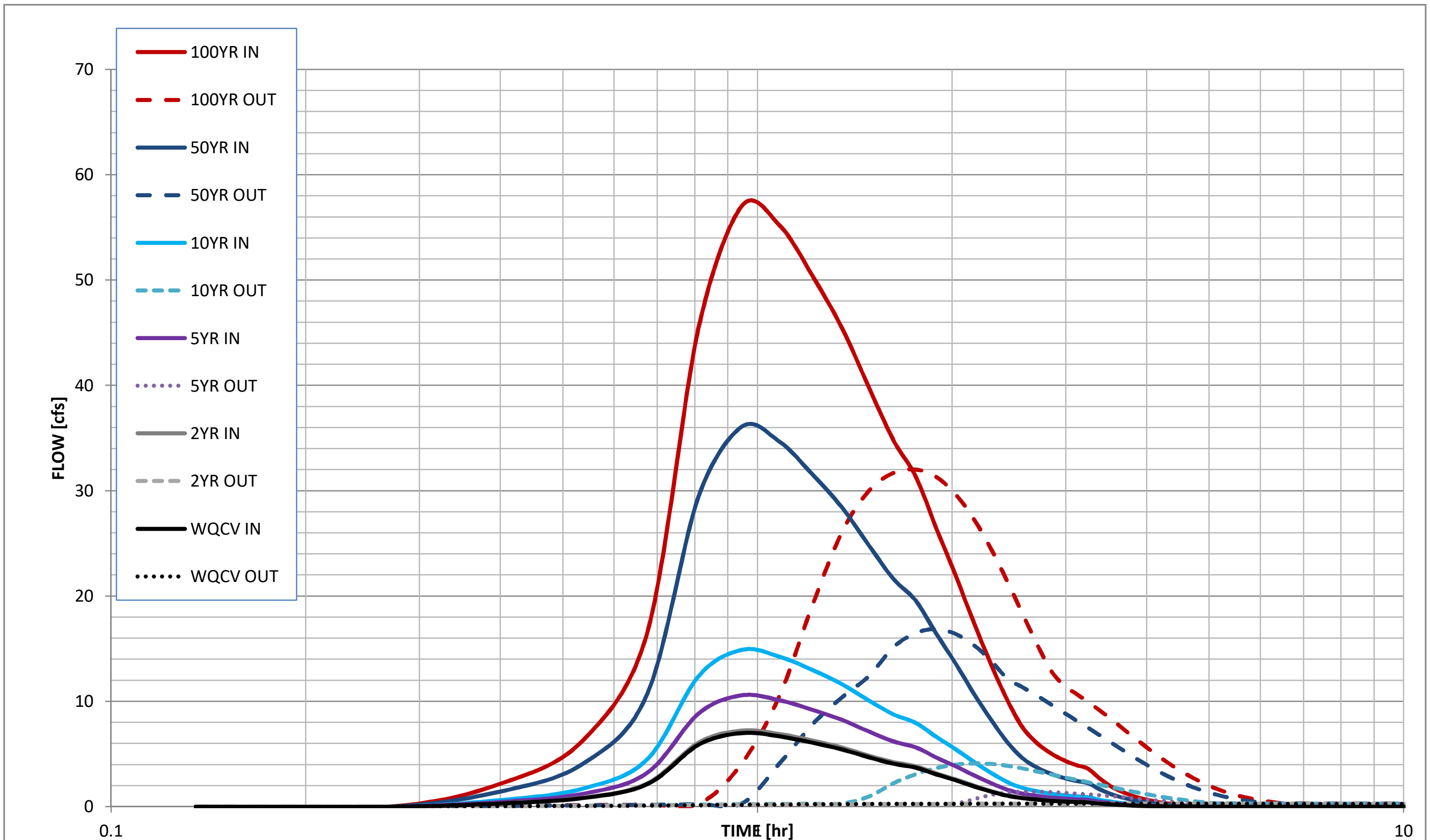
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	36	0.00	0.00
0.33	50	0.33	0.04
1.33	2,789	1.33	0.11
2.33	15,282	2.33	0.21
3.33	33,913	3.33	0.30
4.33	49,906	4.33	12.02
5.33	58,427	5.33	41.73
6.33	67,707	6.33	207.62
6.83	73,617	6.83	360.96

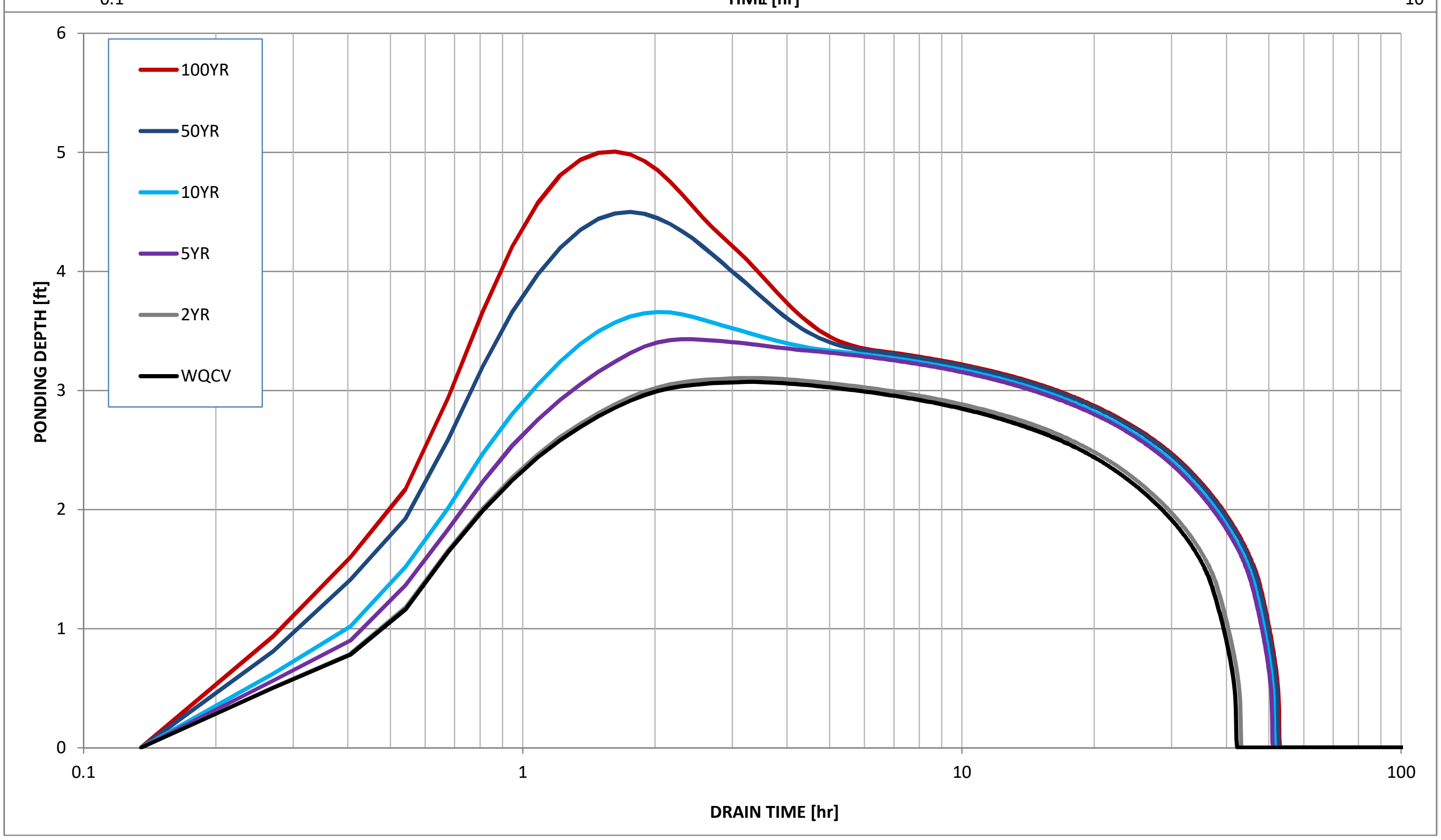
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph 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 =	0.684	0.707	1.039	1.468	3.604	5.758	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.683	0.706	1.038	1.468	3.604	5.752	acre-ft
Time to Drain 97% of Inflow Volume =	38.8	39.7	**46.2**	45.4	41.1	37.0	hours
Time to Drain 99% of Inflow Volume =	40.8	41.8	48.9	48.8	47.3	**45.6**	hours
Maximum Ponding Depth =	3.07	3.10	3.43	3.66	4.50	5.01	ft
Maximum Ponded Area =	0.67	0.68	0.81	0.90	1.18	**1.28**	acres
Maximum Volume Stored =	0.616	0.636	0.880	1.074	1.953	2.582	acre-ft

Stormwater Detention and Infiltration Design Data Sheet





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

FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	BFE (FEET NGVD) EFFECTIVE	BFE (FEET NGVD) REVISED	MAP PANEL NUMBER(S)
Haegler Ranch Tributary 2	Approximately 310 feet upstream of confluence with Geick Ranch West Tributary	None	6,735	08041C0575 F
	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
	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
	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. Long

Kevin C. Long, CFM, Project Engineer
Hazard 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

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

*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.

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

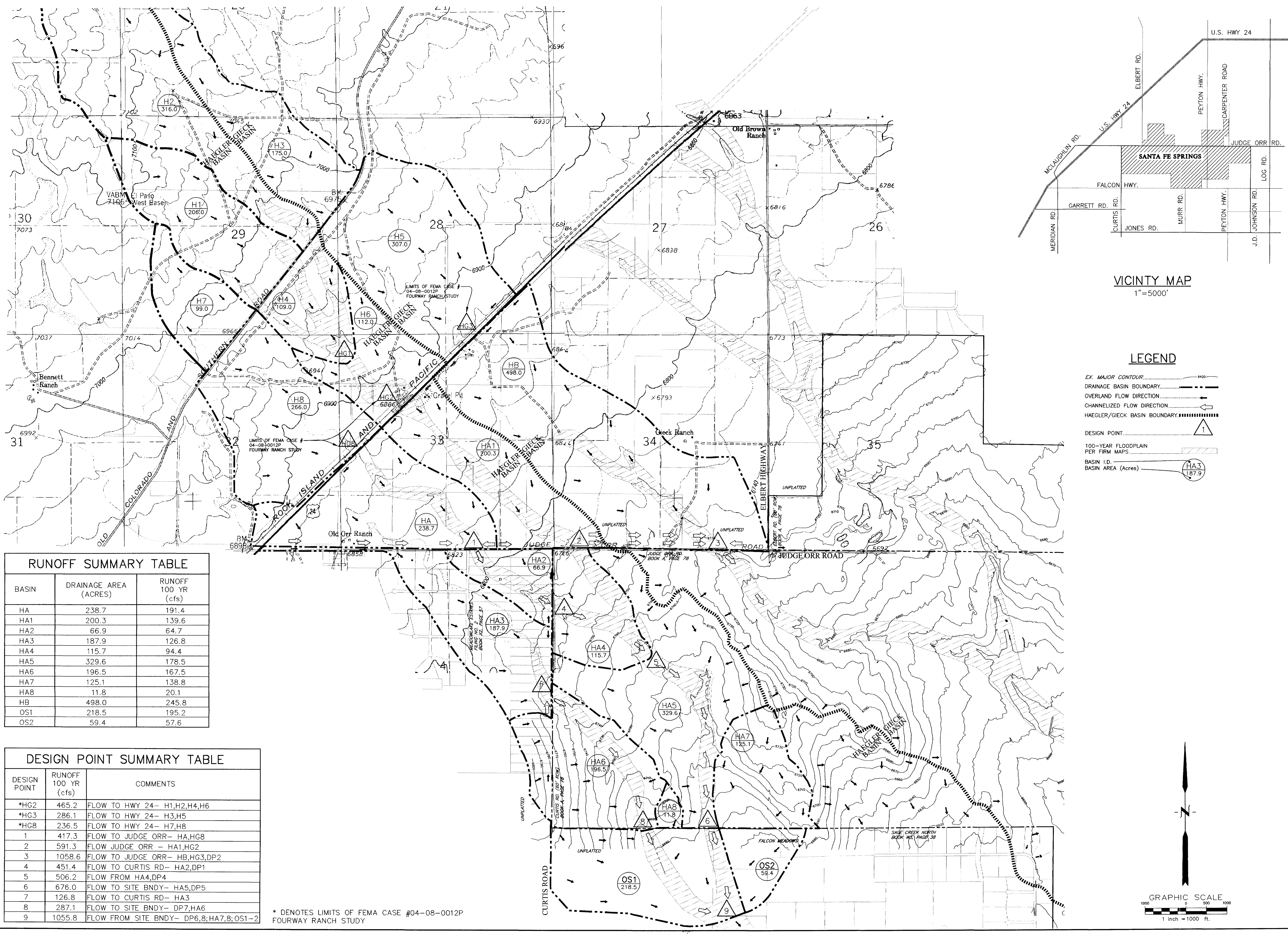
The Honorable Chuck Brown
Chairman, El Paso County
Board of Commissioners
27 Vermijo Avenue
Colorado Springs, CO 80903-2208

Table 3. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 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	__1
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 16 2005



RUNOFF SUMMARY TABLE

BASIN	DRAINAGE AREA (ACRES)	RUNOFF 100 YR (cfs)
HA	238.7	191.4
HA1	200.3	139.6
HA2	66.9	64.7
HA3	187.9	126.8
HA4	115.7	94.4
HA5	329.6	178.5
HA6	196.5	167.5
HA7	125.1	138.8
HA8	11.8	20.1
HB	498.0	245.8
OS1	218.5	195.2
OS2	59.4	57.6

DESIGN POINT SUMMARY TABLE

DESIGN POINT	RUNOFF 100 YR (cfs)	COMMENTS
*HG2	465.2	FLOW TO HWY 24- H1,H2,H4,H6
*HG3	286.1	FLOW TO HWY 24- H3,H5
*HG8	236.5	FLOW TO HWY 24- H7,H8
1	417.3	FLOW TO JUDGE ORR- HA,HG8
2	591.3	FLOW JUDGE ORR - HA1,HG2
3	1058.6	FLOW TO JUDGE ORR- HB,HG3,DP2
4	451.4	FLOW TO CURTIS RD- HA2,DP1
5	506.2	FLOW FROM HA4,DP4
6	676.0	FLOW TO SITE BNDY- HA5,DP5
7	126.8	FLOW TO CURTIS RD- HA3
8	287.1	FLOW TO SITE BNDY- DP7,HA6
9	1055.8	FLOW FROM SITE BNDY- DP6,8;HA7,8;OS1-2

* DENOTES LIMITS OF FEMA CASE #04-08-0012P FOURWAY RANCH STUDY

REVISION				
NO.	DESCRIPTION	REV BY	CKD BY	DATE

TRI-CORE ENGINEERING
5526 N. ACADEMY BLVD., SUITE 204
COLORADO SPRINGS, CO 80918
PHONE (719) 264-1560
FAX (719) 264-1193

SCALE (H): 1"=1000'
SCALE (V): N/A

DRAWN BY: DMM
DESIGNED BY: RLS
CHECKED BY: RLS

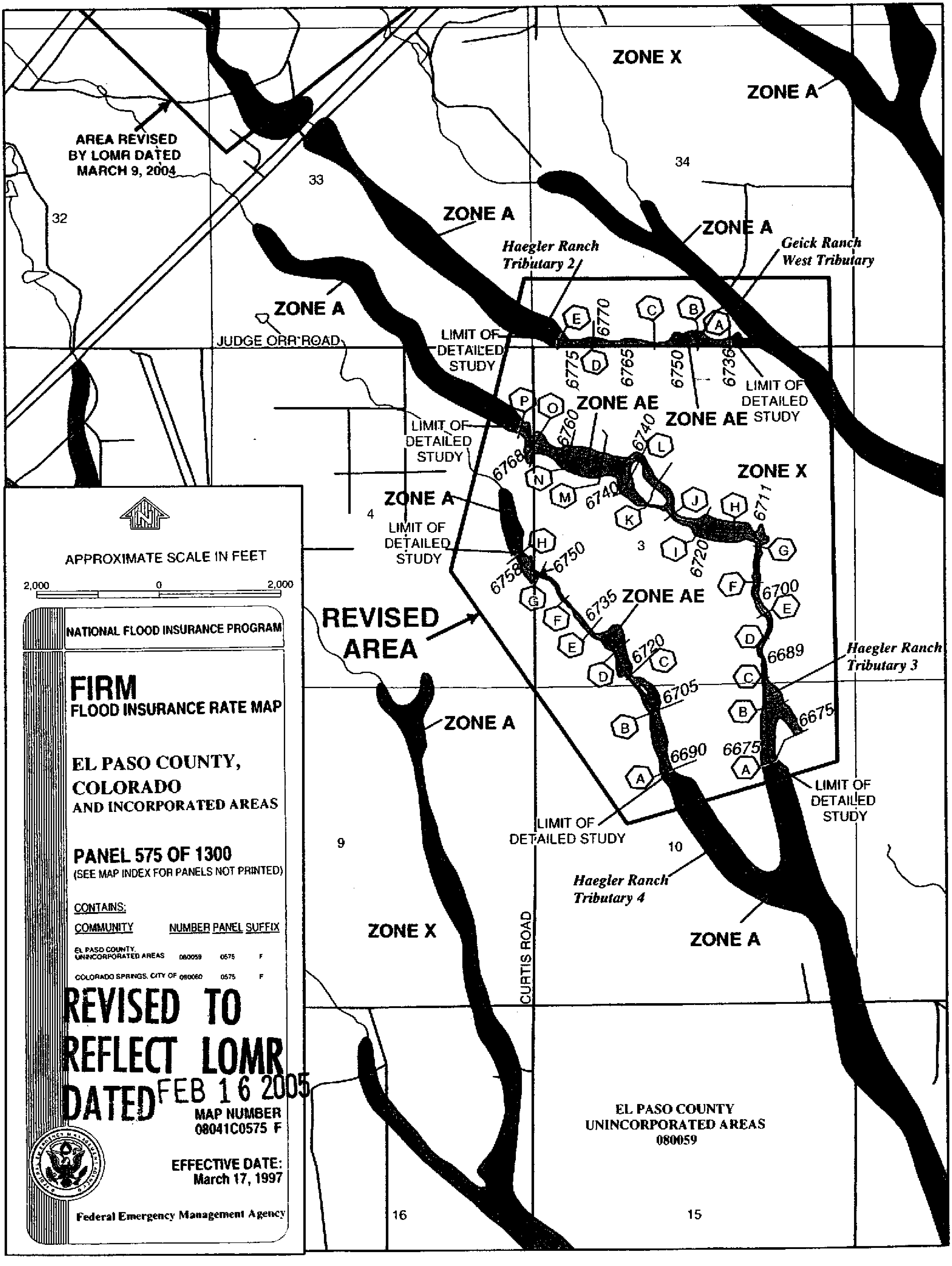
DATE: 05/21/04

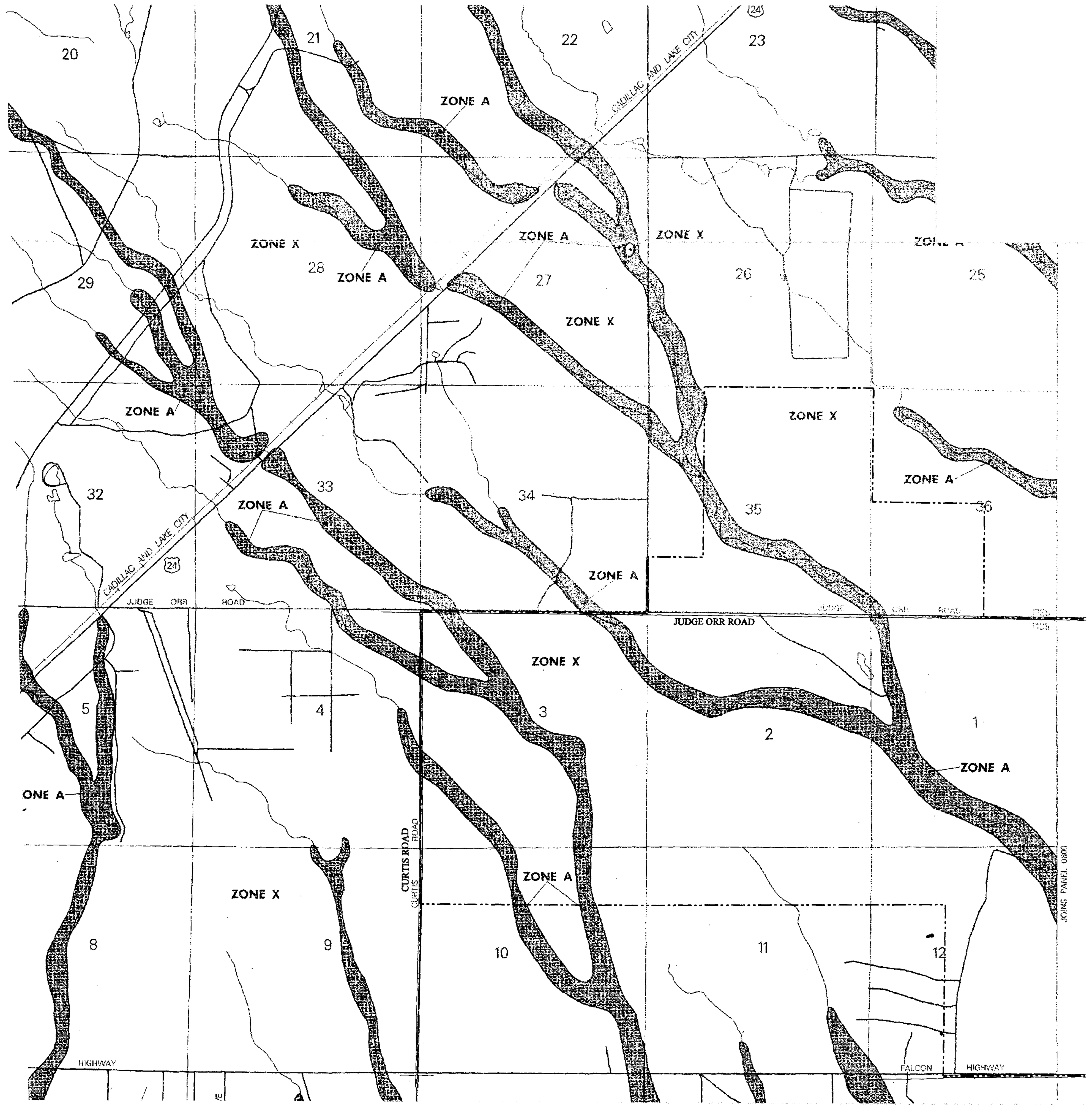
SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO, COUNTY

REALTY DEVELOPMENT SERVICES
25 NORTH TEJON
SUITE 300

EXHIBIT 1
HYDROLOGIC SUBBASIN MAP

PROJECT NO. 6005-0001
FILENAME 01DR_HIST.DWG
DRAWING NO. EXH. 1


ZONE X
ZONE A
AREA REVISED
BY LOMR DATED
MARCH 9, 2004
33
34
32
ZONE A
ZONE A
Haegler Ranch
Tributary 2
Geick Ranch
West Tributary
ZONE A
JUDGE ORR ROAD
LIMIT OF
DETAILED
STUDY
6770
6775
6765
6750
6736
LIMIT OF
DETAILED
STUDY
ZONE AE
ZONE AE
LIMIT OF
DETAILED
STUDY
6760
6740
6768
6740
ZONE X
ZONE A
6711
4
LIMIT OF
DETAILED
STUDY
3
6720
6750
6758
6700
6735
ZONE AE
REVISED
AREA
6689
6720
Haegler Ranch
Tributary 3
6705
ZONE A
6675
6690
6675
LIMIT OF
DETAILED
STUDY
LIMIT OF
DETAILED STUDY
9
10
Haegler Ranch
Tributary 4
ZONE X
CURTIS ROAD
ZONE A
APPROXIMATE SCALE IN FEET
2,000
0
2,000
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY,
COLORADO
AND INCORPORATED AREAS
PANEL 575 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0575 F
COLORADO SPRINGS, CITY OF 080060 0575 F
REVISED TO
REFLECT LOMR
DATED FEB 16 2005
MAP NUMBER
08041C0575 F
EFFECTIVE DATE:
March 17, 1997
Federal Emergency Management Agency
EL PASO COUNTY
UNINCORPORATED AREAS
080059
16
15



EFFECTIVE CONDITION

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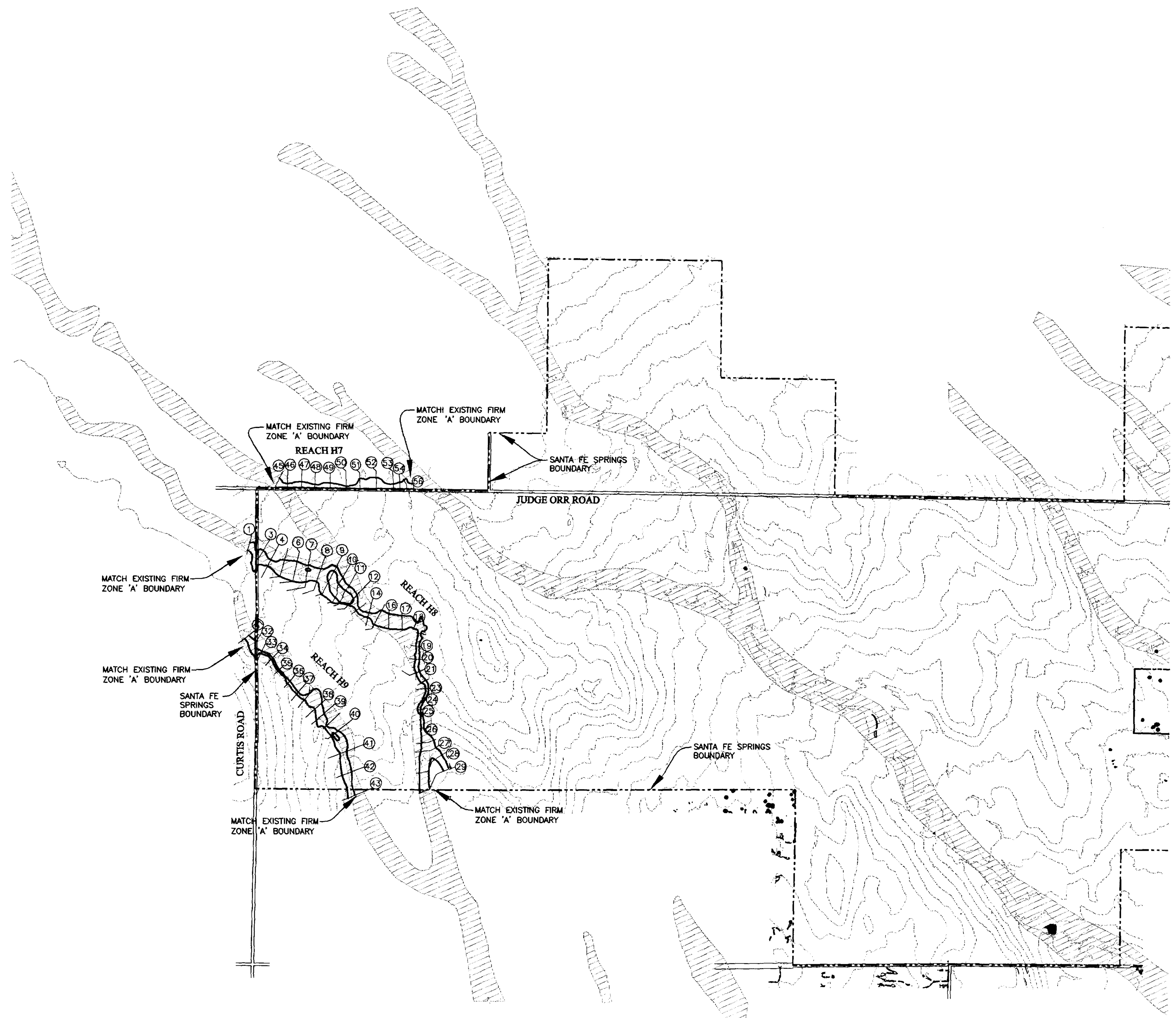
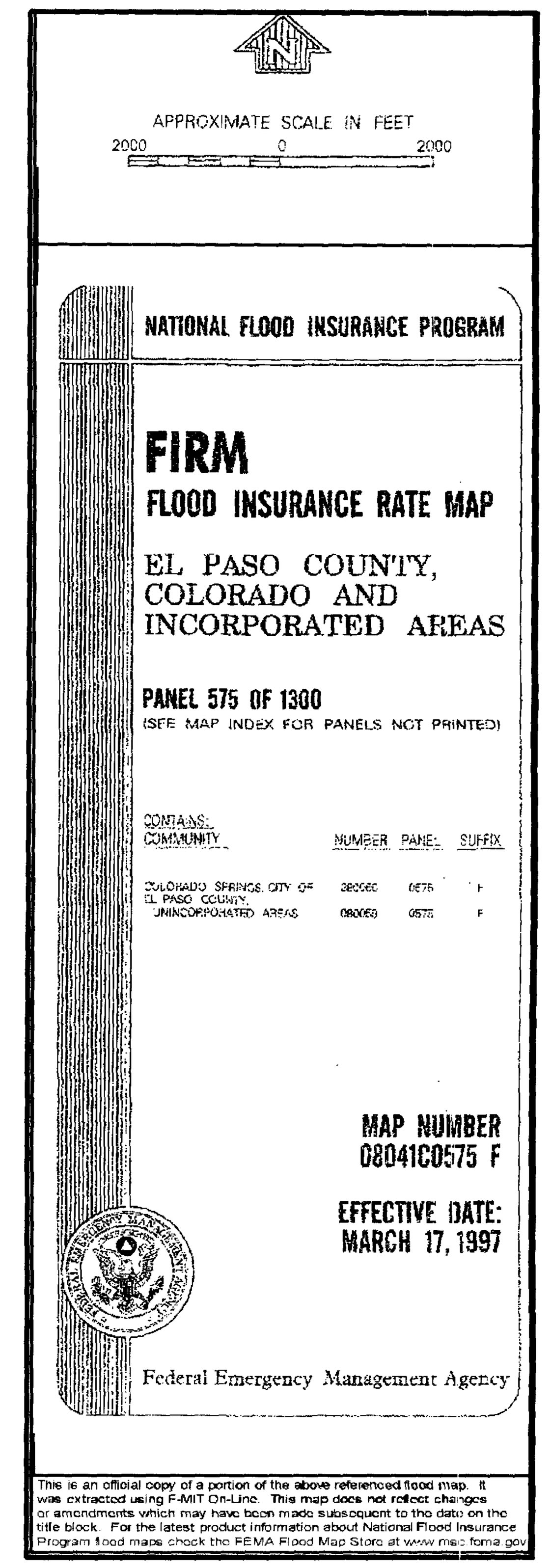
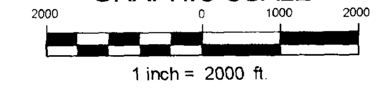


REVISED EFFECTIVE CONDITION





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5526 N. ACADEMY BLVD., SUITE 204
COLORADO SPRINGS, CO 80918
PHONE (719) 264-1560
FAX (719) 264-1193

SCALE (H): 1"=2000'
SCALE (V): N/A

DRAWN BY: DMM
DESIGNED BY: RLS
CHECKED BY: RLS

DATE: 05/21/04

SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO, COUNTY

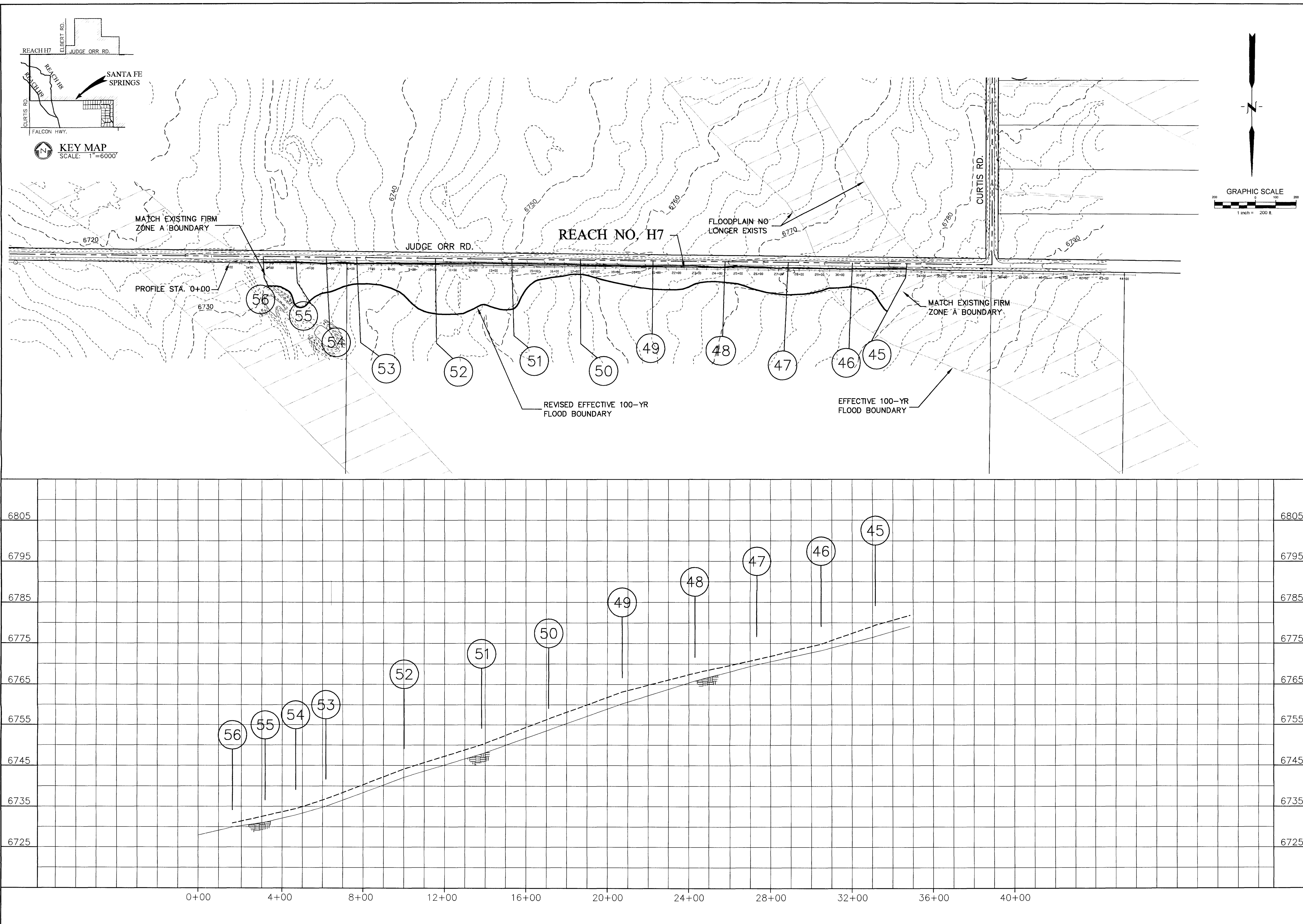
REALTY DEVELOPMENT SERVICES
25 NORTH TEJON
SUITE 300

EXHIBIT 2
REVISED FLOOD INSURANCE RATE MAP

PROJECT NO. 6005-0001

FILENAME RATE_MAP_LOMR.DWG

DRAWING NO. EXH. 2



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DESIGNED BY: RLS
CHECKED BY: RLS

DATE: 06/04/04

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HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO COUNTY

REALTY DEVELOPMENT SERVICES
25 NORTH TEJON, SUITE 300
COLORADO SPRINGS, CO 80903

EXHIBIT 3 100-YEAR FLOODPLAIN BOUNDARY & PROFILE WORKMAP

PROJECT NO. 6005.0001
FILENAME PP-LOMR.DWG
DRAWING NO. EXH. 3

REVISION

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FAX (719) 264-1193

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SCALE (V): 1"=10'

DRAWN BY: KMV
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CHECKED BY: RLS

DATE: 06/04/04

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HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO COUNTY

REALTY DEVELOPMENT SERVICES
25 NORTH TEJON, SUITE 300
COLORADO SPRINGS, CO 80903

EXHIBIT 4 100-YEAR FLOODPLAIN BOUNDARY & PROFILE WORKMAP

PROJECT NO.
6005.0001
FILENAME
PP-LOMR.DWG
DRAWING NO.
EXH. 4

NO.	DESCRIPTION	REV BY	CKD BY	DATE
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FAX (719) 264-1193

SCALE (H): 1"=200'
SCALE (V): 1"=10'

DRAWN BY: KMV
DESIGNED BY: RLS
CHECKED BY: RLS

DATE: 06/04/04

SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO COUNTY

REALTY DEVELOPMENT SERVICES
25 NORTH TEJON, SUITE 300
COLORADO SPRINGS, CO 80903

EXHIBIT 5 100-YEAR FLOODPLAIN BOUNDARY & PROFILE WORKMAP

PROJECT NO. 6005.0001

PP-LOMR.DWG

DRAWING NO. EXH. 5

NO.	DESCRIPTION	REV BY	CKD BY	DATE
	REVISION			

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FAX (719) 264-1193

SCALE (H): 1"=200'
SCALE (V): 1"=10'

DRAWN BY: KMV
DESIGNED BY: RLS
CHECKED BY: RLS

DATE: 06/04/04

SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO COUNTY

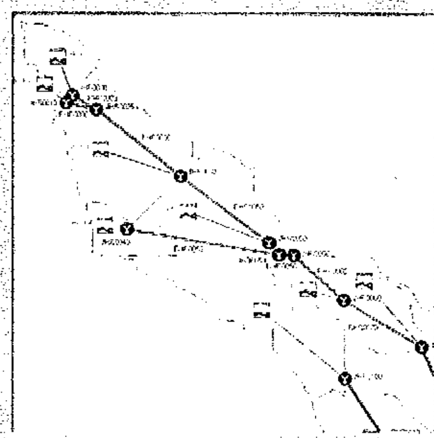
REALTY DEVELOPMENT SERVICES
25 NORTH TEJON, SUITE 300
COLORADO SPRINGS, CO 80903

EXHIBIT 6 100-YEAR FLOODPLAIN BOUNDARY & PROFILE WORKMAP

PROJECT NO.
6005.0001

PP-LOMR.DWG

DRAWING NO. EXH. 6

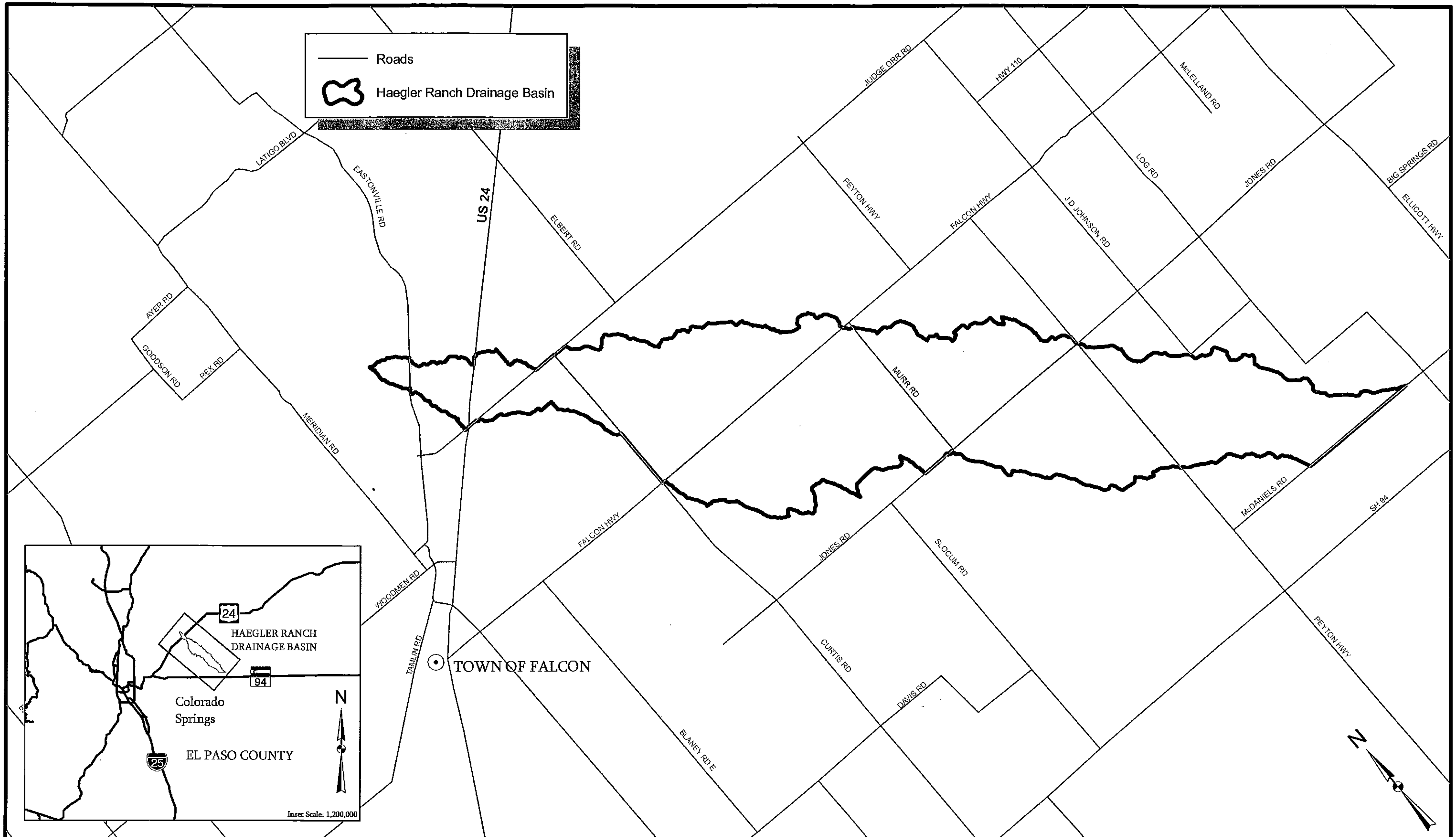


Haegler Ranch Basin

Drainage Basin Planning Study

May 2009

URS



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6,000 3,000 0 6,000 Feet

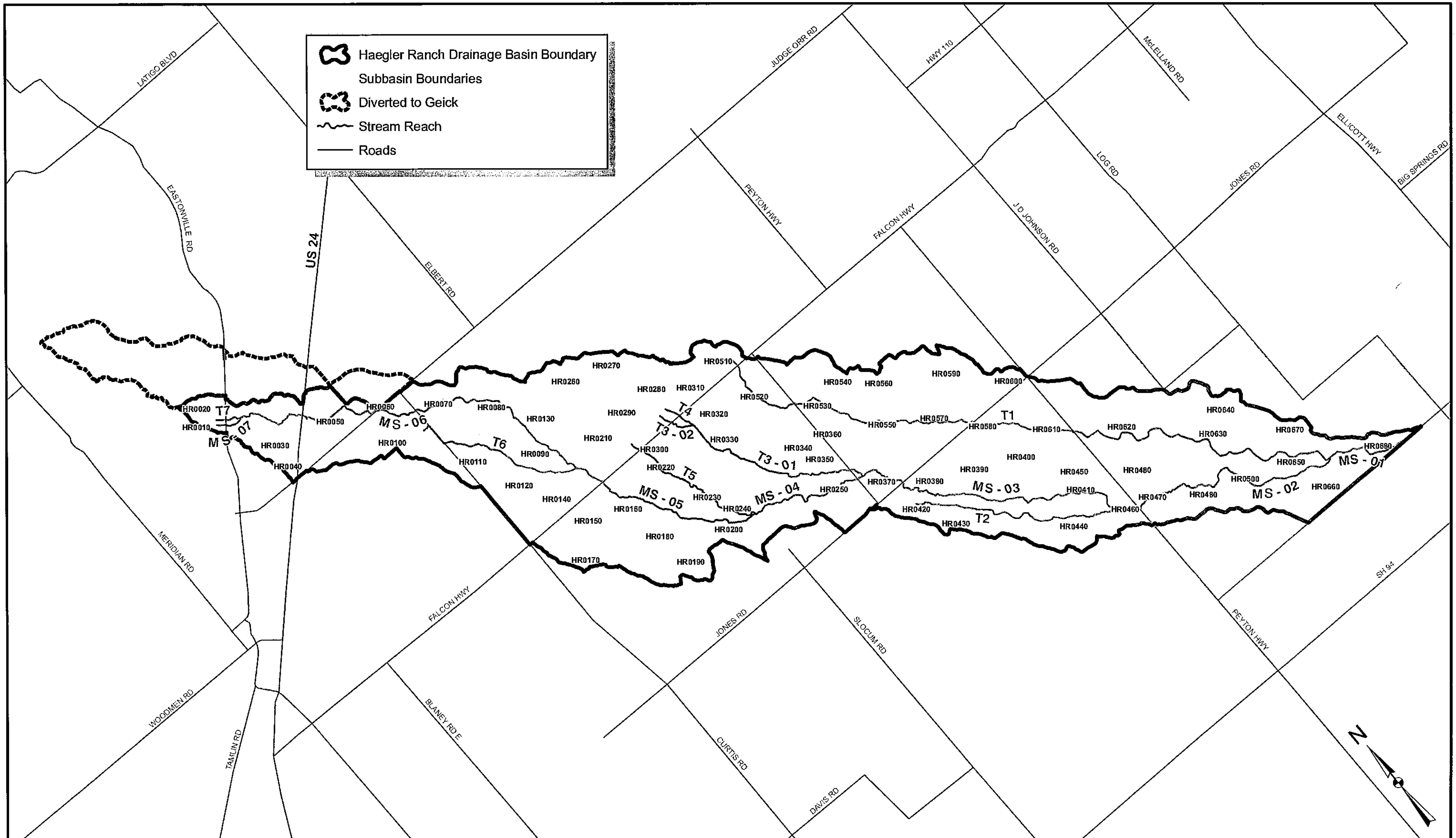
1" = 6,000'

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN

VICINITY MAP
FIGURE 1-1

URS NO. 21711039



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5,000 2,500 0 5,000
Feet
1" = 5,000'

DATE: 09/08

HAEGLER RANCH DRAINAGE BASIN

SUBBASIN DELINEATION
FIGURE 4-1

URS NO. 21711039

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

Key Location	Reach and Station	HEC-RAS Result	Recurrence Intervals			
			2-yr	5-yr	10-yr	100-yr
Main stem at US 24	MS-06 72276	Channel velocity (ft/sec)	1.1	1.63	1.98	2.92
		Water surface depth in channel (ft)	1.36	2.44	3.24	6.49
		Top width (ft)	18.23	24.85	29.7	255.62
Main stem at Judge Orr Road	MS-06 67666	Channel velocity (ft/sec)	3.33	4.09	1.76	3.48
		Water surface depth in channel (ft)	0.52	1.04	1.05	1.35
		Top width (ft)	174.53	534.34	535.52	569.34
Main stem at Falcon Highway	MS-05 52353	Channel velocity (ft/sec)	1.05	1.6	2.04	3.59
		Water surface depth in channel (ft)	1.79	3.69	4.96	5.74
		Top width (ft)	31.42	83.76	556.41	592.33
Main stem at Jones Road	MS-03 33189	Channel velocity (ft/sec)	2.45	3.7	1.27	2.51
		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
Main stem at Peyton Highway	MS-02 18474	Channel velocity (ft/sec)	0.16	0.4	0.59	1.43
		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
Southeast Tributary at Jones Road	T1 22297	Channel velocity (ft/sec)	0.62	1.02	1.47	3.2
		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
Southeast Tributary at Peyton Highway	T1 16611	Channel velocity (ft/sec)	1.67	2.25	2.65	4.05
		Water surface depth in channel (ft)	0.08	0.17	0.24	0.51
		Top width (ft)	239.82	241.36	242.51	247.41
Southeast Tributary at Confluence with Main stem	T1 410	Channel velocity (ft/sec)	3.44	0.11	0.18	0.67
		Water surface depth in channel (ft)	1.69	2.01	2.01	2.01
		Top width (ft)	31.89	1169.3	1169.3	1169.3
At Confluence with Geick Basin	MS-01 82	Channel velocity (ft/sec)	2.68	3.85	19.89	17.33
		Water surface depth in channel (ft)	1.45	2.17	1.11	2.36
		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

Q (cfs)	Grass		
	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.

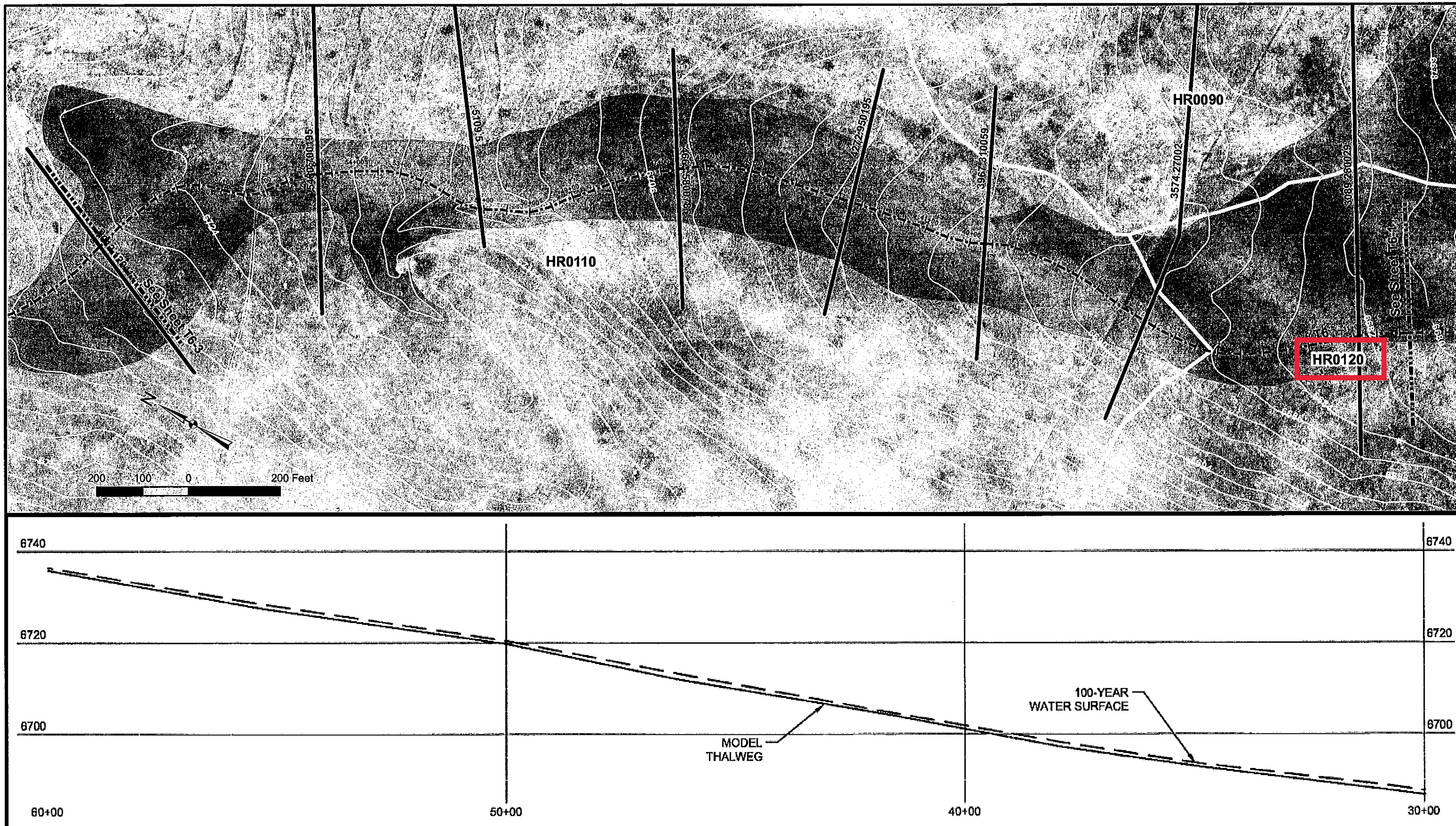
Table 6-3 Existing Conditions Culvert Design

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
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



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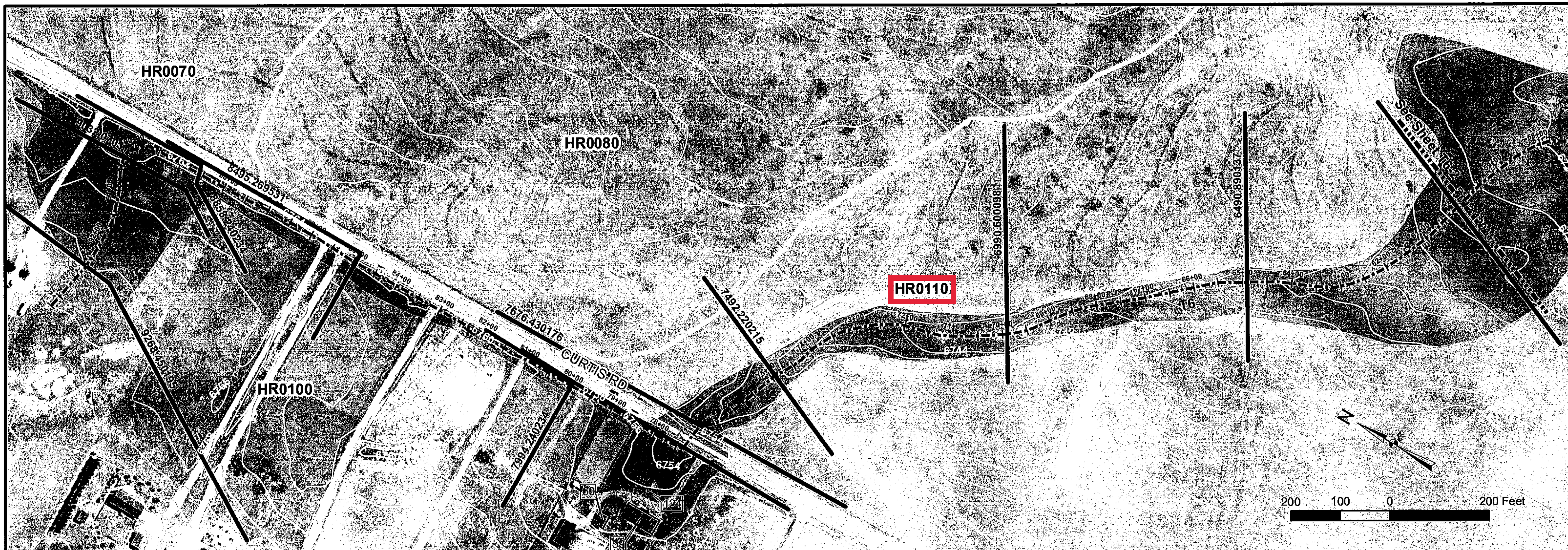
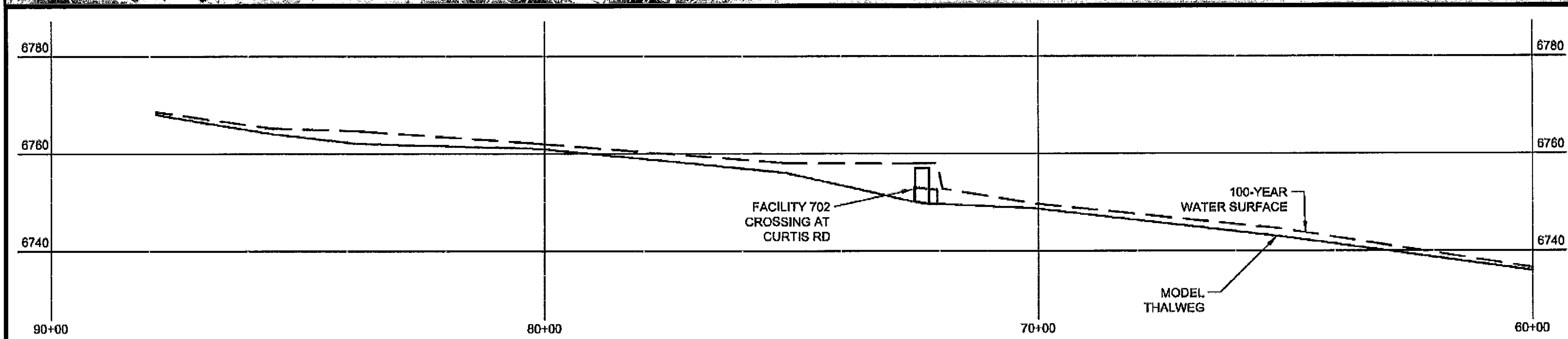
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T6-2
FIGURE 5-4

URS NO. 21711039





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Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 09/08

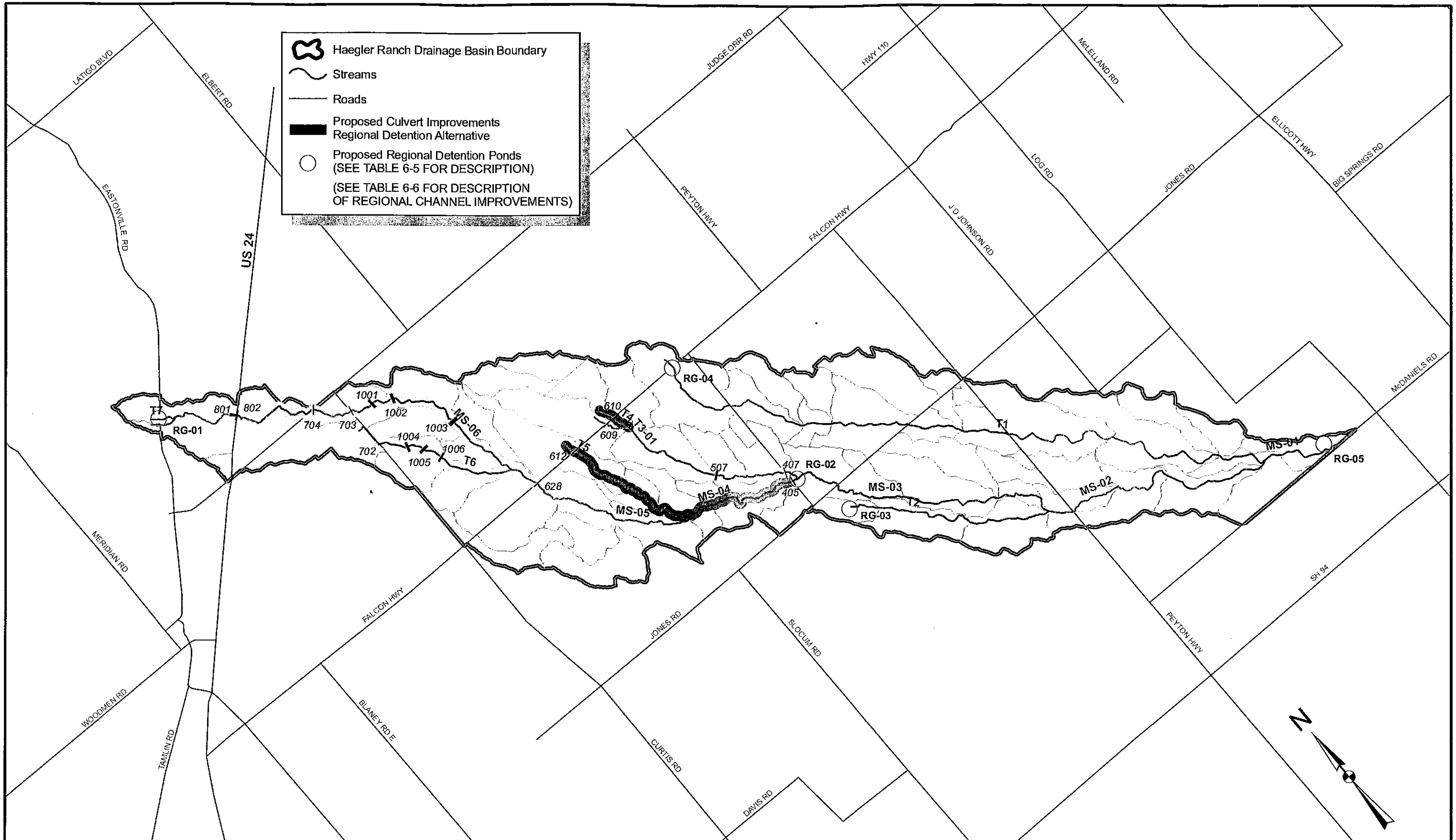
HAEGLER RANCH DRAINAGE BASIN

APPROXIMATE 100-YEAR FLOOD LIMITS

SHEET T6-3

FIGURE 5-4

URS NO. 21711039



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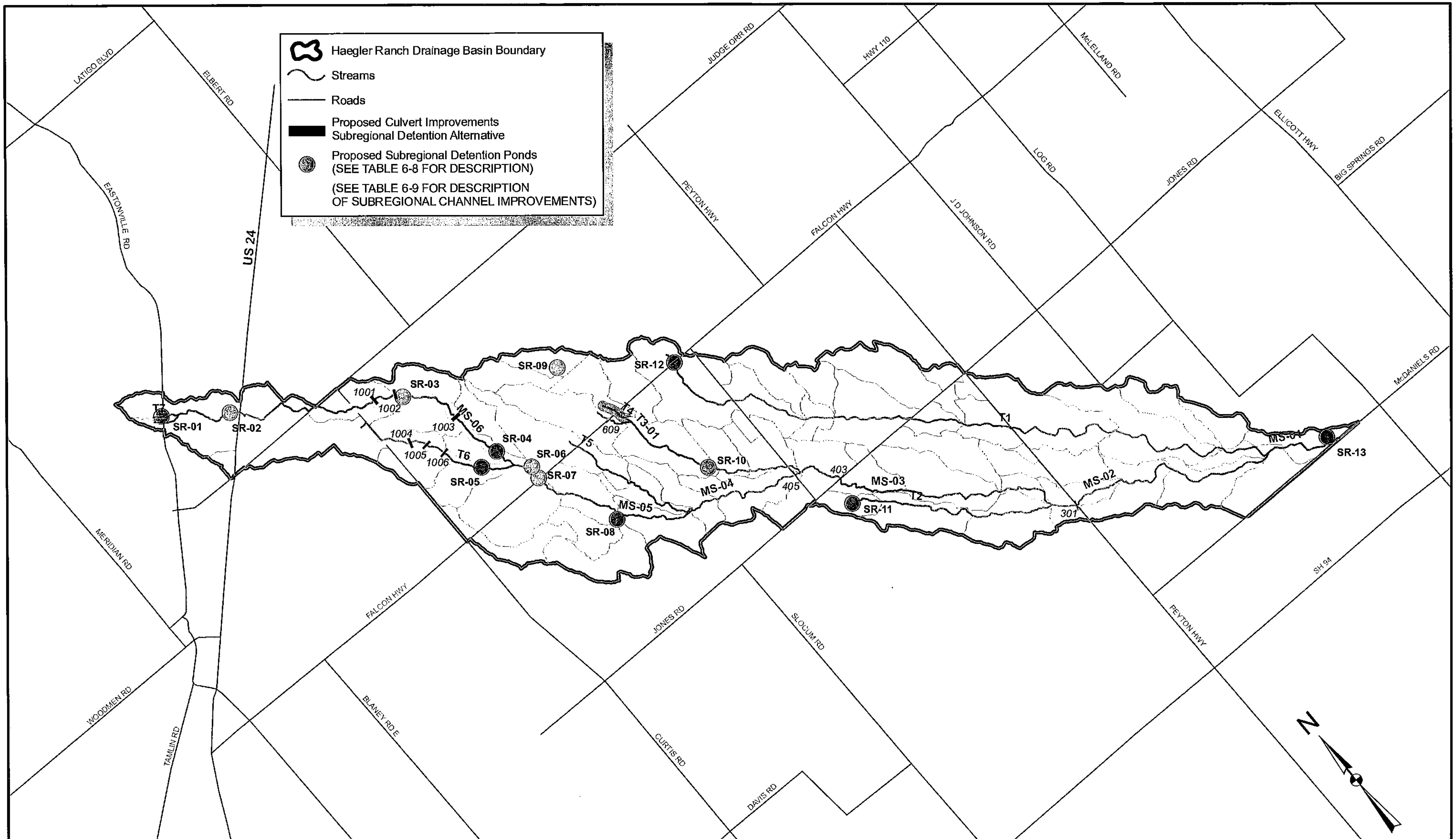
5,000 2,500 0 5,000 Feet

1" = 5,000'

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
REGIONAL DETENTION ALTERNATIVES
FIGURE 6-1

URS NO. 21711039



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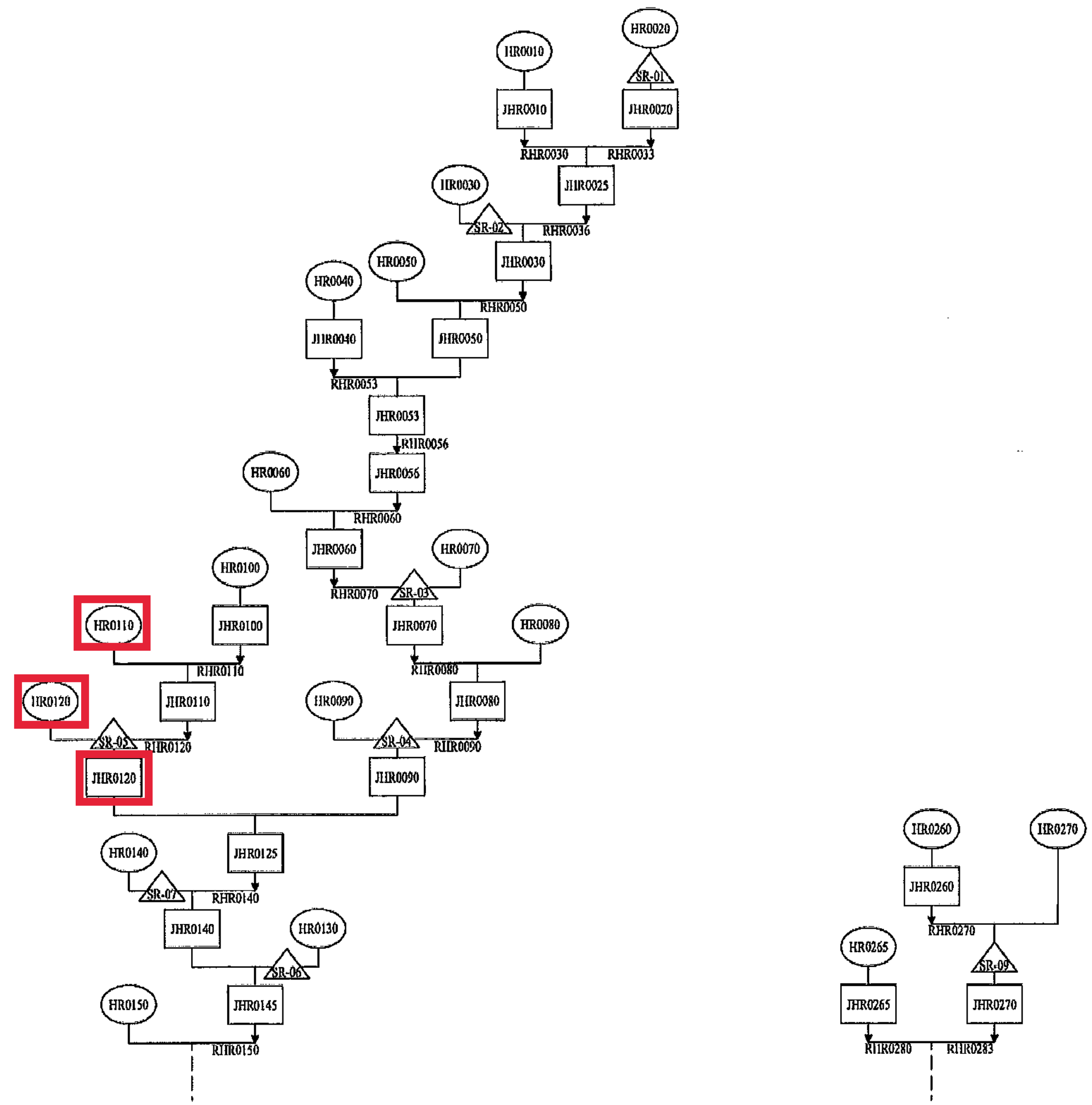
5,000 2,500 0 5,000 Feet

1" = 5,000'

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
SUBREGIONAL DETENTION ALTERNATIVES
FIGURE 6-2

URS NO. 21711039



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HAEGLER RANCH DRAINAGE BASIN

SUBREGIONAL DETENTION ALTERNATIVE

SHEET 1

FIGURE 6-3

URS NO. 21711039

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 Contingency			$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

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 Contingency			$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						$1,591,000
30% Construction Contingency						$477,000
15% Engineering Contingency						$239,000
Total						$2,307,000

(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% Construction Contingency					$475,000
15% Engineering 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

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)

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 Conceptual Alternative 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 7-1. 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 Fee Calculations

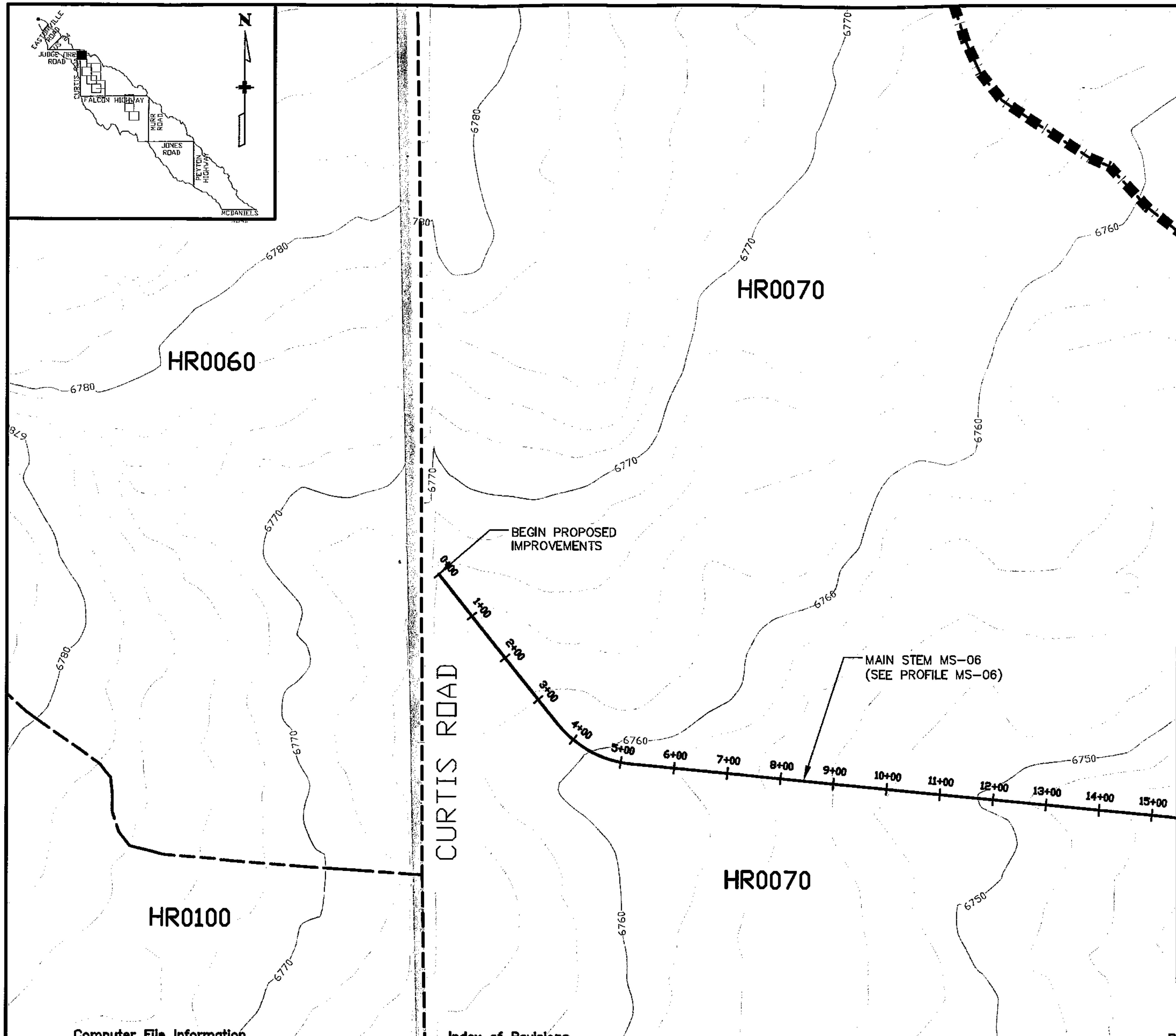
Channel Improvements					
Channel	Basins	Channel Construction Cost	Drop Structure Construction Cost	Contingency Cost	Total Cost
Main Stem (MS-05)	HR0200	$224,000	$363,600	$264,420	$852,020
Main Stem (MS-06)	HR0070	$162,000	$295,400	$205,830	$633,230
Main Stem (MS-06)	HR0080	$331,000	$374,500	$317,475	$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 Improvements					
Culvert	**Road Crossing**	**Channel**	**Culvert Construction Cost**	**Contingency 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					$754,007
Detention Improvements					
Facility	**Storage (AF)**	**Construction Cost**		**Contingency 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 Costs					$3,944,129
Total Cost					**$10,251,636**
Total Unplatted Impervious Acres					**1,343**
Fee Per Impervious Acre					**$7,633**

Table 7-3 Bridge Fee 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 Bridge Costs					$1,512,022
Total Cost					**$1,512,022**
Total Unplatted Impervious Acres					**1,343**
Bridge Fee Per Impervious Acre					**$1,126**

Table 7-4 Reimbursable Costs

Reimbursable Culvert Improvements					
Culvert	Road Crossing	Channel	Culvert Construction Cost	Contingency 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					$2,344,315
Reimbursable Detention Improvements					
Facility	Storage (AF)	Construction Cost		Contingency 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 Costs					$3,944,129
Total Reimbursable Cost					**$6,288,444**



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	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

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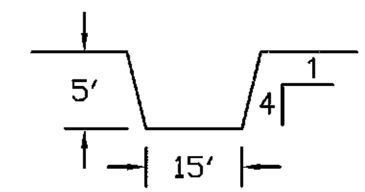
BASIN: HR0070



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Detailed by:	DRM
Checked by:	JAJ

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

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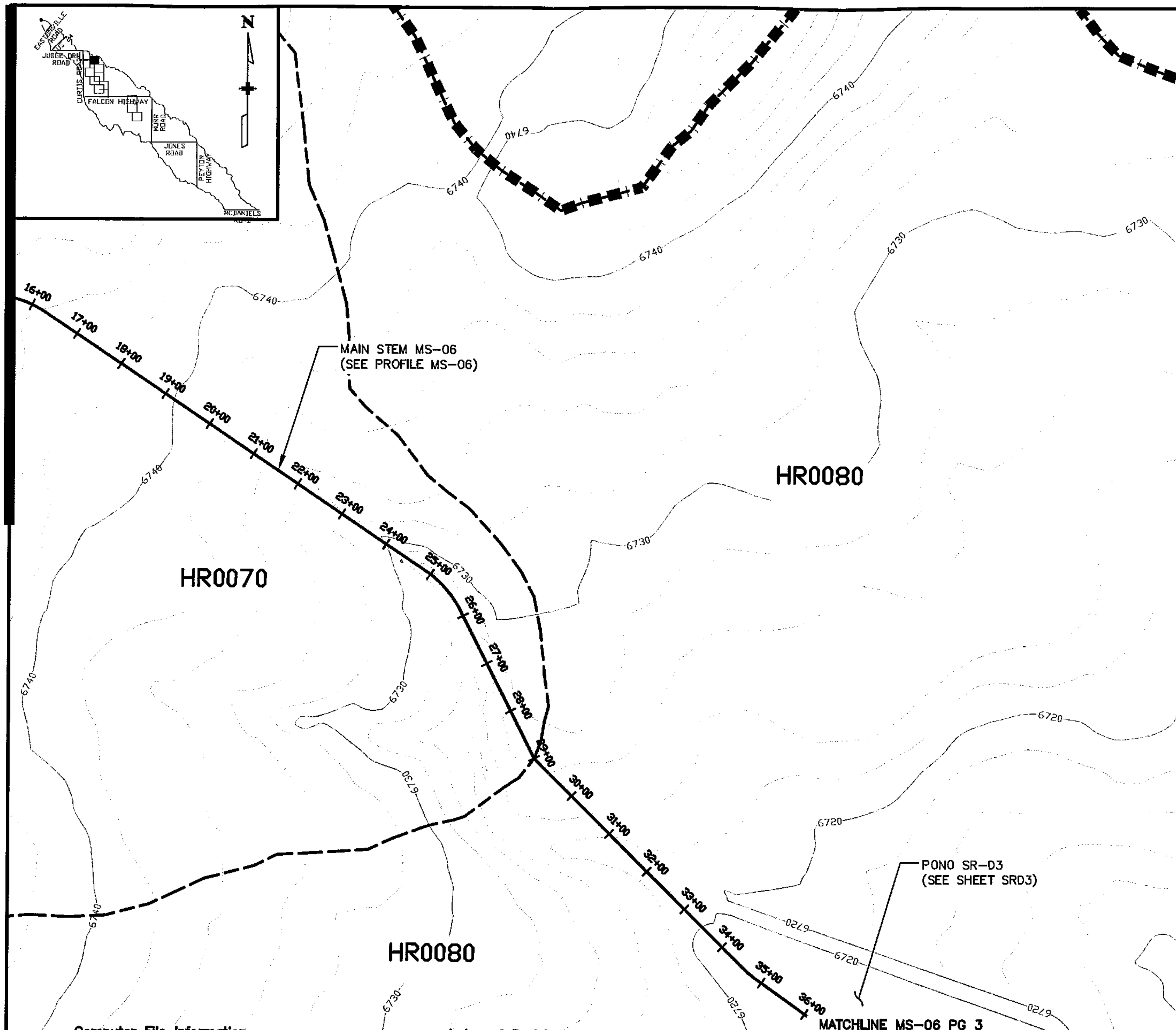

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	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

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BASIN: HR0070

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CHANNEL: MAIN STEM (MS-06)
BASIN: HR0080

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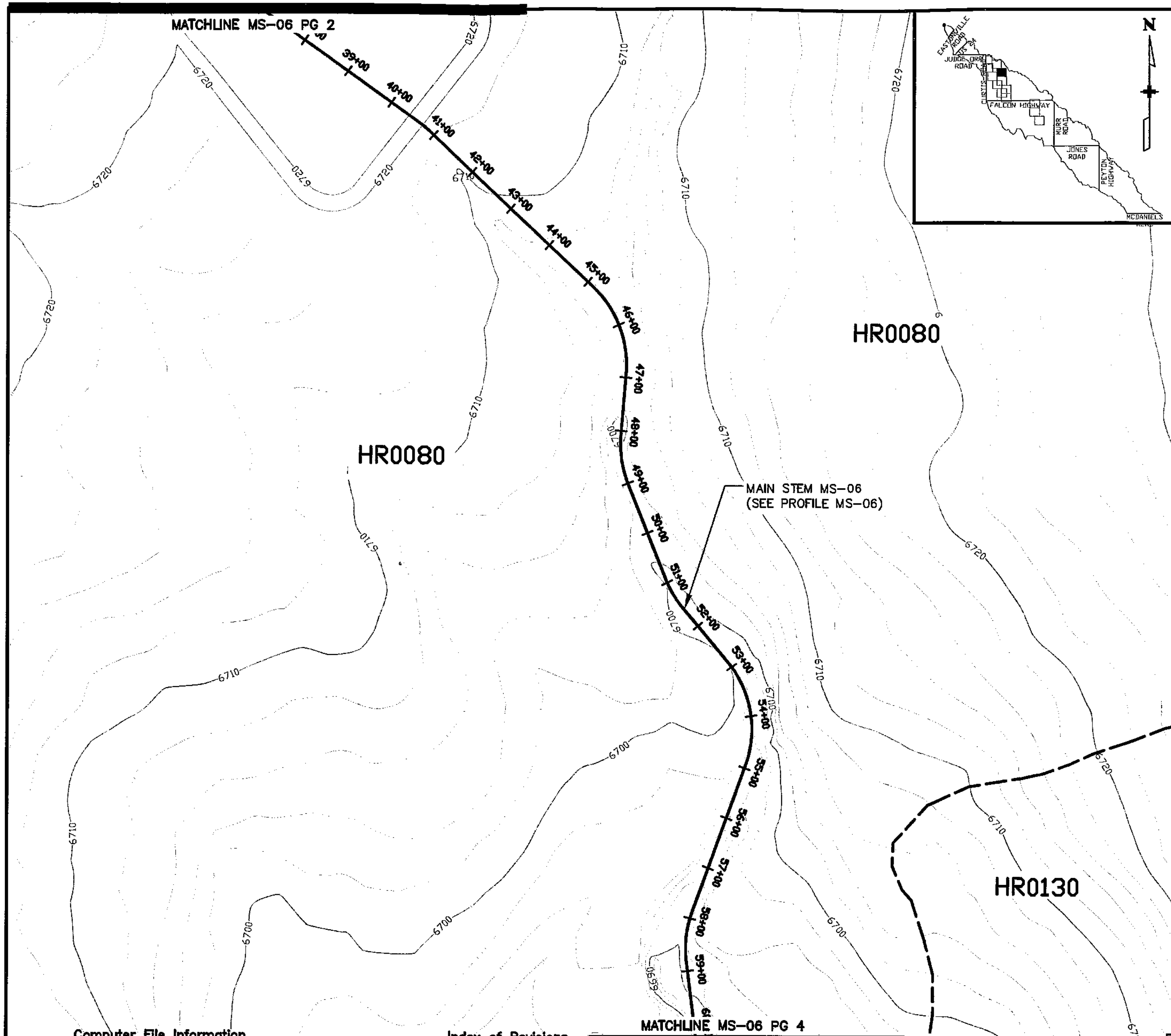

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	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

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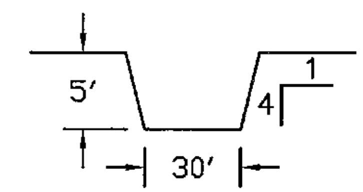

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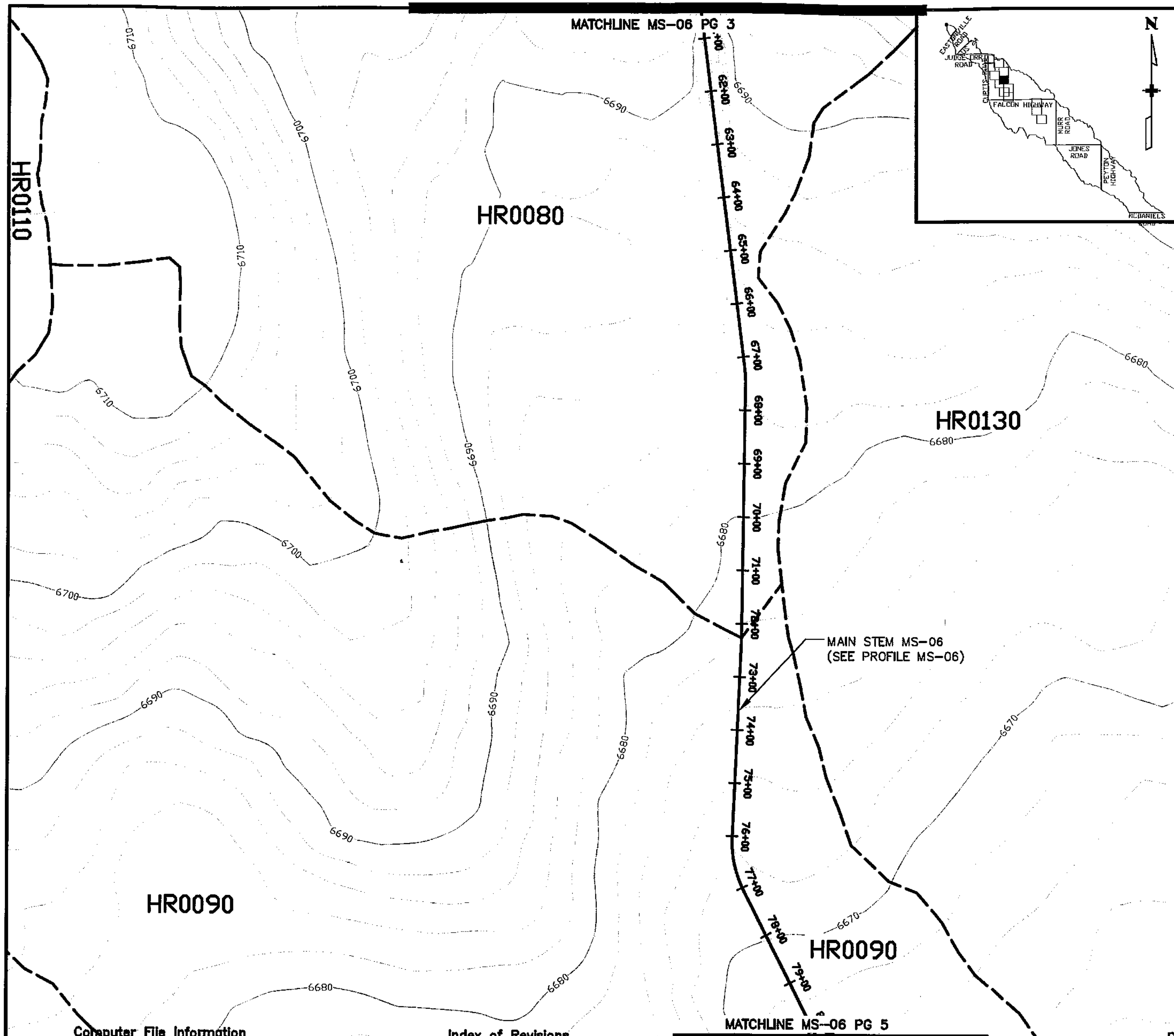

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	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

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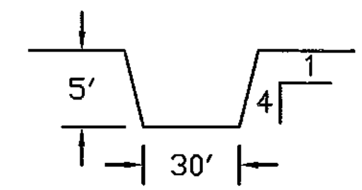

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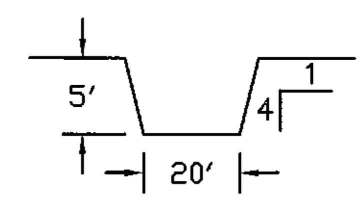

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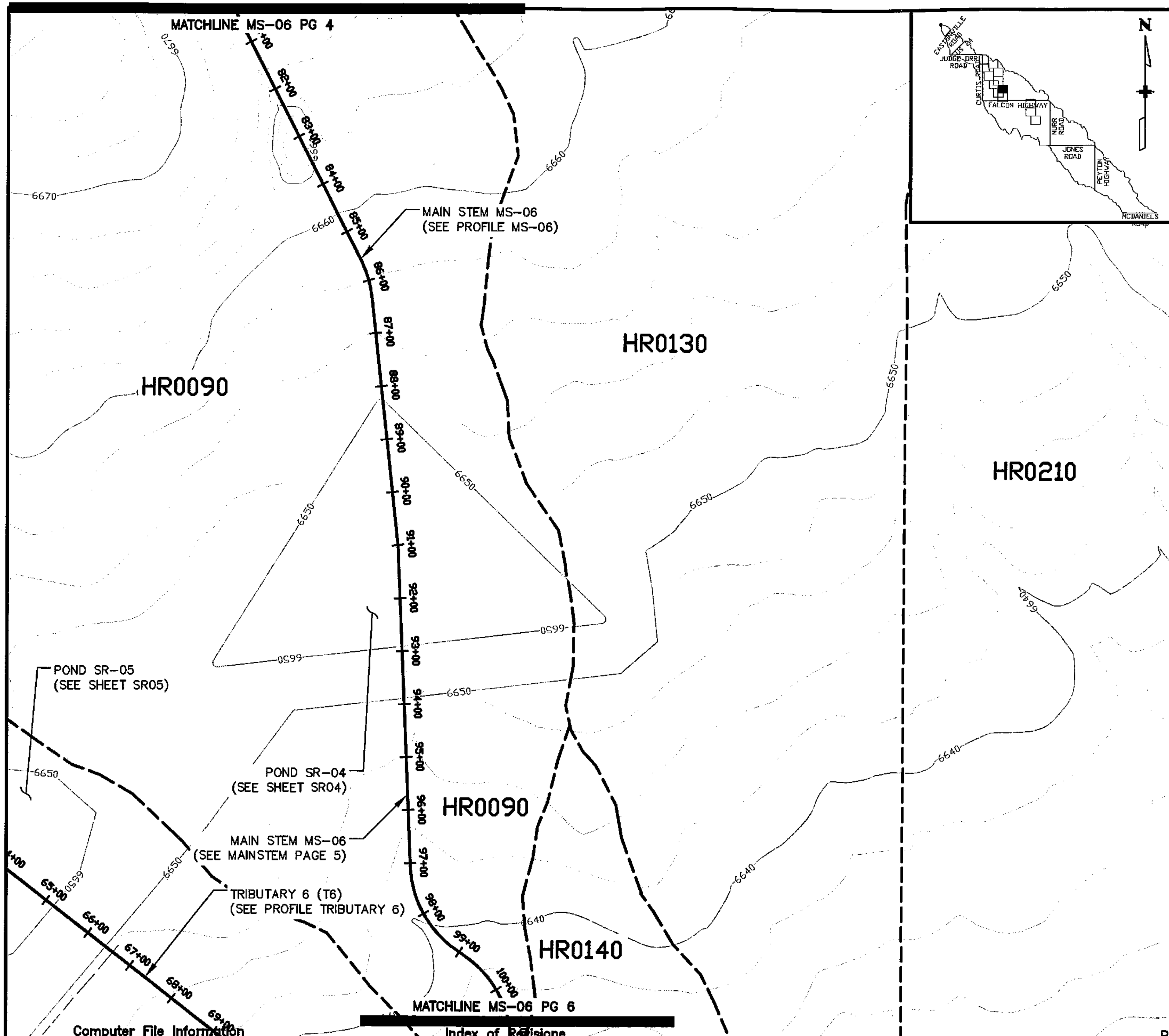

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	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0090

5'
4
1
20'

STA: 74+61 TO STA: 103+62

Q: 800 CFS

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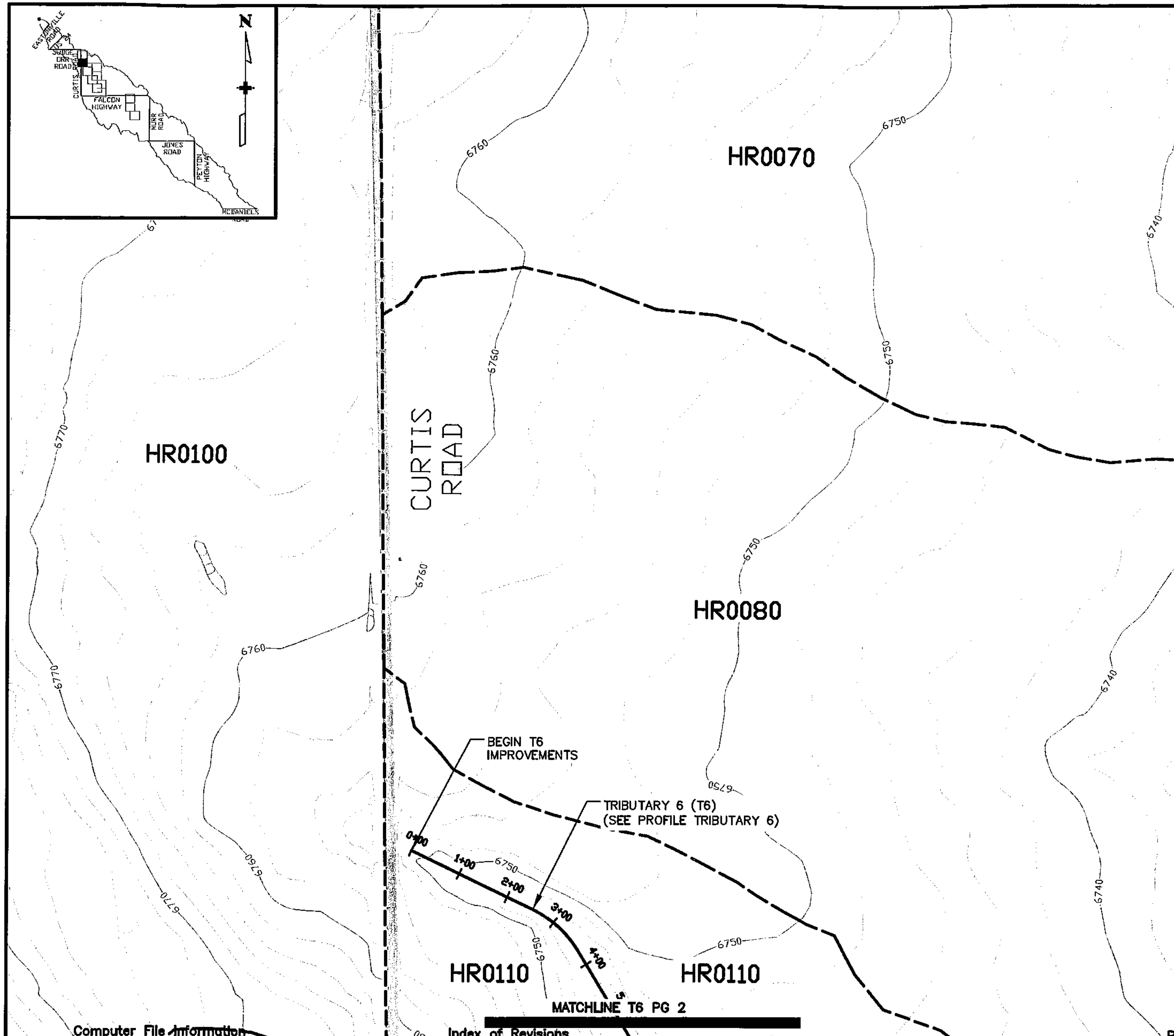
Checked by:	JAJ

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION
ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 5



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	CONTOURS – MINOR ELEVATION
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	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

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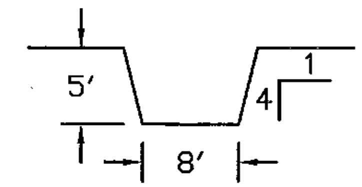
CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0110



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Profiles

URS
9960 Federal Drive, Suite 300
Colorado Springs, CO. 80921
(719) 531-0001
Fax (719) 531-0007

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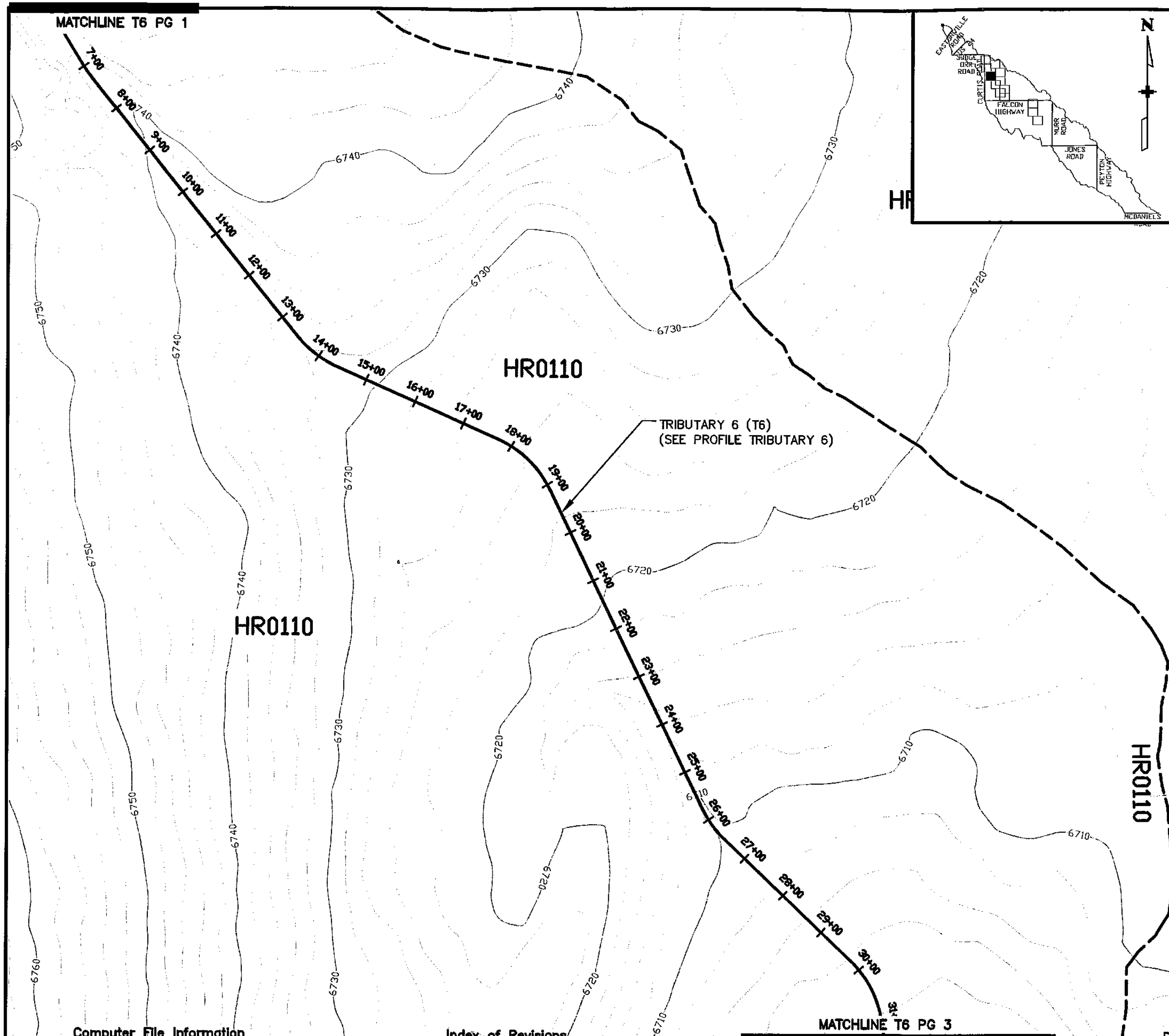
Detailed by: DRM
Checked by: JAJ

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number TRIBUTARY 6 PG 1



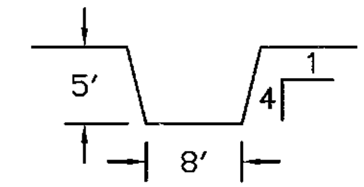
LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0110



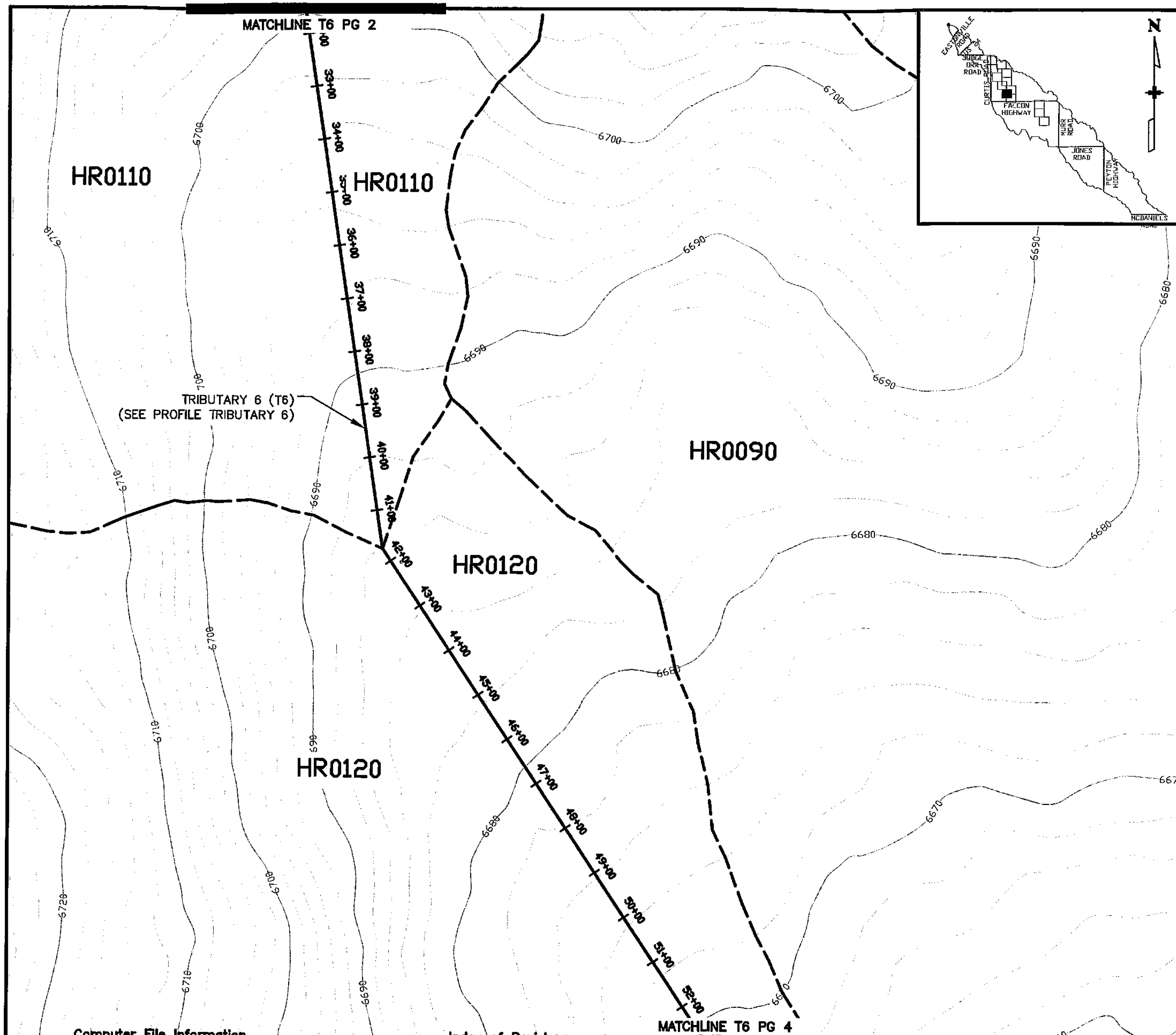
STA: 0+00 TO STA: 41+73

Q: 500 CFS

Computer File Information		Index of Revisions		Profiles	
Full Path: P:\21711039\CAD\PLANSHTS			URS 8950 Federal Drive, Suite 300 Colorado Springs, CO. 80921 (719) 531-0001 Fax (719) 531-0007	Designed by: KAP	Structure Numbers
Drawing File Name: CHANNEL.DWG				Detailed by: DRM	
Acad. Ver. 2006 Scale: 1"=200' Units: Feet				Checked by: JAJ	

HAEGLER RANCH SUB-REGIONAL DETENTION
ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number TRIBUTARY 6 PG 2



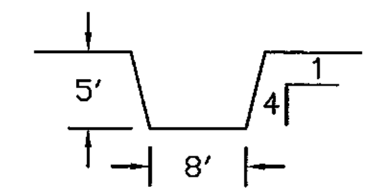
LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

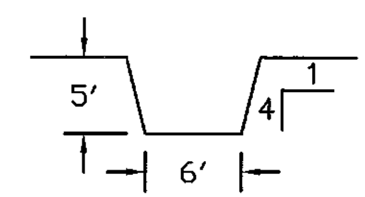
CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0110



STA: 0+00 TO STA: 41+73

Q: 500 CFS

CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0120



STA: 41+73 TO STA: 75+50

Q: 300 CFS

Computer File Information

Full Path:	P:\21711039\CAO\PLANSHTS
Drawing File Name:	CHANNEL.DWG
Acad. Ver. 2006	Scale: 1"=200' Units: Feet

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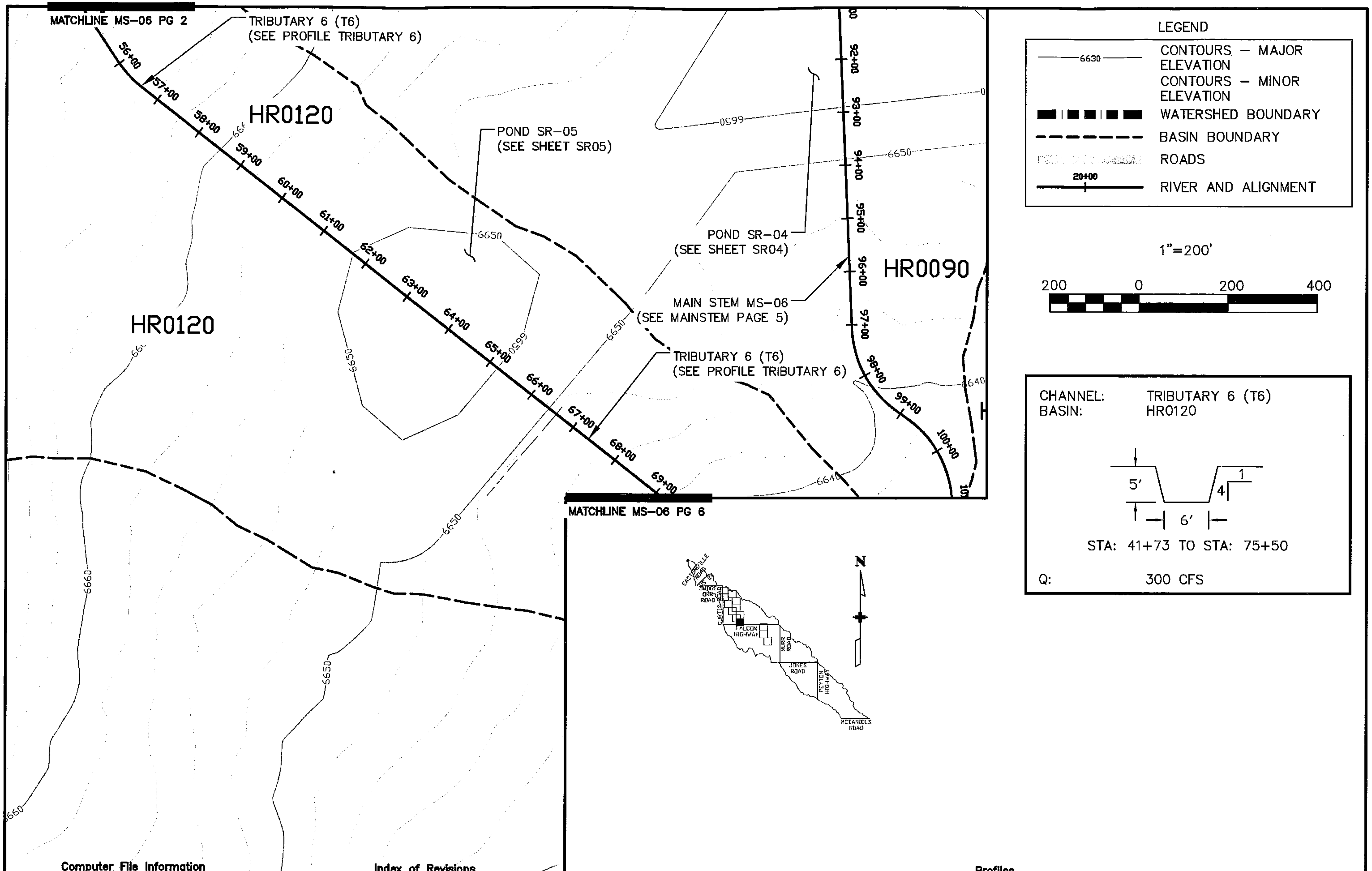
Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION
ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number TRIBUTARY 6 PG 3



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Drawing File Name: CHANNEL.DWG			Detailed by: DRM		
Acad. Ver. 2006 Scale: 1"=200' Units: Feet			Checked by: JAJ		Sheet Number TRIBUTARY 6 PG 4

MS–06 HR0070

SLOPE = 0.60%

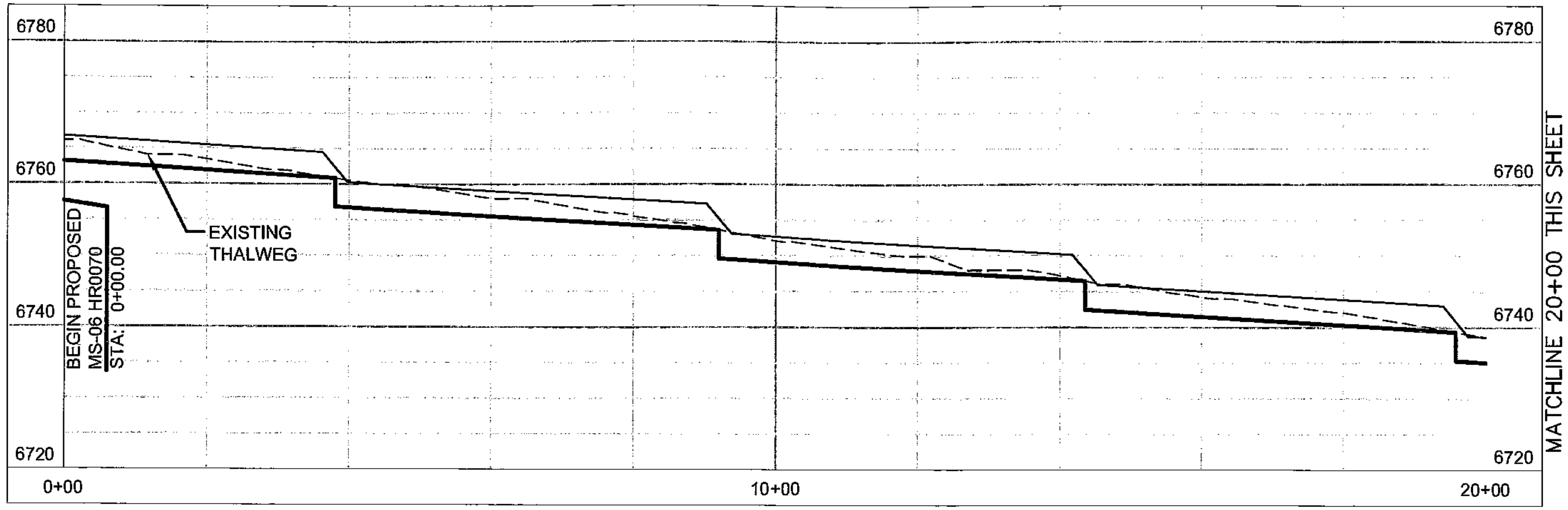
(7) 4' DROPS

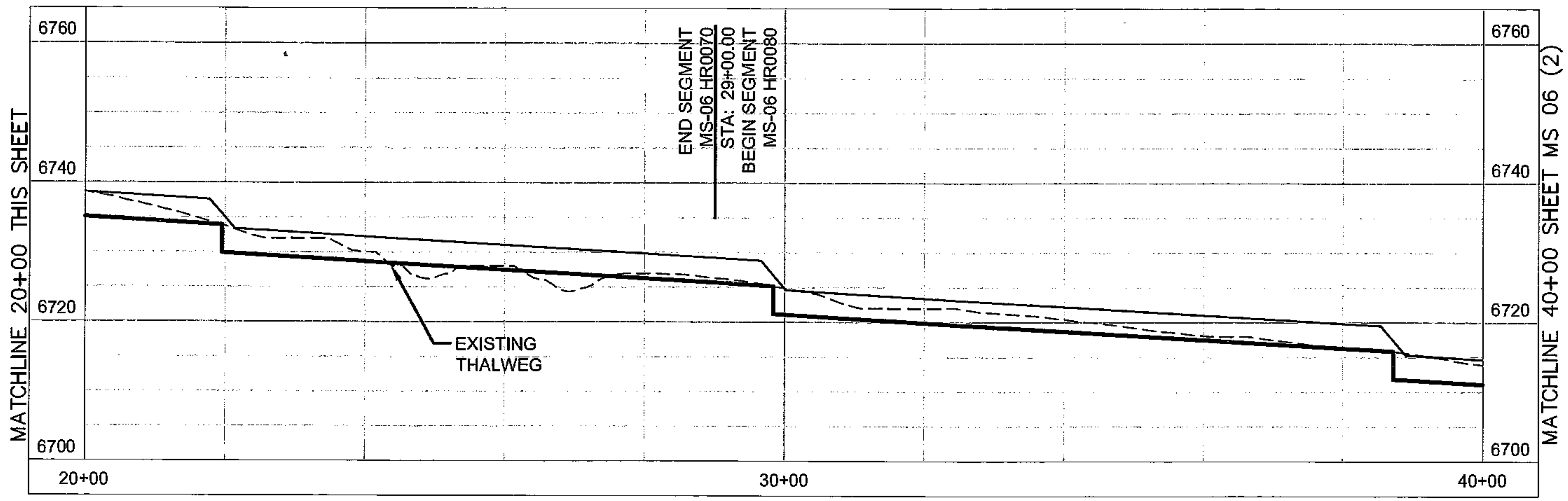
MS–06 HR0080

SLOPE = 0.60%

(7) 4' DROPS

PROFILE MAIN STEM (MS–06 & MS–05)





LEGEND

———	PROPOSED DROP STRUCTURE
– – – –	EXISTING THALWEG
——	HYDRAULIC GRADE LINE

Computer File Information

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	MAINSTEM PROFILES_PROPOSED.DWG
Acad. Ver. 2006	Scale: 1"=20' Units: Feet

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Checked by:	

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number MS 06

MS–06 HR0080

SLOPE = 0.60%

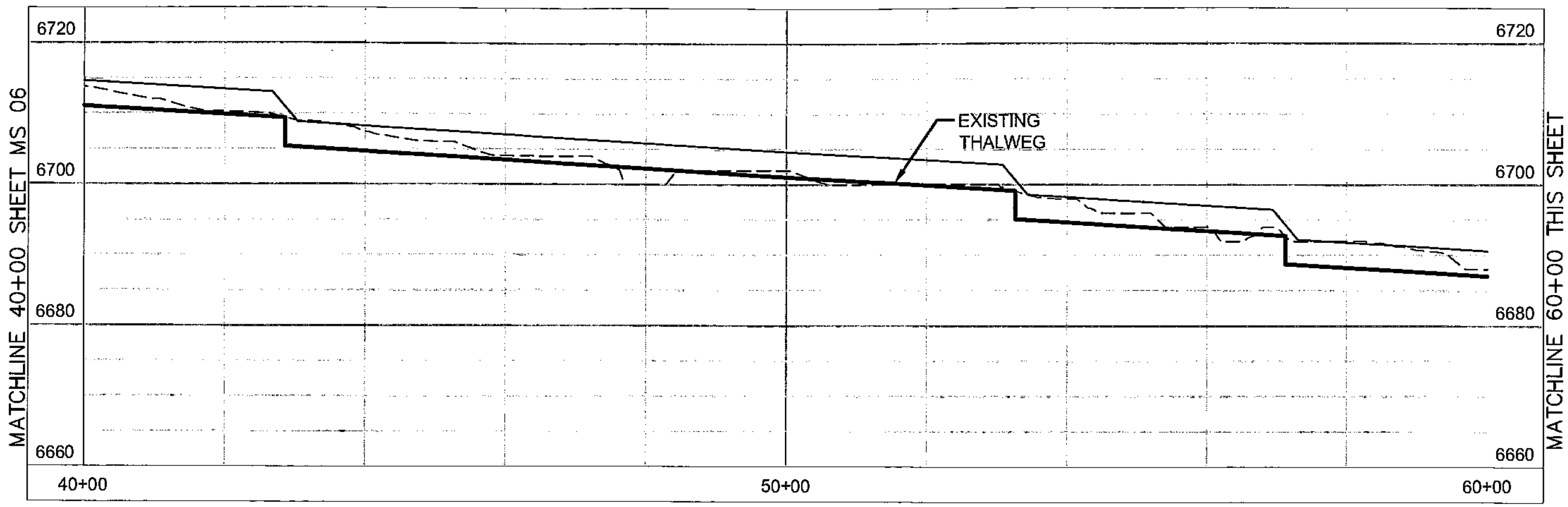
(7) 4' DROPS

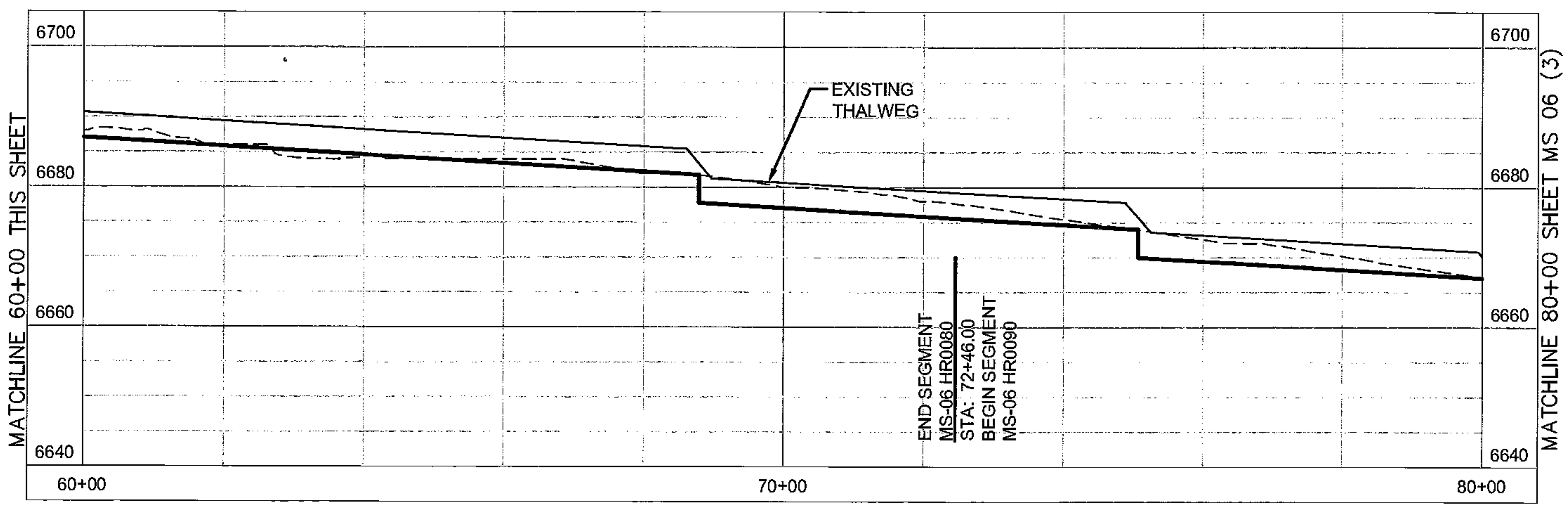
MS–06 HR0090

SLOPE = 0.60%

(8) 4' DROPS

PROFILE MAIN STEM (MS–06 & MS–05)





LEGEND

━━━	PROPOSED DROP STRUCTURE
– – –	EXISTING THALWEG
———	HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: MAINSTEM PROFILES_PROPOSED.DWG

Acad. Ver. 2006 Scale: 1"=20' Units: Feet

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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number MS06 (2)

MS–06 HR0090

SLOPE = 0.60%

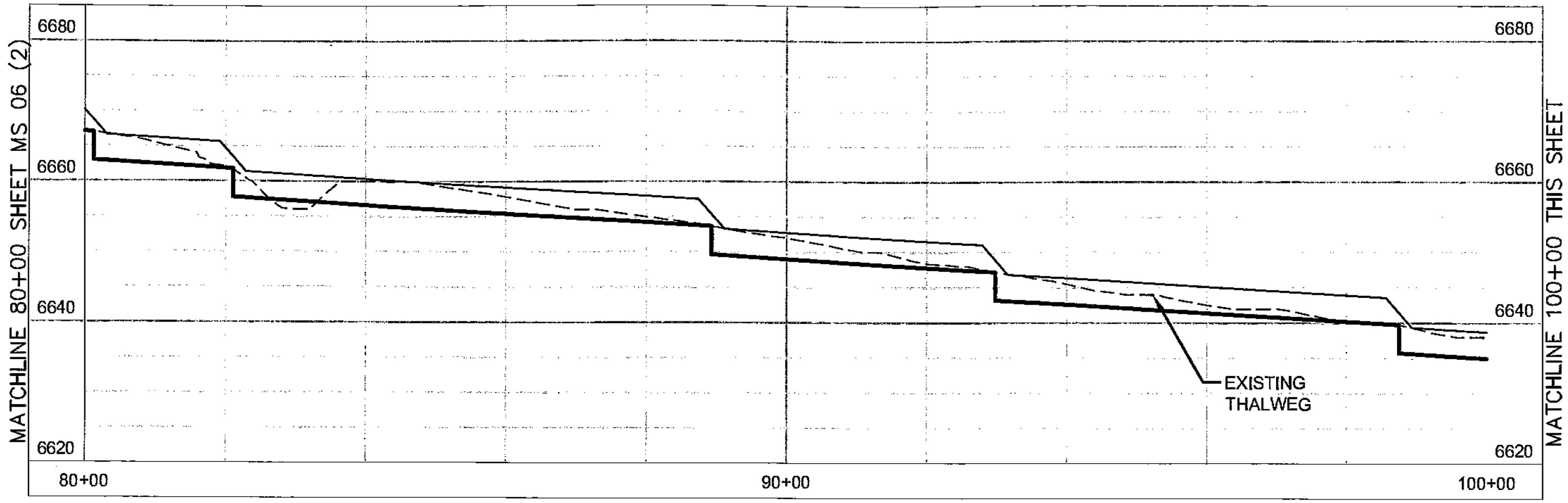
(8) 4' DROPS

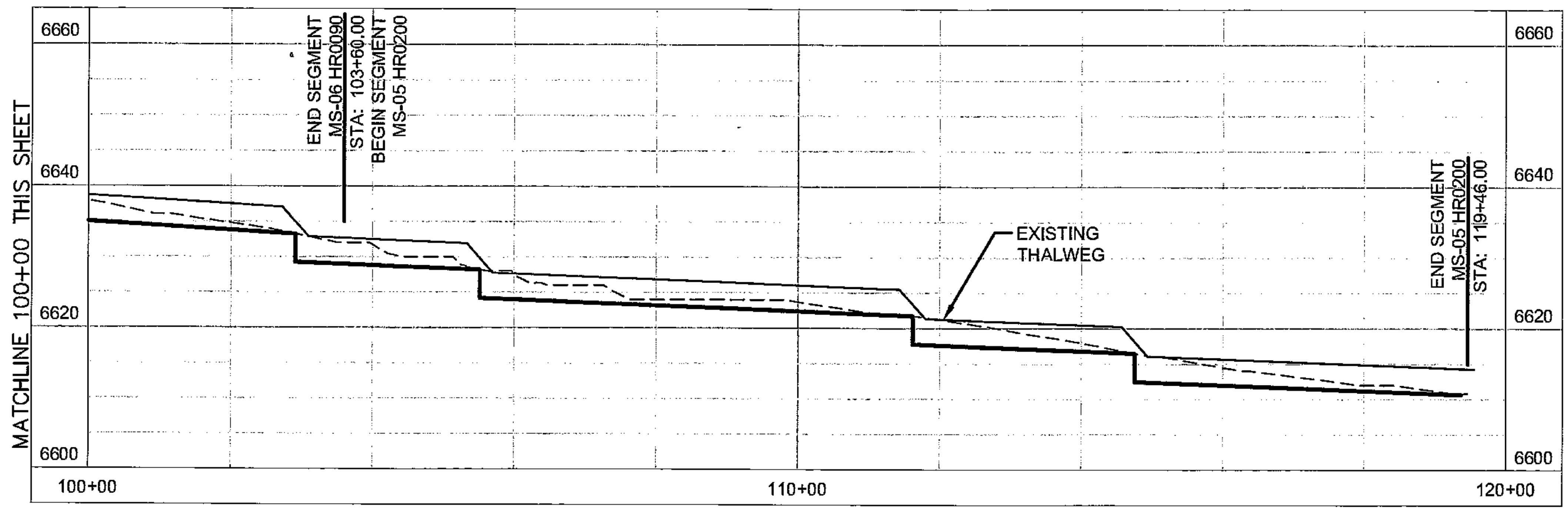
MS–05 HR0200

SLOPE = 0.40%

(4) 4' DROPS

PROFILE MAIN STEM (MS–06 & MS–05)





LEGEND

PROPOSED DROP STRUCTURE

EXISTING THALWEG

HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: MAINSTEM PROFILES_PROPOSED.DWG

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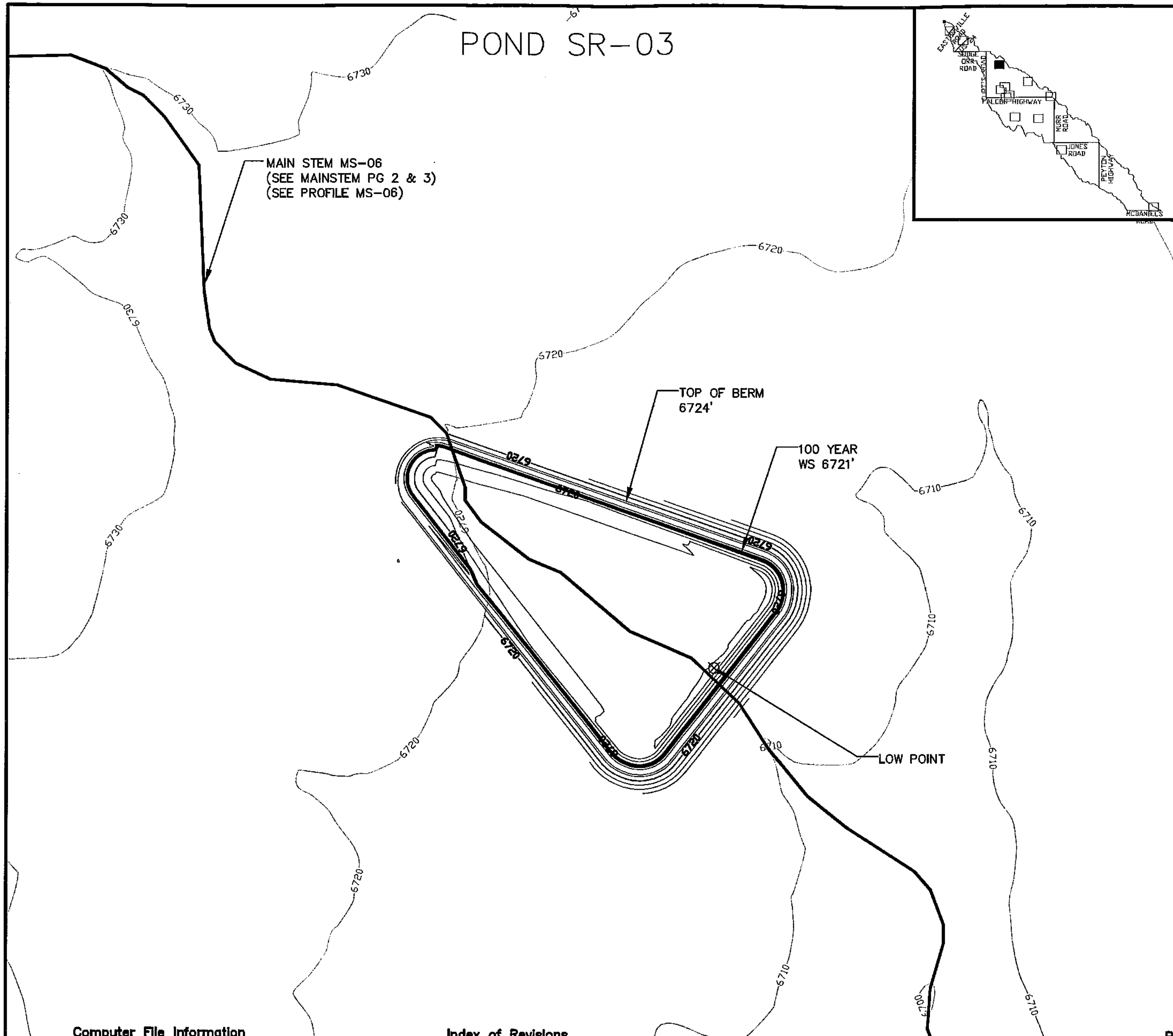
Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number MS06 & MS05 (3)

POND SR-03



LEGEND

6630	PROPOSED CONTOURS – MAJOR ELEVATION
	PROPOSED CONTOURS – MINOR ELEVATION
6630	EXISTING CONTOURS – MAJOR ELEVATION
	EXISTING CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	ROADS
	RIVER
	100 YEAR WATER SURFACE ELEVATION
⊠	OUTLET

POND SR-03
DISCHARGE

Q100	530 CFS
Q2	29 CFS
POND VOLUME AC FT	16
BERM WIDTH	10'
SIDESLOPES	8:1

N

1"=200'

200 0 200 400

Computer File Information

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	PONDS.DWG
Acad. Ver. 2006	Scale: 1"=200' Units: Feet

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Profiles

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Designed by: KAP
Detailed by: DRM
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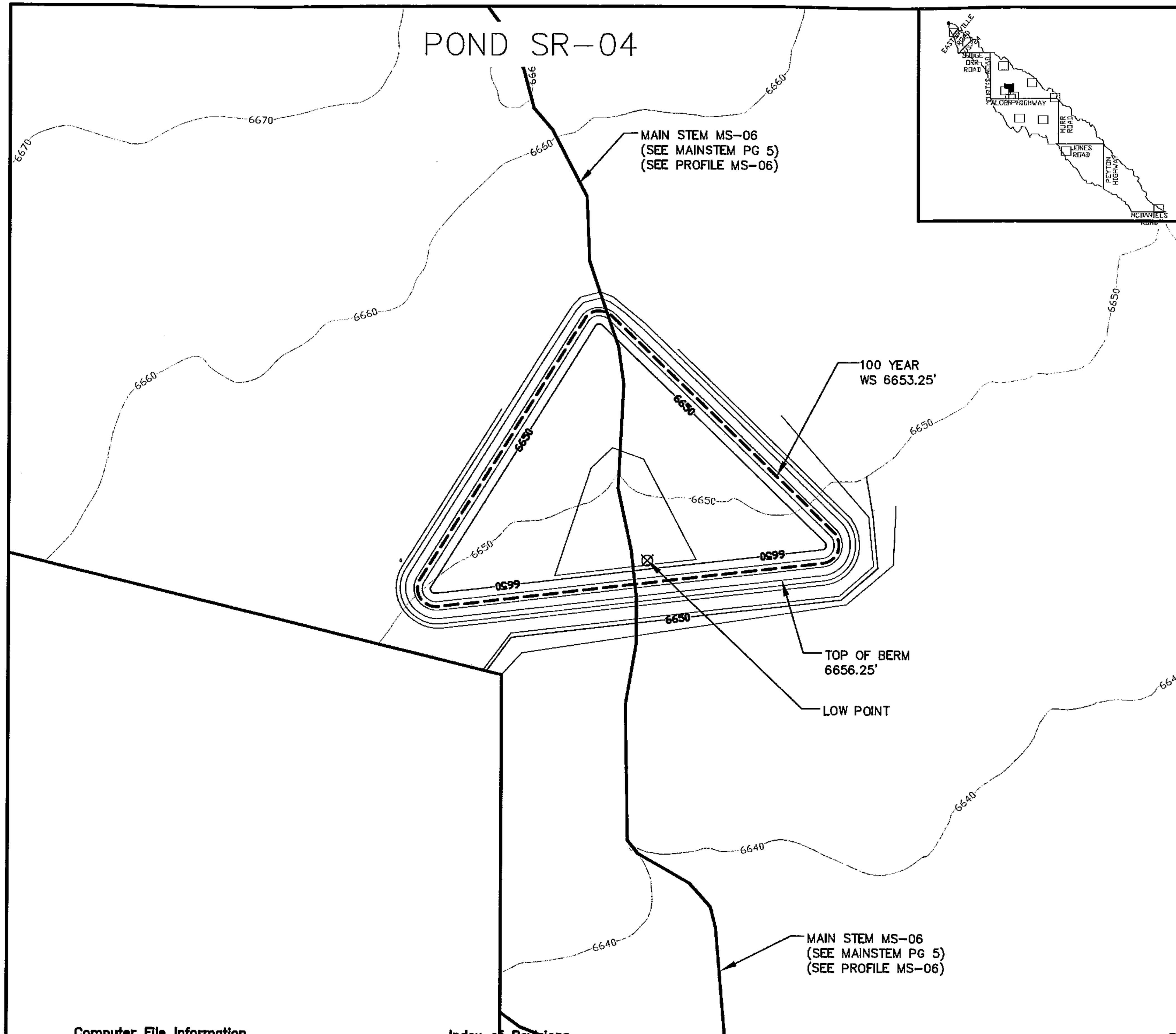
Structure Numbers

HAEGLER RANCH DRAINAGE BASIN

Sheet Number SR03

POND SR-04



LEGEND

6630	PROPOSED CONTOURS – MAJOR ELEVATION
	PROPOSED CONTOURS – MINOR ELEVATION
6630	EXISTING CONTOURS – MAJOR ELEVATION
	EXISTING CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	ROADS
	RIVER
	100 YEAR WATER SURFACE ELEVATION
⊠	OUTLET

POND SR-04
DISCHARGE

Q100	740 CFS
Q2	33 CFS
POND VOLUME AC FT	25
BERM WIDTH	10'
SIDESLOPES	8:1

N

1"=200'

200 0 200 400

Computer File Information

Full Path:	P:\21711039\CAO\PLANSHTS
Drawing File Name:	PONOS.OWG
Acad. Ver. 2006	Scale: 1"=200' Units: Feet

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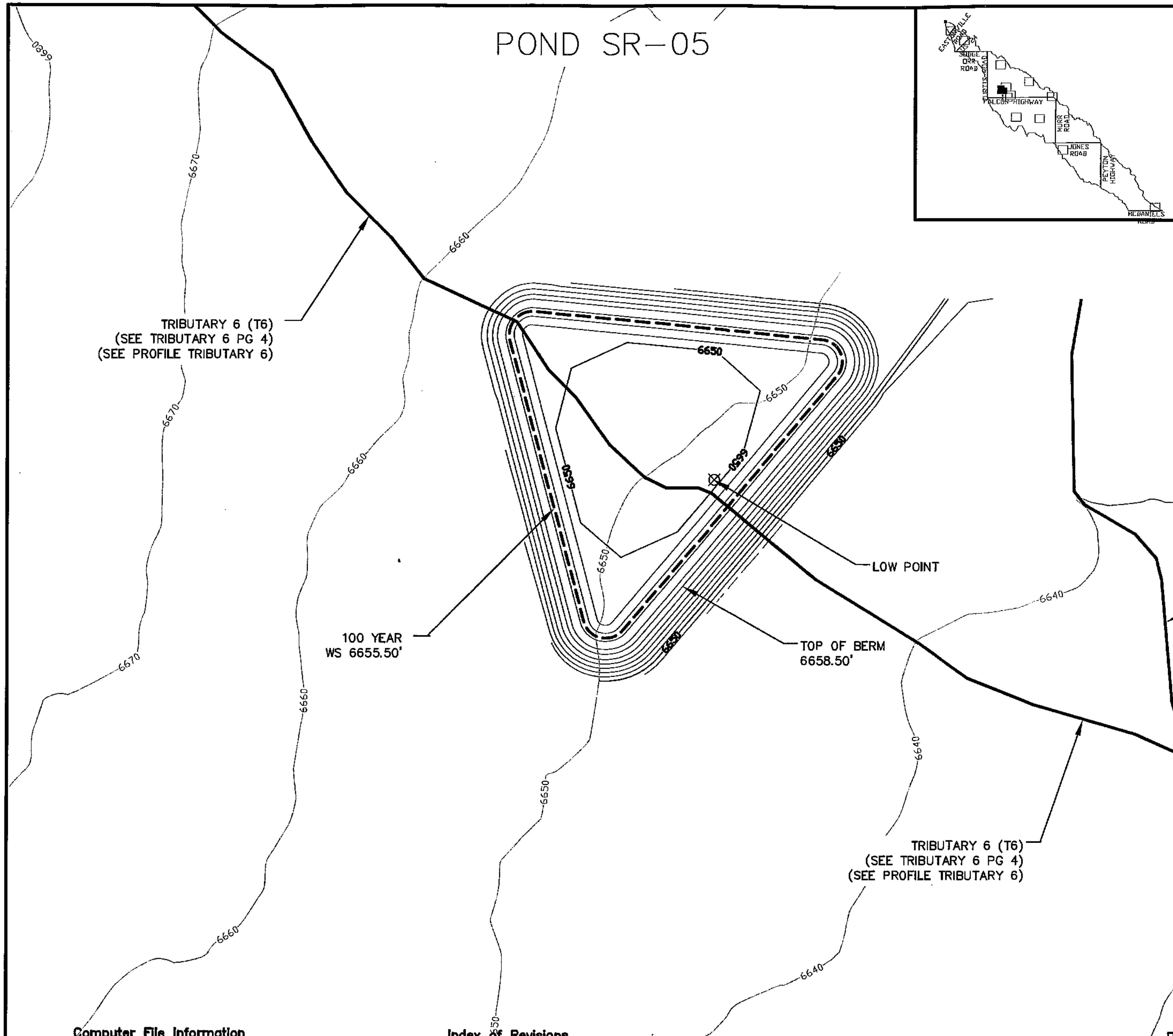
Structure Numbers

HAEGLER RANCH DRAINAGE BASIN

Sheet Number SR04



LEGEND

6630	PROPOSED CONTOURS – MAJOR ELEVATION
	PROPOSED CONTOURS – MINOR ELEVATION
6630	EXISTING CONTOURS – MAJOR ELEVATION
	EXISTING CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	ROADS
	RIVER
	100 YEAR WATER SURFACE ELEVATION
⊠	OUTLET

POND SR-05
DISCHARGE

Q100	250 CFS
Q2	9 CFS
POND VOLUME AC FT	24
BERM WIDTH	10'
SIDESLOPES	8:1

N

1"=200'

200 0 200 400

Computer File Information

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Profiles

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	PONDS.DWG
Acad. Ver. 20D6	Scale: 1"=200' Units: Feet

URS

Designed by: KAP
Detailed by: DRM
Checked by: JAJ

Structure Numbers

HAEGLER RANCH DRAINAGE BASIN

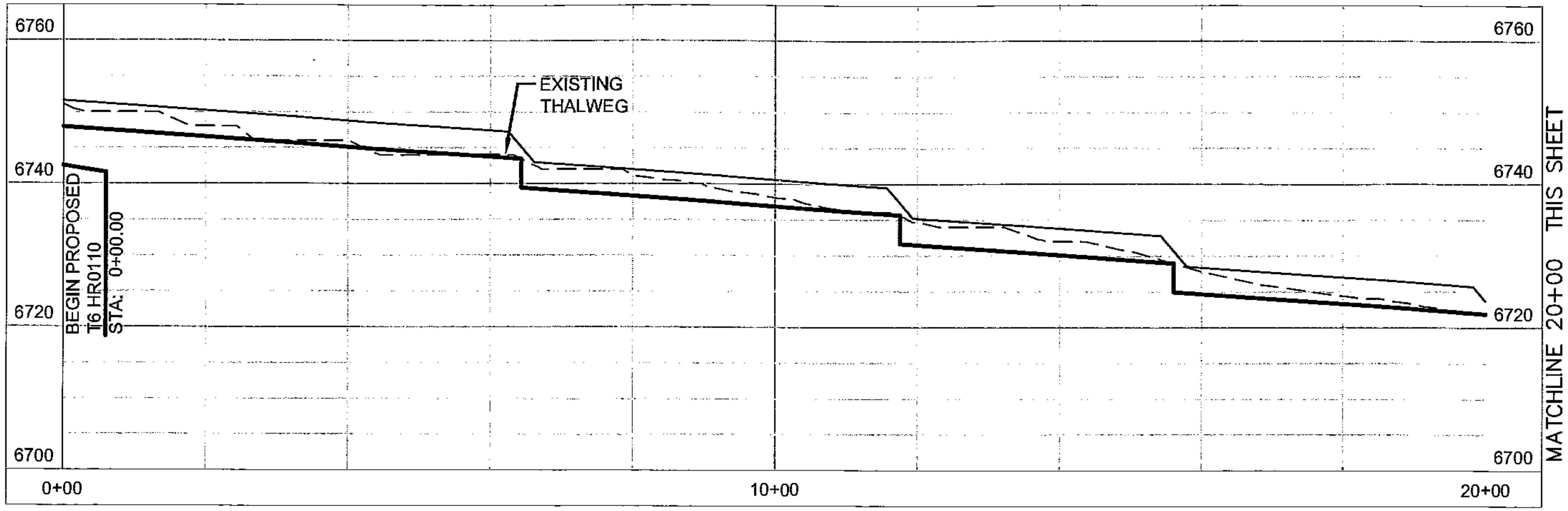
Sheet Number SR05

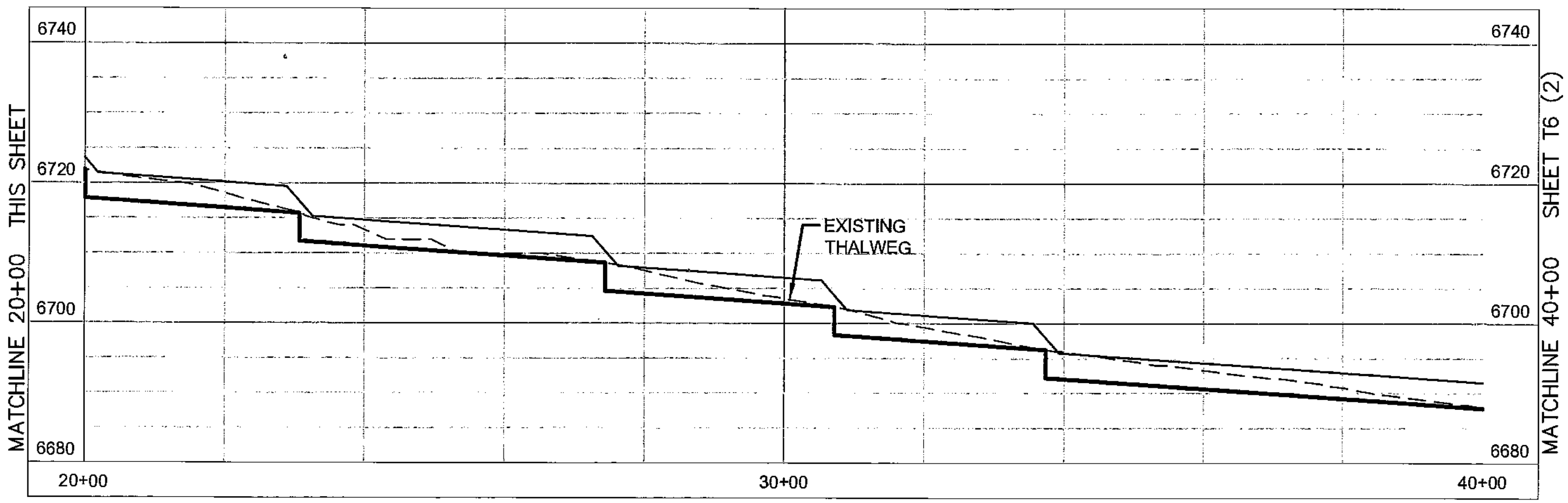
T6 HR0110

SLOPE = 0.70%

(9) 4' DROPS

PROFILE TRIBUTARY 6 (T6)





LEGEND

PROPOSED DROP STRUCTURE

EXISTING THALWEG

HYDRAULIC GRADE LINE

Computer File Information	
Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	T PROFILE SHEETS 6_PROPOSED.DWG
Acad. Ver. 2006	Scale: 1"=20' Units: Feet

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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number T6

T6 HR0110

SLOPE = 0.70%

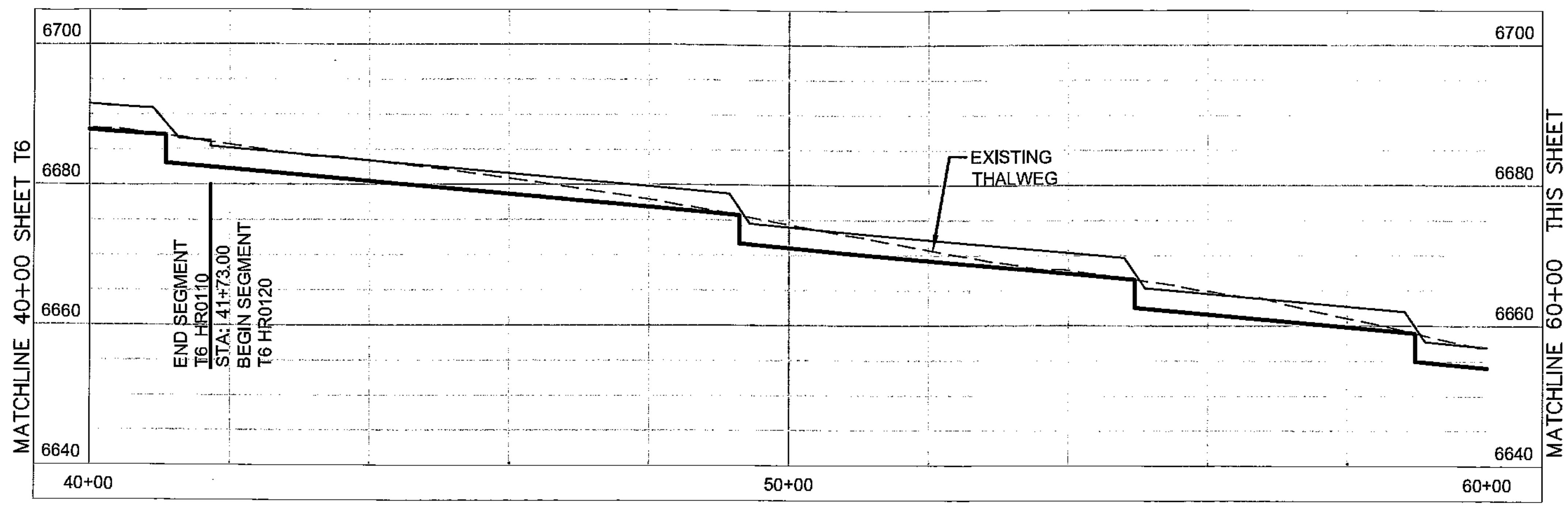
(9) 4' OROPS

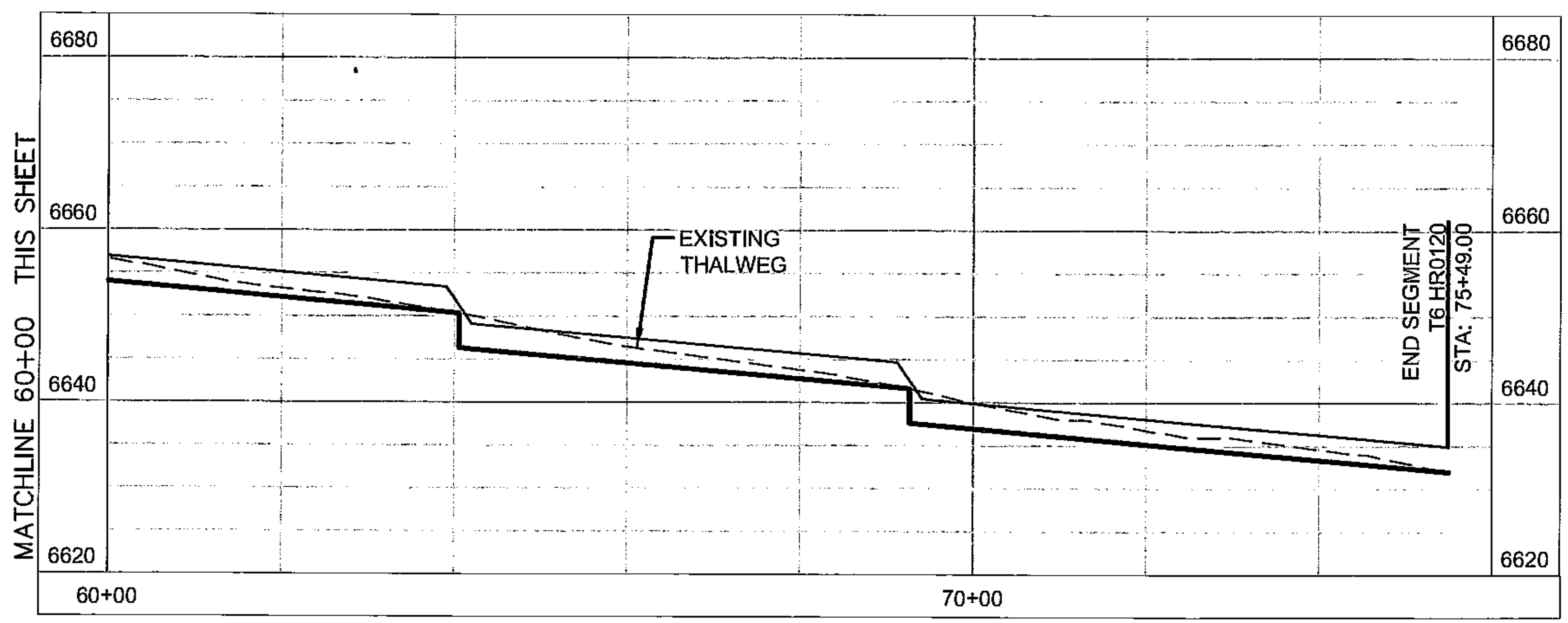
T6 HR0120

SLOPE = 0.90%

(6) 4' DROPS

PROFILE TRIBUTARY 6 (T6)





LEGEND

PROPOSEO OROP STRUCTURE

EXISTING THALWEG

HYORAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: T PROFILE SHEETS 6_PROPOSED.OWG

Acad. Ver. 2006 Scale: 1"=20' Units: Feet

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EL PASO COUNTY DEPARTMENT OF TRANSPORTATION

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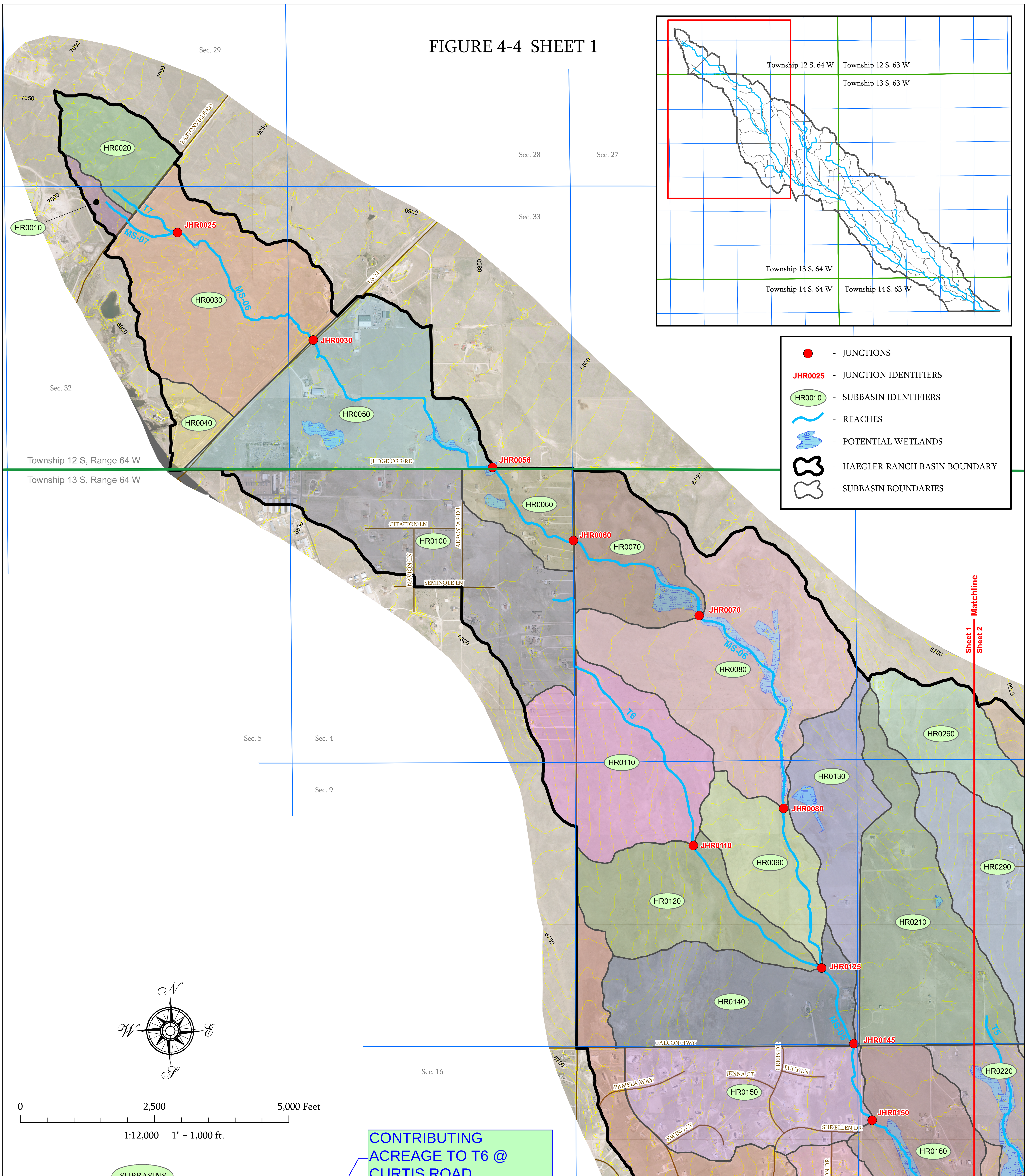
Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number T6 (2)

FIGURE 4-4 SHEET 1



SUBBASINS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	SUBBASIN AREA (sq. mi)
HR0010	3.1	11	25	52	0.022
HR0020	11	100	99	320	0.108
HR0030	9.0	13	260	300	0.393
HR0040	0.36	0.36	26	26	0.045
HR0050	2.7	4.3	170	200	0.377
HR0060	2.0	3.5	54	66	0.101
HR0070	5.4	210	99	580	0.180
HR0080	2.5	190	87	970	0.482
HR0090	0.95	11	44	160	0.154
HR0100	4.3	5.8	120	140	0.394
HR0110	1.9	72	84	420	0.310
HR0120	2.0	4.0	73	150	0.226
HR0130	0.27	15	29	180	0.185
HR0140	3.5	6.4	110	140	0.283
HR0150	21	21	210	210	0.290
HR0160	6.6	6.6	96	96	0.267
HR0170	15	17	130	150	0.241
HR0180	6.4	6.4	85	85	0.194
HR0190	19	19	190	190	0.340
HR0200	6.3	6.8	140	150	0.272
HR0210	13	24	150	240	0.359
HR0220	6.3	6.6	85	90	0.168
HR0260	0.88	36	60	240	0.186
HR0290	20	57	180	460	0.340

JUNCTIONS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	DRAINAGE AREA (sq. mi)
JHR0025	14	110	120	370	0.130
JHR0030	21	120	350	630	0.523
JHR0056	24	120	540	830	0.945
JHR0060	25	120	590	890	1.046
JHR0070	28	210	660	930	1.226
JHR0080	29	340	720	1500	1.708
JHR0110	6.1	72	200	440	0.704
JHR0125	37	410	980	2100	2.792
JHR0145	39	420	1100	2400	3.260
JHR0150	42	440	1100	2600	3.550
JHR0160	44	440	1200	2600	3.817
JHR0185	50	450	1400	2700	4.252
JHR0190	65	470	1400	2900	4.592

URS

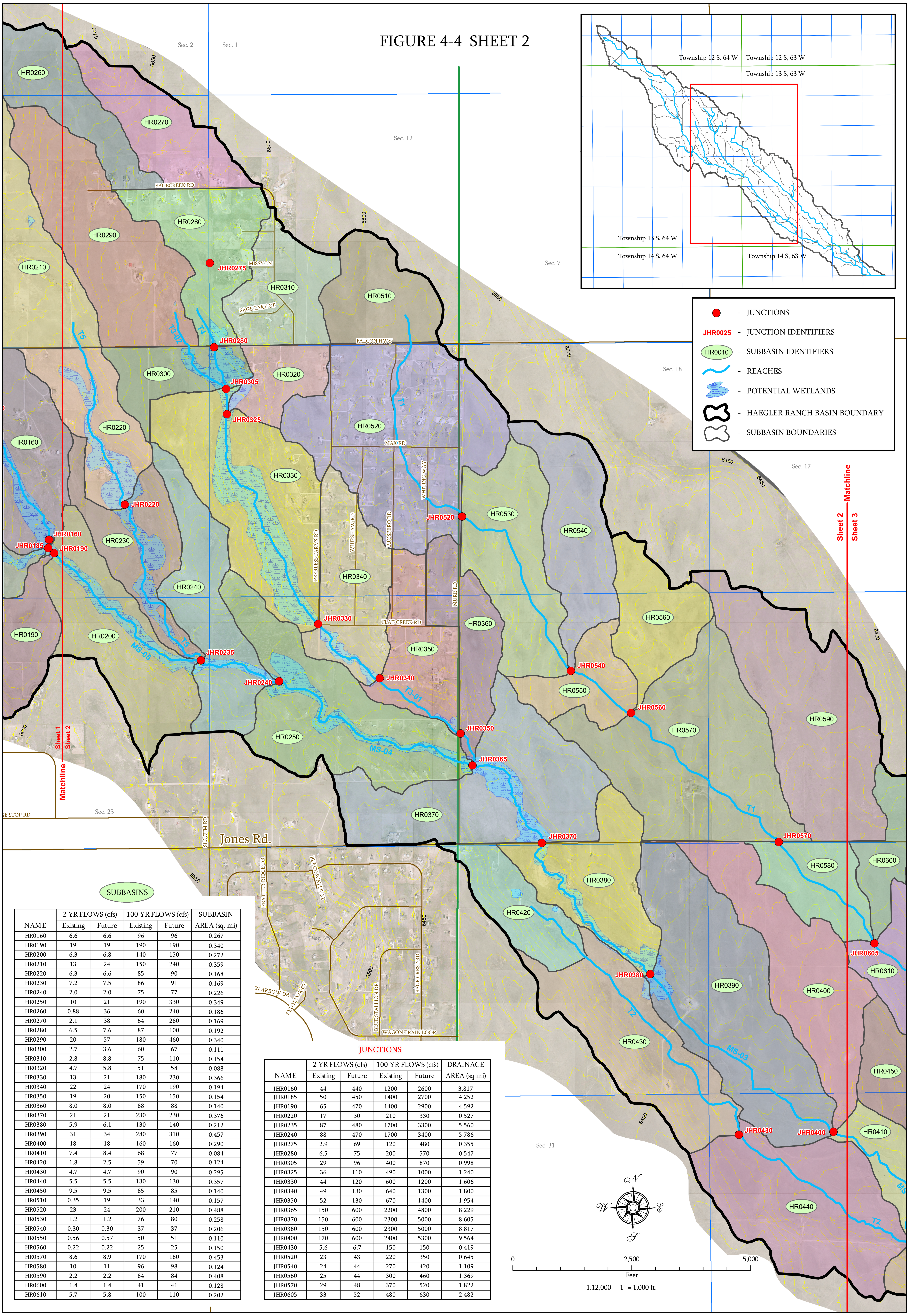
HAEGLER RANCH DRAINAGE BASIN

EXISTING AND FUTURE CONDITIONS HYDROLOGIC MODEL

URS NO. 21711039

DATE: 09/08

FIGURE 4-4 SHEET 2



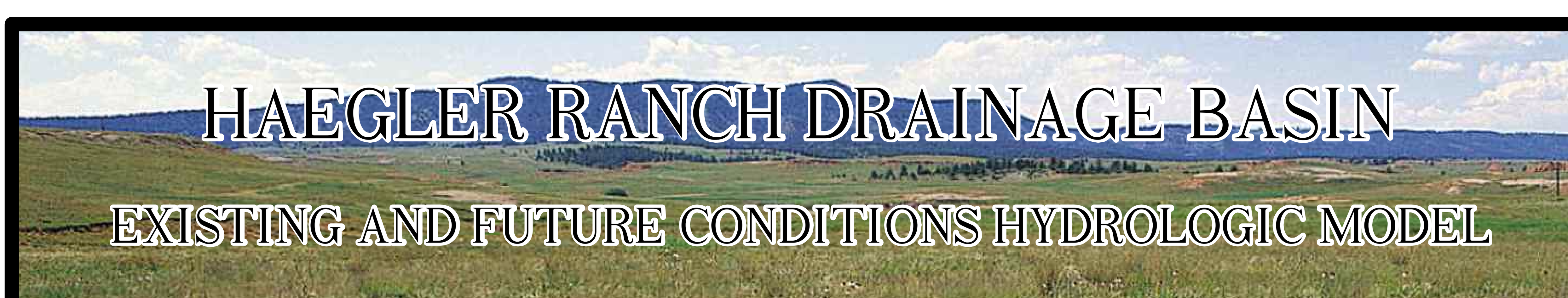
SUBBASINS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	SUBBASIN AREA (sq. mi)
HR0160	6.6	6.6	96	96	0.267
HR0190	19	19	190	190	0.340
HR0200	6.3	6.8	140	150	0.272
HR0210	13	24	150	240	0.359
HR0220	6.3	6.6	85	90	0.168
HR0230	7.2	7.5	86	91	0.169
HR0240	2.0	2.0	75	77	0.226
HR0250	10	21	190	330	0.349
HR0260	0.88	36	60	240	0.186
HR0270	2.1	38	64	280	0.169
HR0280	6.5	7.6	87	100	0.192
HR0290	20	57	180	460	0.340
HR0300	2.7	3.6	60	67	0.111
HR0310	2.8	8.8	75	110	0.154
HR0320	4.7	5.8	51	58	0.088
HR0330	13	21	180	230	0.366
HR0340	22	24	170	190	0.194
HR0350	19	20	150	150	0.154
HR0360	8.0	8.0	88	88	0.140
HR0370	21	21	230	230	0.376
HR0380	5.9	6.1	130	140	0.212
HR0390	31	34	280	310	0.457
HR0400	18	18	160	160	0.290
HR0410	7.4	8.4	68	77	0.084
HR0420	1.8	2.5	59	70	0.124
HR0430	4.7	4.7	90	90	0.295
HR0440	5.5	5.5	130	130	0.357
HR0450	9.5	9.5	85	85	0.140
HR0510	0.35	19	33	140	0.157
HR0520	23	24	200	210	0.488
HR0530	1.2	1.2	76	80	0.258
HR0540	0.30	0.30	37	37	0.206
HR0550	0.56	0.57	50	51	0.110
HR0560	0.22	0.22	25	25	0.150
HR0570	8.6	8.9	170	180	0.453
HR0580	10	11	96	98	0.124
HR0590	2.2	2.2	84	84	0.408
HR0600	1.4	1.4	41	41	0.128
HR0610	5.7	5.8	100	110	0.202

JUNCTIONS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	DRAINAGE AREA (sq mi)
JHR0160	44	440	1200	2600	3.817
JHR0185	50	450	1400	2700	4.252
JHR0190	65	470	1400	2900	4.592
JHR0220	17	30	210	330	0.527
JHR0235	87	480	1700	3300	5.560
JHR0240	88	470	1700	3400	5.786
JHR0275	2.9	69	120	480	0.355
JHR0280	6.5	75	200	570	0.547
JHR0305	29	96	400	870	0.998
JHR0325	36	110	490	1000	1.240
JHR0330	44	120	600	1200	1.606
JHR0340	49	130	640	1300	1.800
JHR0350	52	130	670	1400	1.954
JHR0365	150	600	2200	4800	8.229
JHR0370	150	600	2300	5000	8.605
JHR0380	150	600	2300	5000	8.817
JHR0400	170	600	2400	5300	9.564
JHR0430	5.6	6.7	150	150	0.419
JHR0520	23	43	220	350	0.645
JHR0540	24	44	270	420	1.109
JHR0560	25	44	300	460	1.369
JHR0570	29	48	370	520	1.822
JHR0605	33	52	480	630	2.482

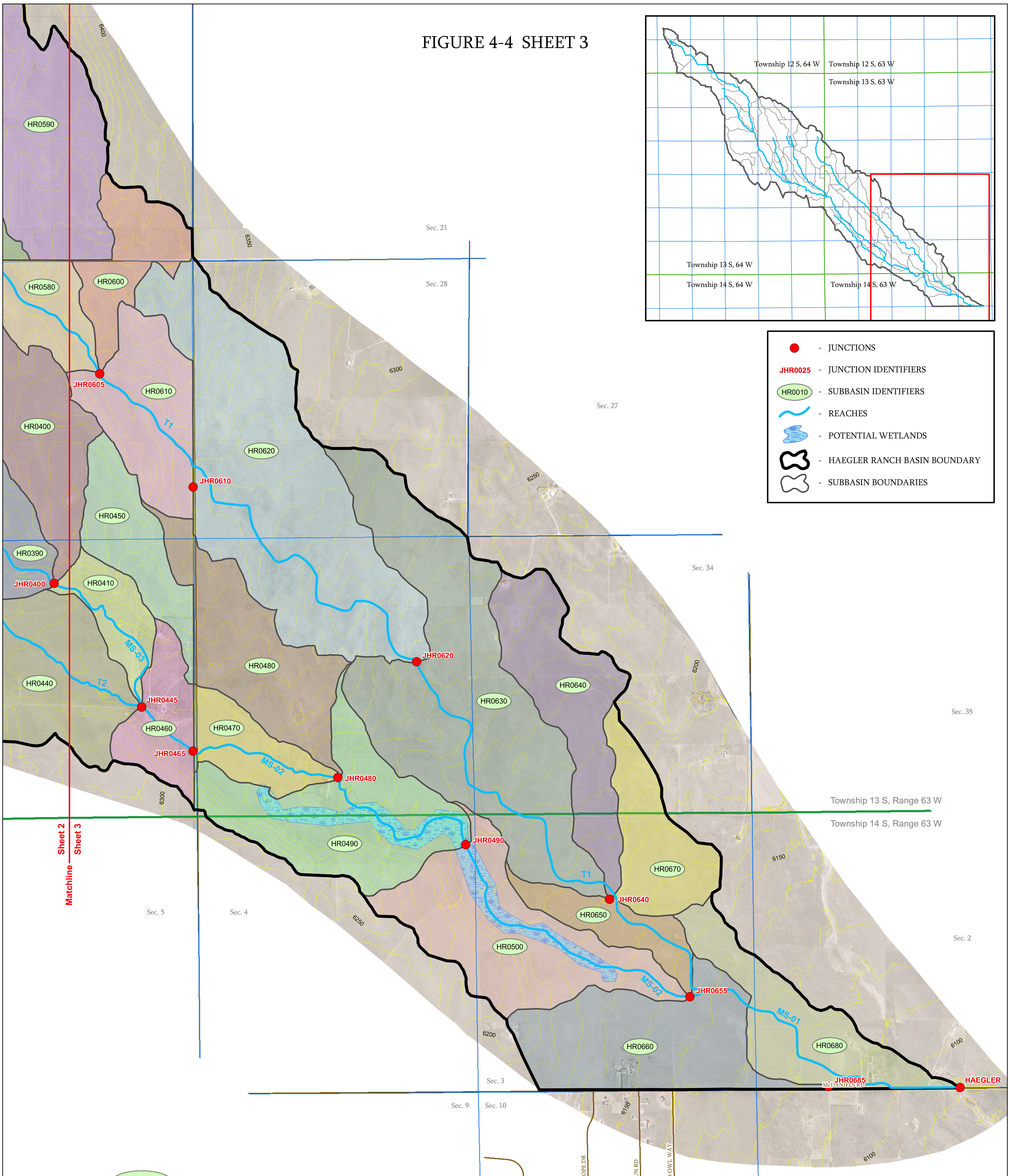
URS



URS NO. 21711039

DATE: 09/08

FIGURE 4-4 SHEET 3



SUBBASINS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	SUBBASIN AREA (sq. mi)
HR0390	31	34	280	310	0.457
HR0400	18	18	160	160	0.290
HR0410	7.4	8.4	68	77	0.084
HR0440	5.5	5.5	130	130	0.357
HR0450	9.5	9.5	85	85	0.140
HR0460	4.0	4.0	76	76	0.109
HR0470	7.3	7.6	73	77	0.102
HR0480	0.86	0.86	34	34	0.244
HR0490	9.2	9.8	210	220	0.312
HR0500	3.3	3.4	140	150	0.326
HR0580	10	11	96	98	0.124
HR0590	2.2	2.2	84	84	0.408
HR0600	1.4	1.4	41	41	0.128
HR0610	5.7	5.8	100	110	0.202
HR0620	1.9	1.9	110	120	0.647
HR0630	2.2	2.2	86	86	0.616
HR0640	0.88	0.88	37	37	0.237
HR0650	4.2	4.3	45	46	0.092
HR0660	0.87	0.87	52	52	0.296
HR0670	0.63	0.63	31	31	0.153
HR0680	11	12	110	120	0.206

JUNCTIONS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	DRAINAGE AREA (sq. mi)
JHR0400	170	600	2400	5300	9.564
JHR0445	180	590	2500	5400	10.424
JHR0465	180	570	2600	5400	10.673
JHR0480	180	570	2600	5400	11.019
JHR0490	180	570	2600	5500	11.331
JHR0605	33	52	480	630	2.482
JHR0610	34	52	500	650	2.684
JHR0620	35	53	560	700	3.331
JHR0640	38	54	670	780	4.184
JHR0655	190	570	3200	5600	15.933
JHR0685	190	550	3200	5600	16.588
HAEGLER	190	550	3200	5600	16.588

N W E S

0 2,500 5,000
Feet
1:12,000 1" = 1,000 ft.

URS

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

X:\2510000.all\2514200\Word\Reports_Drainage\Saddlehorn Ranch MDDP.PDR.docx

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.

______________________________ ______________________
Mike Bramlett, Colorado P.E. # 32314 Date
For and On Behalf of JR Engineering, LLC

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

Business Name: ROI Property Group, LLC

By: ______________________________

Title: ______________________________
Address: 2495 Rigdon Street
Napa, CA 94558

Provide final signed report?

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

______________________________ ______________________
Jennifer Irvine, P.E. Date
County Engineer/ ECM Administrator

Conditions:

CONTENTS

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B. Hydrologic Calculations
C. Hydraulic Calculations
D. Detention and Water Quality Calculations
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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 6th 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
3. 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.

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.

<u>Existing Gieck Ranch Drainage Basin</u>

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.

<u>Existing Haegler Ranch Drainage Basin</u>

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

Provide (unresolved from comment letter)

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

EXISTING BASIN SUMMARY TABLE				
Tributary Sub-Basin	Area (acres)	Percent Impervious	Q_5 (cfs)	Q_{100} (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
H3	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 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.

<u>Existing Haegler Ranch Tributary 6 (T-6)</u>

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_{100} Per Haegler Ranch DBPS:	Q_{100} Per Geick Ranch DBPS:	Q_{100} 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

*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.

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.

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 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^2 of Del Cerro Drive and 14,000 ft^2 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 MS-06 and Ponds G, H, and I 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)
A	POND A	9.2	0.20	1.14	1.14	2.5	2.8
B	POND B	60.4	0.35	1.46	2.17	18.9	21.0
C	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
H	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.

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-

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 Site Composite % Impervious for Basin Fees			
Basin	Area (ac)	% Imperviousness	(Area) * (% Imp.)
A	9.2	67%	6.13
B	60.4	10%	6.28
C	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
H	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
Comp. % Imp. = 68.59%*ac/825.4 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:

1. City of Colorado Springs Drainage Criteria Manual Volume 1, City of Colorado Springs, CO, May 2014.

2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.

3. Gieck Ranch Drainage Basin Planning Study, Drexel, Barrell & Co., October 2007 and revised in February 2010.

4. Haegler Ranch Drainage Basin Planning Study, URS Corporation, May 2009.

5. The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR, Federal Emergency Management Agency, October 20, 2004.

APPENDIX A

FIGURES AND EXHIBITS

APPENDIX B

HYDROLOGIC CALCULATIONS

APPENDIX C

HYDRAULIC CALCULATIONS

APPENDIX D

WATER QUALITY AND DETENTION CALCULATIONS

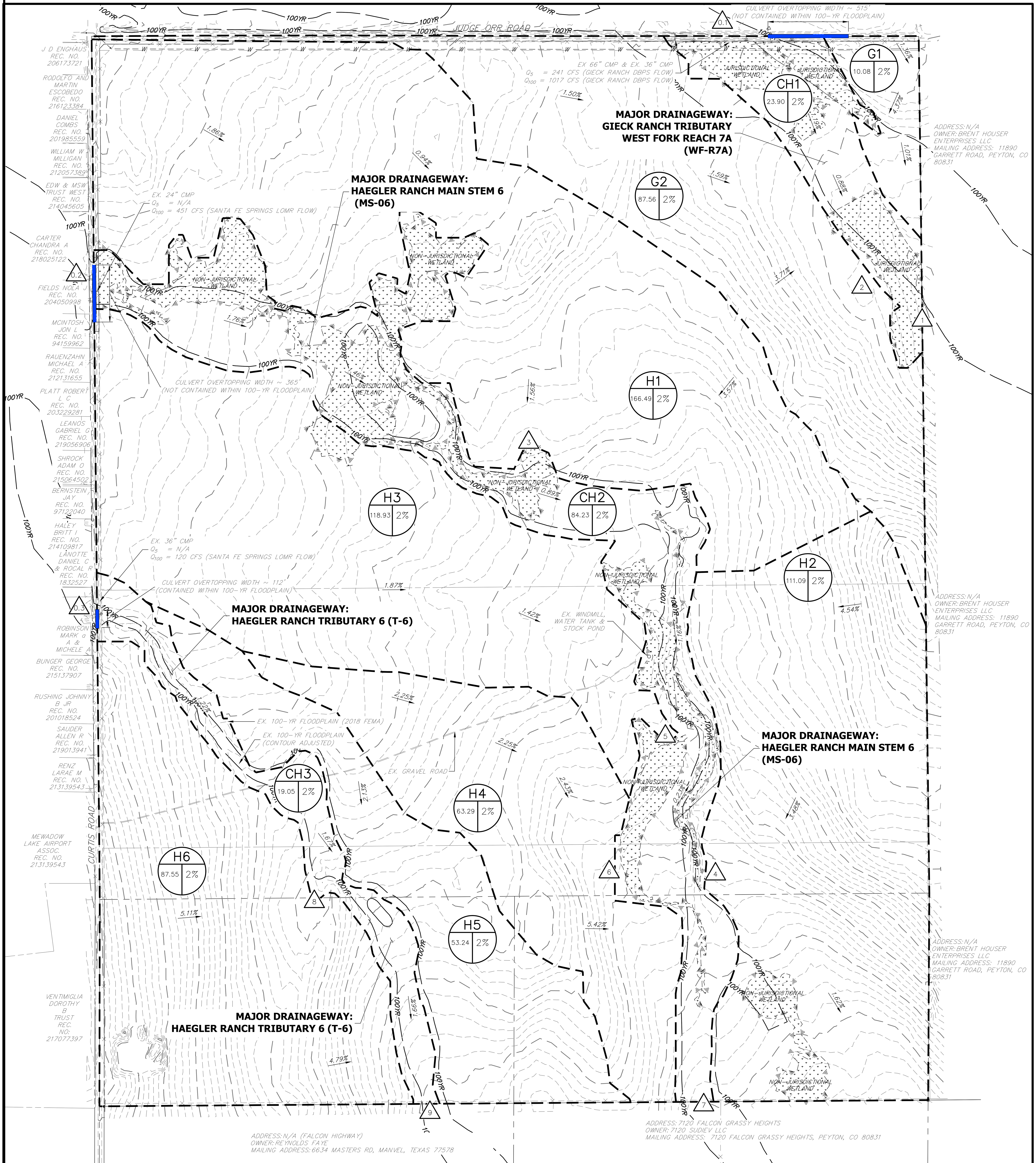
APPENDIX E

REFERENCE MATERIALS

APPENDIX F

DRAINAGE MAPS

824 ACRE CURTIS ROAD SUBDIVISION
EX. CONDITIONS DRAINAGE MAP



LEGEND

I.D. A B	BASIN DESIGNATION I.D.: BASIN IDENTIFIER A: BASIN AREA B: % IMPERVIOUS
X	DESIGN POINT
	BASIN DELINEATION
6100	EXISTING INDEX CONTOURS
	EXISTING INTERMEDIATE CONTOURS
	EXISTING FLOW DIRECTION

BASIN SUMMARY TABLE

Tributary Sub-Basin	Area (acres)	Percent Impervious	Q_5 (cfs)	Q_{100} (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
H3	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

DESIGN POINT SUMMARY TABLE

Tributary Sub-	Q_5 (cfs)	Q_{100} (cfs)
0.1	241.00	1017.0
0.2	-	451.0
0.3	-	120.0
1	6.9	1114.0
2	1.5	76.4
3	0.1	80.9
4	0.1	91.1
5	0.9	64.1
6	1.4	73.2
7	4.1	704.9
8	0.2	110.1
9	0.4	248.1

300 150 0 300 600
ORIGINAL SCALE: 1" = 300'

EX. DRAINAGE MAP
824 CURTIS ROAD
25142.00
5/8/20
SHEET 1 OF 1

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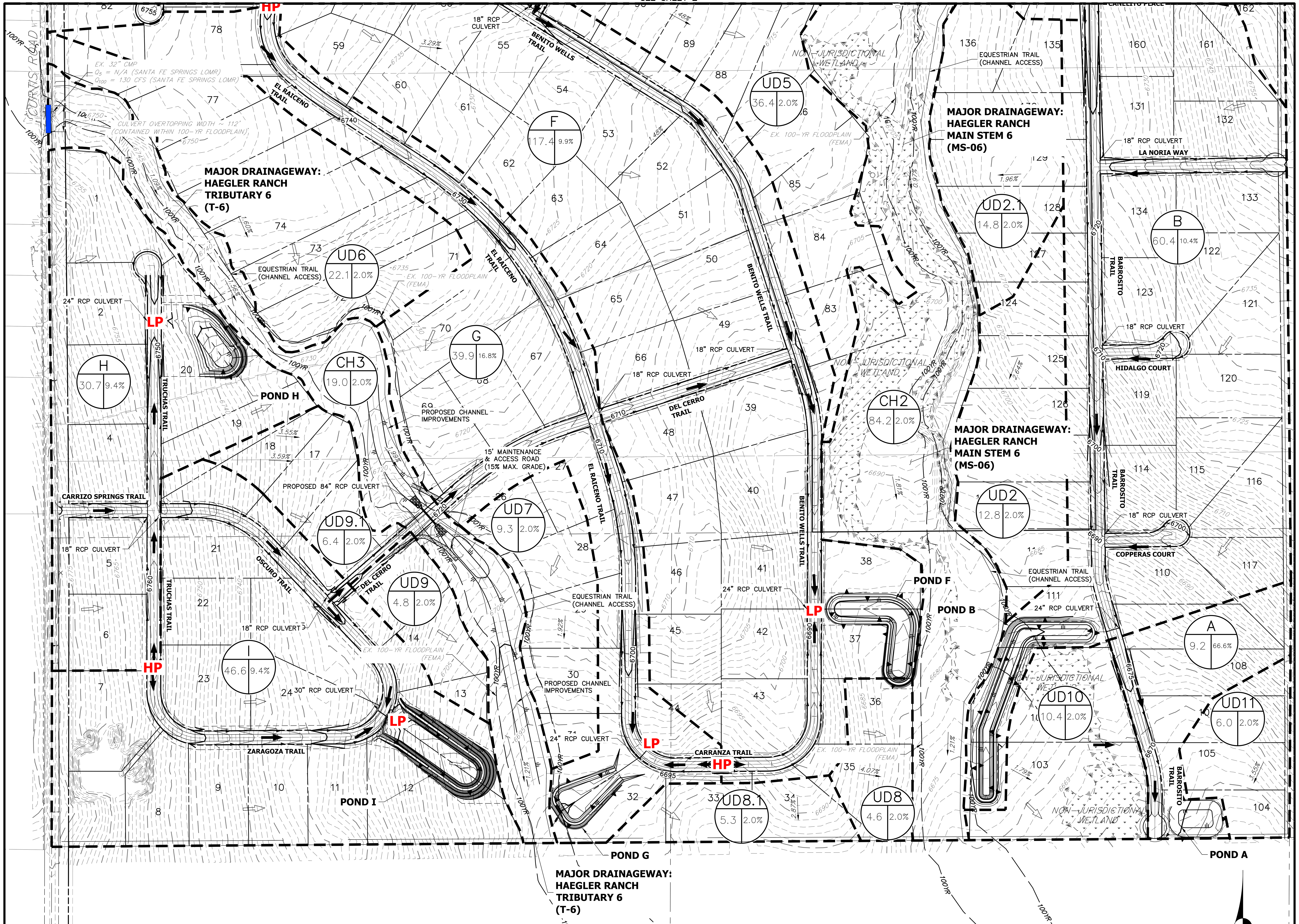
Fort Collins 970-491-9888 • www.jrengineering.com

SADDLEHORN RANCH SUBDIVISION
PROPOSED DRAINAGE MAP

SEE SHEET 2



BASIN SUMMARY TABLE				
Tributary Sub-Basin	Area (acres)	Composite Percent Impervious	Q_5 (cfs)	Q_{100} (cfs)
A	9.2	66.6%	9.5	20.7
B	60.4	10.4%	9.9	46.3
C	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
H	30.7	9.4%	3.7	17.9
I	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)
A	POND A	9.2	0.20	1.14	1.14	2.5	2.8
B	POND B	60.4	0.35	1.46	2.17	18.9	21.0
C	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
H	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
- DESIGN POINT
- BASIN DELINEATION
- EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- PROPOSED INDEX CONTOURS
- PROPOSED INTERMEDIATE CONTOURS
- EXISTING FLOW DIRECTION
- PROPOSED FLOW DIRECTION
- HP PROPOSED HIGH POINT
- LP PROPOSED LOW POINT

SADDLEHORN RANCH SUBDIVISION
MDDP DRAINAGE MAP
25142.00
12/18/19
SHEET 1 OF 3

NOTES

1. ALL CULVERT SIZES ARE PRELIMINARY AND SUBJECT TO CHANGE WITH FINAL DRAINAGE REPORTS.

200 100 0 200 400
ORIGINAL SCALE: 1" = 200'

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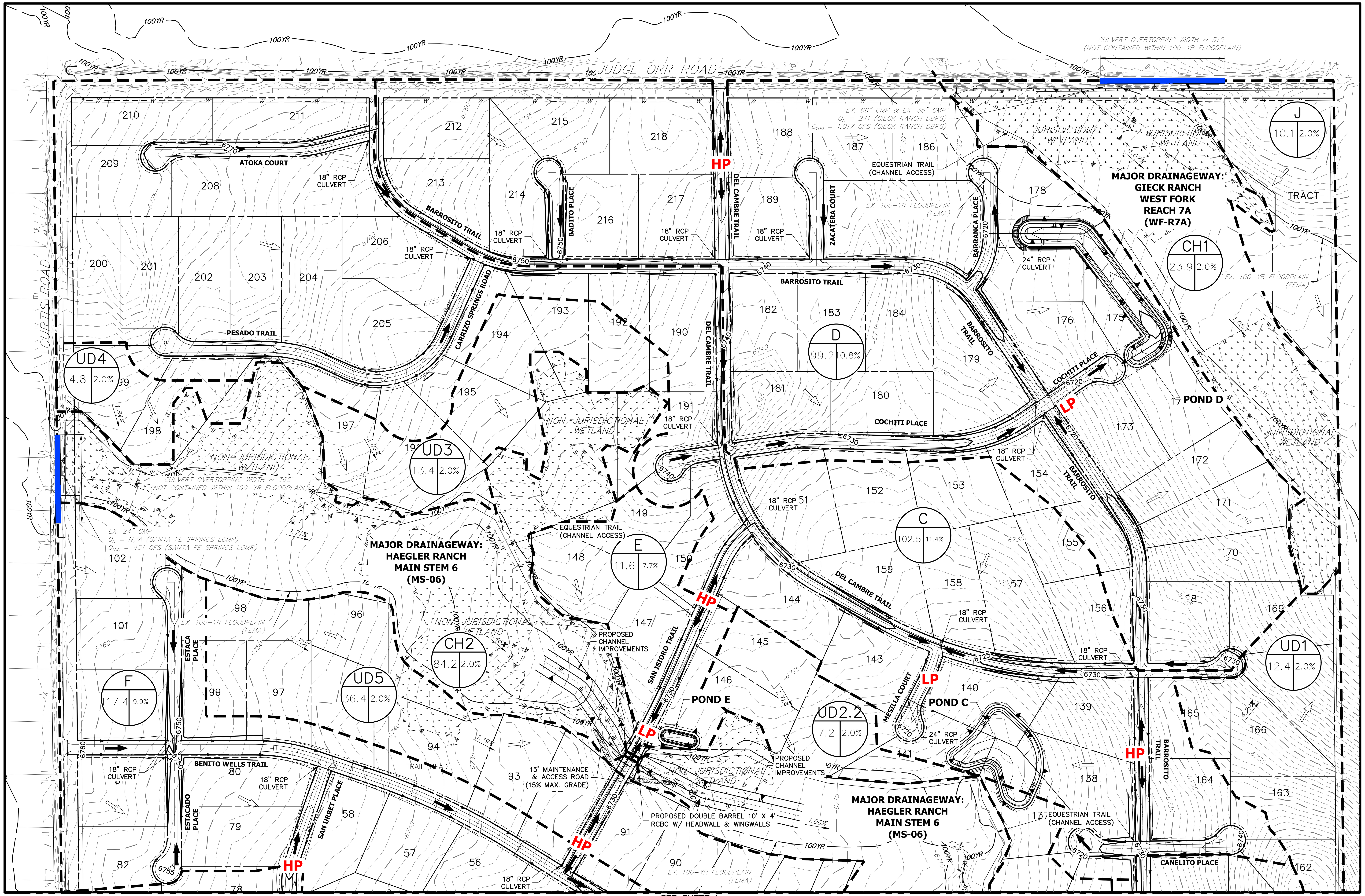
SADDLEHORN RANCH SUBDIVISION
PROPOSED DRAINAGE MAP



SEE SHEET 1

BASIN SUMMARY TABLE				
Tributary Sub-Basin	Area (acres)	Composite Percent Impervious	Q_5 (cfs)	Q_{100} (cfs)
A	9.2	66.6%	9.5	20.7
B	60.4	10.4%	9.9	46.3
C	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
H	30.7	9.4%	3.7	17.9
I	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

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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
H	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

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

X — DESIGN POINT

BASIN DELINEATION

6100 — EXISTING INDEX CONTOURS

EXISTING INTERMEDIATE CONTOURS

6100 — PROPOSED INDEX CONTOURS

PROPOSED INTERMEDIATE CONTOURS

EXISTING FLOW DIRECTION

PROPOSED FLOW DIRECTION

HP — PROPOSED HIGH POINT

LP — PROPOSED LOW POINT

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

NOTES

1. ALL CULVERT SIZES ARE PRELIMINARY AND SUBJECT TO CHANGE WITH FINAL DRAINAGE REPORTS.

200 100 0 200 400
ORIGINAL SCALE: 1" = 200'

J·R ENGINEERING
A Westrian Company

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Fort Collins 970-491-9888 • www.jrengineering.com

FINAL DRAINAGE REPORT
FOR
SADDLEHORN RANCH – FILING 1

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

May 7, 2020
Project No. 25142.02

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

El Paso County PCD File No.:
SF-19-012

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.

______________________________________ ________________________

Mike Bramlett, Colorado P.E. # 32314 Date
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:

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

Business Name: ROI Property Group, LLC

By: ____________________________________

Title: ____________________________________
Address: 2495 Rigdon Street
Napa, CA 94558

Provide final
signed report?

El Paso County:

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

______________________________________ ________________________

Jennifer Irvine, P.E. Date
County Engineer/ ECM Administrator

Conditions:

CONTENTS

PURPOSE

This document is the Final Drainage report for Filing 1 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 1, known as "Filing 1" from herein, is a parcel of land located in Section 3 and 10, Township 13 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. Saddlehorn Ranch is an 824 acre, rural, single family-development. Filing 1 is 174 acres and is comprised of 55 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 Reyonlds. Filing 1 is bound by future filings to the North and East while it is bound by Curtis Road to the West and to the South by undeveloped properties owned by Carolyn Gudzunas and Faye Reyonlds. A vicinity map is presented in Appendix A.

Currently, is one major Drainageway that bisects Filing 1: Haegler Ranch Tributary 6 (T-6). This Drainageway was 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.
- Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch, April 2019.

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

Description of Property

Filing 1 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, Filing 1 slopes from northwest to southeast and the existing Drainageway follows this topography.

Per a NRCS web soil survey of the area, Filing 1 is made up of Type A and B soils. Type A soils cover roughly 91% of Filing 1 while Type B soils cover 9% of Filing 1. Group A soils have a high infiltration rate when thoroughly wet. Type B soils have a moderate infiltration when thoroughly wet. A NRCS soil survey map has been presented in Appendix A.

There are two existing wells in the south west corner of Filing 1.

Floodplain Statement

Based on the FEMA FIRM Map number 08041C0558G, dated December 7, 2018, Filing 1 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 1 will occur in Zone X. The FIRM Map has been presented in Appendix A.

DRAINAGE BASINS AND SUBBASINS

Existing Major Basin Descriptions

Filing 1 lies within Haegler Ranch Drainage Basin based on the "*Haegler Ranch Drainage Basin Planning Study*" prepared by URS Corporation in May 2009.

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.
- Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch, prepared by JR Engineering, April 2019.

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 its existing condition Haegler Ranch contributes a 100-year flow of 120 cfs onto Filing 1. The offsite drainage crosses Curtis Road in an existing 36" CMP onto

Filing 1. Major Drainageway T-6 conveys the stormwater through Filing 1 and to its off-site confluence with Major Drainageway MS-05. The existing 36” CMP culvert is undersized for existing flows.

The *Haegler Ranch DBPS* evaluated two detention alternatives for the drainage basin: region and sub regional. In the regional approach, it is recommended the existing 36” CMP be upsized to a 60” RCP. In the sub-regional approach, this culvert is recommended to be left in its existing condition.

The existing 36” CMP culvert will not be upsized within the context of this report and development. The culvert is owned by El Paso County and timing of improvements, if any, will be controlled by the County.

Furthermore, the *Haegler Ranch DBPS* recommends channel improvements within Drainageway T-6. Per the *Haegler Ranch DBPS,* Drainageway T-6 should be improved to a trapezoidal channel with an 8’ bottom width, 4:1 side slopes and design depth of five feet. The DBPS also recommends a total of seven (7) four-foot drops within the on-site portion of T-6 to limit erosive velocities. The recommended drop structures will not be constructed with Saddlehorn Ranch Filing 1. Proposed channel improvements will limit erosive velocities without the use of drop structures. See recommended channel improvement sheets from the *Haegler Ranch DBPS* 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. However, based on the *Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch,* Filing 1 will utilize on-site 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.

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.

Of the three drainageways that were evaluated in the LOMR, Haegler Ranch Tributary 4 passes through Filing 1. Within the boundary of the proposed development, Haegler Ranch Tributary 4 is synonymous with T-6 from the *Haegler Ranch DBPS*. The purpose of the LOMR was to revise the flood hazard depicted in the current Flood Insurance Study. Per the LOMR, an existing 100-year flow of 130 cfs crosses onto Filing 1 in Haegler Ranch Tributary 4. The off-site flow of 130 cfs carried within Tributary 4 was used to design the 84” RCP culvert and associated channel improvements outline in this report. Plan and profiles of the culvert and Drainageway T-6 improvements has been presented in Appendix F.

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 1: Major Drainageway Naming Convention

Saddlehorn Ranch Filing 1 Final Drainage Report	Per *Haegler Ranch DBPS*:	Per *Sante Fe Springs LOMR*:
T-6	Tributary 6 (T-6)	Haegler Ranch Tributary 4

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

Drainageway Name	Q_{100} Per *Haegler Ranch DBPS*:	Q_{100} Per Sante Fe Springs LOMR:
T-6	120 cfs	130 cfs

The *Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch* proposed the overall drainage facility design for Saddlehorn Ranch. Within the context of this report, onsite drainage basins and associated full spectrum water quality ponds were established. As it pertains to Filing 1, three full spectrum water quality ponds are recommended. Roadside ditches and local street culverts will be utilized to capture and convey Filing 1's runoff to the water quality ponds. Water quality ponds will discharge into Drainageway T-6 at less than historic rates.

In order to maintain the function of Drainageway T-6, the PDR/MDDP recommends an 84" reinforced concrete pipe (RCP) culvert at the crossing of Del Cerro Trail and Drainageway T-6 in addition to channel improvements up and downstream of the culvert. This culvert and channel improvements are designed to ensure a no-rise scenario in the floodplain.

Existing Sub-basin Drainage

On-site, existing sub-basin drainage patterns are generally from northwest to southeast by way of Drainageway T-6. On-site areas flow directly into this drainageway, which also bypasses off-site flow through Filing 1.

Proposed Sub-basin Drainage

The proposed Filing 1 basin delineation is as follows;

Filing 1 contains a 14.0 acre portion of Basin F which is comprised of Sub-basins F1-F4. The remaining area of Basin F is within the boundary of future Filings 2 and 3. In its existing condition, Basin F is rolling rangeland and runoff generally flows southeast towards Drainageway MS-06. In the Filing 1 proposed condition of Basin F, only four 2.5 acre lots will be developed and the remaining area will be undeveloped. During Filing 1, runoff from this basin will be captured in roadside ditches and conveyed to one of two temporary sediment basins. Per Section I.7.1.B.5 of the ECM – Stormwater Quality Policy and Procedures a single-family residential lots, greater than or equal to 2.5 acres, and having a total lot imperviousness no greater than 10% can be excluded from permanent stormwater quality. Sub-basins F1 and F2, Imperviousness (I) =7.0% and I=2.0% respectively, are comprised of 2.5 acre residential lots and undeveloped area, therefore; they are routed to Sediment Basin F1. In future filings of Saddlehorn Ranch, when all of Basin F will develop, a permanent, full spectrum water quality and detention pond (Pond F) will be constructed to detain and treat the developed flows from Sub-basin F1 and F2.

Per Section I.7.1.C.1 of the ECM – Stormwater Quality Policy and Procedures, the County may exclude up to 20%, not to exceed 1 acre, of the applicable development site, from the WQCV standard. Sub-basin F3 and F4 total 2.86 acres, of which 0.17 ac is asphalt roadway and 0.20 acre is gravel cul-de-sac. The combined developed area in F3 and F4 totals 0.37 acres which is approximately 0.2% of the development site. The remaining 2.49 acres are 2.5 acre residential lots with I=6.2%. Per Section I.7.1.C.1 and I.7.1.B.5, Sub-basin F3 and F4 will be excluded from permanent stormwater quality in Filing 1 and instead will be routed to Sediment Basin F2. In future filings of Saddlehorn Ranch, when all of Basin F will develop, a permanent, full spectrum water quality and detention pond (Pond F) will be constructed to detain and treat the developed flows from Sub-basin F3 and F4.

Basin G consists of Sub-basins G1-G7, F-G1 & F-G2 combining for a total of 46.5 acres. In its existing condition, Basin G is rolling rangeland and runoff generally flows south and west to Drainageway T-6. In the proposed condition, Basin G will be rural 2.5 acre lots, paved roadway and will include Pond G. Basins F-G1 & F-G2 are Basin G area outside of Filing 1, however; these basins are tributary to Filing 1 and will be fully developed in future Filing 2. Therefore, F-G1 & F-G2 were analyzed as developed basins within the context of this report to adequately size ditches, culverts and water quality pond for the fully developed future condition. Runoff from this basin will be collected in road side ditches and conveyed south along El Raiceno Trail and west along Carranza Trail to Pond G. Pond G will be a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway T-6.

Basin H consists of Sub-Basins H1-H4 combining for a total of 21.2 acres. In its existing condition, Basin H is rolling rangeland and runoff generally flows southeast towards Drainageway T6. 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 ditches and conveyed along Truchas Trail to Pond H. Pond H will be a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway T-6.

Basin I consists of Sub-basins I1-I7 combining for a total of 37.4 acres. In its existing condition, Basin I is rolling rangeland and 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 I1-I6 will be collected in road side ditches and conveyed south down Oscuro Trail and east down Zaragoza Trail as well as Oscuro Trail to Pond I. Pond I will be a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway T-6. Section I.7.1.B.5 of the ECM – Stormwater Quality Policy and Procedures single-family residential lots, greater than or equal to 2.5 acres, and having total lot imperviousness no greater than 10% can be excluded from permanent stormwater quality. Per Section I.7.1.B.5, Basin I7 (exclusively rural 2.5+ acre residential lots, I=6.2%) will be excluded from permanent stormwater management and due to existing topography it will not be routed to Pond I.

Basin UD1-UD6 combine for a total of 53.4 acres. In their existing condition, these basins are rolling rangeland. Runoff from Basins UD1-UD3 generally flows south and east to Drainageway T-6, while Basins UD4 & UD5 generally flow south and west to Drainageway T-6. Basin UD-6 flows directly south and off site. In the proposed condition, Basins UD1-UD6 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. However; Basin UD2 and UD3 contain approximately 0.30 ac of paved roadway, equal to approximately 0.20% of the total development site. Due to existing topography, these basins can't be captured and routed to a permanent, full spectrum water quality and detention pond. We respectfully request that Basin UD2 and UD3 be excluded from permanent stormwater quality management, per Section I.7.1.C.1.

Basin OS1-OS3 combine for a total of 2.06 acres of offsite area. In their existing condition, these basins are paved roadway (Curtis Road) and undeveloped area. In the proposed condition, Basin OS2 and OS3 will be improved with 1' of pavement width and the stretch of Curtis Road within basin OS1 will be improved with a deceleration lane for access to Filing 1. Basin OS1-OS2 will follow existing drainage patterns and will flow on-site prior to capture in a roadside ditch and conveyed to Pond H. Pond H will be a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway T-6. Basin OS3 will not be detained in Pond H due to its location relative to Pond H as well as Section I.7.1.B.2 of the ECM – Stormwater Quality Policy and Procedures states that site's adding less than 1 acre of paved area per mile of roadway to an existing roadway can be excluded from permanent stormwater quality. The improvements along Curtis Road would add 5,280 ft^2 over the length of one mile and therefore meet the exclusion present in Section I.7.1.B.2.

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

Basins G, H and I runoff will be captured in roadside ditches and conveyed to a corresponding full spectrum water quality and detention pond. Each full spectrum pond will release treated flows at less than historic rates to minimize adverse impacts downstream. Ponds G, H and I will discharge into Major Drainageway T-6. Basin F flows will be captured in roadside ditches and conveyed to two temporary sediment basins. When Filing 2 development commences, these sediment basins will be replaced with a single full spectrum water quality pond (Pond F).

See Table 5 below for comparison of proposed Filing 1 pond parameters.

Table 3: Pond Summary

Tributary Sub-Basin	Pond Name	Tributary Acres	WQ Volume (ac-ft)	Total Detention Volume (ac-ft)	Provided Volume (ac-ft)	Maximum 100-Year Discharge (cfs)
G	POND G	33.57	0.307	1.244	1.286	8.2
H	POND H	21.16	0.181	0.730	0.772	6.5
I	POND I	38.04	0.325	1.335	1.391	20.0

Proposed Channel Improvements – Haegler Ranch T-6

Haegler Ranch T-6 conveys an existing 130 cfs through the site. In order to maintain the drainage patterns in the channel, an 84" RCP culvert is proposed at the crossing with Del Cerro Trail. In order to facilitate this culvert, upstream and downstream channel improvements are required. The proposed channel section includes a 50' bottom width, an 12' wide/1' deep low flow channel and 10:1 tie backs to existing grades. The channel also includes reinforced rock berms at 150' intervals to ensure the flow remains subcritical. The entire channel will be lined with erosion control blanket and seeded with Pawnee Butte Seed Inc. – Low Grow Native Mix which includes fescue and bluegrasses. Per Table 10-4 in the EPC DCM fescue and bluegrass have a permissible velocity of 5 ft/s. Based on hydraulic analysis of the proposed channel geometry and slopes, the highest velocity present in the channel is 4.71 ft/s, therefore; the selected lining and seed mix is adequate for permanent vegetation. Channel hydraulic analysis sheets are presented in Appendix C. Channel cross section is presented on the drainage map in Appendix F.

Maintenance access to the channel will be provided on the upstream and downstream ends of the Del Cerro Culvert crossing with a 15' wide maintenance and access road. The access roads begin off the edge of pavement on Del Cerro Drive and terminate alongside the channel bottom. Existing and proposed grades within the channel are such that maintenance equipment can be operated without additional roadway. Access adjacent to the channel will be provided via equestrian trails that parallel the channel along Tract B and Tract C. Access roads are shown on the drainage map presented in Appendix F. Tract B and Tract C, which contain the existing channel and proposed channel improvements, will be owned and maintained by 824 Acre Metropolitan District No. 1.

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.

Urban Drainage and Flood Control District's UD-Detention, Version 3.07 workbook was used for 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 Drainageway T-6. Per Section 14.3.2 of the CCS/EPCDCM, a maximum headwater to rise ratio of 1.5 was used to size the 84" RCP culvert. The culvert was designed in conjunction with channel improvements to ensure a no rise scenario of the current floodplain elevations. A summary report of the 84" RCP culvert design is presented in Appendix C.

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 capacity, a cross section analysis was performed on the roadside ditch with the basin's minimum ditch slope. In order to check velocity, a cross section analysis was performed on the roadside ditch with the basin's maximum ditch slope. Ditch 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 culverts are 18" or 24" RCP. 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 1 runoff to full spectrum water quality and detention ponds (Pond G, H, I) via roadside ditches and local street culverts. Pond G, H, and I were designed to release at less than historic rates to minimize adverse impacts downstream.

An 84" RCP culvert is proposed within Drainageway T-6 to convey existing, off site flows underneath Del Cerro Trail and through Filing 1, to maintain T-6 drainage patterns presented with the *Haegler Ranch DBPS*.

A trapezoidal channel section, 50' bottom width w/ 10:1 daylights to existing, is proposed 1,200 feet downstream and 650 feet upstream of the 84" RCP culvert in order to maintain water surface elevations at or below the current floodplain's base flood elevations. A proposed drainage map is presented in Appendix F showing locations of channel and culvert 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 1 utilizes roadside ditches with culvert crossings throughout. These roadside ditches direct the on-site development flows to the multiple detention ponds within the project that release at or below historic rates into Drainageway T-6. Drainageway T-6 is stabilized upstream and downstream of the Del Cerro Trail culvert crossing. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impact to downstream Drainageway T-6 is anticipated.

Step 3, Provide WQCV: Runoff from this development is treated through capture and slow release of the WQCV in multiple full spectrum water quality and detention ponds that are 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 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. Complete pond and outlet structure designs 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. The Erosion Control Plan for Filing 1 is 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 824 Acre Metropolitan No. 1. Vegetation in the natural and improved portions of Drainageway T-6 is the responsibility of 824 Acre Metropolitan District No. 1. This includes all mowing, seeding and weed control activities. An Inspection & Maintenance Plan is submitted concurrently 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 1 Platted Acres: 175.7 ac
Total Filing 1 Impervious Acres = 15.8 ac (175.7 ac x 9%)

Filing 1 Fee Totals (Prior to Reductions):

Bridge Fees
$ 1,524/ac x 15.8 ac = $24,079

Drainage Fees
$10,324/ac x 15.8 ac = $163,119

Filing 1 Drainage Fee Reduction: 25% Reduction for Low Density Lots: $163,119 x 25% = $40,780

Filing 1 Fee Totals (After Reductions):

Bridge Fees
$ 1,524/ac x 15.8 ac = $24,079

Drainage Fees
$163,119 - $40,780 = $122,339

Reimbursable Improvements:

The Haegler Ranch DBPS recommended channel improvements and a culvert crossing within the portions of on-site Drainageway T-6, DBPS excerpts are presented in Appendix E. Therefore, Filing 1 channel and culvert improvements within Drainageway T-6 will be considered reimbursable. See below for an analysis of the applicable DBPS cost for the proposed channel and culvert improvements.

Hagler T-6 DBPS Cost Analysis

DBPS Reference	Item	Unit	Qty.	Total Cost	30% Contin.	15% Engr.	Total	$/Unit
Table 6-13	Channel Improvement Costs	LF	4,270	179,000	53,700	26,850	259,550	61
Table 6-13	Drop Structure Costs	Ea	9	330,000	99,000	49,500	478,500	53,167
Table 6-16	Double 66" RCP Culvert Crossing	Ea	1	43,000	12,900	6,450	62,350	62,350

Drainage Basin Fee Cost Ratio

DBPS Fee	7,633
2020 Fee	10,324
Ratio	1.35

Saddlehorn Filing 1 Reimbursable Improvements (DBPS Basis)

Item	Unit	Qty.	$/Unit	Total	DBPS Ratio	Reimbursable Est.
Channel Improvement Costs	LF	1,992	61	121,083	1.35	163,770
Drop Structure Costs	Ea	0	53,167	0	1.35	0
84" RCP Culvert Crossing	Ea	1	62,350	62,350	1.35	84,331
					Total	**248,102**

Due to the reimbursable improvements, no drainage fees are required to be paid at time of final platting.

Construction Cost Opinion

(For Information Only / Non-Reimbursable)
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 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 and is in accordance with the PDR/MDDP for Saddlehorn Ranch.

REFERENCES:

1. City of Colorado Springs Drainage Criteria Manual Volume 1, City of Colorado Springs, CO, May 2014.

2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.

3. Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch, J.R. Engineering, April 2019.

4. Haegler Ranch Drainage Basin Planning Study, URS Corporation, May 2009.

5. The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR, Federal Emergency Management Agency, October 20, 2004.

CURTIS ROAD - SOUTH CULVERT - EX 32" CMP - Q_100 = 130 CFS

Crossing Discharge Data

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

Minimum Flow: 100 cfs

Design Flow: 130 cfs

Maximum Flow: 150 cfs

Table 7 - Summary of Culvert Flows at Crossing: South Curtis Road

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6755.46	100.00	44.64	55.19	10
6755.48	105.00	44.78	60.13	4
6755.50	110.00	44.90	64.80	3
6755.52	115.00	45.03	69.67	3
6755.54	120.00	45.14	74.59	3
6755.55	125.00	45.26	79.52	3
6755.57	130.00	45.37	84.44	3
6755.59	135.00	45.48	89.36	3
6755.60	140.00	45.58	94.28	3
6755.62	145.00	45.68	99.20	3
6755.63	150.00	45.78	104.12	3
6755.01	41.61	41.61	0.00	Overtopping

Rating Curve Plot for Crossing: South Curtis Road

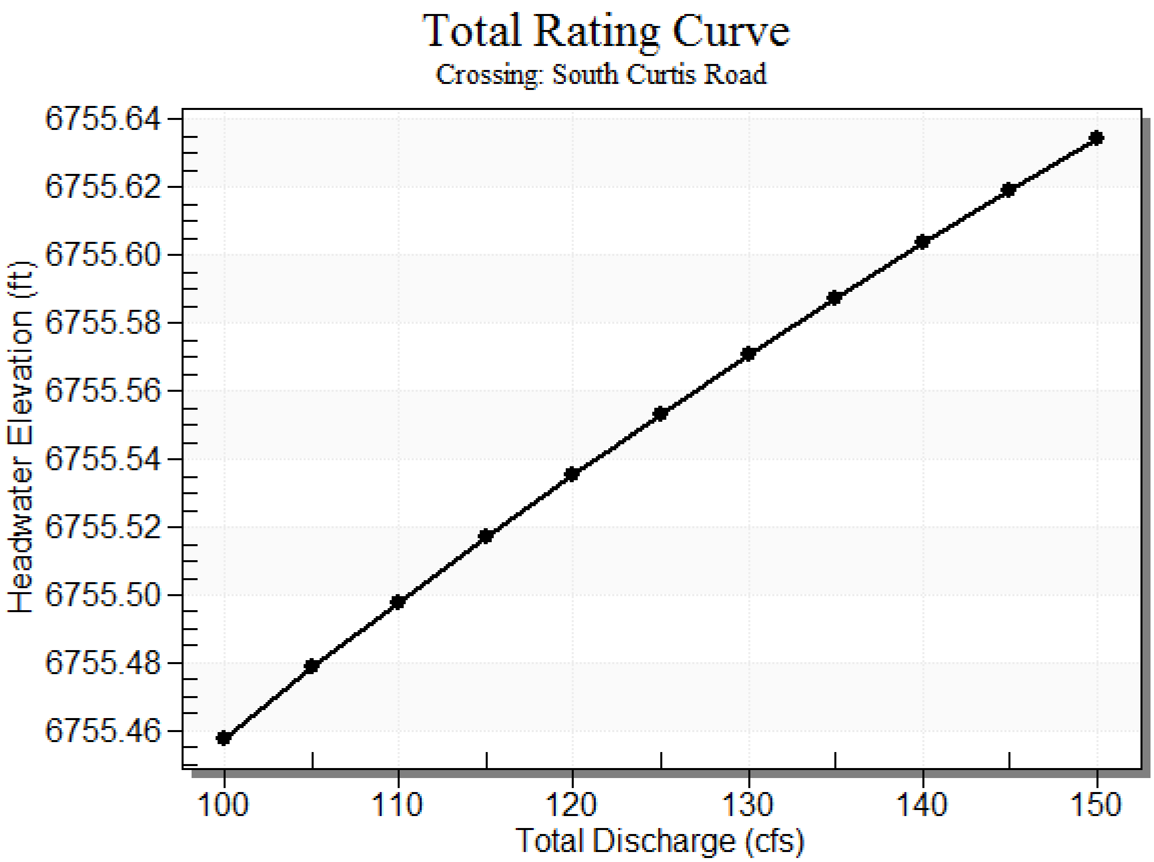


Table 8 - Culvert Summary Table: Culvert 1

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)
100.00	44.64	6755.46	5.127	4.736	7-M2c	2.660	2.221	2.221	0.885	9.005	3.767
105.00	44.78	6755.48	5.148	4.759	7-M2c	2.660	2.224	2.224	0.912	9.022	3.838
110.00	44.90	6755.50	5.167	4.780	7-M2c	2.660	2.227	2.227	0.938	9.038	3.908
115.00	45.03	6755.52	5.186	4.801	7-M2c	2.660	2.229	2.229	0.964	9.053	3.975
120.00	45.14	6755.54	5.205	4.821	7-M2c	2.660	2.232	2.232	0.990	9.068	4.041
125.00	45.26	6755.55	5.223	4.840	7-M2c	2.660	2.234	2.234	1.015	9.082	4.105
130.00	45.37	6755.57	5.240	4.882	7-M2c	2.660	2.237	2.237	1.040	9.096	4.167
135.00	45.48	6755.59	5.257	4.898	7-M2c	2.660	2.239	2.239	1.064	9.110	4.228
140.00	45.58	6755.60	5.273	4.913	7-M2c	2.660	2.241	2.241	1.088	9.123	4.287
145.00	45.68	6755.62	5.289	4.928	7-M2c	2.660	2.243	2.243	1.112	9.136	4.346
150.00	45.78	6755.63	5.304	4.943	7-M2c	2.660	2.245	2.245	1.136	9.148	4.402

****

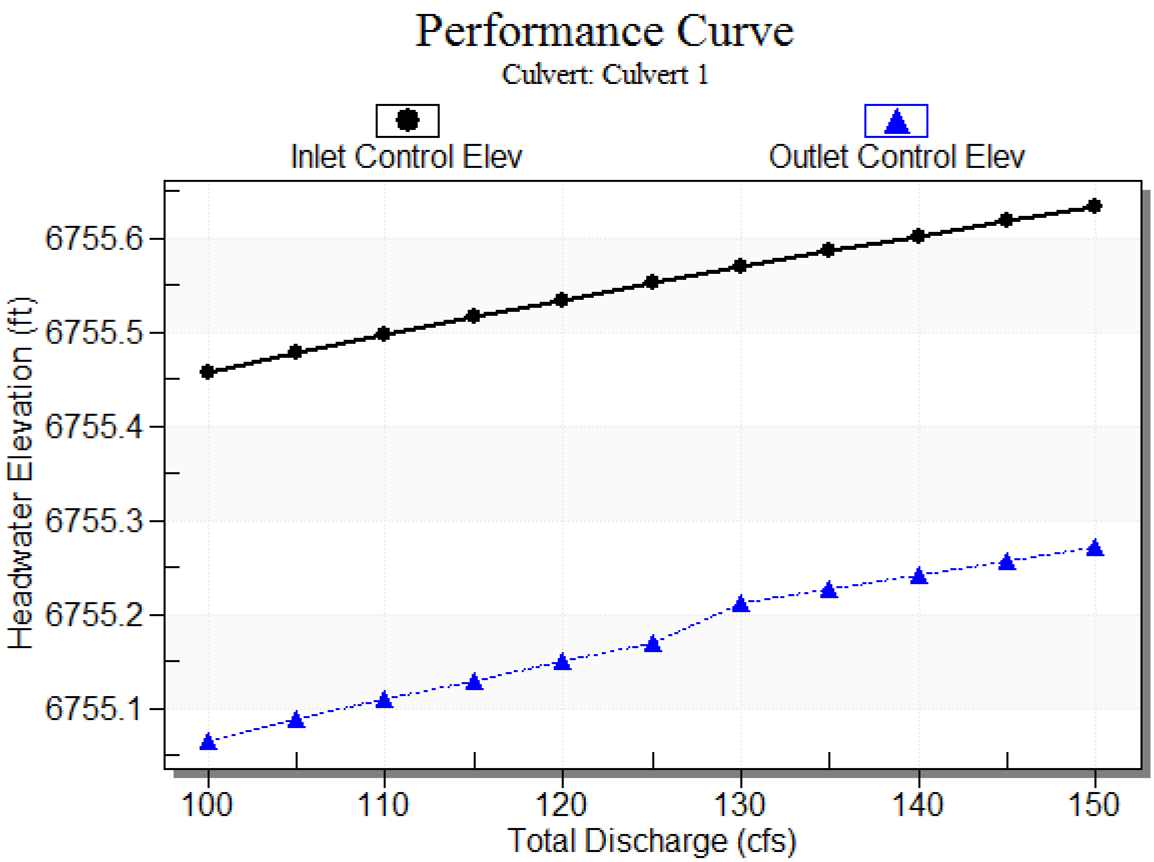
Straight Culvert

Inlet Elevation (invert): 6750.33 ft,   Outlet Elevation (invert): 6749.44 ft

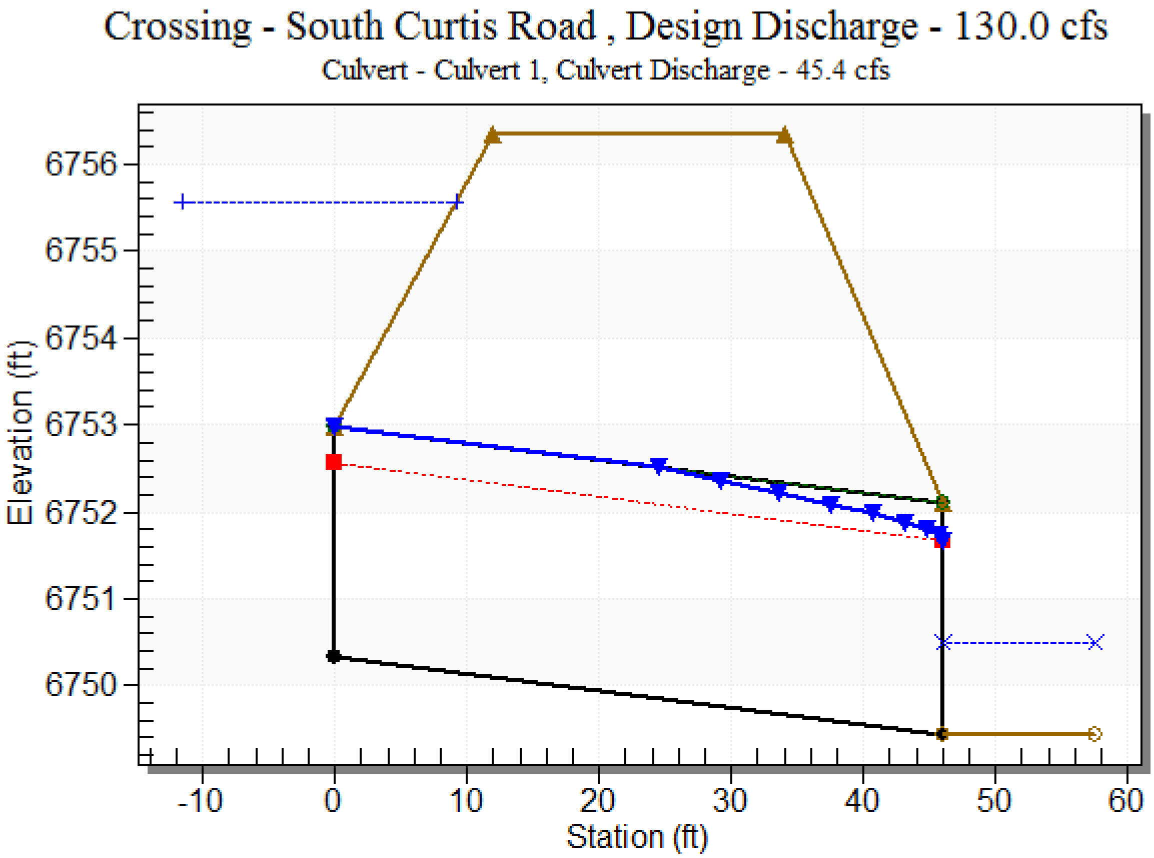
Culvert Length: 46.01 ft,   Culvert Slope: 0.0193

****

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6750.33 ft

Outlet Station: 46.00 ft

Outlet Elevation: 6749.44 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 2.66 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Crossing Front View (Roadway Profile): South Curtis Road

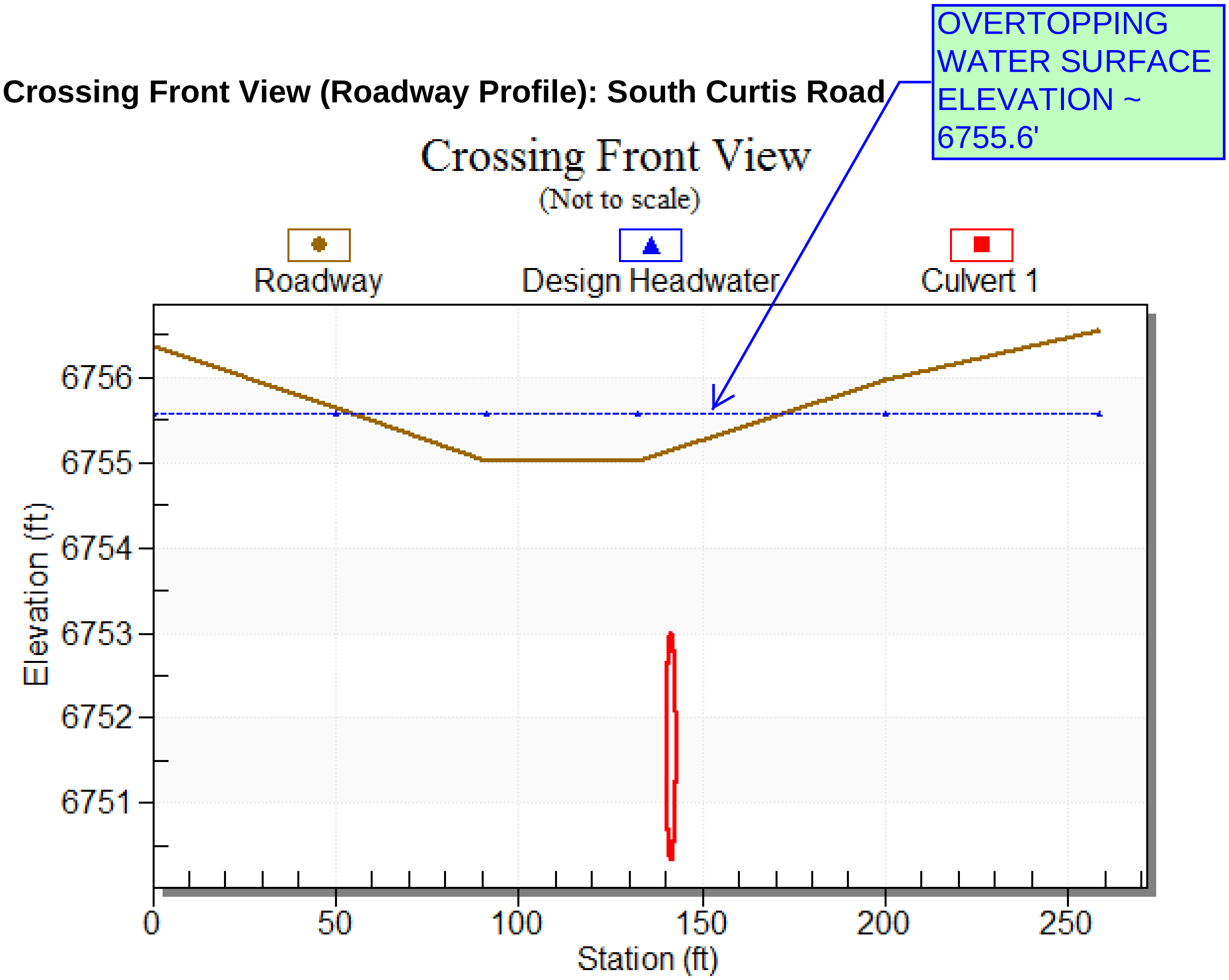


Table 9 - Downstream Channel Rating Curve (Crossing: South Curtis Road)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
100.00	6750.32	0.88	3.77	0.55	0.71
105.00	6750.35	0.91	3.84	0.57	0.71
110.00	6750.38	0.94	3.91	0.59	0.71
115.00	6750.40	0.96	3.98	0.60	0.71
120.00	6750.43	0.99	4.04	0.62	0.72
125.00	6750.46	1.02	4.11	0.63	0.72
130.00	6750.48	1.04	4.17	0.65	0.72
135.00	6750.50	1.06	4.23	0.66	0.72
140.00	6750.53	1.09	4.29	0.68	0.72
145.00	6750.55	1.11	4.35	0.69	0.73
150.00	6750.58	1.14	4.40	0.71	0.73

Tailwater Channel Data - South Curtis Road

Tailwater Channel Option: Rectangular Channel

Bottom Width: 30.00 ft

Channel Slope: 0.0100

Channel Manning's n: 0.0350

Channel Invert Elevation: 6749.44 ft

Roadway Data for Crossing: South Curtis Road

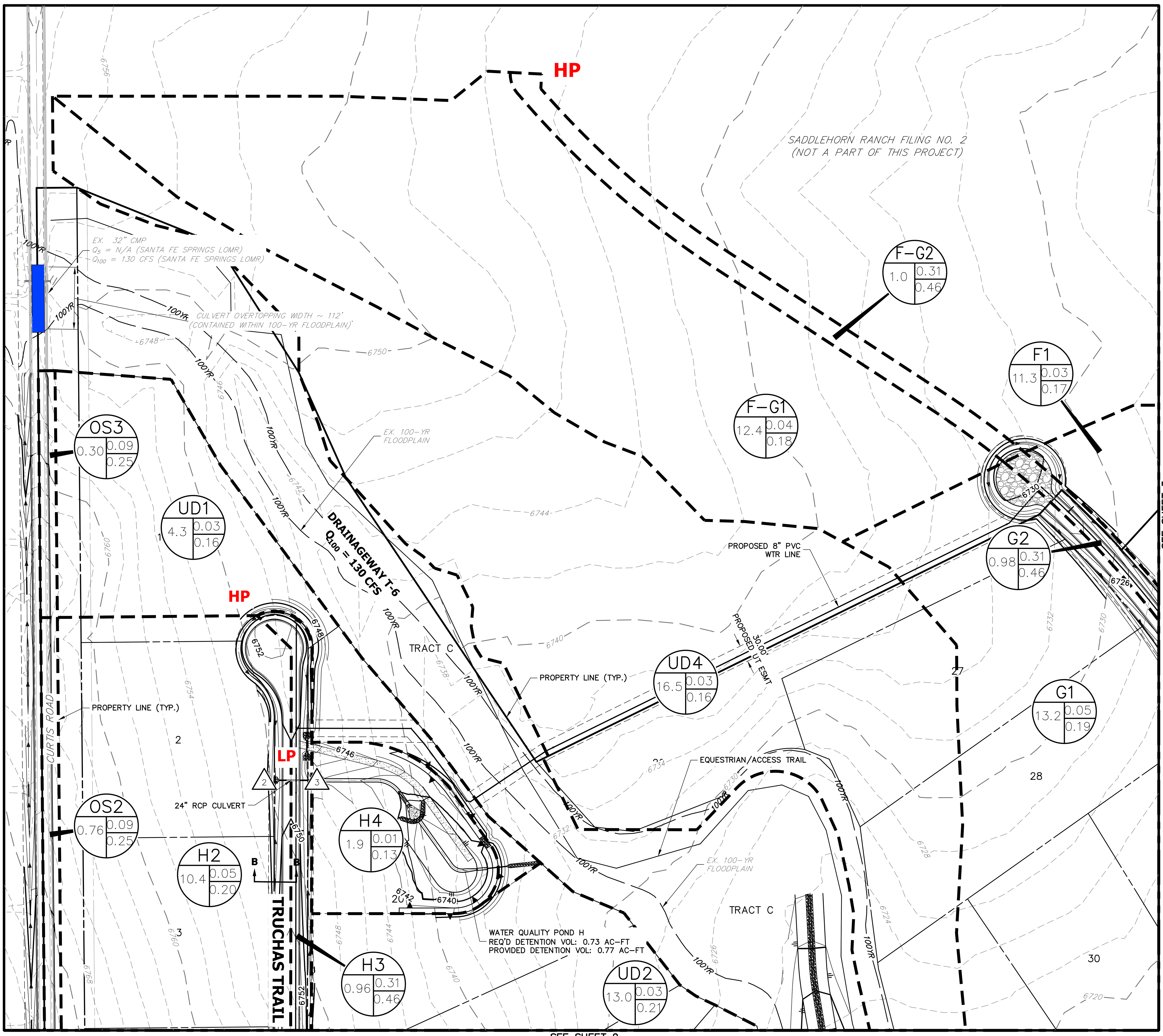
Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Roadway Surface: Paved

Roadway Top Width: 22.00 ft

SADDLEHORN RANCH - FILING 1

PROPOSED DRAINAGE MAP



LEGEND

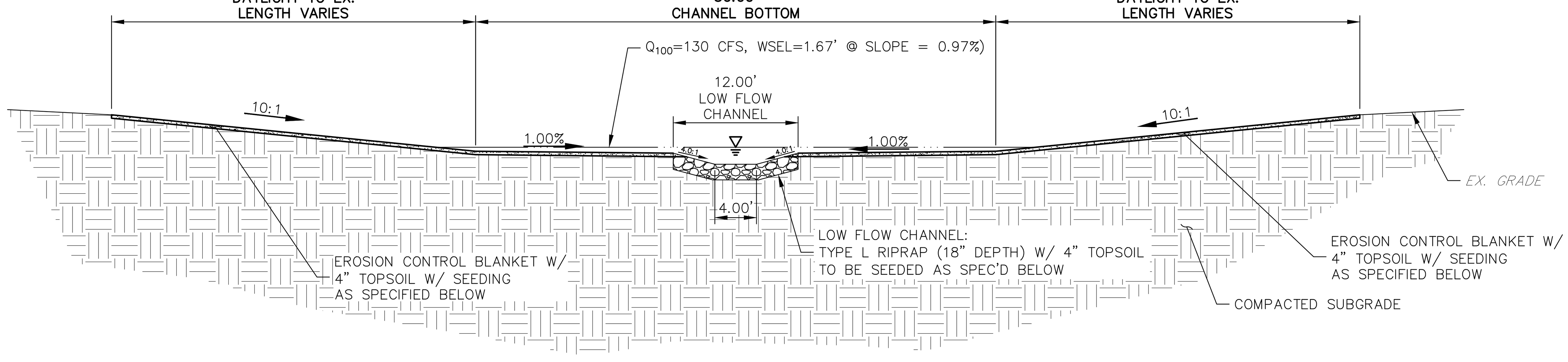
Symbol	Description
I.D. / A / B / C	BASIN DESIGNATION I.D.: BASIN IDENTIFIER A: BASIN AREA B: C_5 C: C_{100}
X (triangle)	DESIGN POINT
	BASIN DELINEATION
6100	EXISTING INDEX CONTOURS
	EXISTING INTERMEDIATE CONTOURS
6100	PROPOSED INDEX CONTOURS
	PROPOSED INTERMEDIATE CONTOURS
	EXISTING FLOW DIRECTION
	PROPOSED FLOW DIRECTION
HP	PROPOSED HIGH POINT
LP	PROPOSED LOW POINT

FILING 1 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	7.90	11%	0.05	0.20	26.7	1.1	6.9
H2	10.40	11%	0.05	0.20	24.2	1.5	9.7
H3	0.96	45%	0.31	0.46	14.7	1.1	2.6
H4	1.90	2%	0.01	0.13	7.9	0.1	1.8
I1	1.10	45%	0.32	0.49	16.0	1.2	3.1
I2	0.74	45%	0.32	0.49	11.3	0.9	2.4
I3	0.61	45%	0.32	0.48	11.8	0.7	1.9
I4	14.85	7%	0.03	0.21	18.6	1.5	16.9
I5	0.82	45%	0.31	0.46	11.0	1.0	2.5
I6	19.92	8%	0.04	0.17	20.9	2.2	17.6
I7	3.91	6%	0.03	0.18	5.5	0.5	6.1
F-G1	12.40	9%	0.04	0.18	39.3	1.1	7.9
F-G2	1.00	45%	0.31	0.46	15.5	1.1	2.7
G1	13.20	11%	0.05	0.19	31.3	1.6	10.5
G2	0.98	45%	0.31	0.46	15.8	1.0	2.6
G3	0.63	45%	0.31	0.46	13.9	0.7	1.8
G4	2.50	26%	0.16	0.31	37.0	0.8	2.8
G5	11.15	11%	0.05	0.19	18.4	1.8	11.5
G6	4.36	5%	0.03	0.29	23.4	0.3	6.0
G7	0.31	45%	0.31	0.46	12.0	0.4	0.9
F1	11.30	7%	0.03	0.17	27.4	0.9	8.2
F2	0.36	2%	0.01	0.13	12.8	0.0	0.3
F3	2.39	7%	0.03	0.16	27.0	0.2	1.7
F4	0.47	45%	0.31	0.46	10.2	0.6	1.5
UD1	4.30	6%	0.03	0.16	9.1	0.5	4.9
UD2	13.00	7%	0.03	0.21	18.3	1.4	14.6
UD3	9.60	8%	0.04	0.26	14.6	1.3	14.7
UD4	16.50	6%	0.03	0.16	22.6	1.2	12.7
UD5	10.00	6%	0.03	0.27	24.9	0.9	12.7
UD6	6.80	6%	0.03	0.22	11.2	0.8	10.0
OS1	1.00	24%	0.14	0.29	27.2	0.4	1.3
OS2	0.76	18%	0.09	0.25	14.8	0.3	1.1
OS3	0.30	18%	0.09	0.25	7.9	0.1	0.6

FILING 1 - DESIGN POINT SUMMARY TABLE

Design Point	Contributing Acreage (ac)	Q_5 (cfs)	Q_{100} (Cfs)
1	8.9	1.4	8.2
2	20.1	2.7	15.7
3	22.9	3.4	18.3
4	0.7	0.9	2.4
5	16.8	3.4	21.8
6	38.0	6.7	41.5
7	25.6	2.1	14.8
8	2.0	1.8	4.4
9	26.2	2.5	15.6
10	13.1	2.7	11.7
11	46.5	4.7	25.9
12	11.7	1.2	12.0
13	2.86	0.6	2.7



T6 CHANNEL IMPROVEMENTS - TYPICAL SECTION

SCALE: 1"=10'

CHANNEL SEED MIX: EROSION CONTROL BLANKET WITH PAWNEE BUTTES SEED INC. – "LOW GROW NATIVE MIX"
–IDAHO FESCUE
–SANDBERG BLUEGRASS
–ROCKY MOUNTAIN FESCUE
–BIG BLUEGRASS

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 1
PROPOSED DRAINAGE MAP
2514202
11/27/19
SHEET 1 OF 4

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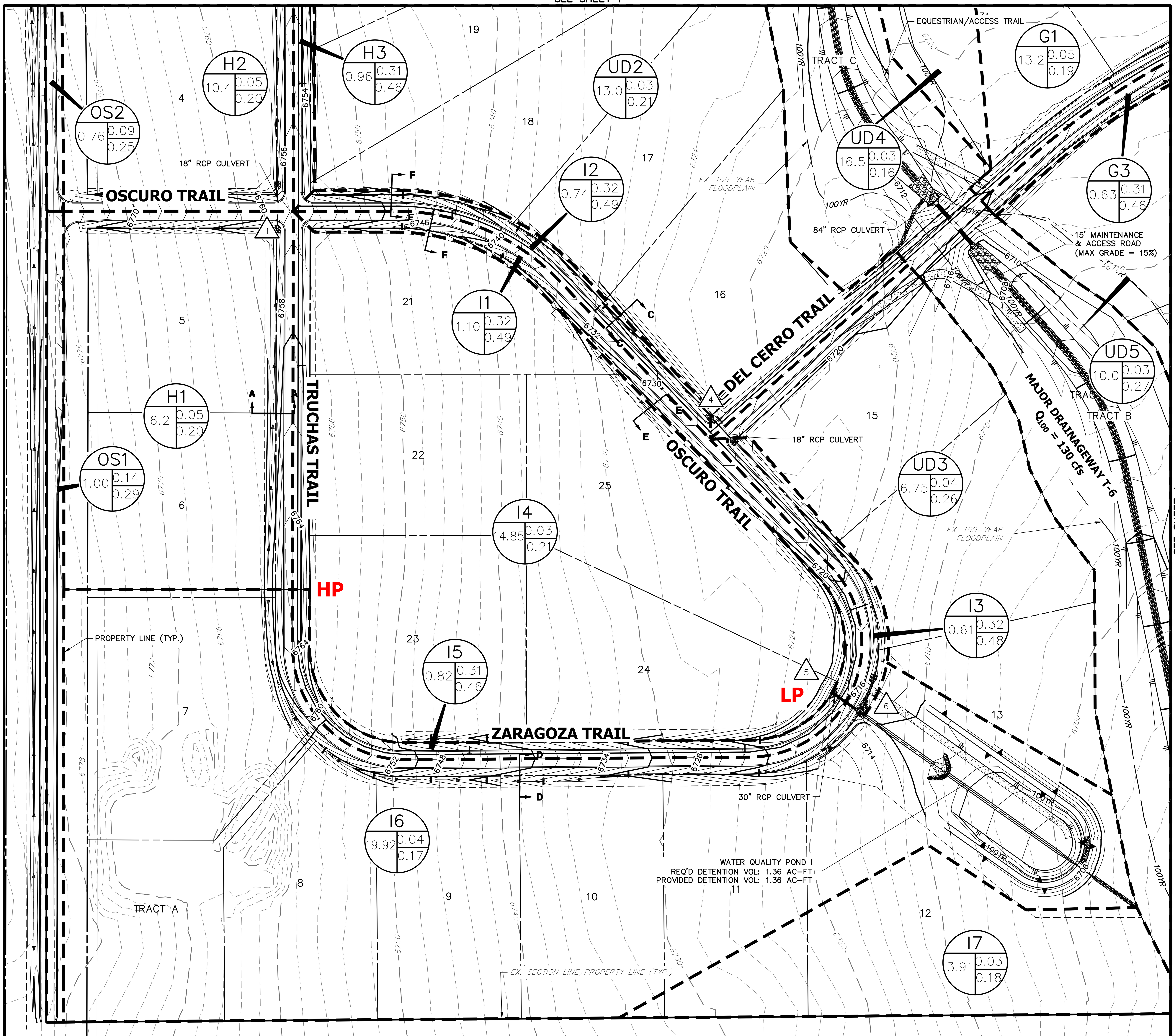
SADDLEHORN RANCH - FILING 1

PROPOSED DRAINAGE MAP



LEGEND

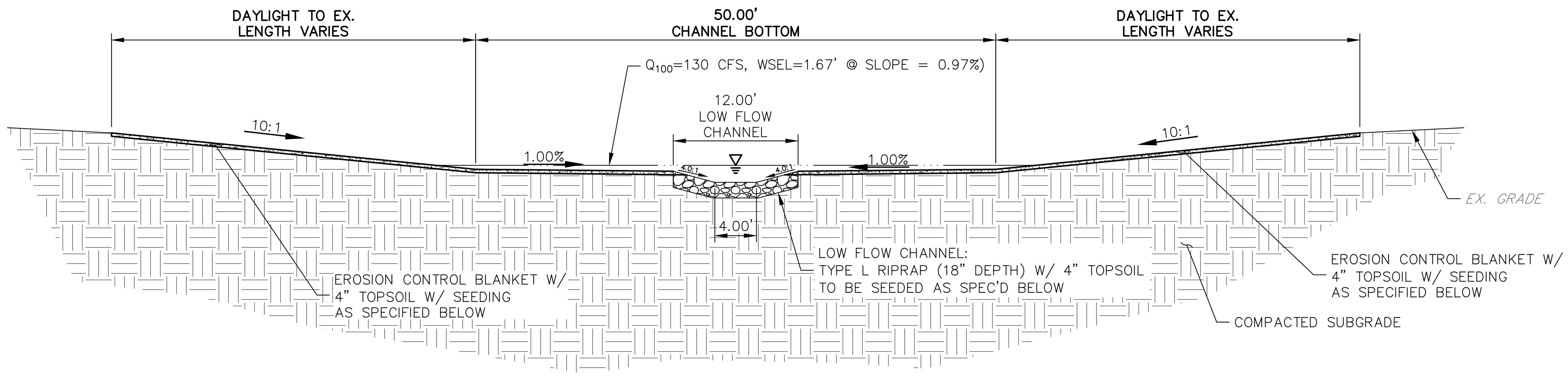
Symbol	Description
I.D. / A / B / C	BASIN DESIGNATION I.D.: BASIN IDENTIFIER A: BASIN AREA B: C_5 C: C_{100}
X (triangle)	DESIGN POINT
	BASIN DELINEATION
6100	EXISTING INDEX CONTOURS
	EXISTING INTERMEDIATE CONTOURS
6100	PROPOSED INDEX CONTOURS
	PROPOSED INTERMEDIATE CONTOURS
	EXISTING FLOW DIRECTION
	PROPOSED FLOW DIRECTION
HP	PROPOSED HIGH POINT
LP	PROPOSED LOW POINT

FILING 1 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	7.90	11%	0.05	0.20	26.7	1.1	6.9
H2	10.40	11%	0.05	0.20	24.2	1.5	9.7
H3	0.96	45%	0.31	0.46	14.7	1.1	2.6
H4	1.90	2%	0.01	0.13	7.9	0.1	1.8
I1	1.10	45%	0.32	0.49	16.0	1.2	3.1
I2	0.74	45%	0.32	0.49	11.3	0.9	2.4
I3	0.61	45%	0.32	0.48	11.8	0.7	1.9
I4	14.85	7%	0.03	0.21	18.6	1.5	16.9
I5	0.82	45%	0.31	0.46	11.0	1.0	2.5
I6	19.92	8%	0.04	0.17	20.9	2.2	17.6
I7	3.91	6%	0.03	0.18	5.5	0.5	6.1
F-G1	12.40	9%	0.04	0.18	39.3	1.1	7.9
F-G2	1.00	45%	0.31	0.46	15.5	1.1	2.7
G1	13.20	11%	0.05	0.19	31.3	1.6	10.5
G2	0.98	45%	0.31	0.46	15.8	1.0	2.6
G3	0.63	45%	0.31	0.46	13.9	0.7	1.8
G4	2.50	26%	0.16	0.31	37.0	0.8	2.8
G5	11.15	11%	0.05	0.19	18.4	1.8	11.5
G6	4.36	5%	0.03	0.29	23.4	0.3	6.0
G7	0.31	45%	0.31	0.46	12.0	0.4	0.9
F1	11.30	7%	0.03	0.17	27.4	0.9	8.2
F2	0.36	2%	0.01	0.13	12.8	0.0	0.3
F3	2.39	7%	0.03	0.16	27.0	0.2	1.7
F4	0.47	45%	0.31	0.46	10.2	0.6	1.5
UD1	4.30	6%	0.03	0.16	9.1	0.5	4.9
UD2	13.00	7%	0.03	0.21	18.3	1.4	14.6
UD3	9.60	8%	0.04	0.26	14.6	1.3	14.7
UD4	16.50	6%	0.03	0.16	22.6	1.2	12.7
UD5	10.00	6%	0.03	0.27	24.9	0.9	12.7
UD6	6.80	6%	0.03	0.22	11.2	0.8	10.0
OS1	1.00	24%	0.14	0.29	27.2	0.4	1.3
OS2	0.76	18%	0.09	0.25	14.8	0.3	1.1
OS3	0.30	18%	0.09	0.25	7.9	0.1	0.6

FILING 1 - DESIGN POINT SUMMARY TABLE

Design Point	Contributing Acreage (ac)	Q_5 (cfs)	Q_{100} (Cfs)
1	8.9	1.4	8.2
2	20.1	2.7	15.7
3	22.9	3.4	18.3
4	0.7	0.9	2.4
5	16.8	3.4	21.8
6	38.0	6.7	41.5
7	25.6	2.1	14.8
8	2.0	1.8	4.4
9	26.2	2.5	15.6
10	13.1	2.7	11.7
11	46.5	4.7	25.9
12	11.7	1.2	12.0
13	2.86	0.6	2.7



T6 CHANNEL IMPROVEMENTS - TYPICAL SECTION

SCALE: 1"=10'

CHANNEL SEED MIX: EROSION CONTROL BLANKET WITH PAWNEE BUTTES SEED INC. – "LOW GROW NATIVE MIX"
- IDAHO FESCUE
- SANDBERG BLUEGRASS
- ROCKY MOUNTAIN FESCUE
- BIG BLUEGRASS

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 1
PROPOSED DRAINAGE MAP
2514202
11/27/19
SHEET 2 OF 4

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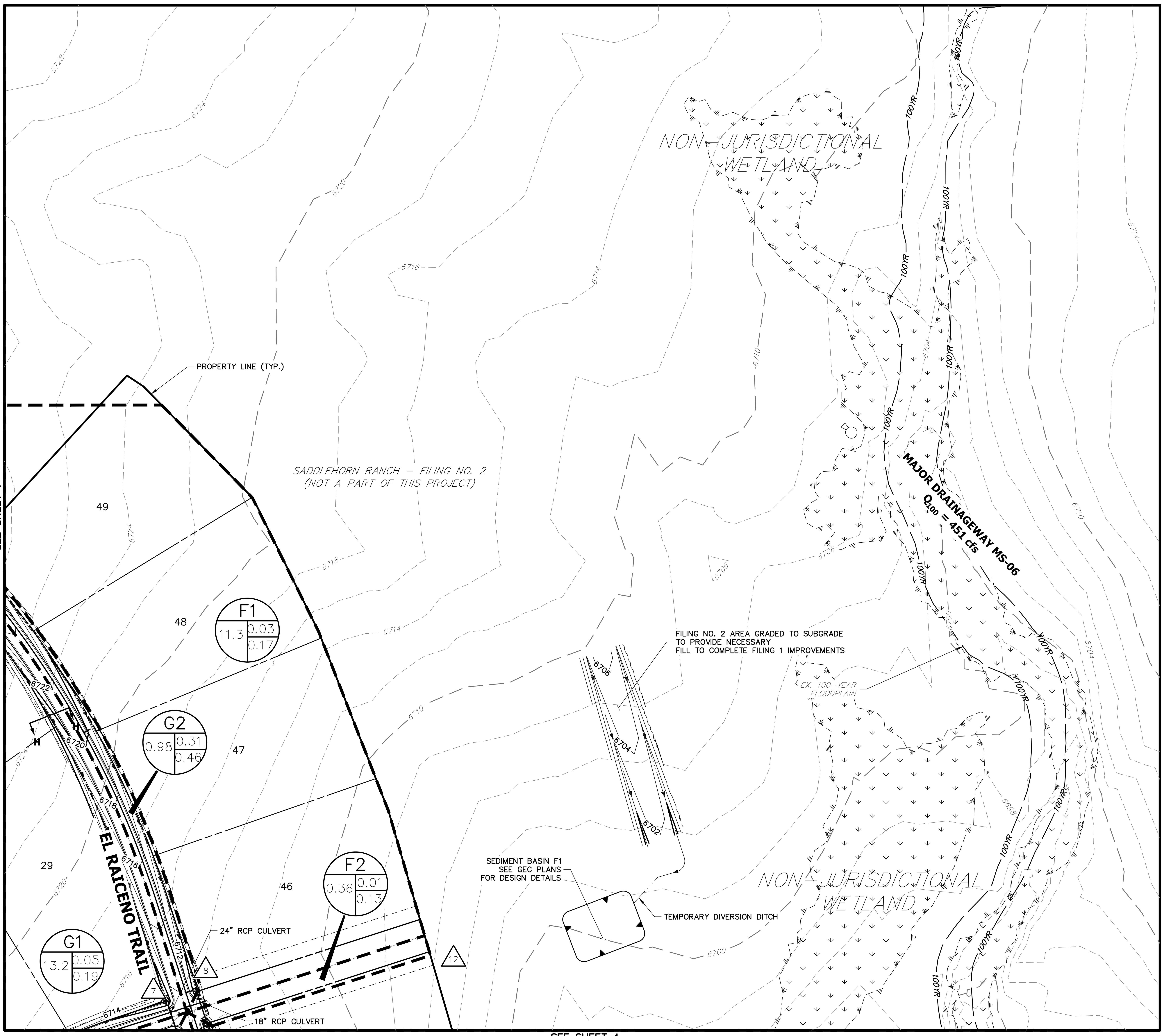
SADDLEHORN RANCH - FILING 1

PROPOSED DRAINAGE MAP



LEGEND

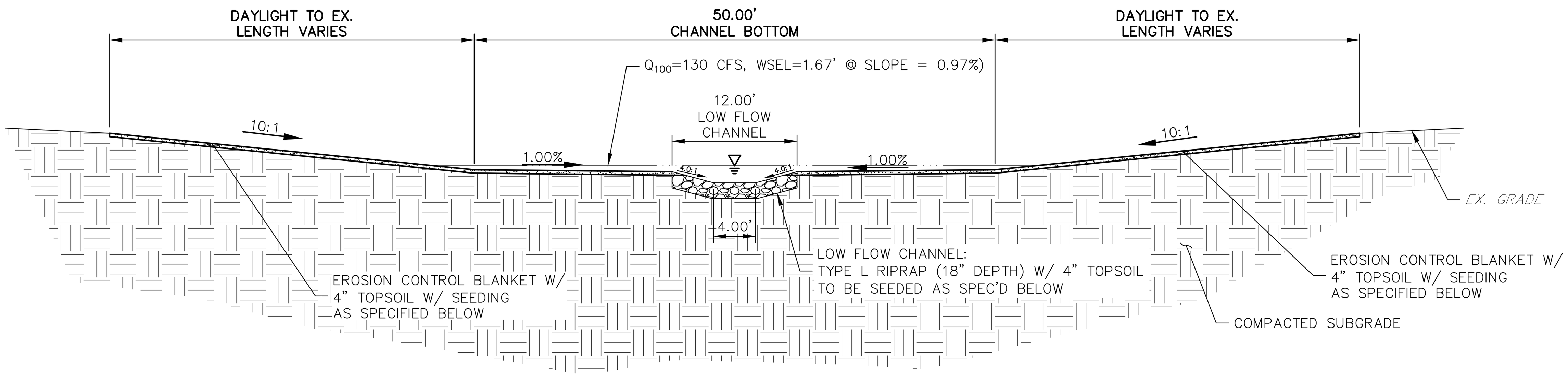
Symbol	Description
I.D. / A / B / C	BASIN DESIGNATION I.D.: BASIN IDENTIFIER A: BASIN AREA B: C_5 C: C_{100}
X (triangle)	DESIGN POINT
— — —	BASIN DELINEATION
— —6100— —	EXISTING INDEX CONTOURS
- - - -	EXISTING INTERMEDIATE CONTOURS
——6100——	PROPOSED INDEX CONTOURS
————	PROPOSED INTERMEDIATE CONTOURS
⇨	EXISTING FLOW DIRECTION
➞	PROPOSED FLOW DIRECTION
HP	PROPOSED HIGH POINT
LP	PROPOSED LOW POINT

FILING 1 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	7.90	11%	0.05	0.20	26.7	1.1	6.9
H2	10.40	11%	0.05	0.20	24.2	1.5	9.7
H3	0.96	45%	0.31	0.46	14.7	1.1	2.6
H4	1.90	2%	0.01	0.13	7.9	0.1	1.8
I1	1.10	45%	0.32	0.49	16.0	1.2	3.1
I2	0.74	45%	0.32	0.49	11.3	0.9	2.4
I3	0.61	45%	0.32	0.48	11.8	0.7	1.9
I4	14.85	7%	0.03	0.21	18.6	1.5	16.9
I5	0.82	45%	0.31	0.46	11.0	1.0	2.5
I6	19.92	8%	0.04	0.17	20.9	2.2	17.6
I7	3.91	6%	0.03	0.18	5.5	0.5	6.1
F-G1	12.40	9%	0.04	0.18	39.3	1.1	7.9
F-G2	1.00	45%	0.31	0.46	15.5	1.1	2.7
G1	13.20	11%	0.05	0.19	31.3	1.6	10.5
G2	0.98	45%	0.31	0.46	15.8	1.0	2.6
G3	0.63	45%	0.31	0.46	13.9	0.7	1.8
G4	2.50	26%	0.16	0.31	37.0	0.8	2.8
G5	11.15	11%	0.05	0.19	18.4	1.8	11.5
G6	4.36	5%	0.03	0.29	23.4	0.3	6.0
G7	0.31	45%	0.31	0.46	12.0	0.4	0.9
F1	11.30	7%	0.03	0.17	27.4	0.9	8.2
F2	0.36	2%	0.01	0.13	12.8	0.0	0.3
F3	2.39	7%	0.03	0.16	27.0	0.2	1.7
F4	0.47	45%	0.31	0.46	10.2	0.6	1.5
UD1	4.30	6%	0.03	0.16	9.1	0.5	4.9
UD2	13.00	7%	0.03	0.21	18.3	1.4	14.6
UD3	9.60	8%	0.04	0.26	14.6	1.3	14.7
UD4	16.50	6%	0.03	0.16	22.6	1.2	12.7
UD5	10.00	6%	0.03	0.27	24.9	0.9	12.7
UD6	6.80	6%	0.03	0.22	11.2	0.8	10.0
OS1	1.00	24%	0.14	0.29	27.2	0.4	1.3
OS2	0.76	18%	0.09	0.25	14.8	0.3	1.1
OS3	0.30	18%	0.09	0.25	7.9	0.1	0.6

FILING 1 - DESIGN POINT SUMMARY TABLE

Design Point	Contributing Acreage (ac)	Q_5 (cfs)	Q_{100} (Cfs)
1	8.9	1.4	8.2
2	20.1	2.7	15.7
3	22.9	3.4	18.3
4	0.7	0.9	2.4
5	16.8	3.4	21.8
6	38.0	6.7	41.5
7	25.6	2.1	14.8
8	2.0	1.8	4.4
9	26.2	2.5	15.6
10	13.1	2.7	11.7
11	46.5	4.7	25.9
12	11.7	1.2	12.0
13	2.86	0.6	2.7



T6 CHANNEL IMPROVEMENTS - TYPICAL SECTION

SCALE: 1"=10'

CHANNEL SEED MIX: EROSION CONTROL BLANKET WITH PAWNEE BUTTES SEED INC. - "LOW GROW NATIVE MIX"
- IDAHO FESCUE
- SANDBERG BLUEGRASS
- ROCKY MOUNTAIN FESCUE
- BIG BLUEGRASS

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 1
PROPOSED DRAINAGE MAP
2514202
11/27/19
SHEET 3 OF 4

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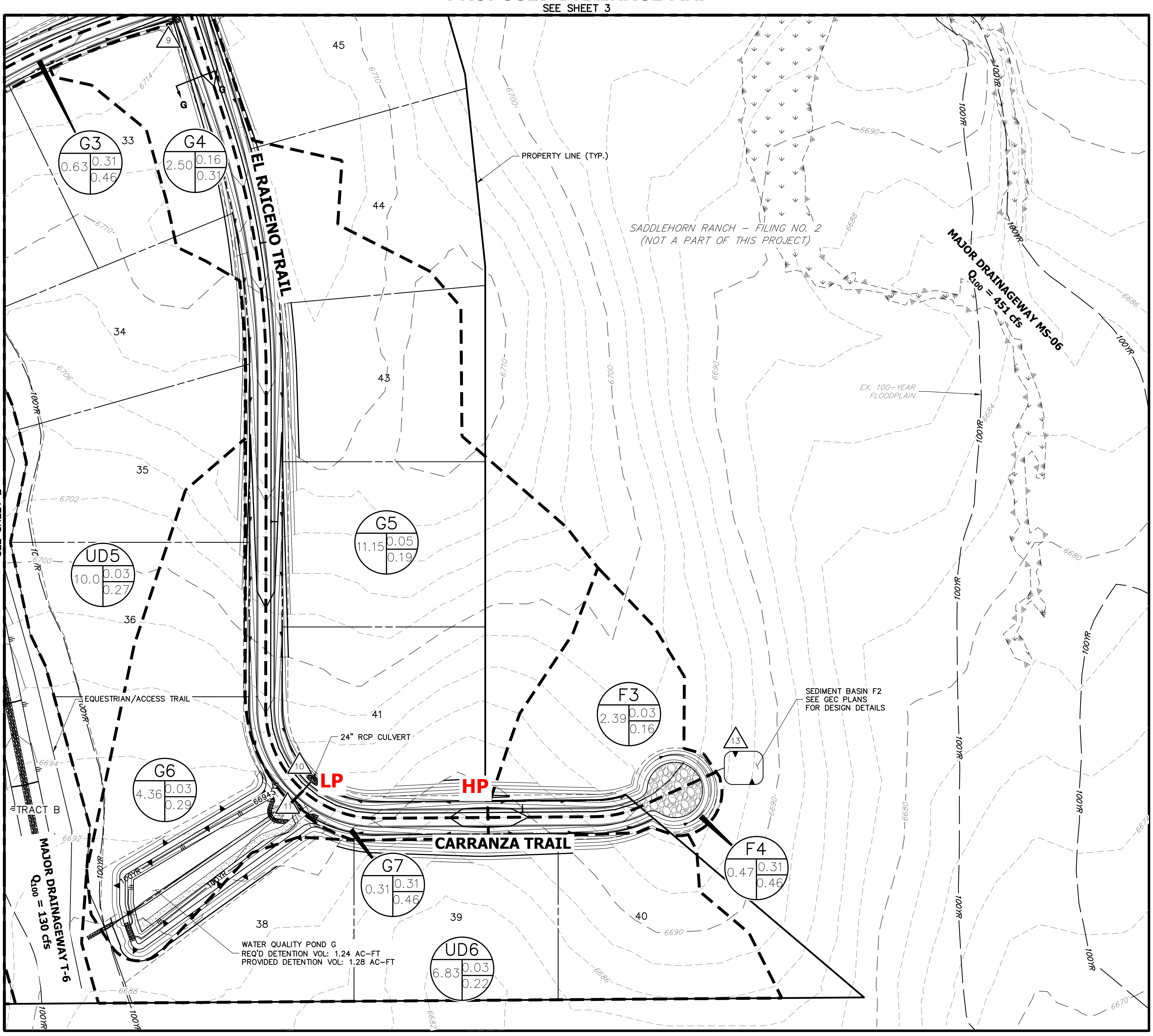
SADDLEHORN RANCH - FILING 1

PROPOSED DRAINAGE MAP

SEE SHEET 3



LEGEND

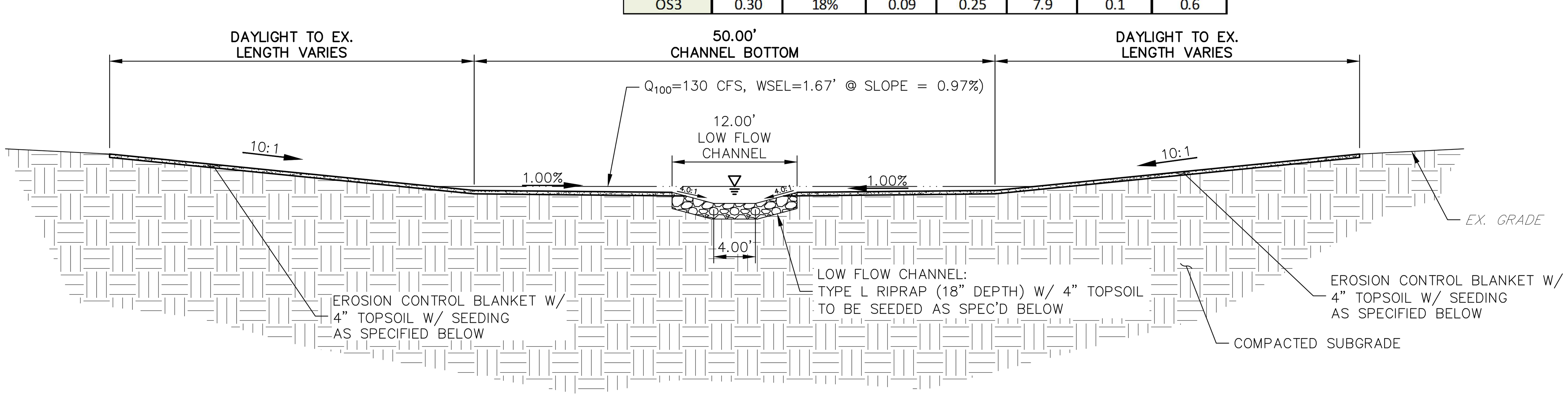
Symbol	Description
I.D. / A / B / C	BASIN DESIGNATION I.D.: BASIN IDENTIFIER A: BASIN AREA B: C_5 C: C_{100}
X (triangle)	DESIGN POINT
— — —	BASIN DELINEATION
- - 6100 - -	EXISTING INDEX CONTOURS
- - - -	EXISTING INTERMEDIATE CONTOURS
—6100—	PROPOSED INDEX CONTOURS
——	PROPOSED INTERMEDIATE CONTOURS
⇨	EXISTING FLOW DIRECTION
→	PROPOSED FLOW DIRECTION
HP	PROPOSED HIGH POINT
LP	PROPOSED LOW POINT

FILING 1 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	7.90	11%	0.05	0.20	26.7	1.1	6.9
H2	10.40	11%	0.05	0.20	24.2	1.5	9.7
H3	0.96	45%	0.31	0.46	14.7	1.1	2.6
H4	1.90	2%	0.01	0.13	7.9	0.1	1.8
I1	1.10	45%	0.32	0.49	16.0	1.2	3.1
I2	0.74	45%	0.32	0.49	11.3	0.9	2.4
I3	0.61	45%	0.32	0.48	11.8	0.7	1.9
I4	14.85	7%	0.03	0.21	18.6	1.5	16.9
I5	0.82	45%	0.31	0.46	11.0	1.0	2.5
I6	19.92	8%	0.04	0.17	20.9	2.2	17.6
I7	3.91	6%	0.03	0.18	5.5	0.5	6.1
F-G1	12.40	9%	0.04	0.18	39.3	1.1	7.9
F-G2	1.00	45%	0.31	0.46	15.5	1.1	2.7
G1	13.20	11%	0.05	0.19	31.3	1.6	10.5
G2	0.98	45%	0.31	0.46	15.8	1.0	2.6
G3	0.63	45%	0.31	0.46	13.9	0.7	1.8
G4	2.50	26%	0.16	0.31	37.0	0.8	2.8
G5	11.15	11%	0.05	0.19	18.4	1.8	11.5
G6	4.36	5%	0.03	0.29	23.4	0.3	6.0
G7	0.31	45%	0.31	0.46	12.0	0.4	0.9
F1	11.30	7%	0.03	0.17	27.4	0.9	8.2
F2	0.36	2%	0.01	0.13	12.8	0.0	0.3
F3	2.39	7%	0.03	0.16	27.0	0.2	1.7
F4	0.47	45%	0.31	0.46	10.2	0.6	1.5
UD1	4.30	6%	0.03	0.16	9.1	0.5	4.9
UD2	13.00	7%	0.03	0.21	18.3	1.4	14.6
UD3	9.60	8%	0.04	0.26	14.6	1.3	14.7
UD4	16.50	6%	0.03	0.16	22.6	1.2	12.7
UD5	10.00	6%	0.03	0.27	24.9	0.9	12.7
UD6	6.80	6%	0.03	0.22	11.2	0.8	10.0
OS1	1.00	24%	0.14	0.29	27.2	0.4	1.3
OS2	0.76	18%	0.09	0.25	14.8	0.3	1.1
OS3	0.30	18%	0.09	0.25	7.9	0.1	0.6

FILING 1 - DESIGN POINT SUMMARY TABLE

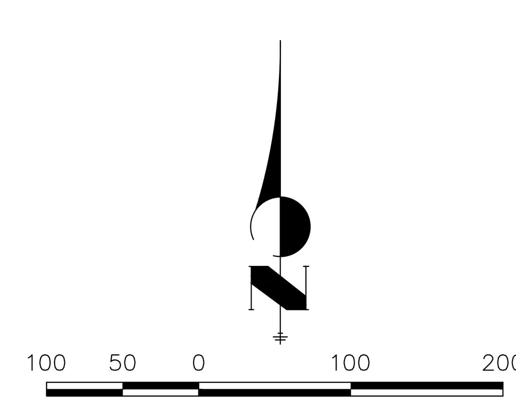
Design Point	Contributing Acreage (ac)	Q_5 (cfs)	Q_{100} (Cfs)
1	8.9	1.4	8.2
2	20.1	2.7	15.7
3	22.9	3.4	18.3
4	0.7	0.9	2.4
5	16.8	3.4	21.8
6	38.0	6.7	41.5
7	25.6	2.1	14.8
8	2.0	1.8	4.4
9	26.2	2.5	15.6
10	13.1	2.7	11.7
11	46.5	4.7	25.9
12	11.7	1.2	12.0
13	2.86	0.6	2.7



T6 CHANNEL IMPROVEMENTS - TYPICAL SECTION

SCALE: 1"=10'

CHANNEL SEED MIX: EROSION CONTROL BLANKET WITH PAWNEE BUTTES SEED INC. – "LOW GROW NATIVE MIX"
–IDAHO FESCUE
–SANDBERG BLUEGRASS
–ROCKY MOUNTAIN FESCUE
–BIG BLUEGRASS



SADDLEHORN RANCH FILING 1
PROPOSED DRAINAGE MAP
2514202
11/27/19
SHEET 4 OF 4

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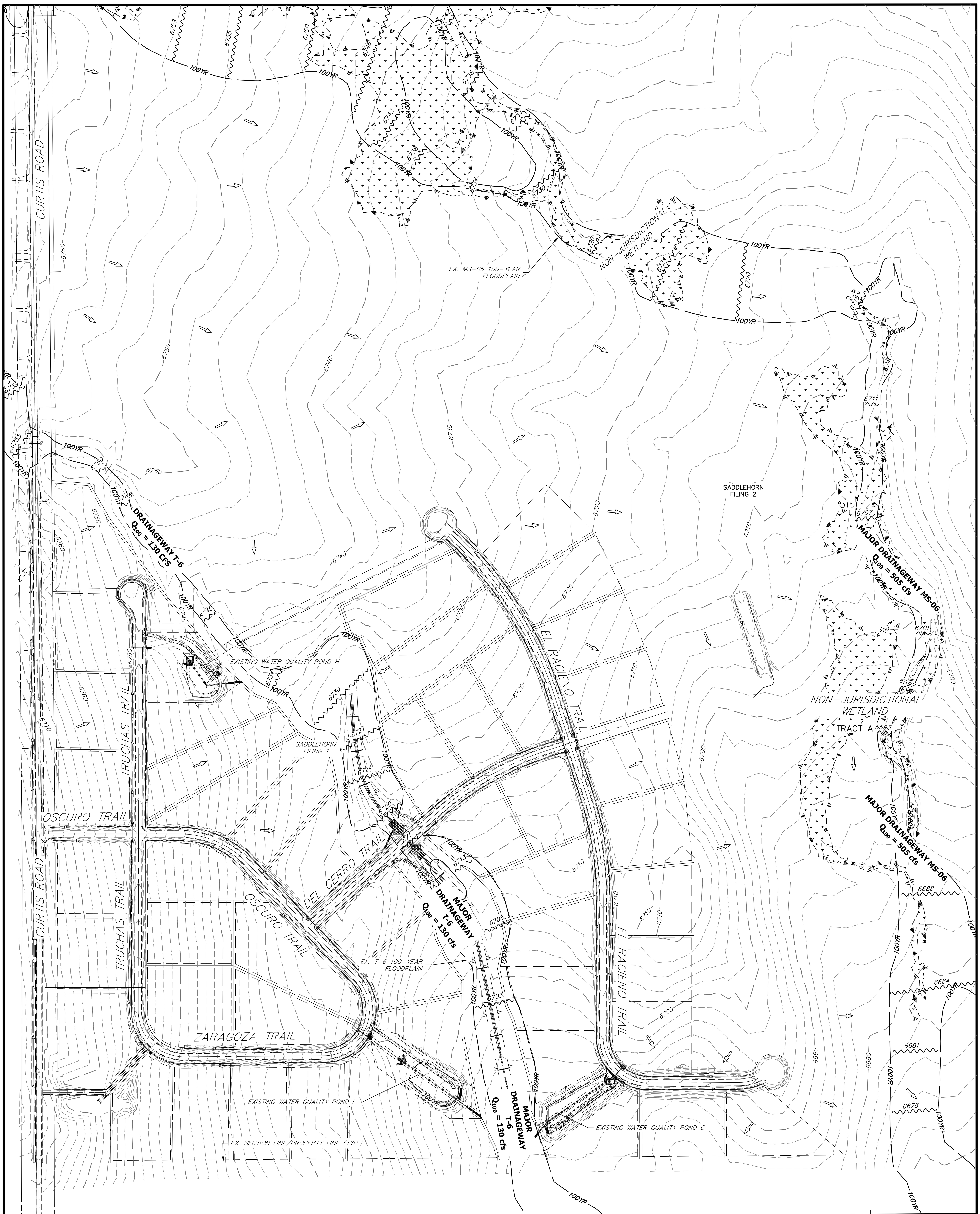
APPENDIX F

DRAINAGE MAPS & PLANS

SADDLEHORN RANCH - FILING 2

EXISTING CONDITIONS PLAN



LEGEND

--6100--	EXISTING INDEX CONTOURS
------	EXISTING INTERMEDIATE CONTOURS
⇨	EXISTING FLOW DIRECTION
——	100 YEAR FLOODPLAIN
6740	FEMA FIRM BASE FLOOD ELEVATION

200 100 0 200 400

ORIGINAL SCALE: 1" = 200'

SADDLEHORN RANCH FILING 2
EXISTING CONDITIONS PLAN
2514204
12/20/21
SHEET 1 OF 1

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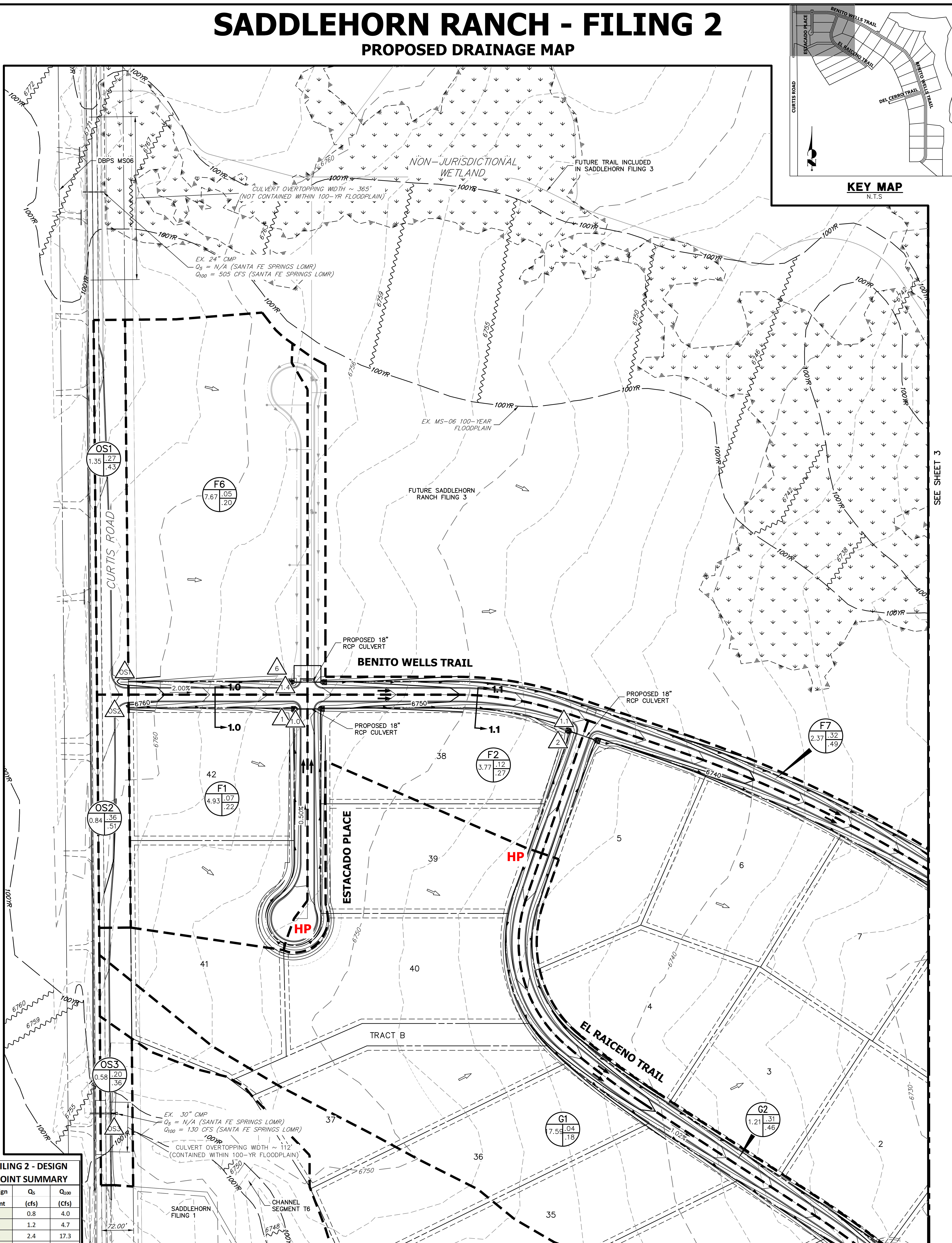
SADDLEHORN RANCH - FILING 2

PROPOSED DRAINAGE MAP



FILING 2 - DESIGN POINT SUMMARY		
Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	0.8	4.0
2	1.2	4.7
3	2.4	17.3
4	1.3	10.3
5	3.4	22.6
6	0.9	5.7
7	1.9	4.9
8	2.3	6.0
9	1.1	2.6
10	0.2	2.9
11	1.4	10.3
12	1.3	3.2
13	1.0	10.5
14	2.8	28.2
15	1.5	26.9
16	0.2	1.6
17	0.4	4.5
1.0	1.5	5.6
1.1	2.3	8.8
1.2	4.5	27.9
1.3	6.1	38.7
1.4	1.7	7.9
1.5	2.8	9.9
1.6	9.6	49.5
1.7	9.7	50.7
OS1	1.2	3.1
OS2	1.1	2.6
OS3	0.4	1.2

FILING 2 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
F1	4.93	14%	0.07	0.22	35.4	0.8	4.0
F2	3.77	21%	0.12	0.27	25.9	1.2	4.7
F3	33.31	10%	0.04	0.19	53.1	2.4	17.3
F4	14.38	8%	0.04	0.17	31.0	1.3	10.3
F5	19.25	12%	0.09	0.36	42.6	3.4	22.6
F6	7.67	11%	0.05	0.20	35.0	0.9	5.7
F7	2.37	45%	0.32	0.49	29.8	1.9	4.9
F8	2.93	45%	0.34	0.52	32.3	2.3	6.0
F9	0.87	45%	0.31	0.46	11.4	1.1	2.6
F10	3.87	4%	0.02	0.14	19.9	0.2	2.9
G1	17.59	9%	0.04	0.18	43.8	1.4	10.3
G2	1.21	45%	0.31	0.46	16.4	1.3	3.2
UD1	16.50	6%	0.03	0.16	31.9	1.0	10.5
UD2	23.67	6%	0.05	0.27	28.0	2.8	28.2
UD3	44.34	2%	0.03	0.32	74.1	1.5	26.9
UD4	1.80	6%	0.03	0.20	27.4	0.2	1.6
UD5	5.82	6%	0.03	0.16	22.6	0.4	4.5
OS1	1.35	40%	0.27	0.43	19.3	1.2	3.1
OS2	0.84	51%	0.36	0.51	14.0	1.1	2.6
OS3	0.58	32%	0.20	0.36	15.9	0.4	1.2

LEGEND

I.D. / A / B / C — BASIN DESIGNATION

I.D.: BASIN IDENTIFIER
A: BASIN AREA
B: C_5
C: C_{100}

BASIN DELINEATION

HP — PROPOSED HIGH POINT

LP — PROPOSED LOW POINT

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 2
PROPOSED DRAINAGE MAP
2514204
6/4/21
SHEET 1 OF 4

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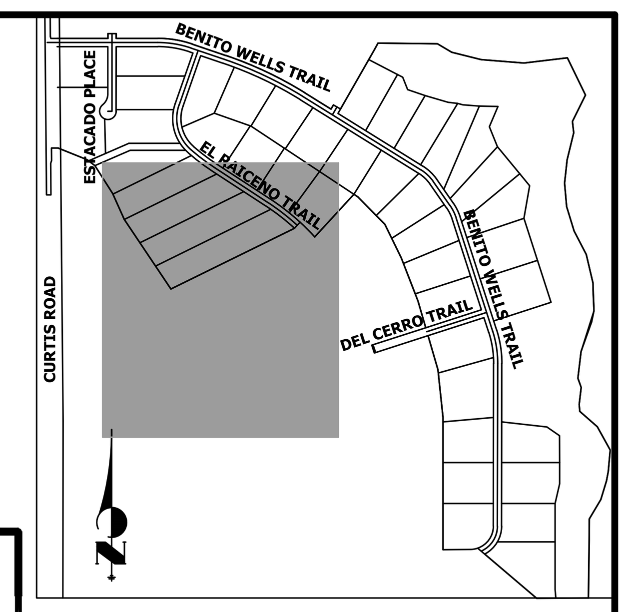
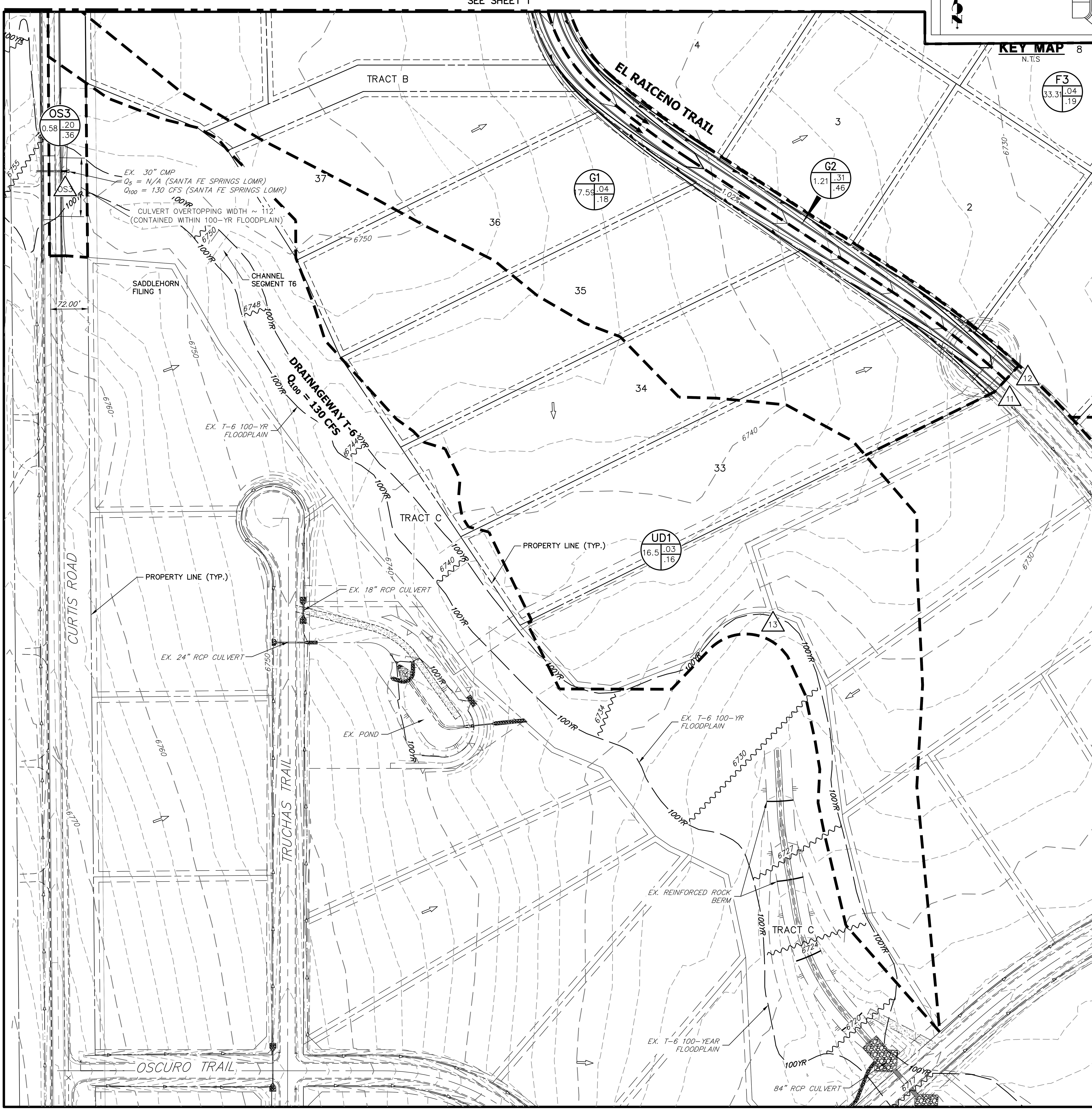
SADDLEHORN RANCH - FILING 2

PROPOSED DRAINAGE MAP





FILING 2 - DESIGN POINT SUMMARY		
Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	0.8	4.0
2	1.2	4.7
3	2.4	17.3
4	1.3	10.3
5	3.4	22.6
6	0.9	5.7
7	1.9	4.9
8	2.3	6.0
9	1.1	2.6
10	0.2	2.9
11	1.4	10.3
12	1.3	3.2
13	1.0	10.5
14	2.8	28.2
15	1.5	26.9
16	0.2	1.6
17	0.4	4.5
1.0	1.5	5.6
1.1	2.3	8.8
1.2	4.5	27.9
1.3	6.1	38.7
1.4	1.7	7.9
1.5	2.8	9.9
1.6	9.6	49.5
1.7	9.7	50.7
OS1	1.2	3.1
OS2	1.1	2.6
OS3	0.4	1.2

FILING 2 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
F1	4.93	14%	0.07	0.22	35.4	0.8	4.0
F2	3.77	21%	0.12	0.27	25.9	1.2	4.7
F3	33.31	10%	0.04	0.19	53.1	2.4	17.3
F4	14.38	8%	0.04	0.17	31.0	1.3	10.3
F5	19.25	12%	0.09	0.36	42.6	3.4	22.6
F6	7.67	11%	0.05	0.20	35.0	0.9	5.7
F7	2.37	45%	0.32	0.49	29.8	1.9	4.9
F8	2.93	45%	0.34	0.52	32.3	2.3	6.0
F9	0.87	45%	0.31	0.46	11.4	1.1	2.6
F10	3.87	4%	0.02	0.14	19.9	0.2	2.9
G1	17.59	9%	0.04	0.18	43.8	1.4	10.3
G2	1.21	45%	0.31	0.46	16.4	1.3	3.2
UD1	16.50	6%	0.03	0.16	31.9	1.0	10.5
UD2	23.67	6%	0.05	0.27	28.0	2.8	28.2
UD3	44.34	2%	0.03	0.32	74.1	1.5	26.9
UD4	1.80	6%	0.03	0.20	27.4	0.2	1.6
UD5	5.82	6%	0.03	0.16	22.6	0.4	4.5
OS1	1.35	40%	0.27	0.43	19.3	1.2	3.1
OS2	0.84	51%	0.36	0.51	14.0	1.1	2.6
OS3	0.58	32%	0.20	0.36	15.9	0.4	1.2

LEGEND

I.D. A B C — BASIN DESIGNATION
I.D.: BASIN IDENTIFIER
A: BASIN AREA
B: C_5
C: C_{100}

BASIN DELINEATION

HP PROPOSED HIGH POINT

LP PROPOSED LOW POINT

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 2
PROPOSED DRAINAGE MAP
2514204
6/4/21
SHEET 2 OF 4

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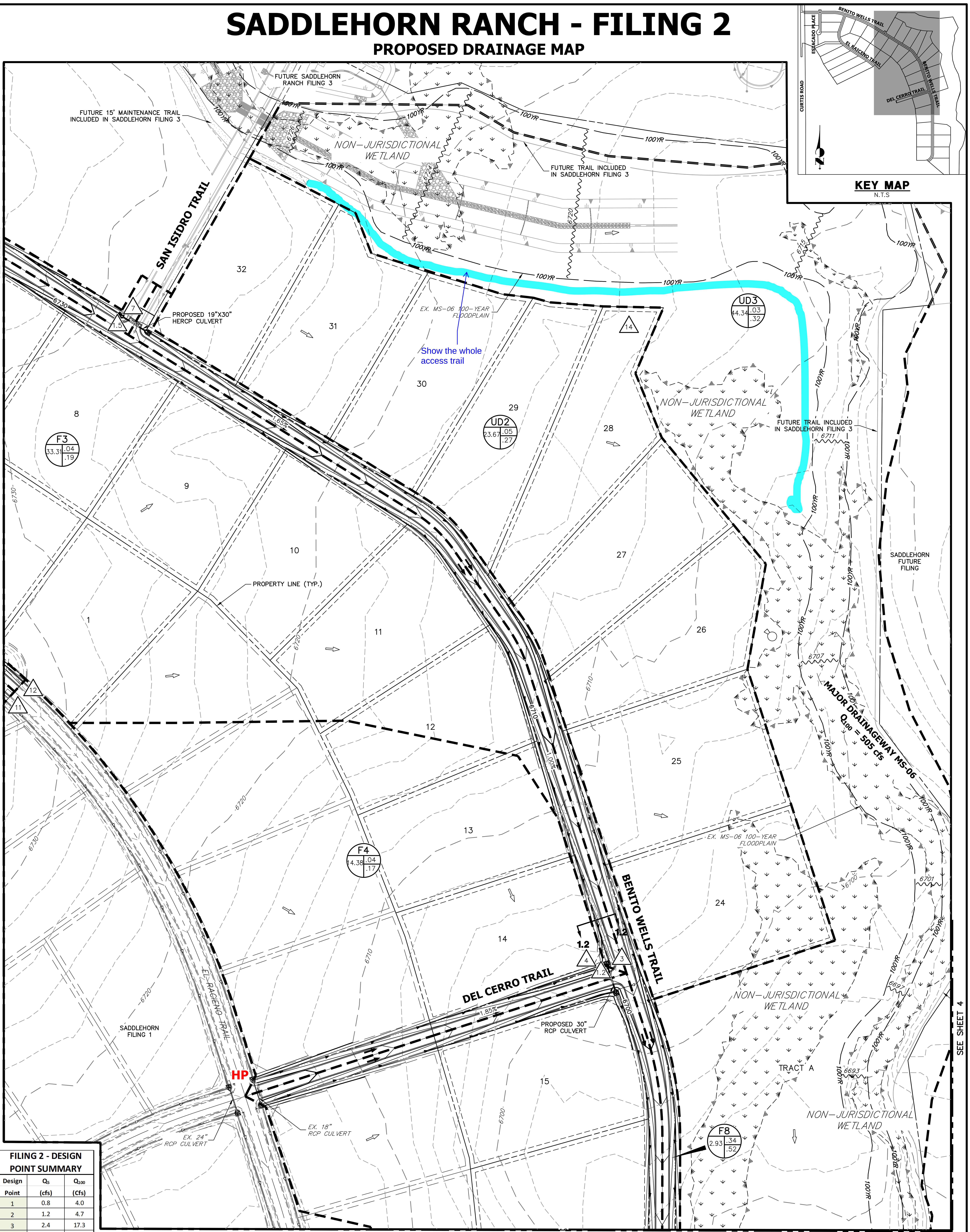
SADDLEHORN RANCH - FILING 2

PROPOSED DRAINAGE MAP



SEE SHEET 4

FILING 2 - DESIGN POINT SUMMARY		
Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	0.8	4.0
2	1.2	4.7
3	2.4	17.3
4	1.3	10.3
5	3.4	22.6
6	0.9	5.7
7	1.9	4.9
8	2.3	6.0
9	1.1	2.6
10	0.2	2.9
11	1.4	10.3
12	1.3	3.2
13	1.0	10.5
14	2.8	28.2
15	1.5	26.9
16	0.2	1.6
17	0.4	4.5
1.0	1.5	5.6
1.1	2.3	8.8
1.2	4.5	27.9
1.3	6.1	38.7
1.4	1.7	7.9
1.5	2.8	9.9
1.6	9.6	49.5
1.7	9.7	50.7
OS1	1.2	3.1
OS2	1.1	2.6
OS3	0.4	1.2

FILING 2 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
F1	4.93	14%	0.07	0.22	35.4	0.8	4.0
F2	3.77	21%	0.12	0.27	25.9	1.2	4.7
F3	33.31	10%	0.04	0.19	53.1	2.4	17.3
F4	14.38	8%	0.04	0.17	31.0	1.3	10.3
F5	19.25	12%	0.09	0.36	42.6	3.4	22.6
F6	7.67	11%	0.05	0.20	35.0	0.9	5.7
F7	2.37	45%	0.32	0.49	29.8	1.9	4.9
F8	2.93	45%	0.34	0.52	32.3	2.3	6.0
F9	0.87	45%	0.31	0.46	11.4	1.1	2.6
F10	3.87	4%	0.02	0.14	19.9	0.2	2.9
G1	17.59	9%	0.04	0.18	43.8	1.4	10.3
G2	1.21	45%	0.31	0.46	16.4	1.3	3.2
UD1	16.50	6%	0.03	0.16	31.9	1.0	10.5
UD2	23.67	6%	0.05	0.27	28.0	2.8	28.2
UD3	44.34	2%	0.03	0.32	74.1	1.5	26.9
UD4	1.80	6%	0.03	0.20	27.4	0.2	1.6
UD5	5.82	6%	0.03	0.16	22.6	0.4	4.5
OS1	1.35	40%	0.27	0.43	19.3	1.2	3.1
OS2	0.84	51%	0.36	0.51	14.0	1.1	2.6
OS3	0.58	32%	0.20	0.36	15.9	0.4	1.2

LEGEND

BASIN DESIGNATION

I.D.: BASIN IDENTIFIER
A: BASIN AREA
B: C_5
C: C_{100}

BASIN DELINEATION

HP PROPOSED HIGH POINT

LP PROPOSED LOW POINT

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 2
PROPOSED DRAINAGE MAP
2514204
6/4/21
SHEET 3 OF 4

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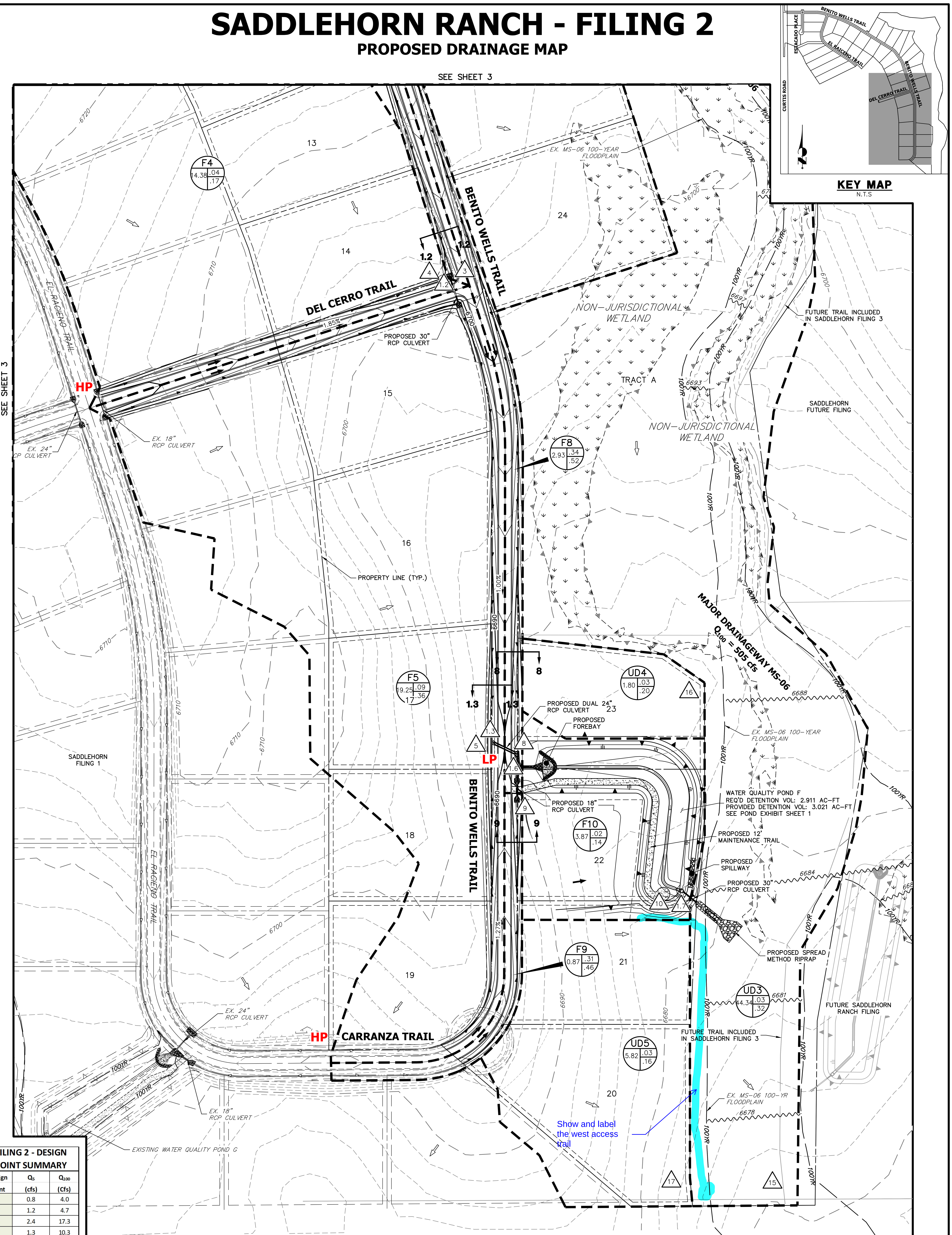
SADDLEHORN RANCH - FILING 2

PROPOSED DRAINAGE MAP



FILING 2 - DESIGN POINT SUMMARY		
Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	0.8	4.0
2	1.2	4.7
3	2.4	17.3
4	1.3	10.3
5	3.4	22.6
6	0.9	5.7
7	1.9	4.9
8	2.3	6.0
9	1.1	2.6
10	0.2	2.9
11	1.4	10.3
12	1.3	3.2
13	1.0	10.5
14	2.8	28.2
15	1.5	26.9
16	0.2	1.6
17	0.4	4.5
1.0	1.5	5.6
1.1	2.3	8.8
1.2	4.5	27.9
1.3	6.1	38.7
1.4	1.7	7.9
1.5	2.8	9.9
1.6	9.6	49.5
1.7	9.7	50.7
OS1	1.2	3.1
OS2	1.1	2.6
OS3	0.4	1.2

FILING 2 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
F1	4.93	14%	0.07	0.22	35.4	0.8	4.0
F2	3.77	21%	0.12	0.27	25.9	1.2	4.7
F3	33.31	10%	0.04	0.19	53.1	2.4	17.3
F4	14.38	8%	0.04	0.17	31.0	1.3	10.3
F5	19.25	12%	0.09	0.36	42.6	3.4	22.6
F6	7.67	11%	0.05	0.20	35.0	0.9	5.7
F7	2.37	45%	0.32	0.49	29.8	1.9	4.9
F8	2.93	45%	0.34	0.52	32.3	2.3	6.0
F9	0.87	45%	0.31	0.46	11.4	1.1	2.6
F10	3.87	4%	0.02	0.14	19.9	0.2	2.9
G1	17.59	9%	0.04	0.18	43.8	1.4	10.3
G2	1.21	45%	0.31	0.46	16.4	1.3	3.2
UD1	16.50	6%	0.03	0.16	31.9	1.0	10.5
UD2	23.67	6%	0.05	0.27	28.0	2.8	28.2
UD3	44.34	2%	0.03	0.32	74.1	1.5	26.9
UD4	1.80	6%	0.03	0.20	27.4	0.2	1.6
UD5	5.82	6%	0.03	0.16	22.6	0.4	4.5
OS1	1.35	40%	0.27	0.43	19.3	1.2	3.1
OS2	0.84	51%	0.36	0.51	14.0	1.1	2.6
OS3	0.58	32%	0.20	0.36	15.9	0.4	1.2

LEGEND

BASIN DESIGNATION
I.D.: BASIN IDENTIFIER
A: BASIN AREA
B: C_5
C: C_{100}

BASIN DELINEATION

HP PROPOSED HIGH POINT

LP PROPOSED LOW POINT

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 2
PROPOSED DRAINAGE MAP
2514204
6/4/21
SHEET 4 OF 4

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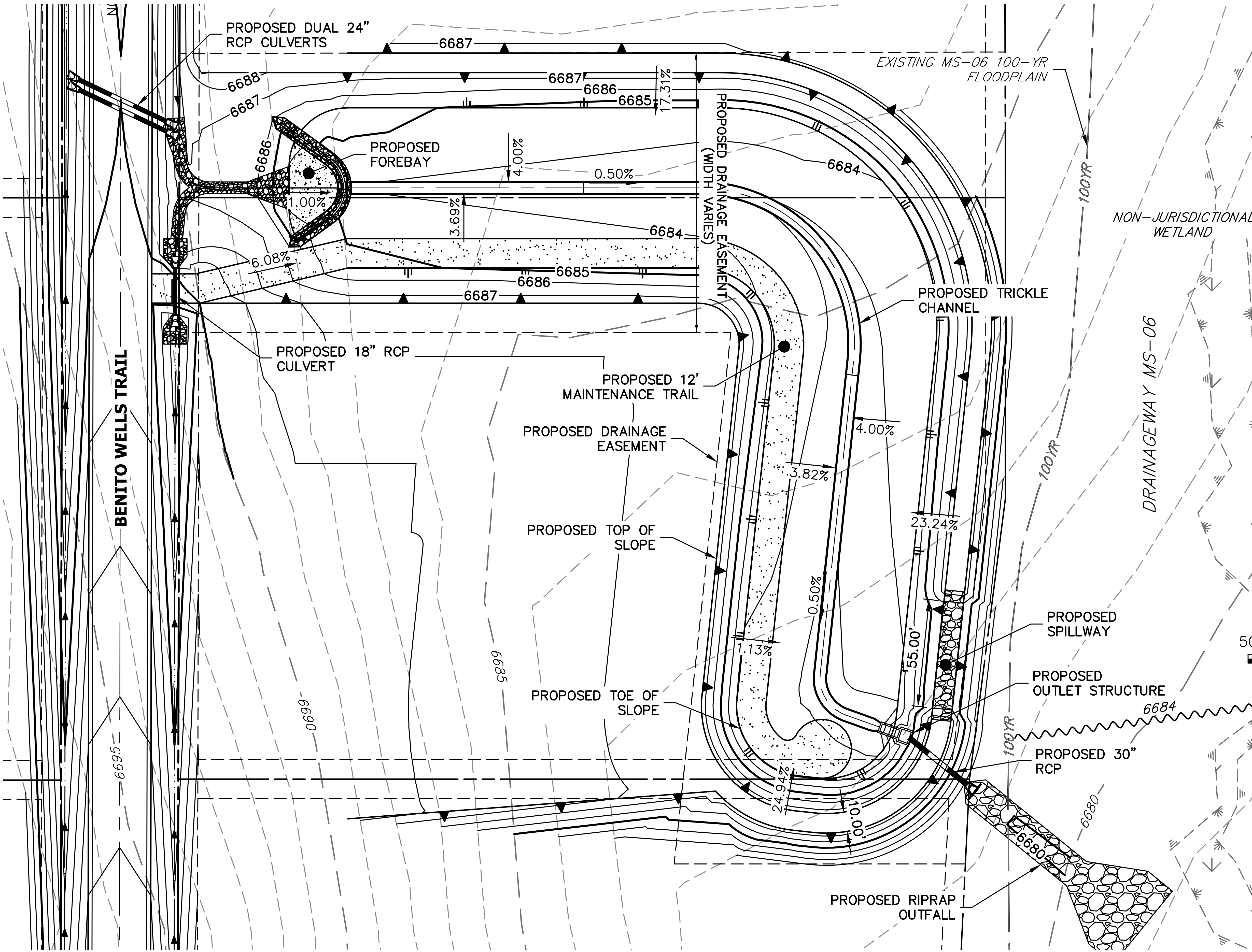

N

50 25 0 50 100

ORIGINAL SCALE: 1" = 50'

POND EXHIBIT
SADDLEHORN FILING 2
JOB NO. 2514204
6/4/21
SHEET 1 OF 1

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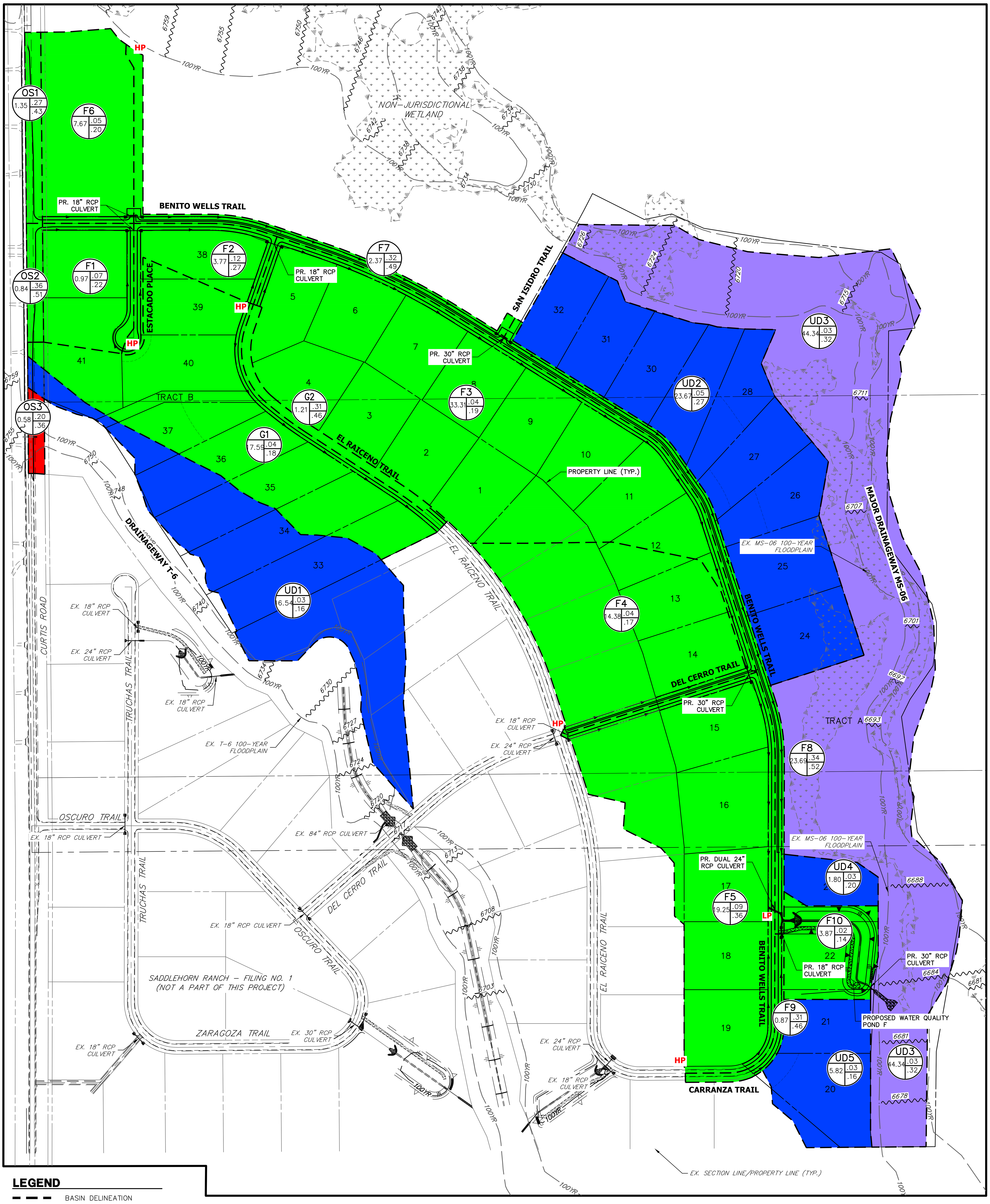
SADDLEHORN RANCH - FILING 2

PERMANENT BMP APPLICABILITY MAP



LEGEND

- BASIN DELINEATION
- EXISTING INDEX CONTOURS (6100)
- EXISTING INTERMEDIATE CONTOURS
- PROPOSED INDEX CONTOURS (6100)
- PROPOSED INTERMEDIATE CONTOURS
- HP — PROPOSED HIGH POINT
- LP — PROPOSED LOW POINT
- AREA DETAINED IN PBMP
- AREA NOT DETAINED IN PBMP PER SECTION I.7.1.B.5 (RURAL 2.5+ ACRE LOTS W/ IMPERVIOUSNESS < 10%)
- AREA NOT DETAINED IN PBMP PER SECTION I.7.1.C.1 (20%, UP TO 1 AC. OF DEVELOPMENT SITE CAN BE EXCLUDED - DUE TO TOPOGRAPHY)
- AREA NOT DETAINED IN PBMP PER SECTION I.7.1.B.7 (LAND DISTURBANCE TO UNDEV. LAND THAT WILL REMAIN UNDEV.)

200 100 0 200 400

ORIGINAL SCALE: 1" = 200'

SADDLEHORN RANCH FILING 2
MS4 PERMIT EXCLUSION AREAS
2514204
6/4/21
SHEET 1 OF 1

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