HAY CREEK HULL SUBDIVISION

FINAL DRAINAGE REPORT

EPC PROJECT #: _____

ALL TERRAIN ENGINEERING PROJECT NO: 24008

NOVEMBER 2024

PREPARED FOR:

3405 HAY CREEK, LLC

CONTACT: JAMIE HULL

3405 HAY CREEK ROAD

COLORADO SPRINGS, CO 80921

PREPARED BY:

ALL TERRAIN ENGINEERING LLC

CONTACT: NICHOLAS Q. JOKERST

NJOKERST@ALLTERRAINENG.COM

(530) 391-7635

ENGINEER'S STATEMENT

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

_____

Nicholas Q. Jokerst, PE Date

State of Colorado No. 59273

For and on behalf of All Terrain Engineering LLC

DEVELOPER'S STATEMENT

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

_____

Jamie Hull Date

3405 Hay Creek, LLC

3405 Hay Creek Road, Colorado Springs, CO 80921

EL PASO COUNTY ONLY

Filed in accordance with Section 51.1 of the El Paso Land Development Code as amended.

_____

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

Conditions:

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Appendices

I. General Purpose, Location & Description

a. Purpose

The purpose of this Final Drainage Report (FDR) for HAY CREEK HULL SUBDIVISION is to describe the site's onsite and offsite drainage patterns, existing and proposed storm infrastructure, and to safely route developed stormwater to adequate outfalls.

b. Location

HAY CREEK HULL SUBDIVISION, referred to as 'the site' herein, is in a portion of southeast quarter of Section 33, Township 11 South, Range 67 West of the 6th P.M., El Paso County, Colorado. The site is bound by Hay Creek Road to the north and single family residential parcels to the east, west and south. Surrounding platted developments include Hay Creek Ranch subdivision to the east. A vicinity map is presented in Appendix A.

c. Description of Property

The site is approximately 28.54 acres and includes a single family residence and barn. The remaining area of the lot is undeveloped land with existing vegetation consisting of native grasses. The approximate disturbed area associated with this project is 0.99 acres. The site is currently unplatted. The development will plat 6 single family residential lots. In general, the site slopes towards Hay Creek. Onsite elevations range from 6935' - 7114' with slopes ranging 1 – 50%. Per a NRCS soil survey, the site is made up of Hydrologic Type B soils consisting of Jarre-Tecolote complex and Type B Peyton-Pring complex.

Hay Creek bisects the site. Hay Creek is tributary to Beaver Creek to the east. There are on-site utility services to the existing residence, however; there are no on-site utility mains within the project's disturbance area. An existing, private 18" CMP private culvert is present within Hay Creek in addition to two bridge crossings.

d. Floodplain Statement

Based on FEMA Firm map 08041C0267G dated December 7, 2018, the site is Zone X and Zone A. Zone X are areas determined to be outside the 0.2% annual chance flood. Zone A (no base flood elevations determined) areas are determined to be within the 1% annual chance of flooding zone.

Portions of the proposed lots within the Zone A floodplain will be platted in a no-build easement.

The County has completed a "Base Line Engineering" (BLE) study of Hay Creek which used detailed methods to determine Base Flood Elevations (BFE's). The results of the study are considered the "best available data" but are not formally adopted by FEMA. The cross sections and BFE's from the BLE study are shown on the attached drainage map. Reference material from the BLE study are included in Appendix E.

II. Drainage Basins

a. Major Basin Description

The site is located within the Hay Creek Valley which is within the Beaver Creek Major Drainage Basin. There is no current DBPS for the site. Hay Creek discharges to Beaver Creek approximately a mile downstream of the site.

b. Existing Subbasin Description

In the existing condition, Hay Creek collects the site's stormwater and conveys it east towards Beaver Creek. See below for existing basin descriptions:

Basin EX1 is 9.89 acres of Hay Creek Road, a single residence and undeveloped land. Existing stormwater from this basin (Q_5 = 2.9 cfs Q_{100} = 14.3 cfs) flows into Hay Creek at DP1 (Q_5 = 6.7cfs, Q_{100} = 39.6 cfs) and is conveyed easterly offsite.

Basin EX2 is 19.19 acres of undeveloped land. Existing stormwater from this basin (Q_5 = 4.1 cfs Q_{100} = 27.4 cfs) flows into Hay Creek at DP1 (Q_5 = 6.7cfs, Q_{100} = 39.6 cfs) and is conveyed easterly offsite.

c. Proposed Subbasin Description

The proposed site has been divided into 4 subbasins for analysis. The site is being developed as a "Large Lot Single-Family Site". An imperviousness of 10% impervious is assumed for buildable portions of the lots. No-build areas are delineated on the plat and drainage map for areas within the Zone A floodplain. Generally, runoff is conveyed overland to Hay Creek which flows east and offsite. Per the County BLE study, Hay Creek conveys Q_{100} = 311 cfs through the site. The culvert at DP1 is sized per this flow. Q_5 and Q_{100} values below indicate that basin's contribution to the 311 cfs. See below for proposed detailed basin descriptions:

Basin 1 is 4.54 acres of Hay Creek Road, an existing barn, existing dirt driveways and undeveloped area. There is no proposed development or disturbance within this basin. Stormwater from this basin (Q_5 = 1.5 cfs Q_{100} = 7.6 cfs) follows historic drainage patterns to Hay Creek at DP1 (Q_5 = 4.2 cfs, Q_{100} = 21.7 cfs). A proposed, private twin 7'x3' reinforced concrete box culvert (RCBC) conveys DP1 flows under the proposed, private driveway to DP2.

Basin 2 is 10.07 acres of 5 acre single family residential lots and undeveloped area. Stormwater from this basin (Q_5 = 2.9 cfs Q_{100} = 15.0 cfs) sheet flows north and east per historic drainage patterns to Hay Creek at DP1. A proposed, private twin 7'x3' RCBC conveys DP1 flows under the proposed, private driveway to DP2.

Basin 3 is 5.35 acres of Hay Creek Road, 5 acre lots, a private driveway and undeveloped area. Stormwater from this basin (Q_5 = 3.2 cfs Q_{100} = 12.2 cfs) flows overland south and east to Hay Creek at DP2 (Q_5 = 8.6 cfs, Q_{100} = 41.3 cfs).

Basin 4 is 9.12 acres of 5-acre single family residential lots and a private cul-de-sac. Stormwater from this basin (Q_5 = 3.0 cfs, Q_{100} = 15.3 cfs) sheet flows north and east per historic drainage patterns to Hay Creek at DP2 (Q_5 = 8.6 cfs, Q_{100} = 41.3 cfs).

III. Drainage Design Criteria

a. Development Criteria Reference

The drainage analysis, proposed stormwater improvements follow the criteria from the "Drainage Criteria Manual of El Paso County, Colorado" Volumes 1 and 2, as amended (EPCDCM).

b. Hydrologic Criteria

Hydrologic data was obtained from NOAA Atlas 14 for the site location. Onsite drainage analysis included the 5-year storm (minor event) and 100-year storm (major event) using 1-hr duration rainfall depths from NOAA Atlas 14. Runoff was calculated per EPCDCM Chapter 5 – Storm Runoff Method of Analysis.

c.

d. Hydraulic Criteria

Hydraulic criteria for culvert design was obtained from the EPCDCM Chapter 9 – Culvert Design. The U.S. Department of Transportation HY-8 Culvert Hydraulic Analysis program was utilized in culvert analysis.

IV. Drainage Facility Design

a. General Concept

Proposed improvements for the subdivision are limited to the proposed, private driveway, cul-de-sac and box culverts, which do not alter the site's stormwater discharge point. The remainder of the site will remain undisturbed and follow historic drainage patterns to Hay Creek until individual lots are developed. This drainage report assumes an imperviousness of 10% imperviousness for buildable lot area. If future improvements exceed the maximum 10% imperviousness threshold, an additional drainage report will be required to address the increase. The proposed imperviousness increase generates a minor increase in flow.

FLOW INCREASE SUMMARY			
BASINS	**AREA**	**$Q_{5\text{-YR}}$**	**$Q_{100\text{-YR}}$**
EX1 & EX2	29.08 AC	6.7	39.6
1 - 4	29.08 AC	8.6	41.3
Percent Increase		29%	4%

The increase in 5-year and 100-year flows will have a negligible impact to downstream infrastructure or water quality. The increase in flow will be experienced on-site only as the time of concentration of the Hay Creek basin greatly exceeds the on-site time of concentration of 37.7 minutes. Hay Creek's time of concentration in this reach is approximately 2-hours. Therefore, peak flows leaving the site will be gone prior to the Hay Creek basin and creek flow peaks. Therefore there is no anticipated increase in peak 100-yr flows downstream of this site. Excerpts from an adjacent drainage report (Hay Creek Ranch) including Hay Creek Time of Concentration calculations have been included in Appendix E.

To address the minor increase in the site's stormwater flows on-site, onsite stormwater flows will not be concentrated and allowed to sheet flow across undisturbed ground. This approach will promote infiltration and thereby reduce runoff.

The proposed Hay Creek crossing will consist of a private, twin 7'x3' RCBC, sized to convey Hay Creek's 100-yr peak flows, without causing a rise greater than 6" to the computed 100-yr water surface elevation. The culvert has a headwater to depth ratio of less than 1.5 and will include type L soil-riprap stabilization on the downstream end per the calculations included in appendix C. The upstream end will include a local

depression and concrete apron w/ cut-off wall to protect the inlet. Culvert calculations are presented in Appendix C.

This crossing is being coordinated with the Flood Plain Manager.

b. Water Quality & Detention

The site will not require water quality treatment as it is being developed as "Large Lot Single-Family Residential" lots with total imperviousness areas of less than 10%. These lots are excluded from water quality treatment per Section I.7.1.B.5 of the ECM. It is worth noting that the site design and restraints include large no-build areas centered on the creek and flood plain. This will guarantee that a large vegetated buffer will remain in perpetuity between proposed imperviousness from the future home construction and the creek/site outfall.

No detention is proposed for the site, as the site will not increase peak flows off-site or downstream. A negligible increase of 4% above historic rates for the 100-yr storm is anticipated on-site, however this increase equates to only a 1.7 cfs increase in 100-yr peak flows. The site naturally drains over-land to the creek from both sides and these drainage patterns will be preserved, therefore; flows are distributed across the entire creek frontage length prior to entering the creek (950 LF feet per side), this equates to only 0.0009 cfs per foot, which is indetectable and negligible. A 29% increase to 5-yr peak flows is anticipated which equates to a 1.9 cfs increase. However, no adverse affects are anticipated due to this increase as the 100-yr peak flows are stable, and therefore the 5-yr flows are stable and non-erosive as well.

c. Operations & Maintenance

An Operations and Maintenance Manual will not be required as there are no permanent stormwater facilities being constructed with this project. Improvements will be maintained by the property owner, unless assigned through proper legal channels to another accepting party.

d. Grading & Erosion Control Plan

A separate Grading and Erosion Control plan has been submitted concurrently with this report to support the proposed site improvements (common access drive and culvert).

e. Four Step Method

Step 1 – Reducing Runoff Volumes: The site is currently farm land/range land and is highly vegetated with native grasses and shrubs. The natural vegetation on-site will be preserved to the extent practical with this project and historic drainage patterns will be preserved. Overall lot imperviousness will be limited to less than 10%. The site drains towards Hay Creek from the north and south, and the floodplain will be plated with a "no build" easement, along with additional "no build" areas south of the creek. This facilitates a permanent vegetated buffer between the proposed improvements and Hay Creek which will slow runoff, promote infiltration and increase water quality treatment for the developed runoff.

Step 2 – Treat and slowly release the WQCV: The site is comprised of 5+ acre lots with imperviousness less than 10% and meets the requirements for "Large Lot Single-Family Residential". These lots are excluded from

water quality treatment per Section I.7.1.B.5 of the ECM. Additionally, the site includes "no build" easements encompassing the floodplain and Hay Creek. This will preserve the existing grass buffers and native vegetation between developed areas and the site outfall. This grass buffer will provide in-line water quality treatment for developed flows prior to them leaving the site. No formal calculation has been included, as this is not a requirement.

Step 3 – Stabilize stream channels: All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization with the drainage basin. This site does not increase peak flows to the creek or downstream properties, therefore; no negative effects of downstream or adjacent properties are anticipated as a result of this project.

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

f. Drainage Basin & Bridge Fees

Drainage and bridge fees for the Beaver Creek Drainage Basin are due at time of platting. See table below for anticipated drainage and bridge fees for HAY CREEK HULL SUBDIVISION. Per the El Paso County Engineering Criteria Manual, Appendix I, Section 3.10.1a fee reductions for low density lots are applicable at a rate of 25%. Please see the calculation for imperviousness area

Beaver Creek Drainage Basin Fees				
Total Acreage	Site % Impervious	Impervious Acreage	Basin Fee/ Imp. Ac.	Basin Fee w/ 25% reduction
28.40	8.4	2.38	$14,846	$26,500.11

g. Engineer's Opinion of Probable Cost

An engineer's opinion of probable cost has been included in Appendix E.

V. Summary

HAY CREEK HULL SUBDIVISION remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements. The proposed development will not adversely affect downstream or adjacent properties, stormwater infrastructure, or surrounding developments. This report meets the latest El Paso County Drainage criteria.

VI. References

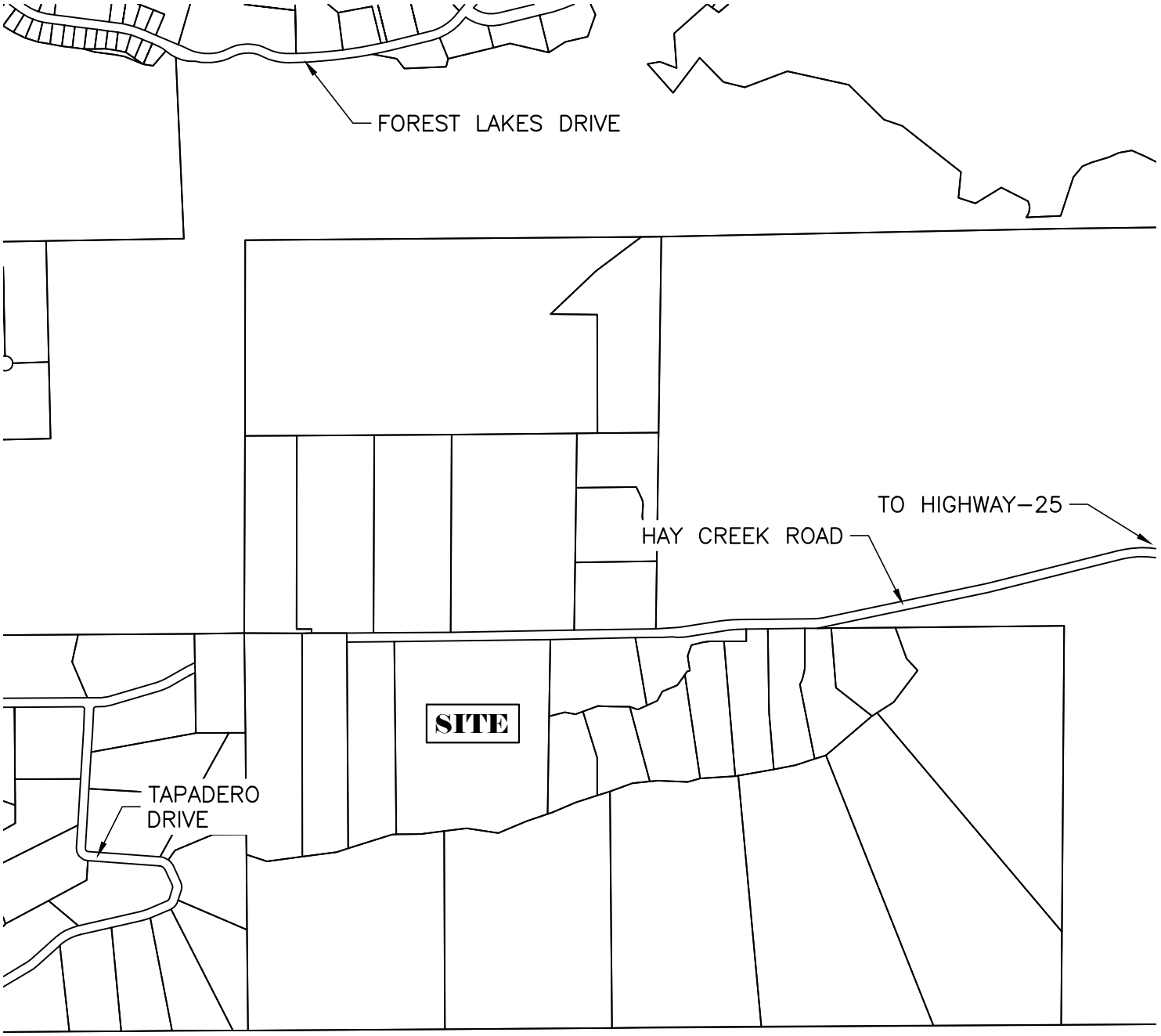
1. Drainage Criteria Manual of El Paso County, Colorado, October 2018.

2. Urban Storm Drainage Criteria Manual, Mile High Flood District, January 2018.
3. Final Drainage Report for Hay Creek Ranch, Matrix Design Group, March 28, 2003
4. El Paso County Base Level Engineering Study Effort, HEC-RAS model

APPENDIX A – VICINITY MAP, FEMA MAP, NRCS WEB SOIL SURVEY & NOAA ATLAS 14

HAY CREEK SUBDIVISION

VICINITY MAP



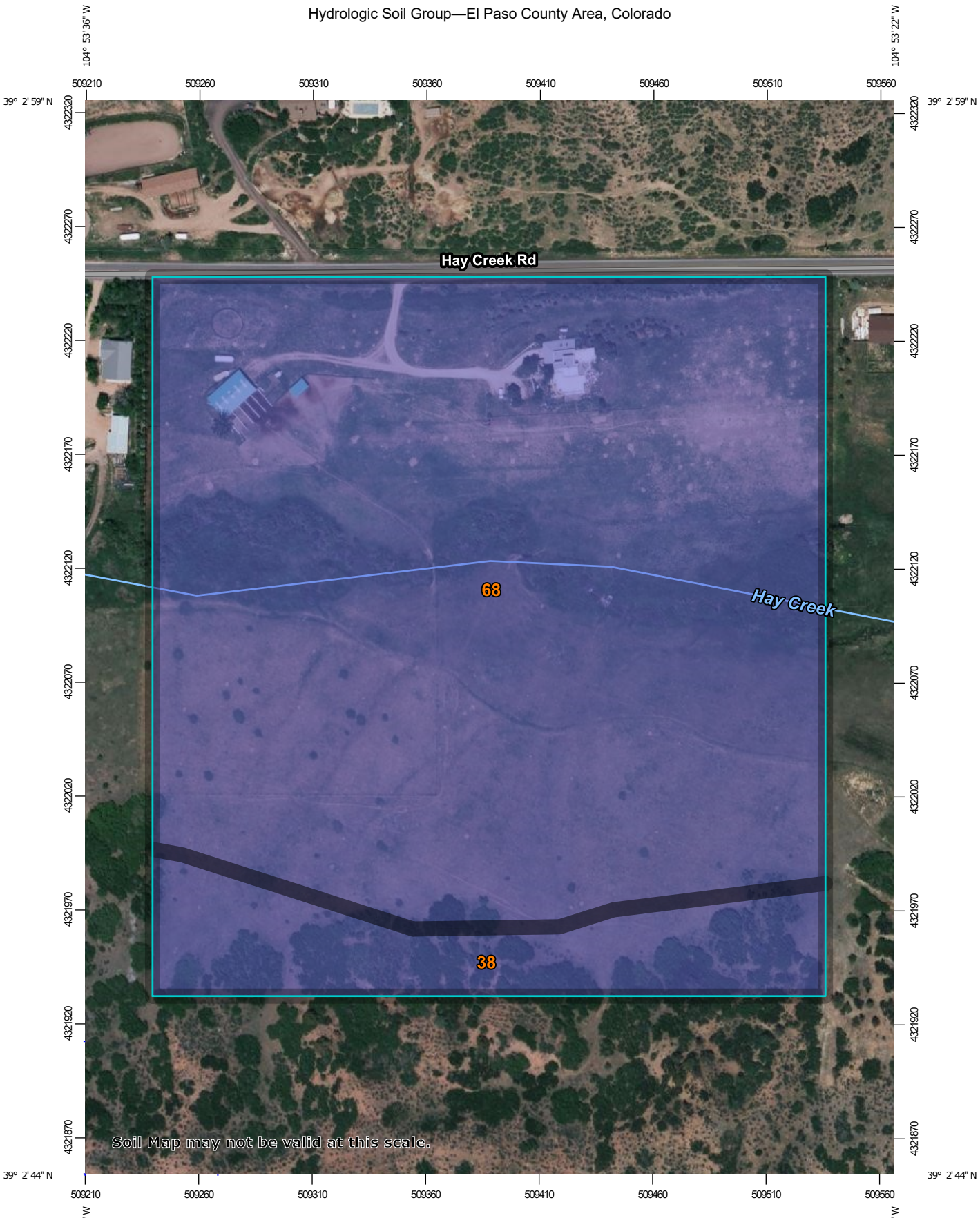
AIR FORCE ACADEMY

1000 500 0 1000 2000

ORIGINAL SCALE: 1" = 1000'

VICINITY MAP	
HAY CREEK SUBDIVISION	
JOB NO. 24008	
LOCATION: EPC	SHEET 1
09/13/2024	

ALL TERRAIN ENGINEERING
1004 WEST VAN BUREN STREET
COLORADO SPRINGS, CO 80907



Map Scale: 1:2,300 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 21, Aug 24, 2023

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

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

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
38	Jarre-Tecolote complex, 8 to 65 percent slopes	B	3.1	13.1%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	20.2	86.9%
Totals for Area of Interest			**23.2**	**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

National Flood Hazard Layer FIRMette

FEMA

104°53'48"W 39°3'10"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

104°53'10"W 39°2'42"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/13/2024 at 11:48 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 39.05°, Longitude: -104.8925°
Elevation: 7044 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.233** (0.190-0.284)	**0.297** (0.243-0.363)	**0.405** (0.329-0.495)	**0.497** (0.402-0.610)	**0.627** (0.490-0.797)	**0.730** (0.557-0.938)	**0.836** (0.615-1.10)	**0.947** (0.667-1.27)	**1.10** (0.742-1.51)	**1.21** (0.799-1.69)
10-min	**0.341** (0.279-0.416)	**0.435** (0.355-0.531)	**0.593** (0.482-0.725)	**0.727** (0.588-0.893)	**0.918** (0.717-1.17)	**1.07** (0.815-1.37)	**1.22** (0.901-1.61)	**1.39** (0.977-1.86)	**1.61** (1.09-2.21)	**1.78** (1.17-2.48)
15-min	**0.416** (0.340-0.507)	**0.530** (0.433-0.647)	**0.723** (0.588-0.884)	**0.887** (0.717-1.09)	**1.12** (0.875-1.42)	**1.30** (0.994-1.68)	**1.49** (1.10-1.96)	**1.69** (1.19-2.27)	**1.96** (1.32-2.70)	**2.17** (1.43-3.02)
30-min	**0.560** (0.458-0.683)	**0.715** (0.584-0.873)	**0.975** (0.793-1.19)	**1.20** (0.968-1.47)	**1.51** (1.18-1.92)	**1.76** (1.34-2.26)	**2.02** (1.48-2.64)	**2.28** (1.61-3.06)	**2.64** (1.79-3.64)	**2.92** (1.92-4.07)
60-min	**0.715** (0.585-0.873)	**0.879** (0.718-1.07)	**1.17** (0.950-1.43)	**1.43** (1.15-1.75)	**1.81** (1.43-2.33)	**2.13** (1.63-2.76)	**2.47** (1.83-3.27)	**2.84** (2.01-3.84)	**3.35** (2.28-4.64)	**3.77** (2.48-5.25)
2-hr	**0.871** (0.716-1.05)	**1.04** (0.857-1.26)	**1.36** (1.11-1.65)	**1.66** (1.35-2.02)	**2.11** (1.68-2.71)	**2.51** (1.94-3.23)	**2.93** (2.19-3.86)	**3.40** (2.42-4.58)	**4.07** (2.79-5.61)	**4.62** (3.06-6.39)
3-hr	**0.982** (0.810-1.18)	**1.14** (0.943-1.38)	**1.46** (1.20-1.76)	**1.77** (1.45-2.15)	**2.27** (1.83-2.92)	**2.71** (2.11-3.50)	**3.20** (2.41-4.22)	**3.75** (2.70-5.06)	**4.56** (3.14-6.28)	**5.22** (3.48-7.20)
6-hr	**1.20** (1.00-1.44)	**1.38** (1.15-1.65)	**1.74** (1.44-2.09)	**2.11** (1.73-2.54)	**2.70** (2.20-3.46)	**3.24** (2.55-4.16)	**3.84** (2.91-5.04)	**4.52** (3.27-6.06)	**5.52** (3.83-7.57)	**6.35** (4.26-8.70)
12-hr	**1.48** (1.23-1.75)	**1.73** (1.44-2.05)	**2.21** (1.84-2.63)	**2.68** (2.21-3.19)	**3.40** (2.76-4.29)	**4.04** (3.18-5.12)	**4.74** (3.60-6.14)	**5.51** (4.01-7.31)	**6.63** (4.63-9.00)	**7.56** (5.10-10.3)
24-hr	**1.78** (1.50-2.09)	**2.12** (1.78-2.49)	**2.73** (2.28-3.21)	**3.28** (2.73-3.88)	**4.13** (3.36-5.12)	**4.84** (3.83-6.06)	**5.61** (4.28-7.18)	**6.45** (4.71-8.46)	**7.64** (5.36-10.3)	**8.61** (5.85-11.6)
2-day	**2.10** (1.78-2.44)	**2.48** (2.09-2.88)	**3.14** (2.65-3.67)	**3.75** (3.14-4.39)	**4.66** (3.80-5.72)	**5.42** (4.31-6.72)	**6.24** (4.78-7.90)	**7.12** (5.23-9.25)	**8.36** (5.90-11.2)	**9.37** (6.41-12.6)
3-day	**2.27** (1.93-2.63)	**2.66** (2.26-3.08)	**3.36** (2.84-3.90)	**3.99** (3.36-4.66)	**4.94** (4.05-6.03)	**5.74** (4.57-7.07)	**6.58** (5.07-8.30)	**7.50** (5.53-9.70)	**8.79** (6.23-11.7)	**9.83** (6.75-13.2)
4-day	**2.41** (2.05-2.77)	**2.81** (2.39-3.24)	**3.53** (2.99-4.08)	**4.18** (3.52-4.85)	**5.15** (4.23-6.26)	**5.97** (4.77-7.33)	**6.84** (5.28-8.60)	**7.78** (5.76-10.0)	**9.12** (6.48-12.1)	**10.2** (7.02-13.6)
7-day	**2.78** (2.38-3.19)	**3.20** (2.74-3.67)	**3.95** (3.37-4.54)	**4.64** (3.93-5.35)	**5.67** (4.68-6.84)	**6.53** (5.25-7.97)	**7.46** (5.79-9.32)	**8.46** (6.29-10.8)	**9.88** (7.06-13.0)	**11.0** (7.64-14.6)
10-day	**3.14** (2.69-3.57)	**3.59** (3.08-4.09)	**4.39** (3.75-5.02)	**5.11** (4.34-5.87)	**6.20** (5.13-7.44)	**7.10** (5.73-8.62)	**8.08** (6.29-10.0)	**9.12** (6.81-11.6)	**10.6** (7.60-13.9)	**11.8** (8.20-15.6)
20-day	**4.15** (3.59-4.69)	**4.75** (4.10-5.38)	**5.78** (4.97-6.55)	**6.67** (5.70-7.60)	**7.96** (6.61-9.41)	**9.00** (7.29-10.8)	**10.1** (7.89-12.4)	**11.2** (8.42-14.2)	**12.8** (9.23-16.6)	**14.0** (9.84-18.4)
30-day	**4.99** (4.32-5.60)	**5.72** (4.96-6.44)	**6.94** (5.99-7.83)	**7.97** (6.84-9.03)	**9.41** (7.82-11.0)	**10.5** (8.56-12.5)	**11.7** (9.17-14.2)	**12.9** (9.68-16.1)	**14.5** (10.5-18.6)	**15.7** (11.1-20.6)
45-day	**6.02** (5.24-6.73)	**6.91** (6.01-7.73)	**8.35** (7.24-9.37)	**9.53** (8.21-10.7)	**11.1** (9.26-12.9)	**12.4** (10.0-14.6)	**13.6** (10.7-16.4)	**14.8** (11.1-18.4)	**16.4** (11.8-20.9)	**17.5** (12.4-22.9)
60-day	**6.88** (6.01-7.67)	**7.90** (6.88-8.80)	**9.50** (8.26-10.6)	**10.8** (9.33-12.1)	**12.5** (10.4-14.4)	**13.8** (11.2-16.1)	**15.0** (11.8-18.0)	**16.2** (12.2-20.1)	**17.8** (12.9-22.6)	**18.9** (13.4-24.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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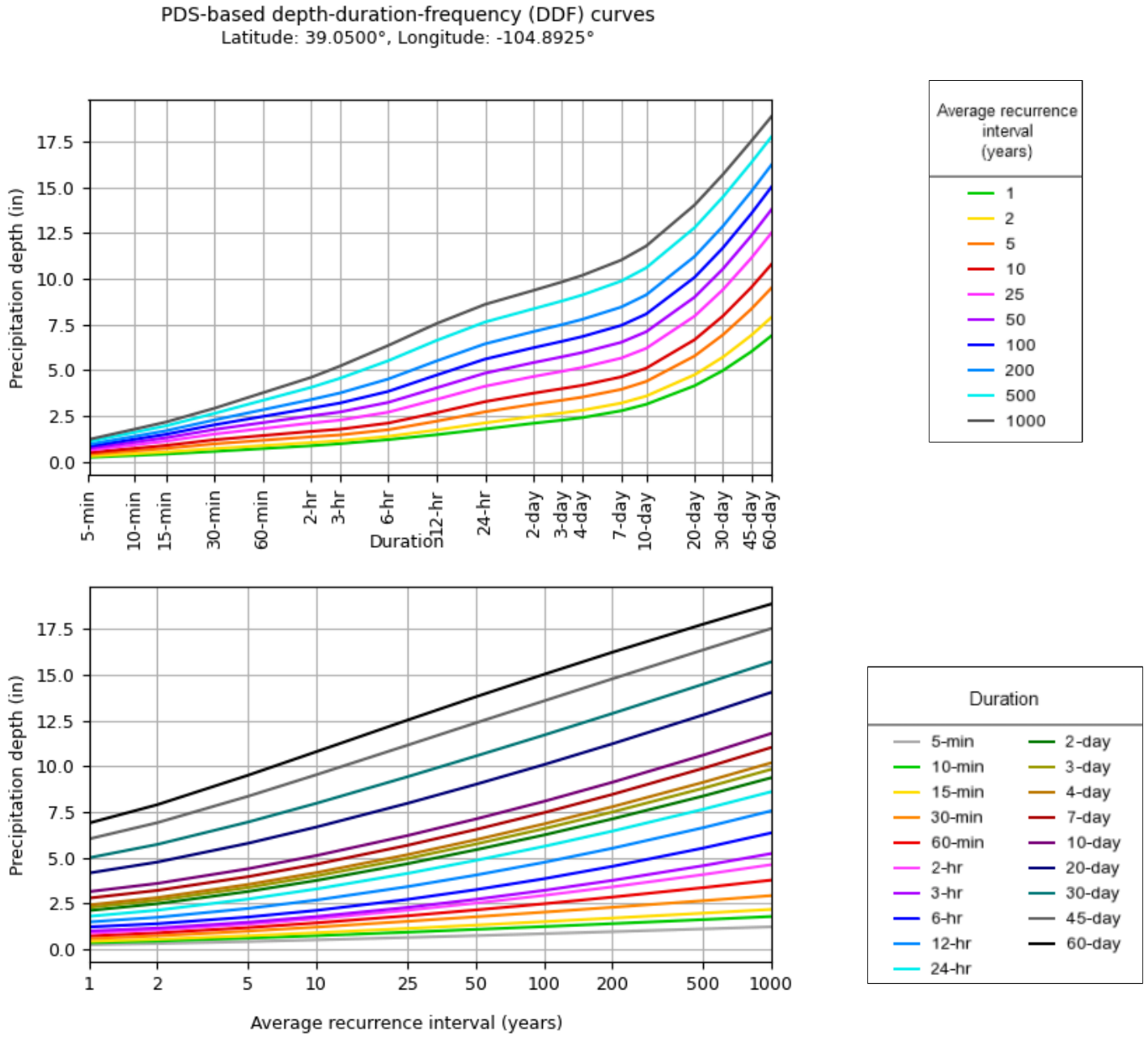
PF graphical



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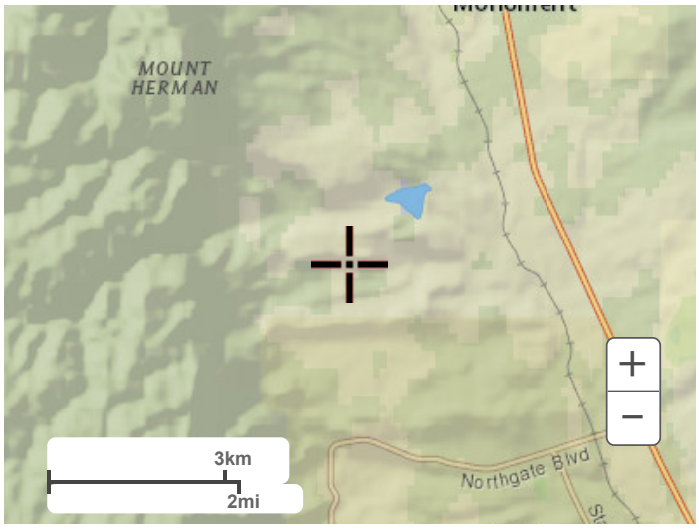
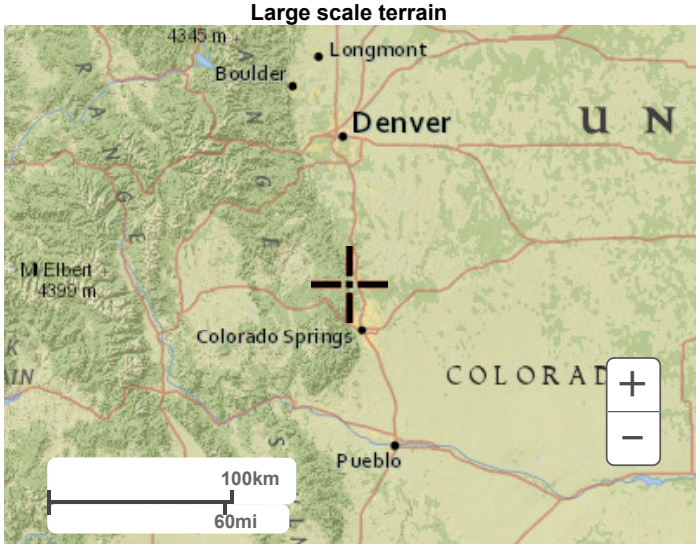
Maps & aerials

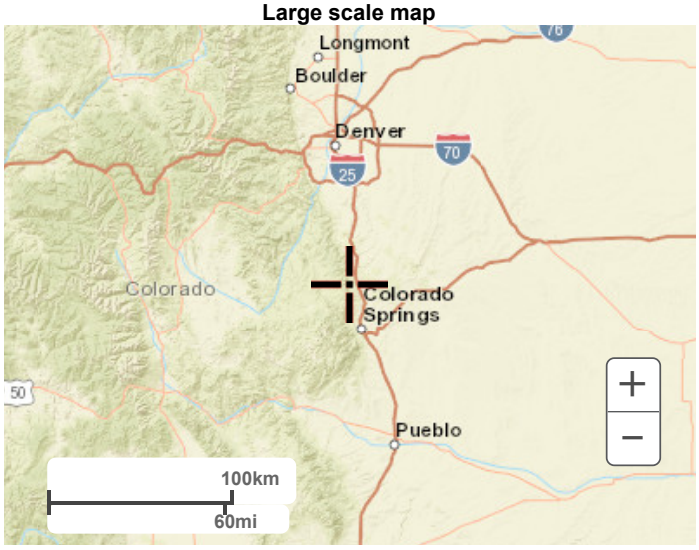
Small scale terrain



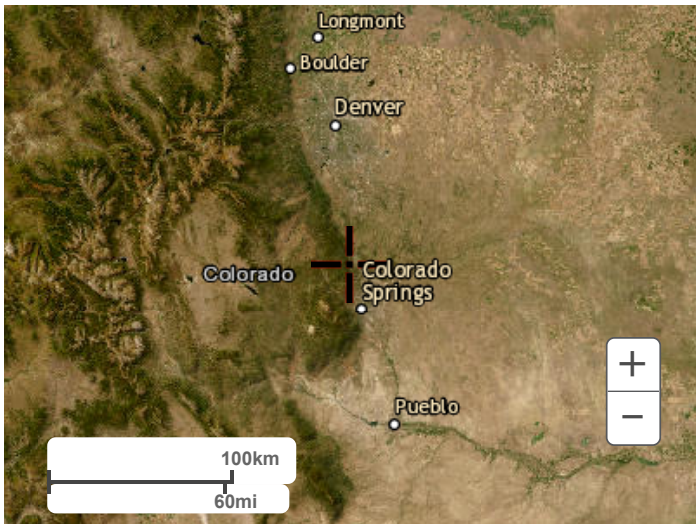
Large scale terrain



Large scale map



Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
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Silver Spring, MD 20910
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Disclaimer

APPENDIX B – HYDROLOGIC CALCULATIONS

COMPOSITE % IMPERVIOUS CALCULATIONS - EXISTING CONDITIONS

Subdivision: Hay Creek Subdivision
Location: El Paso County

Project Name: Hay Creek Subdivision
Project No.: 24008.00
Calculated By: NQJ
Checked By:
Date: 9/13/24

		Gravel Drives				Paved				Roofs				Historic/Agriculture				Weighted C_5 & C_{100}		Basins Total Weighted % Imp.
Basin ID	Total Area (ac)	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	
EX1	9.89	0.59	0.70	0.26	80.0%	0.90	0.96	0.29	100.0%	0.73	0.81	0.14	90.0%	0.09	0.36	9.20	2.0%	0.14	0.39	8.2%
EX2	19.19	0.59	0.70	0.00	80.0%	0.90	0.96	0.00	100.0%	0.73	0.81	0.00	90.0%	0.09	0.36	19.19	2.0%	0.09	0.36	2.0%
Total	**29.08**																			**4.1%**

STANDARD FORM SF-2 - EXISTING CONDITIONS
TIME OF CONCENTRATION

Subdivision: Hay Creek Subdivision
Location: El Paso County

Project Name: Hay Creek Subdivision
Project No.: 24019.00
Calculated By: NQJ
Checked By:
Date: 9/13/24

SUB-BASIN DATA					INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Weighted C_5	Impervious (%)	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)
EX1	9.89	B	0.14	4.1%	226	6.8%	13.9	1092	2.6%	5.0	0.8	22.6	36.5	1318.0	37.1	36.5
EX2	19.19	B	0.09	2%	217	30.0%	8.7	1674	5.5%	5.0	1.2	23.8	32.5	1891.0	38.5	32.5

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Where:

t_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).

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

Equation 6-4 $26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$ Equation 6-5

:

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).

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

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 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Hay Creek Subdivision
Location: El Paso County
Design Storm: 5-Year

Project Name: Hay Creek Subdivision
Project No.: 24008.00
Calculated By: NQJ
Checked By:
Date: 9/13/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			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)	
		EX1	9.89	0.14	36.5	1.34	2.19	2.9															BASIN EX1 HISTORIC FLOW, OVERLAND FLOW TO HAY CREEK, CREEK FLOW TO DP1
		EX2	19.19	0.09	32.5	1.73	2.36	4.1															BASIN EX1 HISTORIC FLOW, OVERLAND FLOW TO HAY CREEK, CREEK FLOW TO DP1
	1								36.5	3.07	2.19	6.7											TOTAL **ONSITE** FLOW @ DP1 (TOTAL FLOW IN HAY CREEK PER FEMA HEC-RAS MODEL = 311 CFS)

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

STANDARD FORM SF-3 - EXISTING CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Hay Creek Subdivision
Location: El Paso County
Design Storm: 100-Year

Project Name: Hay Creek Subdivision
Project No.: 24008.00
Calculated By: NQJ
Checked By:
Date: 9/13/24

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			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)	
		EX1	9.89	0.39	36.5	3.89	3.67	14.3															BASIN EX1 HISTORIC FLOW, OVERLAND FLOW TO HAY CREEK, CREEK FLOW TO DP1
		EX2	19.19	0.36	32.5	6.91	3.96	27.4															BASIN EX1 HISTORIC FLOW, OVERLAND FLOW TO HAY CREEK, CREEK FLOW TO DP1
	1								36.5	10.79	3.67	39.6											TOTAL **ONSITE** FLOW @ DP1 (TOTAL FLOW IN HAY CREEK PER FEMA HEC-RAS MODEL = 311 CFS)

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

COMPOSITE % IMPERVIOUS CALCULATIONS - PROPOSED CONDITIONS

Subdivision: Hay Creek Subdivision
Location: El Paso County

Project Name: Hay Creek Subdivision
Project No.: 24008.00
Calculated By: NQJ
Checked By:
Date: 9/13/24

		Gravel Drives				Paved				Roofs				5-acre Lots (10% max imp.)				Lawns/Pasture				Weighted C_5 & C_{100}		Basins Total
Basin ID	Total Area (ac)	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Weighted
1	4.54	0.59	0.70	0.18	80.0%	0.90	0.96	0.12	100.0%	0.73	0.81	0.06	90.0%	0.14	0.40	0.00	10.0%	0.08	0.35	4.18	0.0%	0.13	0.39	7.0%
2	10.07	0.59	0.70	0.00	80.0%	0.90	0.96	0.00	100.0%	0.73	0.81	0.00	90.0%	0.14	0.40	7.32	10.0%	0.08	0.35	2.75	0.0%	0.12	0.39	7.3%
3	5.35	0.59	0.70	0.28	80.0%	0.90	0.96	0.24	100.0%	0.73	0.81	0.09	90.0%	0.14	0.40	3.57	10.0%	0.08	0.35	1.17	0.0%	0.19	0.44	16.8%
4	9.12	0.59	0.70	0.20	80.0%	0.90	0.96	0.00	100.0%	0.73	0.81	0.00	90.0%	0.14	0.40	5.59	10.0%	0.08	0.35	3.33	0.0%	0.13	0.39	7.9%
Total	**29.08**																							**9.2%**

STANDARD FORM SF-2 - PROPOSED CONDITIONS
TIME OF CONCENTRATION

Subdivision: Hay Creek Subdivision
Location: El Paso County

Project Name: Hay Creek Subdivision
Project No.: 24019.00
Calculated By: NQJ
Checked By:
Date: 9/13/24

SUB-BASIN DATA					INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Weighted C_5	Impervious (%)	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)
1	4.54	B	0.08	7.0%	201	6.1%	14.4	665	2.6%	5.0	0.8	13.7	28.1	866.0	31.7	28.1
2	10.07	B	0.08	7.3%	177	29.0%	8.1	1309	5.5%	3.0	0.7	31.0	39.1	1486.0	34.1	34.1
3	5.35	B	0.08	16.8%	179	13.2%	10.5	718	7.0%	5.0	1.3	9.0	19.6	897.0	27.1	19.6
4	9.12	B	0.08	7.9%	207	15.4%	10.7	881	7.9%	3.0	0.8	17.4	28.2	1088.0	29.8	28.2

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Where:

t_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).

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

Equation 6-4 $(6 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$ Equation 6-5

:

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).

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

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 - PROPOSED CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Hay Creek Subdivision
Location: El Paso County
Design Storm: 5-Year

Project Name: Hay Creek Subdivision
Project No.: 24008.00
Calculated By: NQJ
Checked By:
Date: 9/13/24

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	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)	REMARKS
		1	4.54	0.13	28.1	0.59	2.58	1.5															BASIN 1 HISTORIC FLOW, OVERLAND FLOW TO HAY CREEK, CREEK FLOW TO DP1
		2	10.07	0.12	34.1	1.24	2.29	2.9															BASIN 2 HISTORIC FLOW, OVERLAND FLOW TO HAY CREEK, CREEK FLOW TO DP1
	1								34.1	1.84	2.29	4.2	4.21	1.84	2.7					360	1.6	3.7	COMBINED BASIN 1 & 2 FLOW @ DP1, CREEK FLOW TO DP2
		3	5.35	0.19	19.6	1.04	3.12	3.2															BASIN 3 FLOW @ DP2
		4	9.12	0.13	28.2	1.17	2.58	3.0															BASIN 4 FLOW @ DP2
	2								37.7	4.04	2.14	8.6											TOTAL **ONSITE** FLOW TO DP2 (HAY CREEK), FOLLOWS HISTORIC PATTERNS OFFSITE TO THE EAST

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

STANDARD FORM SF-3 - PROPOSED CONDITIONS

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Hay Creek Subdivision
Location: El Paso County
Design Storm: 100-Year

Project Name: Hay Creek Subdivision
Project No.: 24008.00
Calculated By: NQJ
Checked By:
Date: 9/13/24

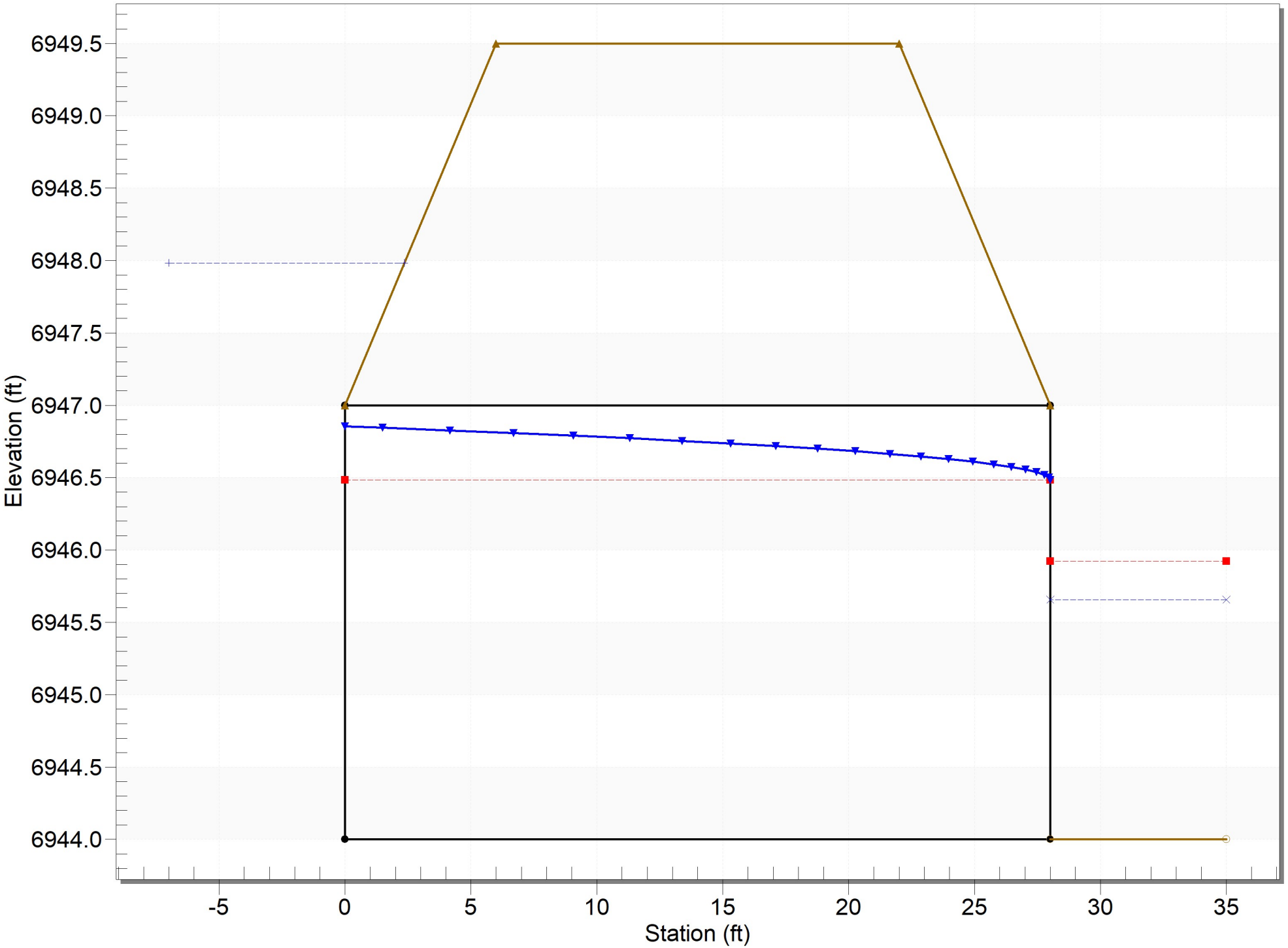
STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
		1	4.54	0.39	28.1	1.75	4.33	7.6															BASIN 1 HISTORIC FLOW, OVERLAND FLOW TO HAY CREEK, CREEK FLOW TO DP1
		2	10.07	0.39	34.1	3.89	3.84	15.0															BASIN 2 HISTORIC FLOW, OVERLAND FLOW TO HAY CREEK, CREEK FLOW TO DP1
	1								34.1	5.64	3.84	21.7	21.7	5.64	2.7					360	1.6	3.7	COMBINED BASIN 1 & 2 FLOW @ DP1, CREEK FLOW TO DP2
		3	5.35	0.44	19.6	2.34	5.24	12.2															BASIN 3 FLOW @ DP2
		4	9.12	0.39	28.2	3.54	4.32	15.3															BASIN 4 FLOW @ DP2
	2								37.7	11.52	3.59	41.3											TOTAL **ONSITE** FLOW TO DP2 (HAY CREEK), FOLLOWS HISTORIC PATTERNS OFFSITE TO THE EAST

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

APPENDIX C – HYDRAULIC CALCULATIONS

Crossing - Crossing 1, Design Discharge - 311.0 cfs

Culvert - Culvert 1 - modified channel DS, Culvert Discharge - 311.0 cfs



Culvert Crossing: Crossing 1

Culvert Summary Table - Culvert 1

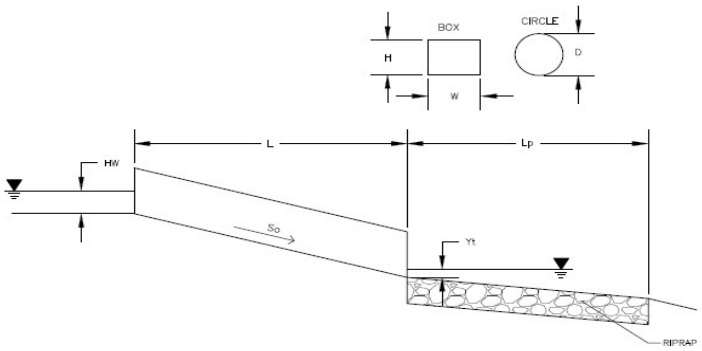
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
Q5	55.00	55.00	6945.52	1.52	1.31	7-H2t	NA	0.78	0.90	0.90	4.36	5.61
Q100	311.00	311.00	6948.01	3.93	4.01	7-H2c	NA	2.48	2.48	2.25	8.94	9.53

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Hay Creek**

ID: **Road Crossing Culvert (twin 7'x3' box)**

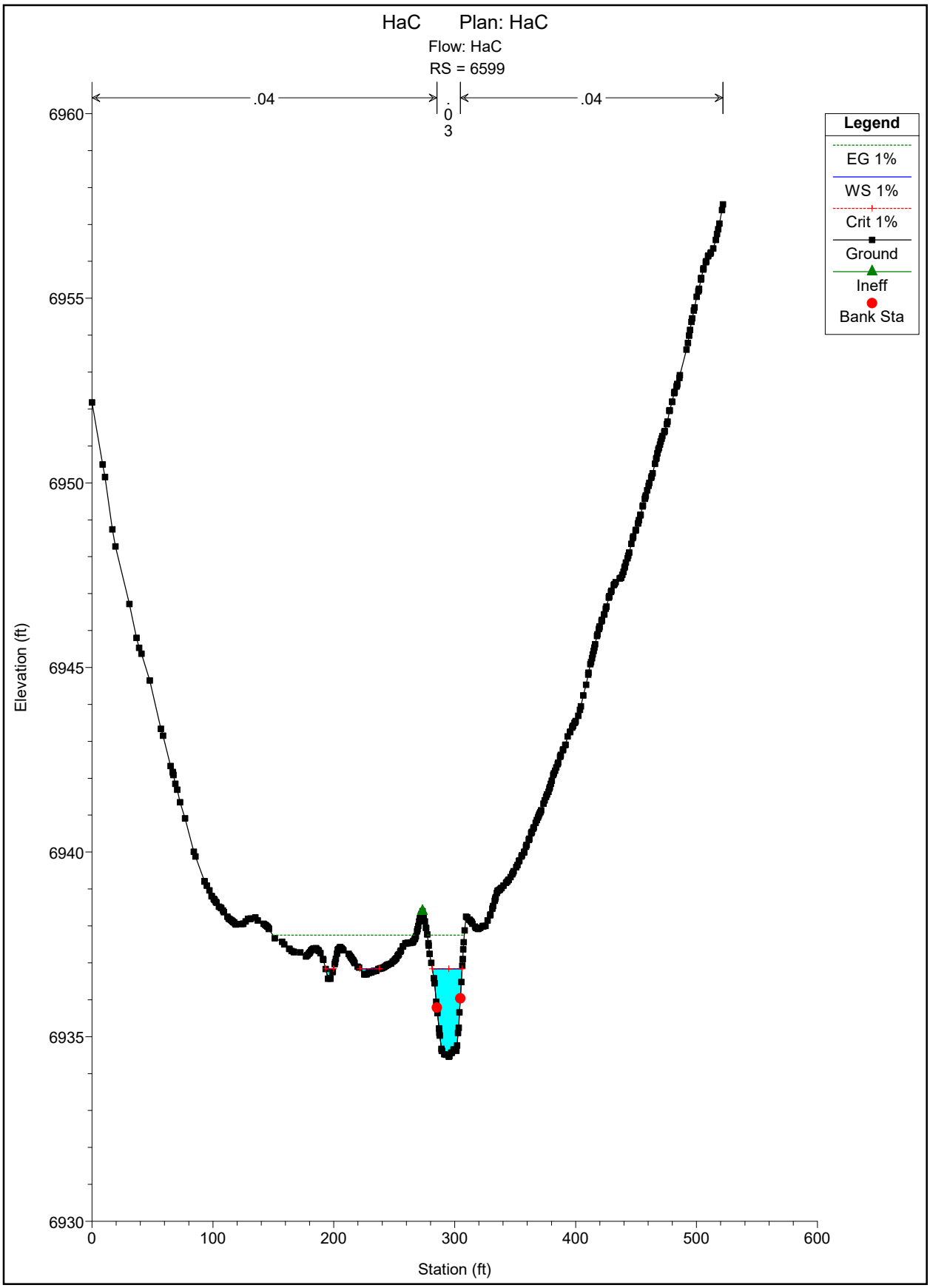


Soil Type:

Choose One:
- (●) Sandy
- ( ) Non-Sandy

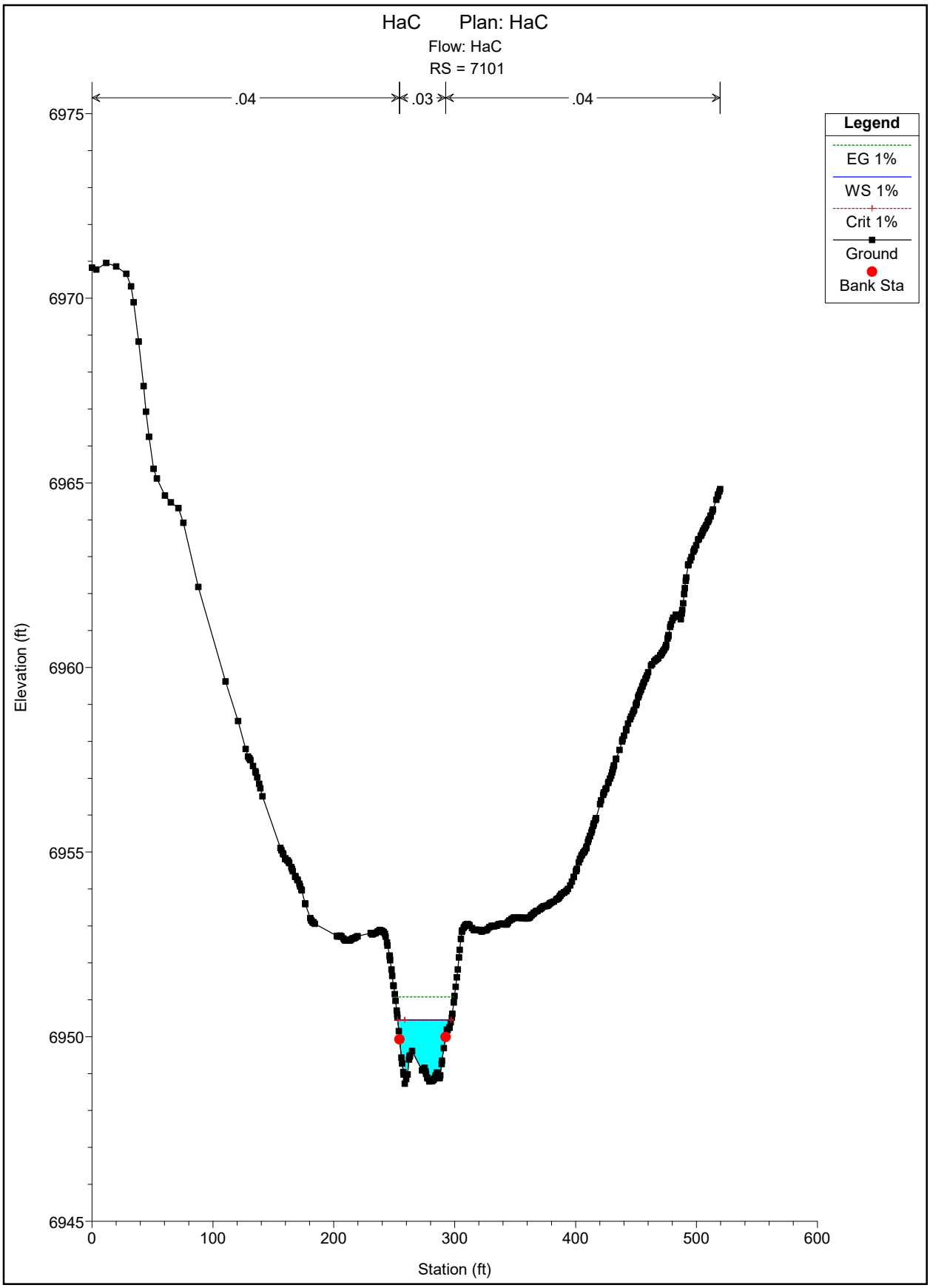
Design Information:				
	Design Discharge	Q =	311	cfs
Circular Culvert:				
	Barrel Diameter in Inches	D =		inches
	Inlet Edge Type (Choose from pull-down list)			
OR:				
Box Culvert:			**OR**	
	Barrel Height (Rise) in Feet	H (Rise) =	3	ft
	Barrel Width (Span) in Feet	W (Span) =	7	ft
	Inlet Edge Type (Choose from pull-down list)		1.5:1 Bevel w/ 90 deg. Headwall	
	Number of Barrels	# Barrels =	2	
	Inlet Elevation	Elev IN =	44	ft
	Outlet Elevation **OR** Slope	Elev OUT =	44	ft
	Culvert Length	L =	28	ft
	Manning's Roughness	n =	0.012	
	Bend Loss Coefficient	k_b =	0	
	Exit Loss Coefficient	k_x =	1	
	Tailwater Surface Elevation	$Y_{t,\ Elevation}$ =		ft
	Max Allowable Channel Velocity	V =	5	ft/s

Calculated Results:				
	Culvert Cross Sectional Area Available	A =	21.00	ft^2
	Culvert Normal Depth	Y_n =	3.00	ft
	Culvert Critical Depth	Y_c =	2.48	ft
	Froude Number	Fr =	-	**Pressure flow!**
	Entrance Loss Coefficient	k_e =	#REF!	
	Friction Loss Coefficient	k_f =	0.11	
	Sum of All Loss Coefficients	k_s =	#REF!	ft
Headwater:				
	Inlet Control Headwater	HW_I =	3.93	ft
	Outlet Control Headwater	HW_O =		ft
	Design Headwater Elevation	**HW =**	**47.93**	**ft**
	Headwater/Diameter OR Headwater/Rise Ratio	**HW/H=**	**1.31**	
Outlet Protection:				
	Flow/(Span * Rise^1.5)	Q/WH^1.5 =	4.28	$ft^{0.5}/s$
	Tailwater Surface Height	Y_t =	1.20	ft
	Tailwater/Rise	Yt/H =	0.40	
	Expansion Factor	1/(2*tan(Θ)) =	2.08	
	Flow Area at Max Channel Velocity	A_t =	62.20	ft^2
	Width of Equivalent Conduit for Multiple Barrels	W_{eq} =	14.00	ft
	Length of Riprap Protection	**L_p =**	**30**	**ft**
	Width of Riprap Protection at Downstream End	**T =**	**29**	**ft**
	Adjusted Rise for Supercritical Flow	Ha =	-	ft
	Minimum Theoretical Riprap Size	d_{50} min=	5	in
	Nominal Riprap Size	d_{50} nominal=	6	in
	MHFD Riprap Type	**Type =**	**VL**	


HaC Plan: HaC
Flow: HaC
RS = 6599
.04
.03
.04
Legend
EG 1%
WS 1%
Crit 1%
Ground
Ineff
Bank Sta
Elevation (ft)
6960
6955
6950
6945
6940
6935
6930
0
100
200
300
400
500
600
Station (ft)

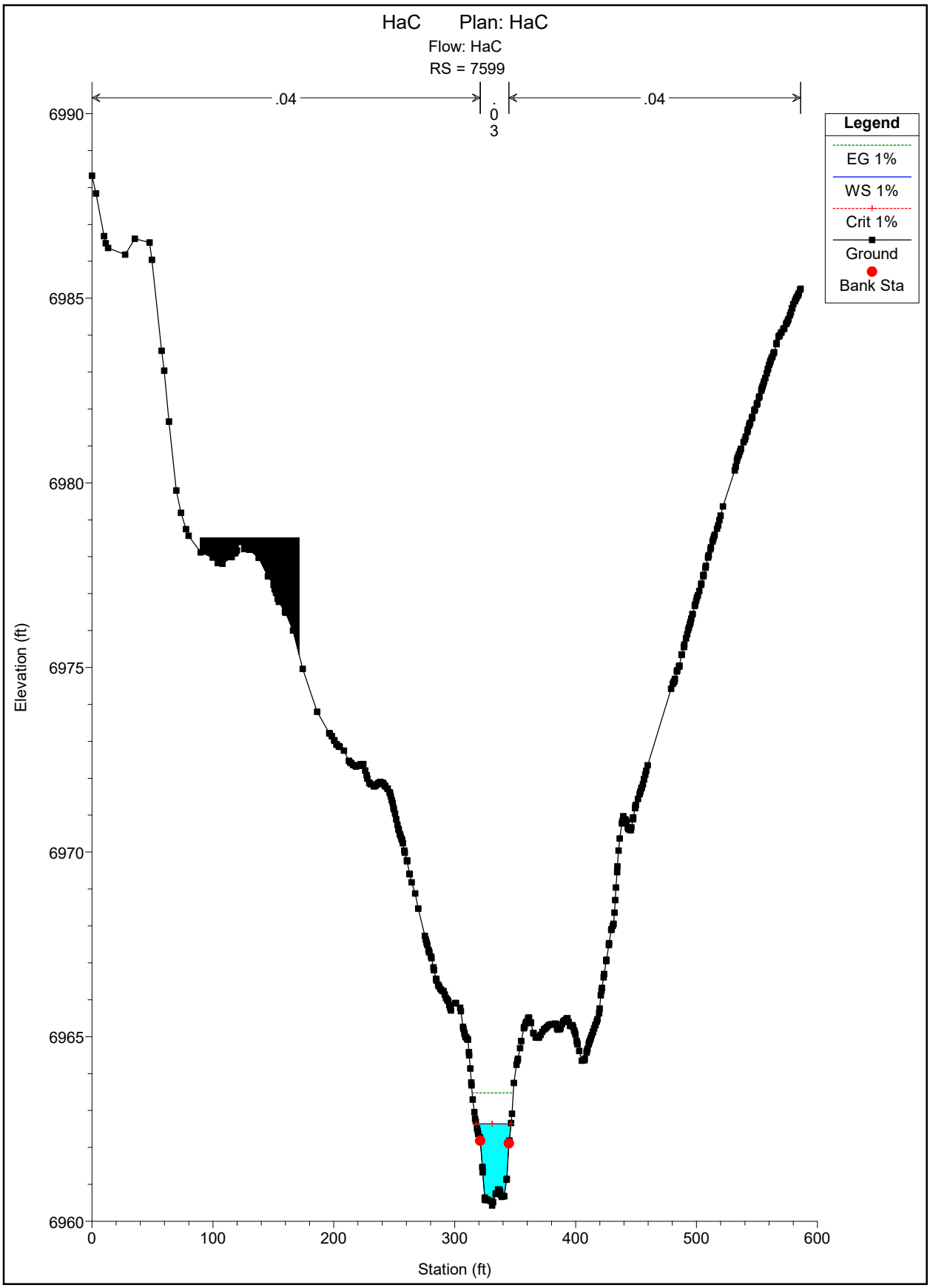
Plan: HaC HaC 1 RS: 6599 Profile: 1%

E.G. Elev (ft)	6937.75	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.92	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	6936.84	Reach Len. (ft)	319.90	319.90	319.90
Crit W.S. (ft)	6936.84	Flow Area (sq ft)	1.80	39.62	0.52
E.G. Slope (ft/ft)	0.009730	Area (sq ft)	4.30	39.62	0.52
Q Total (cfs)	311.00	Flow (cfs)	3.86	306.23	0.92
Top Width (ft)	47.42	Top Width (ft)	26.66	19.40	1.35
Vel Total (ft/s)	7.42	Avg. Vel. (ft/s)	2.14	7.73	1.76
Max Chl Dpth (ft)	2.38	Hydr. Depth (ft)	0.46	2.04	0.39
Conv. Total (cfs)	3152.9	Conv. (cfs)	39.1	3104.5	9.3
Length Wtd. (ft)	319.90	Wetted Per. (ft)	4.04	19.91	1.57
Min Ch El (ft)	6934.46	Shear (lb/sq ft)	0.27	1.21	0.20
Alpha	1.07	Stream Power (lb/ft s)	0.58	9.34	0.35
Frctn Loss (ft)	2.93	Cum Volume (acre-ft)	0.48	25.46	0.25
C & E Loss (ft)	0.20	Cum SA (acres)	1.38	7.47	0.78


HaC Plan: HaC
Flow: HaC
RS = 7101
.04
.03
.04
Legend
EG 1%
WS 1%
Crit 1%
Ground
Bank Sta
Elevation (ft)
6975
6970
6965
6960
6955
6950
6945
0
100
200
300
400
500
600
Station (ft)

Plan: HaC HaC 1 RS: 7101 Profile: 1%

E.G. Elev (ft)	6951.07	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.62	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	6950.46	Reach Len. (ft)	502.50	502.50	502.50
Crit W.S. (ft)	6950.46	Flow Area (sq ft)	0.39	48.84	1.06
E.G. Slope (ft/ft)	0.011876	Area (sq ft)	0.39	48.84	1.06
Q Total (cfs)	311.00	Flow (cfs)	0.61	308.80	1.59
Top Width (ft)	44.26	Top Width (ft)	1.51	38.10	4.65
Vel Total (ft/s)	6.18	Avg. Vel. (ft/s)	1.58	6.32	1.50
Max Chl Dpth (ft)	1.73	Hydr. Depth (ft)	0.26	1.28	0.23
Conv. Total (cfs)	2853.8	Conv. (cfs)	5.6	2833.6	14.6
Length Wtd. (ft)	502.50	Wetted Per. (ft)	1.60	38.53	4.69
Min Ch El (ft)	6948.73	Shear (lb/sq ft)	0.18	0.94	0.17
Alpha	1.04	Stream Power (lb/ft s)	0.28	5.94	0.25
Frctn Loss (ft)	5.39	Cum Volume (acre-ft)	0.50	25.97	0.26
C & E Loss (ft)	0.03	Cum SA (acres)	1.54	7.80	0.82


HaC Plan: HaC
Flow: HaC
RS = 7599
.04
.03
.04
Legend
EG 1%
WS 1%
Crit 1%
Ground
Bank Sta
Elevation (ft)
6990
6985
6980
6975
6970
6965
6960
0
100
200
300
400
500
600
Station (ft)

Plan: HaC HaC 1 RS: 7599 Profile: 1%

E.G. Elev (ft)	6963.48	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.84	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	6962.63	Reach Len. (ft)	498.10	498.10	498.10
Crit W.S. (ft)	6962.63	Flow Area (sq ft)	0.78	41.91	0.46
E.G. Slope (ft/ft)	0.010806	Area (sq ft)	0.78	41.91	0.46
Q Total (cfs)	311.00	Flow (cfs)	1.15	309.14	0.71
Top Width (ft)	28.79	Top Width (ft)	3.27	23.80	1.72
Vel Total (ft/s)	7.21	Avg. Vel. (ft/s)	1.47	7.38	1.55
Max Chl Dpth (ft)	2.20	Hydr. Depth (ft)	0.24	1.76	0.27
Conv. Total (cfs)	2991.8	Conv. (cfs)	11.1	2973.9	6.8
Length Wtd. (ft)	498.10	Wetted Per. (ft)	3.32	24.45	1.80
Min Ch El (ft)	6960.43	Shear (lb/sq ft)	0.16	1.16	0.17
Alpha	1.04	Stream Power (lb/ft s)	0.23	8.53	0.26
Frctn Loss (ft)	5.64	Cum Volume (acre-ft)	0.51	26.49	0.27
C & E Loss (ft)	0.07	Cum SA (acres)	1.57	8.15	0.85

APPENDIX D – WATER QUALITY & DETENTION

APPENDIX E – REFERENCE MATERIAL

2024 Financial Assurance Estimate Form
(with pre-plat construction)

Updated: 10/2023

PROJECT INFORMATION		
HAY CREEK HULL SUBDIVISION	11/7/2024	
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	150.	CY	$ 8.00	=	$ 5,300.00		$ 5,300.00	*
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		CY	$ 2.50	=	$ -		$ -	*
greater than 200,000; $500,000 min		CY	$ 2.00	=	$ -		$ -	*
Permanent Erosion Control Blanket		SY	$ 9.00	=	$ -		$ -	*
Permanent Seeding (inc. noxious weed mgmnt.) & Mulching	.4	AC	$ 2,018.00	=	$ 807.20		$ 807.20	*
Permanent Pond/BMP (provide engineer's estimate)		EA		=	$ -		$ -	*
Concrete Washout Basin		EA	$ 1,172.00	=	$ -		$ -	
Inlet Protection	1.	EA	$ 217.00	=	$ 217.00		$ 217.00	
Rock Check Dam		EA	$ 651.00	=	$ -		$ -	
Safety Fence		LF	$ 3.00	=	$ -		$ -	
Sediment Basin	1.	EA	$ 2,294.00	=	$ 2,294.00		$ 2,294.00	
Sediment Trap		EA	$ 538.00	=	$ -		$ -	
Silt Fence	1020.	LF	$ 3.00	=	$ 3,060.00		$ 3,060.00	
Slope Drain		LF	$ 43.00		$ -		$ -	
Straw Bale		EA	$ 33.00	=	$ -		$ -	
Straw Wattle/Rock Sock		LF	$ 8.00	=	$ -		$ -	
Surface Roughening		AC	$ 269.00		$ -		$ -	
Temporary Erosion Control Blanket	1995.	SY	$ 3.00	=	$ 5,985.00		$ 5,985.00	
Temporary Seeding and Mulching		AC	$ 1,793.00	=	$ -		$ -	
Vehicle Tracking Control	1.	EA	$ 3,085.00	=	$ 3,085.00		$ 3,085.00	
				=	$ -		$ -	
[insert items not listed but part of construction plans]				=	$ -		$ -	
MAINTENANCE (35% of Construction BMPs)				=	$ 5,124.35		$ 5,124.35	
* - Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)		**Section 1 Subtotal**		**=**	**$ 25,872.55**		**$ 25,872.55**	
SECTION 2 - PUBLIC IMPROVEMENTS *								
ROADWAY IMPROVEMENTS								*
Construction Traffic Control		LS		=	$ -		$ -	*
Aggregate Base Course (135 lbs/cf)		Tons	$ 37.00	=	$ -		$ -	*
Aggregate Base Course (135 lbs/cf)	76.	CY	$ 66.00		$ 5,016.00		$ 5,016.00	*
Asphalt Pavement (3" thick)		SY	$ 18.00		$ -		$ -	*
Asphalt Pavement (4" thick)	222.	SY	$ 25.00		$ 5,550.00		$ 5,550.00	*
Asphalt Pavement (6" thick)		SY	$ 38.00		$ -		$ -	*
Asphalt Pavement (147 lbs/cf) __" thick		Tons	$ 114.00	=	$ -		$ -	*
Raised Median, Paved		SF	$ 11.00	=	$ -		$ -	*
Regulatory Sign/Advisory Sign		EA	$ 392.00	=	$ -		$ -	*
Guide/Street Name Sign		EA		=	$ -		$ -	*
Epoxy Pavement Marking		SF	$ 17.00	=	$ -		$ -	*
Thermoplastic Pavement Marking		SF	$ 30.00	=	$ -		$ -	*
Barricade - Type 3		EA	$ 259.00	=	$ -		$ -	*
Delineator - Type I		EA	$ 31.00	=	$ -		$ -	*
Curb and Gutter, Type A (6" Vertical)		LF	$ 38.00	=	$ -		$ -	*
Curb and Gutter, Type B (Median)		LF	$ 38.00	=	$ -		$ -	*
Curb and Gutter, Type C (Ramp)		LF	$ 38.00	=	$ -		$ -	*
4" Sidewalk (common areas only)		SY	$ 62.00	=	$ -		$ -	*
5" Sidewalk		SY	$ 77.00	=	$ -		$ -	*
6" Sidewalk		SY	$ 94.00	=	$ -		$ -	*
8" Sidewalk		SY	$ 125.00		$ -		$ -	*
Pedestrian Ramp		EA	$ 1,496.00	=	$ -		$ -	*
Cross Pan, local (8" thick, 6' wide to include return)		LF	$ 79.00	=	$ -		$ -	*
Cross Pan, collector (9" thick, 8' wide to include return)		LF	$ 119.00		$ -		$ -	*
Curb Opening with Drainage Chase		EA	$ 1,926.00	=	$ -		$ -	*
Guardrail Type 3 (W-Beam)		LF	$ 65.00	=	$ -		$ -	*
Guardrail Type 7 (Concrete)		LF	$ 94.00	=	$ -		$ -	*
Guardrail End Anchorage		EA	$ 2,731.00	=	$ -		$ -	*
Guardrail Impact Attenuator		EA	$ 4,902.00	=	$ -		$ -	*
Sound Barrier Fence (CMU block, 6' high)		LF	$ 102.00		$ -		$ -	*
Sound Barrier Fence (panels, 6' high)		LF	$ 104.00	=	$ -		$ -	*
Electrical Conduit, Size =		LF	$ 22.00	=	$ -		$ -	*
Traffic Signal, (provide engineer's estimate)		EA		=	$ -		$ -	*

PROJECT INFORMATION		
HAY CREEK HULL SUBDIVISION	11/7/2024	
Project Name	Date	PCD File No.

Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction) % Complete	Remaining	
CISTERN				=	$ -		$ -	
[insert items not listed but part of construction plans]				=	$ -		$ -	*
STORM DRAIN IMPROVEMENTS								*
Concrete Box Culvert (M Standard), Size (7 x 3)		LF		=	$ -		$ -	*
18" Reinforced Concrete Pipe		LF	$ 82.00	=	$ -		$ -	*
24" Reinforced Concrete Pipe		LF	$ 98.00	=	$ -		$ -	*
30" Reinforced Concrete Pipe		LF	$ 123.00	=	$ -		$ -	*
36" Reinforced Concrete Pipe		LF	$ 151.00	=	$ -		$ -	*
42" Reinforced Concrete Pipe		LF	$ 201.00	=	$ -		$ -	*
48" Reinforced Concrete Pipe		LF	$ 245.00	=	$ -		$ -	*
54" Reinforced Concrete Pipe		LF	$ 320.00	=	$ -		$ -	*
60" Reinforced Concrete Pipe		LF	$ 374.00	=	$ -		$ -	*
66" Reinforced Concrete Pipe		LF	$ 433.00	=	$ -		$ -	*
72" Reinforced Concrete Pipe		LF	$ 495.00	=	$ -		$ -	*
18" Corrugated Steel Pipe		LF	$ 105.00	=	$ -		$ -	*
24" Corrugated Steel Pipe		LF	$ 121.00	=	$ -		$ -	*
30" Corrugated Steel Pipe		LF	$ 154.00	=	$ -		$ -	*
36" Corrugated Steel Pipe		LF	$ 184.00	=	$ -		$ -	*
42" Corrugated Steel Pipe		LF	$ 212.00	=	$ -		$ -	*
48" Corrugated Steel Pipe		LF	$ 223.00	=	$ -		$ -	*
54" Corrugated Steel Pipe		LF	$ 327.00	=	$ -		$ -	*
60" Corrugated Steel Pipe		LF	$ 353.00	=	$ -		$ -	*
66" Corrugated Steel Pipe		LF	$ 427.00	=	$ -		$ -	*
72" Corrugated Steel Pipe		LF	$ 502.00	=	$ -		$ -	*
78" Corrugated Steel Pipe		LF	$ 578.00	=	$ -		$ -	*
84" Corrugated Steel Pipe		LF	$ 691.00	=	$ -		$ -	*
Flared End Section (FES) RCP Size = (unit cost = 6x pipe unit cost)		EA		=	$ -		$ -	*
Flared End Section (FES) CSP Size = (unit cost = 6x pipe unit cost)		EA		=	$ -		$ -	*
End Treatment- Headwall		EA		=	$ -		$ -	*
End Treatment- Wingwall		EA		=	$ -		$ -	*
End Treatment - Cutoff Wall		EA		=	$ -		$ -	*
Curb Inlet (Type R) L=5', Depth < 5'		EA	$ 7,212.00	=	$ -		$ -	*
Curb Inlet (Type R) L=5', 5' ≤ Depth < 10'		EA	$ 9,377.00	=	$ -		$ -	*
Curb Inlet (Type R) L =5', 10' ≤ Depth < 15'		EA	$ 10,859.00	=	$ -		$ -	*
Curb Inlet (Type R) L =10', Depth < 5'		EA	$ 9,925.00	=	$ -		$ -	*
Curb Inlet (Type R) L =10', 5' ≤ Depth < 10'		EA	$ 10,230.00	=	$ -		$ -	*
Curb Inlet (Type R) L =10', 10' ≤ Depth < 15'		EA	$ 12,805.00	=	$ -		$ -	*
Curb Inlet (Type R) L =15', Depth < 5'		EA	$ 12,907.00	=	$ -		$ -	*
Curb Inlet (Type R) L =15', 5' ≤ Depth < 10'		EA	$ 13,835.00	=	$ -		$ -	*
Curb Inlet (Type R) L =15', 10' ≤ Depth < 15'		EA	$ 15,130.00	=	$ -		$ -	*
Curb Inlet (Type R) L =20', Depth < 5'		EA	$ 13,755.00	=	$ -		$ -	*
Curb Inlet (Type R) L =20', 5' ≤ Depth < 10'		EA	$ 15,181.00	=	$ -		$ -	*
Grated Inlet (Type C), Depth < 5'		EA	$ 6,037.00	=	$ -		$ -	*
Grated Inlet (Type D), Depth < 5'		EA	$ 7,458.00	=	$ -		$ -	*
Storm Sewer Manhole, Box Base		EA	$ 15,130.00	=	$ -		$ -	*
Storm Sewer Manhole, Slab Base		EA	$ 8,322.00	=	$ -		$ -	*
Geotextile (Erosion Control)		SY	$ 9.00	=	$ -		$ -	*
Rip Rap, d50 size from 6" to 24"		Tons	$ 104.00	=	$ -		$ -	*
Rip Rap, Grouted		Tons	$ 124.00	=	$ -		$ -	*
Drainage Channel Construction, Size (W x H)		LF		=	$ -		$ -	*
Drainage Channel Lining, Concrete		CY	$ 741.00	=	$ -		$ -	*
Drainage Channel Lining, Rip Rap		CY	$ 145.00	=	$ -		$ -	*
Drainage Channel Lining, Grass		AC	$ 1,911.00	=	$ -		$ -	*
Drainage Channel Lining, Other Stabilization				=	$ -		$ -	*
				=	$ -		$ -	
[insert items not listed but part of construction plans]				=	$ -		$ -	
Section 2 Subtotal				=	**$ 10,566.00**		**$ 10,566.00**	

* - Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)

PROJECT INFORMATION		
HAY CREEK HULL SUBDIVISION	11/7/2024	
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							
Aggregate Base Course (135 lbs/cf)	700.	CY	$ 66.00	=	$ 46,200.00		$ 46,200.00
Earthwork - 1,000-5,000; $8,000 min	2000.	CY	$ 6.00	=	$ 12,000.00		$ 12,000.00
				=	$ -		$ -
				=	$ -		$ -
				=	$ -		$ -
				=	$ -		$ -
STORM DRAIN IMPROVEMENTS (Exception: Permanent Pond/BMP shall be itemized under Section 1)							
7' x 3' Reinforced Concrete Box Culvert	57.	LF	$ 1,200.00	=	$ 68,400.00		$ 68,400.00
Rip Rap, d50 size from 6" to 24"	48.	TONS	$ 104.00	=	$ 4,992.00		$ 4,992.00
Headwall	2.	EA	$ 7,500.00	=	$ 15,000.00		$ 15,000.00
				=	$ -		$ -
				=	$ -		$ -
				=	$ -		$ -
WATER SYSTEM IMPROVEMENTS							
Water Main Pipe (PVC), Size 8"		LF	$ 84.00	=	$ -		$ -
Water Main Pipe (Ductile Iron), Size 8"		LF	$ 98.00	=	$ -		$ -
Gate Valves, 8"		EA	$ 2,418.00	=	$ -		$ -
Fire Hydrant Assembly, w/ all valves		EA	$ 8,584.00	=	$ -		$ -
Water Service Line Installation, inc. tap and valves		EA	$ 1,723.00	=	$ -		$ -
Fire Cistern Installation, complete		EA		=	$ -		$ -
				=	$ -		$ -
[insert items not listed but part of construction plans]				=	$ -		$ -
SANITARY SEWER IMPROVEMENTS							
Sewer Main Pipe (PVC), Size 8"		LF	$ 84.00	=	$ -		$ -
Sanitary Sewer Manhole, Depth < 15 feet		EA	$ 5,708.00	=	$ -		$ -
Sanitary Service Line Installation, complete		EA	$ 1,825.00	=	$ -		$ -
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**		**=**	**$ 146,592.00**		**$ 146,592.00**

PROJECT INFORMATION		
HAY CREEK HULL SUBDIVISION	11/7/2024	
Project Name	Date	PCD File No.

Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction) % Complete	Remaining
AS-BUILT PLANS (Public Improvements inc. Permanent WQCV BMPs)				=	$ -		$ -
POND/BMP CERTIFICATION (inc. elevations and volume calculations)		LS		=	$ -		$ -

Total Construction Financial Assurance **$ 183,030.55**
(Sum of all section subtotals plus as-builts and pond/BMP certification)

Total Remaining Construction Financial Assurance (with Pre-Plat Construction) **$ 183,030.55**
(Sum of all section totals less credit for items complete plus as-builts and pond/BMP certification)

Total Defect Warranty Financial Assurance **$ 3,334.64**
(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

COMPOSITE % IMPERVIOUS CALCULATIONS - PROPOSED CONDITIONS

Subdivision: Hay Creek Subdivision
Location: El Paso County

Project Name: Hay Creek Subdivision
Project No.: 24008.00
Calculated By: NQJ
Checked By:
Date: 9/13/24

.68 acres of ROW removed for Fee calculation

		Gravel Drives				Paved				Roofs				5-acre Lots (10% max imp.)				Lawns/Pasture				Weighted C_5 & C_{100}		Basins Total Weighted
Basin ID	Total Area (ac)	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	Area (ac)	% Imp.	C_5	C_{100}	
1	3.86	0.59	0.70	0.18	80.0%	0.90	0.96	0.00	100.0%	0.73	0.81	0.06	90.0%	0.14	0.40	0.00	10.0%	0.08	0.35	3.62	0.0%	0.11	0.37	5.1%
2	10.07	0.59	0.70	0.00	80.0%	0.90	0.96	0.00	100.0%	0.73	0.81	0.00	90.0%	0.14	0.40	7.32	10.0%	0.08	0.35	2.75	0.0%	0.12	0.39	7.3%
3	5.35	0.59	0.70	0.28	80.0%	0.90	0.96	0.06	100.0%	0.73	0.81	0.09	90.0%	0.14	0.40	3.75	10.0%	0.08	0.35	1.17	0.0%	0.17	0.42	13.8%
4	9.12	0.59	0.70	0.20	80.0%	0.90	0.96	0.00	100.0%	0.73	0.81	0.00	90.0%	0.14	0.40	5.59	10.0%	0.08	0.35	3.33	0.0%	0.13	0.39	7.9%
Total	**28.40**																							**8.4%**

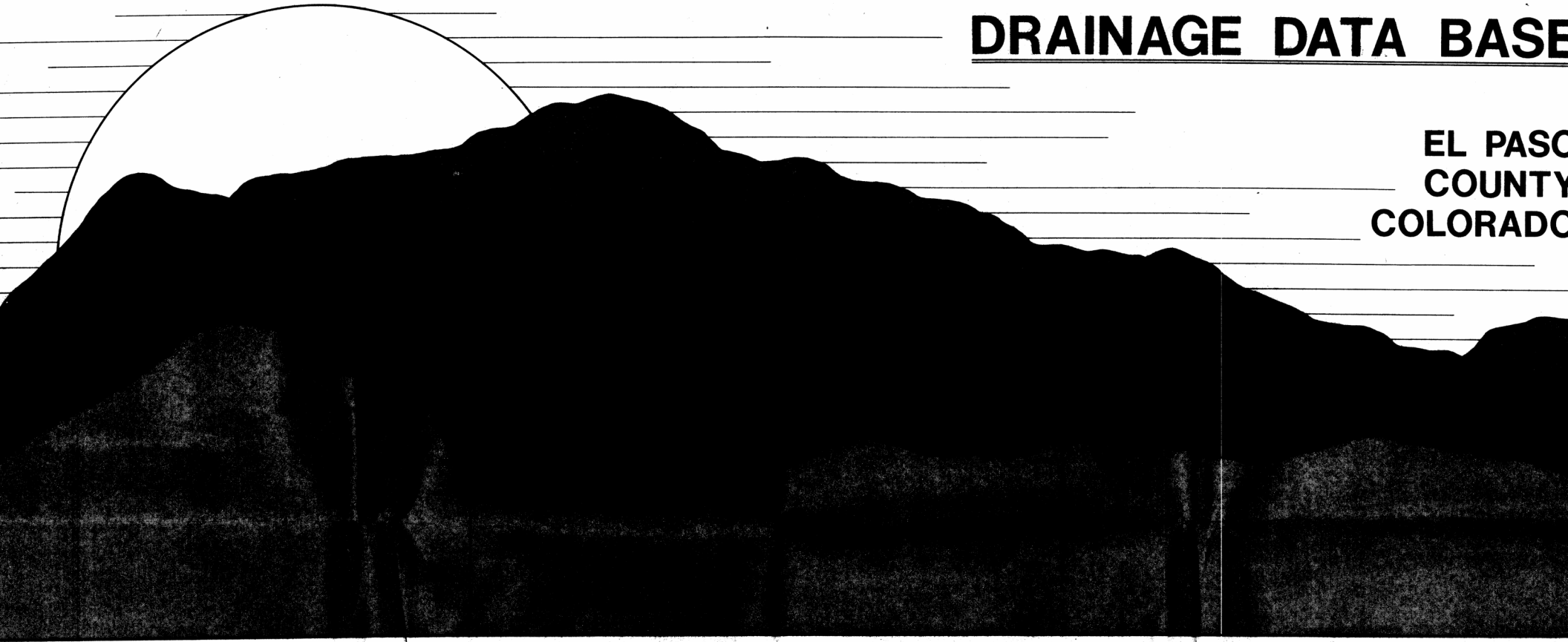
Off-site impervious areas not included (Hay Creek Road ROW improvements)

Total on-site imperviouness

0.084 * 28.40 ac = 2.38 impervious acres
Drainage Fee = 14,846/imp. acre
Total Fee Calculated = 2.38 * $14,846 = $35,416.62
25% reduction (low density lots) = .75* $35,416.62 = $26,562.46

DRAINAGE DATA BASE

EL PASO COUNTY COLORADO



DRAINAGE BASIN IDENTIFICATION AND FEE ESTIMATION MAPS

VOLUME II

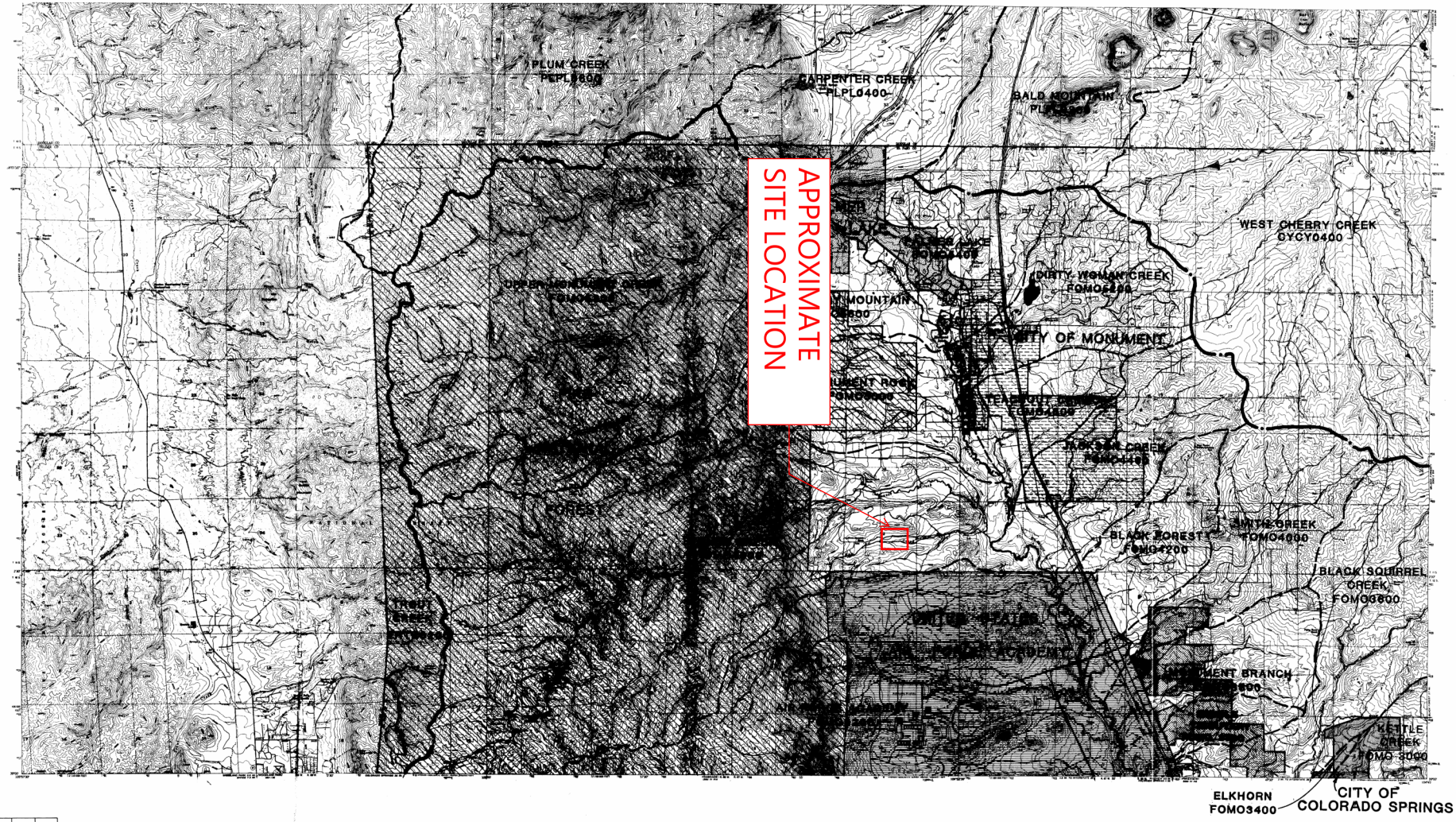
LEGEND

- HYDROLOGIC REGION BOUNDARY
- MAJOR BASIN BOUNDARY
- BASIN BOUNDARY
- STREAM
- COUNTY BOUNDARY
- SAND CREEK — BASIN NAME
- FOFO4000 — BASIN NUMBER
- CITY OF COLORADO SPRINGS
- CITY OF MONUMENT
- CITY OF PALMER LAKE
- CITY OF MANITOU SPRINGS
- CITY OF FOUNTAIN
- PIKE NATIONAL FOREST
- MILITARY RESERVATION

DRAWING INDEX

SHEET NO.	TITLE
1	TITLE SHEET
2	INDEX SHEET
3	DRAINAGE BASIN MAP NO. 1
4	DRAINAGE BASIN MAP NO. 2
5	DRAINAGE BASIN MAP NO. 3
6	DRAINAGE BASIN MAP NO. 4
7	DRAINAGE BASIN MAP NO. 5
8	DRAINAGE BASIN MAP NO. 6
9	DRAINAGE BASIN MAP NO. 7
10	DRAINAGE BASIN MAP NO. 8
11	DRAINAGE BASIN MAP NO. 9
12	DRAINAGE BASIN MAP NO. 10
13	DRAINAGE BASIN MAP NO. 11
14	DRAINAGE BASIN MAP NO. 12
15	DRAINAGE BASIN MAP NO. 13
16	DRAINAGE BASIN MAP NO. 14
17	DRAINAGE BASIN MAP NO. 15

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340



USGS QUADRANGLE MAP
AND BASIN MAP INDEX

7.5 MINUTE USGS QUADRANGLE MAPS
DAKAN MOUNTAIN — MOUNT DECEPTION
LARKSPUR — PALMER LAKE
GREENLAND — MONUMENT

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
7000 WEST FOURTEENTH AVENUE
LAKEWOOD, COLORADO 80215
(303) 232-9340

DESIGNED	JTW, BAD	DATE	4/88
DRAWN	BMG	DATE	4/88
CHECKED	LAM	DATE	4/88
REVISED	PDK/JTW	DATE	10-31

EL PASO COUNTY, COLORADO
Department of Transportation
3170 CENTURY STREET, COLORADO SPRINGS, COLORADO 80907

DRAINAGE AREA
IDENTIFICATION STUDY

DRAINAGE BASIN
MAP NO. 1

Drawing No
Sheet 3
MEC Proje

FINAL DRAINAGE REPORT

for

Hay Creek Ranch

Prepared for:
El Paso County
Department of Public Works
Engineering Division

On Behalf of:

Hay Creek, LLC

Prepared by:

Matrix Design Group, Inc.
Integrated Design Solutions
Infrastructure Engineering
Community Development
Program Management

2925 Professional Place, Suite 202
Colorado Springs, Colorado 80904
(719) 575-0100
fax (719) 575-0208

March 28, 2003

R:\01.054.001\Drainage\03-2003DR.doc

Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the 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.

SEAL

Jay S. Peters
Registered Professional Engineer
State of Colorado
No. 35068

Developer's Statement:

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

Hay Creek, LLC.
Business Name

By: _____
Title: Member
Address: 3045 Hay Creek Road
Colorado Springs, CO
80921

El Paso County:

Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

_____ 5-23-03
County Engineer/Director Date

Conditions:

3.0 Drainage Design Criteria

3.1 Development Criteria

Matrix Design Group (Matrix) planned the stormwater system based on the criteria presented in the City of Colorado Springs and El Paso County Drainage Criteria Manual, 1987, revised in 1994. The system is planned to not adversely impact off site flows, or aggravate existing stormwater related off site problems.

3.2 Hydrologic Criteria

Matrix conducted the hydrologic analyses based on the information presented in the City of Colorado Springs and El Paso County Drainage Criteria Manual, 1987, revised 1994.

Major Basin Hydrology

Flows for the Hay Creek Basin were analyzed using the National Resource Conservation Service (NRCS, Previously the Soil Conservation Service, or SCS) hydrograph method. We used the TR-20 computer model developed by the NRCS, which applies the unit hydrograph method presented in the DCM.

We evaluated the 10- and 100-year 24-hour storm events. The 24-hour rainfall depths are 3.0 and 4.4 inches for the 10- and 100-year storm events, respectively. We used the NRCS 24-hour Type IIa rainfall distribution (see Figure 5) to simulate storm events. Hydrologic information used in the analysis is summarized in Table 1. Detailed calculations are presented in Appendix A, as well as the TR-20 input and output.

The Hay Creek Watershed area was planimetered from the USGS quadrangle map. Land cover was obtained from aerial photos of the watershed. Soils information was obtained from the El Paso County Soil Survey and the 1992 Monument Creek Drainage Basin Study. The Curve Numbers (CN) used in the hydrologic analysis match the projected values presented in the Monument Creek Study (see Tables A.1 and A.2, and Figure A.2 in Appendix A).

We estimated the time of concentration using the standard NRCS method. The Hay Creek channel has a slope of about 4% for most of its length, and 33% for about 4,700 feet. See Figure A.2 and Table A.3 in Appendix A illustrating the time of concentration calculations. Matrix used the normal depth method to estimate the average channel velocity used in the NRCS peak flow estimates. The channel slopes used in the calculations were derived from contours on the USGS maps. The velocities used in the NRCS calculations are reasonable.

Table 1
NRCS Hydrograph Method Parameters

10-year 24-Hr Rainfall Depth (in)	100-Year 24-Hr Rainfall Depth (in)	Rainfall Distribution Type	Watershed Area (sq. mi.)	Time of Concentration (hrs)	CN
3.0	4.4	IIa 24-Hour	2.85	2.07	75

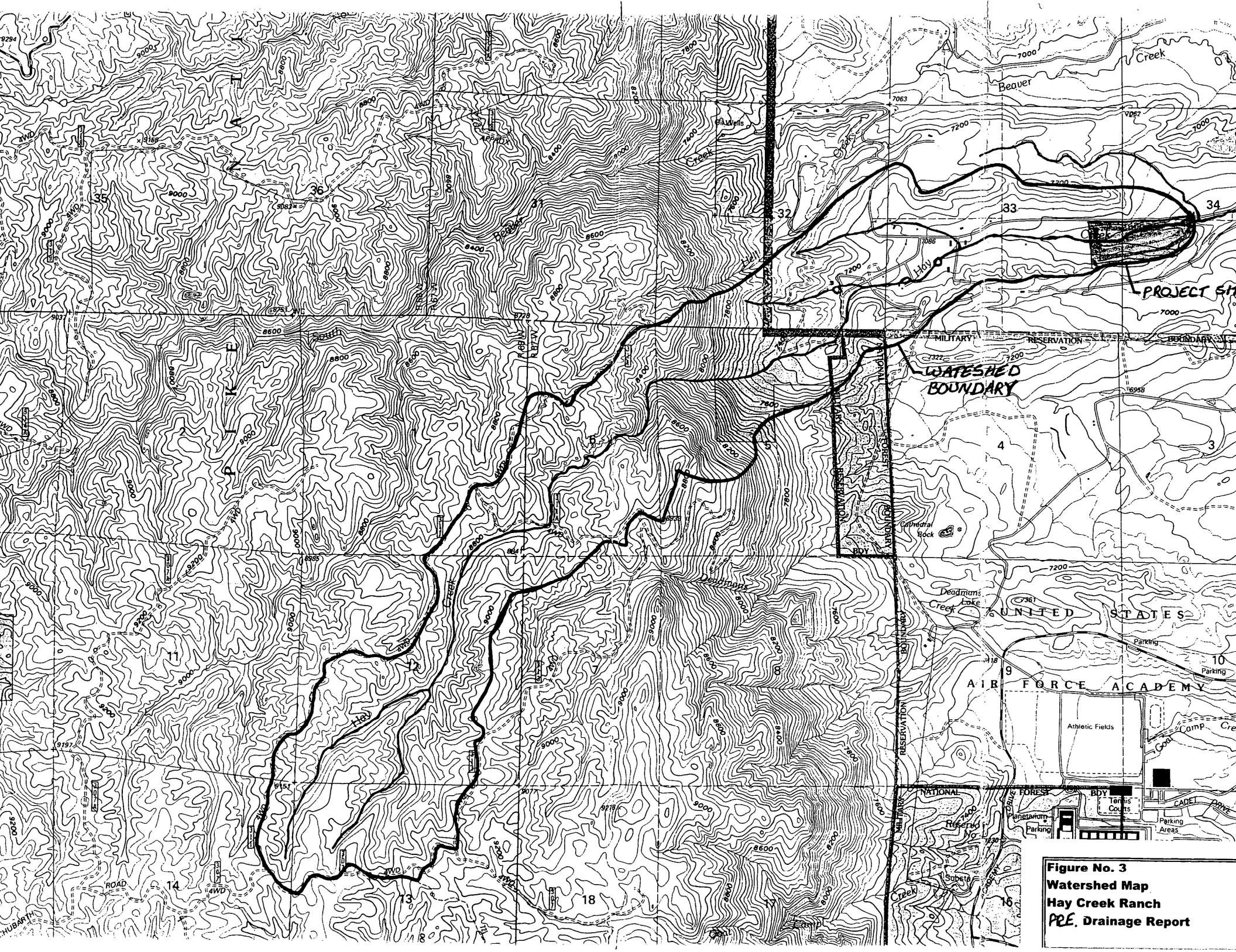


Figure No. 3
Watershed Map
Hay Creek Ranch
PRE. Drainage Report

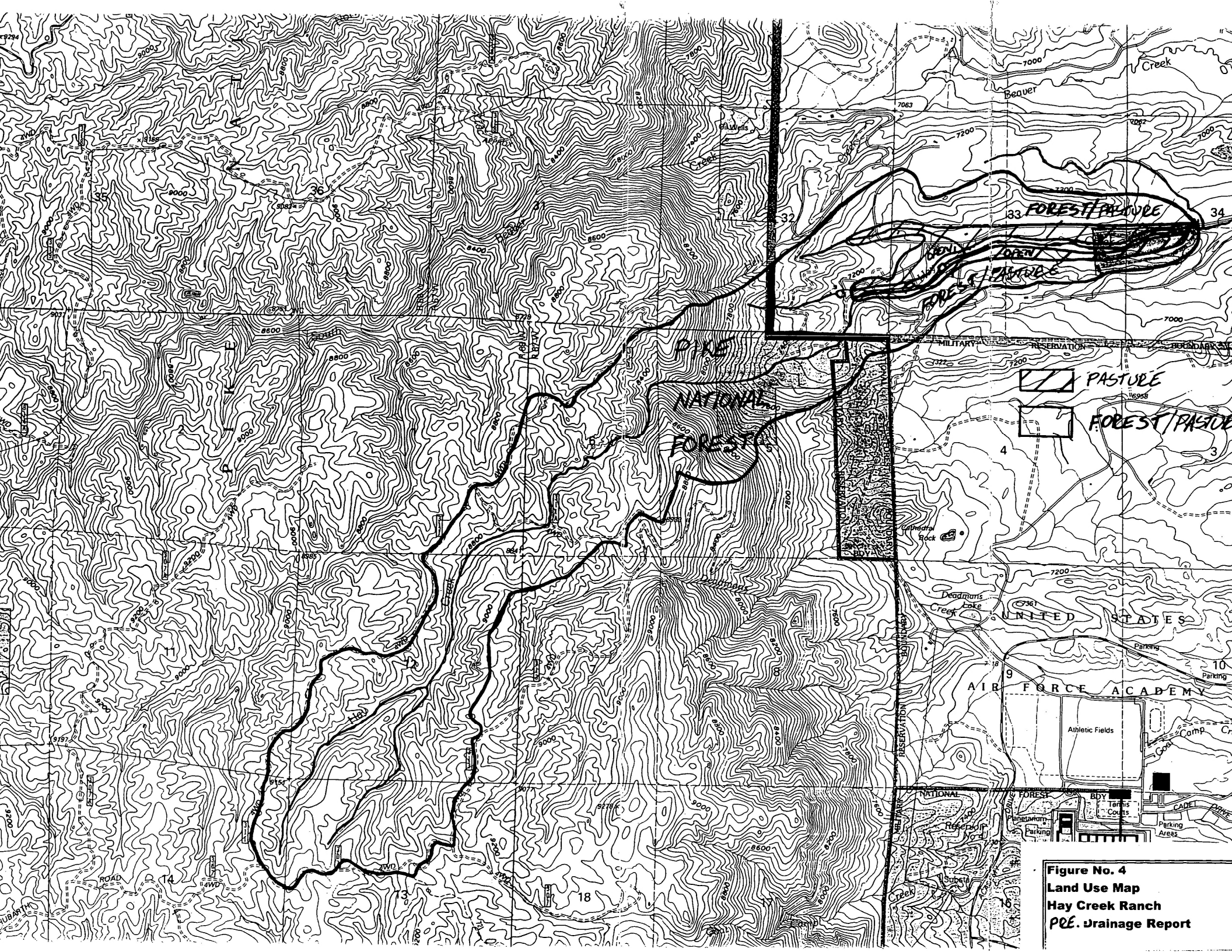


Figure No. 4
Land Use Map
Hay Creek Ranch
PRE. Drainage Report

FIGURE 5

TR-55

Custom Rainfall Distribution

C:\Program Files\WinTR55\RainfallDistributions\IA.tbl

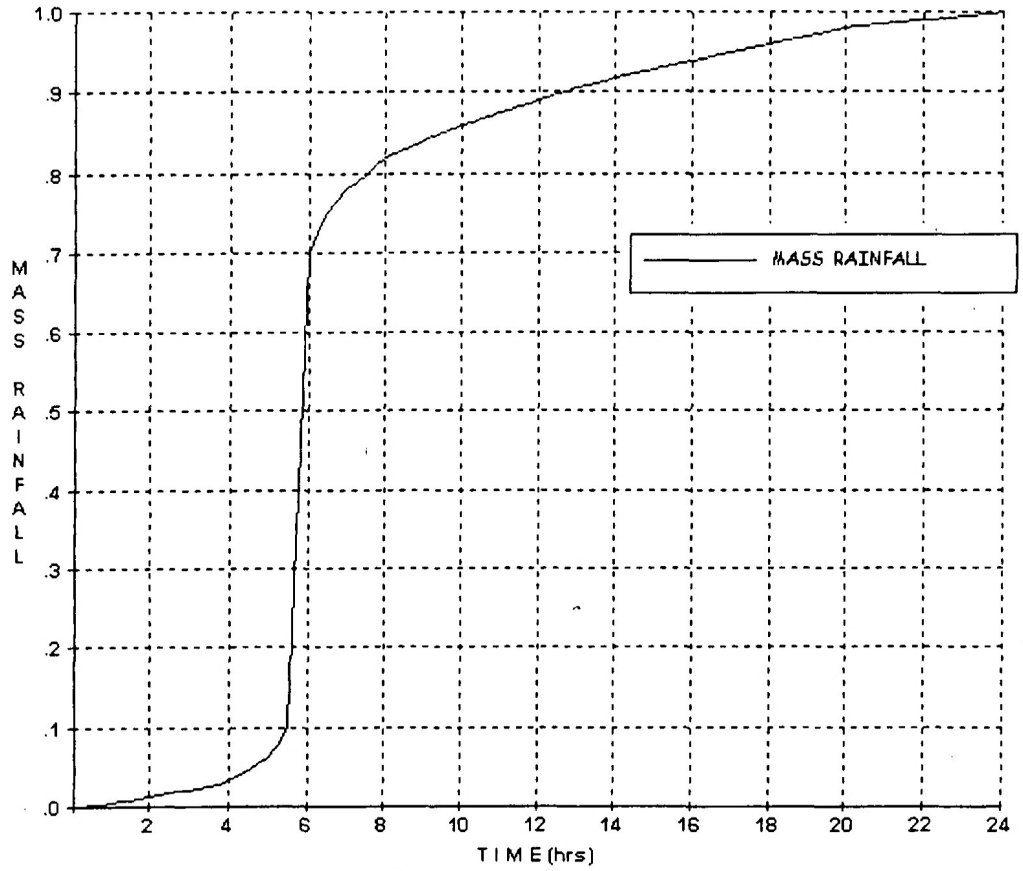


FIGURE 6

TR-55 Output Hydrograph

Project: Hay Creek Ranch

Subarea: (Outlet) Storms: 10-Yr, 100-Yr

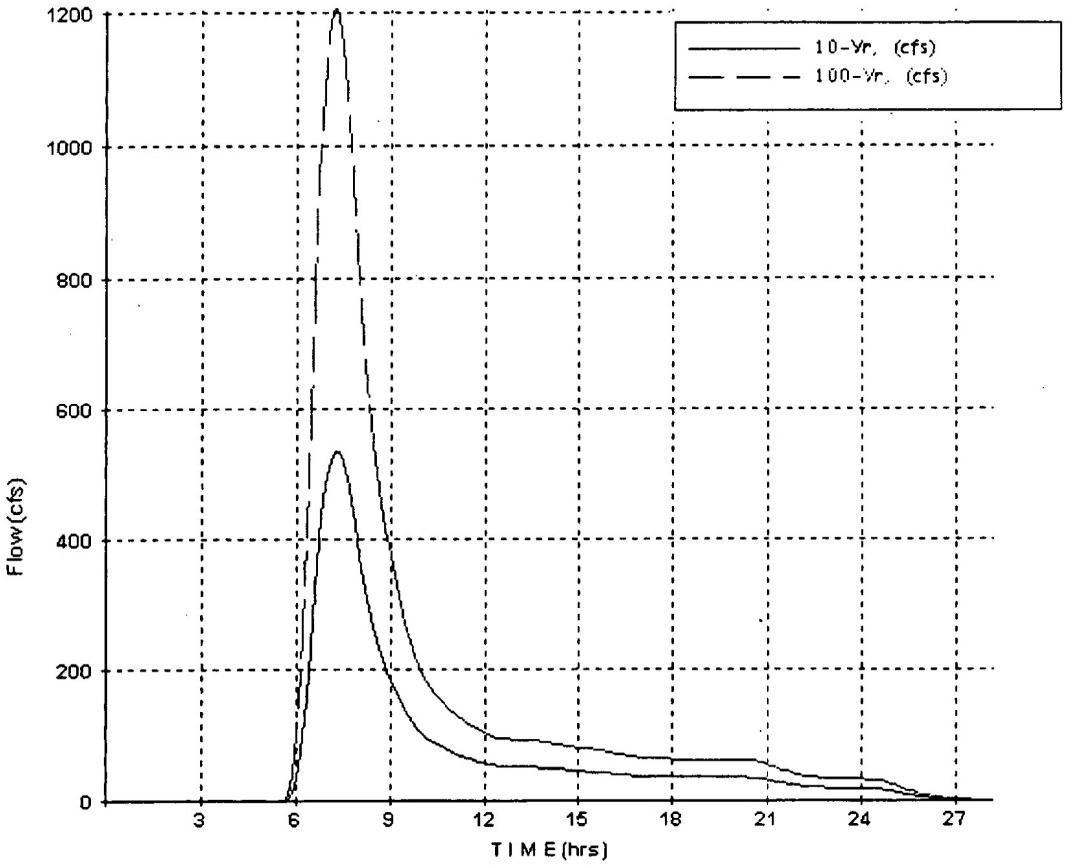


Table A.1
CN Value Computations
Monument Creek Basin Study Comparison
Projected Values

Subbasin	Area	Percent Soil Type			Land Cover	CN
		B	D	% check		
HYC157	0.72	0%	100%	100%	Forest	80
HYC159	0.64	0%	100%	100%	Forest	80
HYC161	0.73	34%	66%	100%	Forest	75
HYC163	0.73	100%	0%	100%	Forest, Pasture	65
Total Area	2.82				Average CN Value	74.8

Note: Hay Creek CN values used in the Hay Creek Ranch Hydrology match those used in the Monument Creek Drainage Basin Study. See Table A.2

TABLE A.2

Jay Peters

Hay Creek Ranch
Hay Creek Hydrology
El Paso County, Colorado

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (mi^2)	Curve Number
Hay Creek	Pasture, grassland or range	(fair)	B	.72	69
	Woods	(fair)	B	.28	60
	Woods	(fair)	D	1.85	79
	Total Area / Weighted Curve Number			2.85	75

Jay Peters

TABLE A.3

Hay Creek Ranch
Hay Creek Hydrology
El Paso County, Colorado

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Hay Creek							
SHEET	100	0.1200					0.221
SHALLOW	1000	0.1000	0.050				0.054
CHANNEL	24000					4.000	1.667
CHANNEL	4700					10.000	0.131
					Time of Concentration		2.07

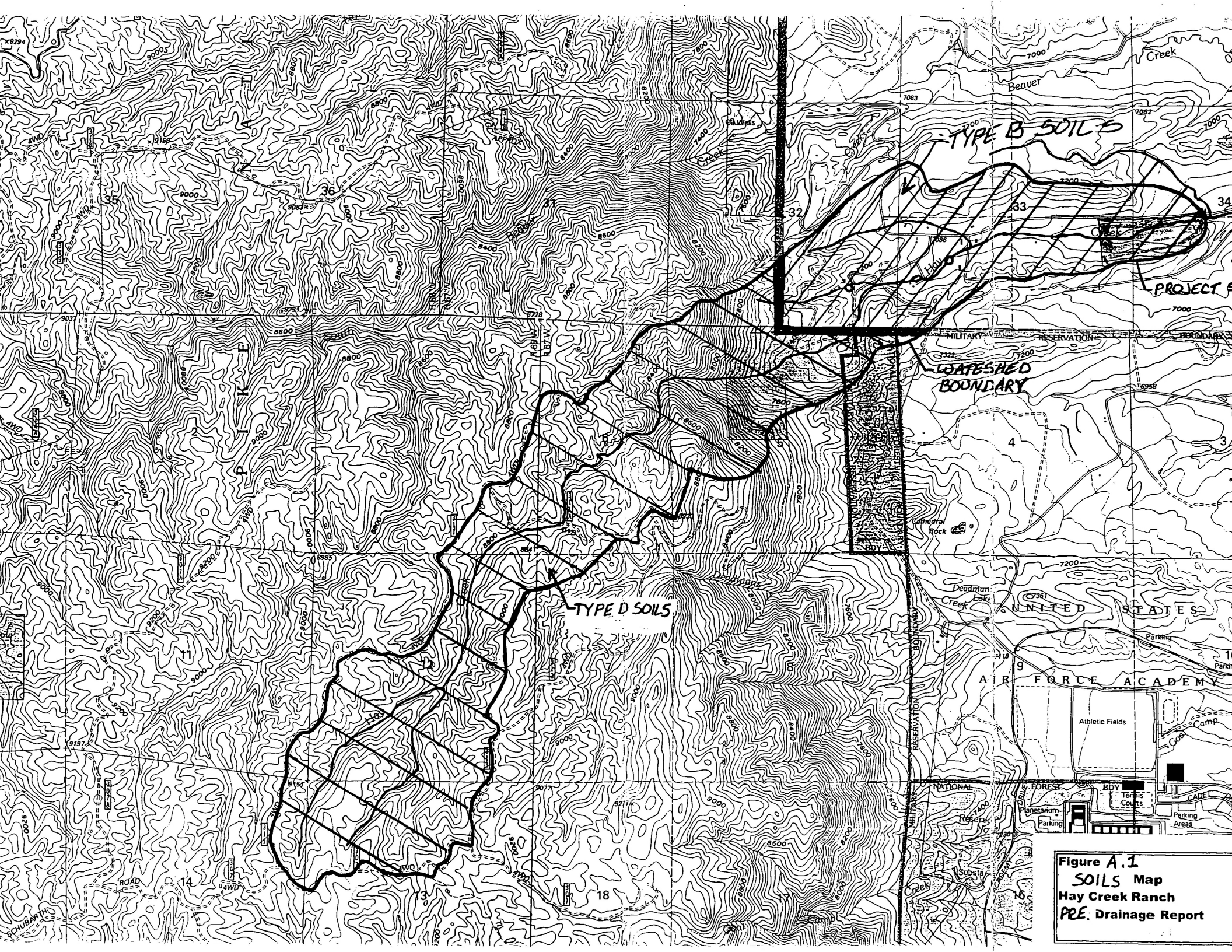


Figure A.1
SOILS Map
Hay Creek Ranch
PRE. Drainage Report

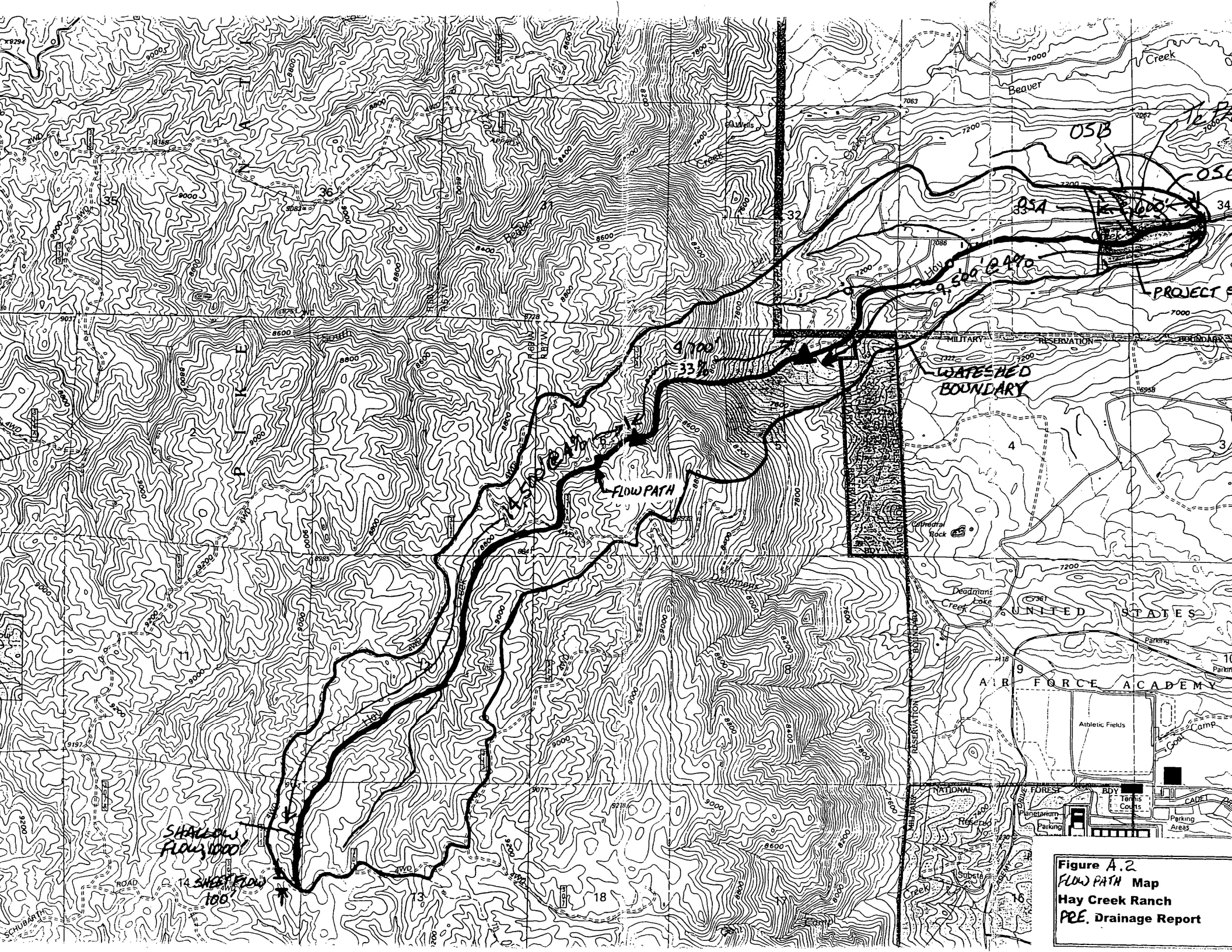


Figure A.2
FLOW PATH **Map**
Hay Creek Ranch
PRE. **Drainage Report**

APPENDIX F – DRAINAGE MAPS

HAY CREEK SUBDIVISION

EXISTING DRAINAGE MAP

HAY CREEK DRIVE
EX 60.00' ROW
EX EDGE OF ASPHALT
EX EDGE OF ASPHALT
EX HOUSE
EX DIRT DRIVEWAY
EX BARN
EX HORSE DEN
EX FENCE (TYP)
EX1
9.89 | 2.9 | 14.3
APPROXIMATE LOCATION OF BLE STUDY X-SECTION RS = 7599
THALWEG ELEVATION = 6960.43
100-YR WSEL = 6962.63
Depth = 2.20'
HAY CREEK
EX WOODEN BRIDGE
EX 18" CMP CULVERT (PRIVATE)
EX HAY CREEK FLOW
Q100 = 311 CFS
BASIN & DESIGN POINT SUMMARY TABLES CALCULATE SITE'S CONTRIBUTION TO TOTAL FLOW OF 311 CFS
APPROXIMATE LOCATION OF BLE STUDY X-SECTION RS = 7101
THALWEG ELEVATION = 6948.73
100-YR WSEL = 6950.46
DEPTH = 1.73'
EX2
19.19 | 4.1 | 27.4
3555 HAY CREEK DRIVE
LOT 1 TIMMINS SUB EXEMPTION
ZONE: RR-5
OWNER: GERARD P. TIMMINS
3255 HAY CREEK ROAD
LOT 9 HAY CREEK RANCH SUB
ZONE: PUD
OWNER: MATTHEW W DUNSTON
3260 SNOW MOUNTAIN HEIGHTS
LOT 8 HAY CREEK RANCH SUB
ZONE: PUD
OWNER: EDWARD P. BEHR
2855 HAY CREEK ROAD
UNPLATTED
ZONE: RR-5
OWNER: RANDALL OLEARY
UNPLATTED
ZONE: RR-5
OWNER: RANDALL OLEARY

LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
FLOW DIRECTION		
BASIN ID	ID / AC / Q5 / Q100	
DESIGN POINT DESIGNATION	1	
SUB-BASIN DELINEATION		
OVERLAND FLOW PATH		

EX DRAINAGE CALCS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX1	9.89	4%	0.09	0.36	37.1	2.9	14.3
EX2	19.19	2%	0.09	0.36	38.5	4.1	27.4

DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	6.7	39.6

N

50 25 0 50 100

ORIGINAL SCALE: 1" = 50'

EX DRAINAGE MAP
HAY CREEK SUBDIVISION
JOB NO. 24008
LOCATION: EPC
09/13/2024
SHEET 1

ALL TERRAIN ENGINEERING

HAY CREEK HULL SUBDIVISION

PROPOSED DRAINAGE MAP

HAY CREEK DRIVE
EX 60.00' ROW
EX EDGE OF ASPHALT
EX DIRT DRIVEWAY
EX HORSE DEN
EX FENCE (TYP)
EX BARN
EX HOUSE
PR. PROP LINE (TYP)
Lot 1
5.00 ac
Lot 2
3.54 ac
16 ACCESS DRIVE
W/ 2' SHOULDERS
(GRAVEL)
NO-BUILD EASEMENT
NO-BUILD EASEMENT
NO-BUILD EASEMENT
(CONTIGUOUS W/ ZONE A FLOODPLAIN)
MAX BFE = 6967.1
MAX BFE = 6967.1
MAX BFE = 6961.6
MAX BFE = 6954.5
MAX BFE = 6948.2
MAX BFE = 6948.1
INTERPOLATED WSEL PER BLE STUDY = 6947.70
STATION = 6995, 0.21 OF REACH LENGTH
HAY CREEK
APPROXIMATE LOCATION OF BLE STUDY X-SECTION RS = 7599
THALWEG ELEVATION = 6960.43
100-YR WSEL = 6962.63
Depth = 2.20'
EX TREES (TYP.)
EX HAY CREEK FLOW
Q100 = 311 CFS*
*Q100 INCLUDES ENTIRE UNDEVELOPED PROJECT SITE AREA
EX 18" CMP CULVERT (PRIVATE)
APPROXIMATE LOCATION OF BLE STUDY X-SECTION RS = 7101
THALWEG ELEVATION = 6948.73
100-YR WSEL = 6950.46
DEPTH = 1.73'
EX WOODEN BRIDGE (TO BE REMOVED)
PR TWIN 7' x 3' RCBC
PR RIPRAP OUTFALL PROTECTION
TYPE L SOIL RIPRAP, 18" DEPTH
R50.00'
NO-BUILD EASEMENT (WIDTH VARIES)
APPROXIMATE LOCATION OF BLE STUDY X-SECTION RS = 6599
THALWEG ELEVATION = 6934.46
100-YR WSEL = 6936.84
DEPTH = 2.38'
EX ZONE A 100-YR FLOODPLAIN
PR. PROP LINE (TYP)
Lot 6 5.00 ac
Lot 5 5.00 ac
Lot 4 5.00 ac
Lot 3 5.00 ac
NO-BUILD EASEMENT
NO-BUILD EASEMENT
EX TREES (TYP.)
2855 HAY CREEK ROAD
UNPLATTED
ZONE: RR-5
OWNER: RANDALL OLEARY
UNPLATTED
ZONE: RR-5
OWNER: RANDALL OLEARY
3555 HAY CREEK DRIVE
LOT 1 TIMMINS SUB EXEMPTION
ZONE: RR-5
OWNER: GERARD P. TIMMINS
3255 HAY CREEK ROAD
LOT 9 HAY CREEK RANCH SUB
ZONE: PUD
OWNER: MATTHEW W DUNSTON
3260 SNOW MOUNTAIN HEIGHTS
LOT 8 HAY CREEK RANCH SUB
ZONE: PUD
OWNER: EDWARD P. BEHR

1 | 4.54 | 1.5 | 7.6
2 | 10.07 | 2.9 | 15.0
3 | 5.35 | 3.2 | 12.2
4 | 9.12 | 3.0 | 15.3

LEGEND

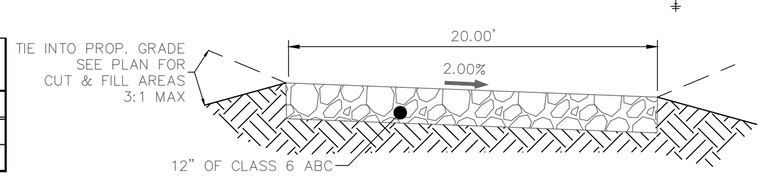
	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	6100
INTERMEDIATE CONTOUR		
FLOW DIRECTION		
BASIN ID	ID / AC / Q5 / Q100	
DESIGN POINT DESIGNATION		1
SUB-BASIN DELINEATION		
OVERLAND FLOW PATH		

PR DRAINAGE CALCS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
1	4.54	7.0%	0.13	0.39	28.1	1.5	7.6
2	10.07	7.3%	0.12	0.39	34.1	2.9	15.0
3	5.35	16.8%	0.19	0.44	19.6	3.2	12.2
4	9.12	7.9%	0.13	0.39	28.2	3.0	15.3

DESIGN POINT SUMMARY TABLE

DP#	$Q_{5\text{-YR}}$	$Q_{100\text{-YR}}$
1	4.2	21.7
2	8.6	41.3



20' FIRE ACCESS ROAD
N.T.S.

50 25 0 50 100
ORIGINAL SCALE: 1" = 50'

PR DRAINAGE MAP
HAY CREEK SUBDIVISION
JOB NO. 24008
LOCATION: EPC
09/13/2024
SHEET #

ALL TERRAIN ENGINEERING