

Submit an updated drainage report meeting current criteria



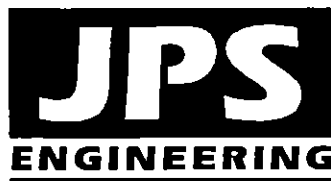
FINAL DRAINAGE REPORT
for
FALCON ACRES SUBDIVISION

Prepared for:

United Planning & Engineering
4575 Galley Road, Suite 200
Colorado Springs, CO 80915

June 25, 2007
Revised September 4, 2007
Revised October 31, 2007
Revised February 7, 2008

Prepared by:



19 E. Willamette Avenue
Colorado Springs, CO 80903
(719)-477-9429
(719)-471-0766 FAX

JPS Project No. 020506

Add PCD File No. SF223

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MAR 31 2008

EPC DEVELOPMENT SERVICES

**FALCON ACRES SUBDIVISION
FINAL DRAINAGE REPORT
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DRAINAGE STATEMENT

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 City/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.

 3/28/08
John P. Schwab, P.E. #29891

Developer's Statement:

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

By: Lois Elliott

Printed Name: LOIS ELLIOTT

Title: OWNER

3/28/08
Date

El Paso County's Statement

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

for John A. McCarty
John A. McCarty, P.E., Director / County Engineer

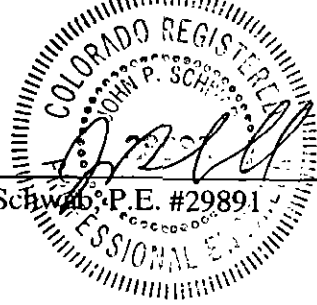
4-15-08
Date

Conditions:

FLOODPLAIN STATEMENT

To the best of my knowledge and belief, Falcon Acres Subdivision is not located in a FEMA designated floodplain, as shown on FIRM panel No. 08041C0800F, dated March 17, 1997.

John P. Schwab, P.E. #29891



3/28/08

I. GENERAL LOCATION AND DESCRIPTION

A. Background

Falcon Acres is a proposed residential subdivision located in northeastern El Paso County, Colorado. The Falcon Acres parcel (El Paso County Assessor's Number 44040-00-014) is located at the southwest corner of Curtis Road and Davis Road, as shown in Figure A1 (Appendix A). Falcon Acres Subdivision will consist of 8 rural residential lots (5-acre lot sizes) on a 47.6-acre parcel.

B. Scope

This report is intended to fulfill the El Paso County requirements for a "Final Drainage Report" in support of the final subdivision plat approval process. This report will provide a summary of site drainage issues impacting the proposed residential development. The report will analyze impacts from upstream drainage patterns, site-specific developed drainage patterns, and impacts on downstream facilities. This report is based on the guidelines and criteria presented in the El Paso County Drainage Criteria Manual.

C. Site Location and Description

The Falcon Acres parcel is located in the northeast quarter of the northeast quarter (NE1/4), and the east half of the east half of the northwest quarter of the northeast quarter (NE1/4) of Section 4, Township 14 South, Range 64 West of the 6th Principal Meridian. The site is currently inhabited by an existing ranch and pasture/meadow areas. The parcel is zoned RR-3 (rural residential), allowing for 5-acre minimum lot sizes. A new public road (Peaceful Prairie Road) extending south from Davis Road will provide access to the subdivision. Associated site improvements will include grading, driveway paving, and utility service improvements for the eight residential lots.

The parcel is bordered by existing rural residential lots on all sides, typically consisting of 5-acre lots. Davis Road borders the north boundary of the parcel, and Curtis Road borders the east boundary of the parcel. Ground elevations within the site range from approximately 6,530 to 6,550 feet above mean sea level.

The site is located near the upstream end of the Livestock Company Drainage Basin, which is tributary to the West Fork of Black Squirrel Creek. The terrain is gently rolling with average grades ranging from 1 to 5 percent. The existing site is a rural ranch parcel and pasture / meadow area.

D. General Soil Conditions

According to the Soil Survey of El Paso County, on-site soils are comprised of Type 97, which are classified as hydrologic soils group "B," with moderately rapid permeability, slow to medium surface runoff characteristics, and moderate hazard of erosion.

Add Chapter 6 of the City DCM, May 2014

Add MHFD DCM

E. References

City of Colorado Springs & El Paso County "Drainage Criteria Manual," revised October 12, 1994.

CDOT, "CDOT Drainage Design Manual," July, 1995.

Update all reference to the latest version.

El Paso County "Engineering Criteria Manual," December, 2004.

FEMA, Flood Insurance Rate Map (FIRM) Number 08041C0800F, March 17, 1997.

JPS Engineering, Inc., "Preliminary Drainage Report for Falcon Acres Subdivision," August 29, 2006 (approved by El Paso County 9/18/06).

Kiowa Engineering Corporation, "Final Drainage Report, Davis Ranch Subdivision Filing Nos. 3, 4, and 5," August 9, 2005.

USDA Natural Resources Conservation Service, "Soil Survey of El Paso County Area, Colorado," June, 1981.

WRC Engineering, Inc., "Adams County Storm Drainage Design and Technical Criteria," February, 1989.

Remove.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

The proposed development lies completely within the Livestock Company Drainage Basin (CHWS 0400) as classified by El Paso County. Drainage from this site parcel flows southeasterly to a downstream confluence with the West Fork of Black Squirrel Creek.

B. Floodplain Impacts

The project site is located beyond the limits of any 100-year floodplain delineated by the Federal Emergency Management Agency (FEMA). The floodplain limits in the vicinity of the site are shown in Flood Insurance Rate Map (FIRM) Number 08041C0800-F, dated March 17, 1997, as shown in Figure A2 (Appendix A).

Update to the current effective FIRM

C. Sub-Basin Description

The existing drainage basins lying in and around the proposed development are depicted in Figure EX1 (Appendix A). The site is impacted by off-site drainage basins to the west, northwest, and southwest, which generally drain in an easterly direction across the site. Two existing sub-basins have been delineated within the site, each characterized by an existing depression as indicated by the hatched areas on Figure EX2 (Appendix A). Overflows from the existing depressions within the site would tend to drain northeasterly towards the intersection of Davis Road and Curtis Road, where no culvert currently exists. The natural drainage patterns within the site will be impacted through development by site grading and concentration of runoff in subdivision streets. Developed runoff will generally continue to follow historic paths.

III. DRAINAGE DESIGN CRITERIA

A. Development Criteria Reference

No Drainage Basin Planning Study (DBPS) has been completed for the Livestock Company Drainage Basin. No Master Development Drainage Plans (MDDP) were found for any adjacent subdivisions.

B. Hydrologic Criteria

SCS procedures were utilized for analysis of the major off-site basin flows impacting the site. In accordance with El Paso County drainage criteria, SCS hydrologic calculations were based on the following assumptions:

- | | |
|---|---|
| • Design storm (minor) | 5-year |
| • Design storm (major) | 100-year |
| • Storm distribution | SCS Type IIA (eastern Colorado) |
| • 100-year, 24-hour rainfall | 4.4 inches per hour (NOAA isopluvial map) |
| • 5-year, 24-hour rainfall | 2.6 inches per hour (NOAA isopluvial map) |
| • Hydrologic soil type | B |
| • SCS curve number - undeveloped conditions | 61 (pasture / range) |
| • SCS curve number - undeveloped conditions | 50 (range with upstream retention ponds) |
| • SCS curve number - developed conditions | 98 (paved areas) |
| • SCS curve number - developed 5-acre lots | 63 (composite calculation) |

A curve number of 50 has been selected for hydrologic modeling of upstream areas with existing retention ponds. This approach is consistent with the approved Final Drainage Report for Davis Ranch Subdivision, which is located a few miles east of this site.

Verify and update as
necessary per the
adopted City DCM
(May 2014)

Revise to current
criteria (City 2014
DCM Chapter 6)

Rational Method procedures were utilized for calculation of peak flows within the on-site drainage basins. Rational Method hydrologic calculations were based on the following assumptions:

- Design storm (minor) 5-year
 - Design storm (major) 100-year
 - Time of Concentration – Overland Flow “Airport” equation (300’ max. developed)
 - Time of Concentration – Gutter/Ditch Flow “SCS Upland” equation
 - Rainfall Intensities El Paso County I-D-F Curve
 - Hydrologic soil type B
- | | C5 | C100 |
|--|------|------------------------------|
| • Runoff Coefficients - undeveloped:
Existing pasture/range areas | 0.25 | 0.35 |
| • Runoff Coefficients - developed:
Proposed lot areas (5-acre lots) | 0.29 | 0.38 (composite calculation) |

Hydrologic calculations are enclosed in Appendix B, and peak design flows are identified on the drawings.

Update per City 2014
DCM Table 6-6 for
existing pasture

RAINAGE FACILITY DESIGN

Update. value seems high. 5 ac
lot typically has 7% imperviousness
so C5 value should be around 0.12

A. General Concept

Development of the proposed subdivision will require site grading and paving work within 8 proposed rural residential lots, resulting in a limited amount of additional impervious area within

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

Historic drainage conditions are depicted in Figures EX1 and EX2. There are no existing drainage facilities within or adjacent to the site. The existing site is characterized by two large drainage retention areas within the site, represented by the hatch patterns on Sheet EX2. Off-site flows from Basins OA1-OA3 combine with on-site drainage from Basin A, draining to the existing depression within Basin A on the west side of the parcel. As shown on Sheet EX1, the existing upstream basins have several stock ponds and retention areas. There is currently no culvert for drainage to cross the low point in Davis Road at the north boundary of the Falcon Acres site. Based on the topography, overflows from Basin OA1 would overtop Davis Road and flow south into Basin A.

This sentence seems to contradict the subsequent sentence. Revise to clarify.

Off-site flows from Basins OA1, OA2.1, OA2.2, and OA3 combine with on-site flows at the existing retention area within Basin A, with calculated historic peak flows of $Q_5 = 2.0$ cfs and $Q_{100} = 78.8$ cfs at Design Point A.

The westerly retention area (Retention Area A) within the Falcon Acres site currently has a storage volume of approximately 91.6 acre-feet between the 6528 and 6536 contours. Overflows from this retention area would drain northeasterly to Basin B.

Off-site flows from Basin OB1 combine with on-site drainage from Basin B, draining to the existing depression within Basin B on the east side of the parcel.

Off-site flows from Basin OB1 combine with on-site flows at the existing retention area within Basin B, with calculated historic peak flows of $Q_5 = 0.04$ cfs and $Q_{100} = 2.8$ cfs at Design Point B.

The easterly retention area (Retention Area B) has a storage volume of approximately 6.9 acre-feet between the 6528 and 6530 contours. Overflows from Retention Area B would drain northeasterly towards the intersection of Curtis Road and Davis Road.

Based on the substantial retention volume within the site, no 100-year flows would be expected to reach Design Point #1 at the northeast corner of the site. In the unlikely event the existing retention ponds were completely full, overflows from Basin A would flow northeasterly, combining with flows from Basin B at Design Point #1, with calculated historic peak flows (SCS Method) of $Q_5 = 1.9$ cfs and $Q_{100} = 68.6$ cfs. As noted in Appendix B, the calculated flows for off-site basins with retention ponds have incorporated an SCS runoff curve number of 50 based on the existence of numerous upstream retention areas. Historic overflows from the Falcon Acres parcel would tend to overtop Curtis Road and flow to an existing depression on the parcel at the southeast corner of Curtis Road and Davis Road.

2. Developed Drainage Conditions

The developed drainage basins and projected flows are shown in the Developed Drainage and Erosion Control Plan (Figure D1, Appendix A). In the developed condition, Basin A has been divided into sub-basins A1 and A2 by the proposed public road within the site. Off-site flows from Basin OA2.1 and OA2.2 will combine with on-site drainage from Sub-Basins A1 and A2, draining to a new culvert crossing at the low point of the proposed roadway profile. Developed peak flows at Design Point A1 are projected to be $Q_5 = 1.4$ cfs and $Q_{100} = 54.6$ cfs. A proposed culvert (36-inch RCP) will cross the new public road at Design Point A1.

Given the lack of any existing drainage facility crossing the low point in Davis Road, a future 24-inch culvert is recommended at Design Point OA1 prior to paving this off-site roadway. An 18-inch private driveway culvert will be installed across the private shared

driveway (Satellite View) south of Design Point OA1. Another 21-inch private driveway culvert will be constructed across Moonglow Heights at Design Point A3.1 to convey drainage across the retention area split by the new shared driveway.

Off-site flows from Basins OA1-OA3 will continue to combine with flows from Basins A1-A3 in the existing "Retention Area A" on the west side of the site. Off-site flows from Basins OA1, OA2.1, OA2.2, and OA3 will continue to combine with on-site flows from Basins A1-A3.2 at the existing retention area within Basin A, with calculated developed peak flows of $Q_5 = 2.3$ cfs and $Q_{100} = 89.8$ cfs at Design Point A.

This retention area has a bottom elevation of 6528.0 and the existing saddle northeast of this area has an elevation of approximately 6536.0, which would be the natural overflow point. Channel A3 is proposed to provide an overflow swale northeasterly from Retention Area B. This channel will be excavated to an elevation of 6533.5. A drainage easement will encompass ground elevations within Area A up to the grade of 6533.5 to preclude building anywhere within the retention area.

Verify if the current MHFD criteria still has the same requirements. Update per current criteria.

Drainage and Flood Control District (UDFCD) has adopted criteria requiring stormwater retention ponds to have a storage volume of 1.5 times the 24-hour, 100-year volume. As detailed in Appendix C, the calculated 100-year, 24-hour retention volume for Design Point A is 64.8 acre-feet. The available retention storage volume up to the 6533.5 contour level within Basin A is 47.3 acre-feet, which is approximately equal to the calculated 100-year storage volume requirement of 48.3 acre-feet (based on a 24-hour retention volume with safety factor of 1.5 per UDFCD criteria). Overflow channels will be provided to safely convey overflows or back-to-back storm events to existing downstream swales.

Off-site flows from Basin OB1 will continue to combine with on-site drainage from Basin B, draining to the existing "Retention Area B" on the east side of the site. Off-site flows from Basin OB1 will continue to combine with on-site flows at the existing retention area within Basin B, with calculated developed peak flows of $Q_5 = 1.7$ cfs and $Q_{100} = 11.7$ cfs at Design Point B.

This retention area has a bottom elevation of 6528.0 and the existing overflow swale northeast has an elevation of approximately 6530.0. A drainage easement will encompass ground elevations within Area B up to the grade of 6530 to preclude building within the retention area.

As detailed in Appendix C, the calculated 100-year, 24-hour retention volume for Design Point B is 2.3 acre-feet, which is below the available retention storage volume of 2.8 acre-feet.

As with the historic conditions, no 100-year flows would be expected to reach Design Point #1 based on the substantial retention volume within the site. In the unlikely event the

existing retention ponds were completely full, overflows from off-site Basins OA1-OA3 and OB1 will combine with flows from on-site Basins A and B at Design Point #1, with developed peak flows (SCS Method) of $Q_5 = 2.4$ cfs and $Q_{100} = 81.1$ cfs.

The proposed rural residential lot layout has been designed to maintain the two existing drainage retention areas, while providing an overflow channel to the northeast. Given the lack of any existing drainage facility crossing the low point on the south side of Davis Road at the Curtis Road intersection, a culvert is recommended at this location. The proposed culvert will be a 14'x23" elliptical (HERCP) culvert sized to convey overflows only from the on-site retention areas (beyond 100-year flows).

As depicted on Sheet EX1, the off-site parcel to the east also has an existing depression which serves as a drainage retention area. The proposed drainage approach of maintaining the existing drainage retention areas within the Falcon Acres parcel should maintain conditions that mimic pre-development hydrology downstream of the site.

C. Comparison of Developed to Historic Discharges

Based on the hydrologic calculations in Appendix B, the total developed flow from the site will remain unchanged based on the existing retention volumes. If the existing retention volume were excluded from the analysis, the total developed flow would exceed historic flow from the site by a negligible amount. The increase in developed flow will be mitigated by maintaining the existing on-site drainage retention areas. The comparison of developed to historic discharges at key design points is summarized as follows:

Design Point	Historic Flow			Developed Flow			Comparison of Developed to Historic Flow ($Q_5\%/Q_{100}\%$)
	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)	
I (with Retention)	766.2	0	0	766.2	0	0	(no change)
I (w/o Retention)	766.2	1.9	68.6	766.2	2.4	81.1	126% / 118% (increase)

The total developed storm runoff downstream of the proposed subdivision will be maintained at historic levels by routing flows through two existing retention ponds within the site. The retention volume has been sized to retain the calculated 24-hour, 100-year storm discharge from the developed basins within the site, as detailed in Appendix D. Overflow swales will be provided to convey major storm discharges downstream following historic drainage patterns. Based on the drainage concept of protecting the existing on-site retention areas, the proposed development will have a negligible downstream drainage impact.

D. On-Site Drainage Facility Design

Developed sub-basins and proposed drainage improvements are depicted in the enclosed Drainage Plan (Sheet D1). In accordance with El Paso County standards, new roadways will be graded with a minimum longitudinal slope of 1.0 percent.

On-site drainage facilities will consist of roadside ditches, grass-lined channels, and culverts. Hydraulic calculations for sizing of drainage facilities are enclosed in Appendix C and design criteria are summarized as follows:

1. Culverts

The internal road system will be graded to drain roadside ditches to low points along the road profile, where cross-culverts will convey developed flows into grass-lined channels following historic drainage paths. Culvert pipes have been specified as reinforced concrete pipe (RCP) with a minimum diameter of 18-inches. Culvert sizes have been identified based on a maximum headwater-to-depth ratio (HW/D) of 1.0 for the minor (5-year) design storm. Final culvert design has been performed utilizing the FHWA HY-8 software package to perform a detailed analysis of inlet and outlet control conditions, meeting El Paso County criteria for allowable overtopping. Riprap outlet protection will be provided at all culverts. Culvert sizing parameters are summarized in Appendix C.

2. Open Channels

Drainage easements have been dedicated along major drainage channels and existing depressions within the site, following historic drainage paths through the subdivision. Proposed channels will generally be grass-lined channels designed to convey 100-year flows, with a trapezoidal cross-section, variable bottom width and depth, 4:1 maximum side slopes, 1-foot minimum freeboard, and a minimum slope of 0.5 percent.

The proposed drainage channels have been sized utilizing Manning's equation for open channel flow, assuming a friction factor ("n") of 0.030 for dry-land grass channels. Maximum allowable velocities have been evaluated based on El Paso County drainage criteria, typically allowing for a maximum 100-year velocity of 5 feet per second. The proposed channels will be seeded with native grasses for erosion control. Ditch flows will be diverted to drainage channels at the nearest practical location to minimize excessive roadside ditch sizes. Detailed channel hydraulic calculations are provided in Appendix C.

Drainage swales crossing proposed lots and existing drainage retention areas within the site have been placed in drainage easements, with variable widths based on the calculated 100-year water surface elevations and retention area configuration. Based on the proposed channel section (4' bottom, 2' deep, 4:1 side slopes) and calculations in Appendix C, a minimum drainage easement width of 30 feet is required for the overflow swales from each of the retention ponds.

Add a section for the 4-step process (ECM Appendix I Section I.7.2.A)
Under each step, summarize how the step was considered or implemented.

E. Anticipated Drainage Problems and Solutions

The drainage plan for this subdivision includes a system of roadside ditches, channels, and culverts to convey developed flows through the site. The primary drainage problems anticipated within this development will consist of maintenance of these drainage channels and culverts. Care will need to be taken to implement proper erosion control measures in the proposed roadside ditches, channels, and swales. Ditches have been designed to meet allowable velocity criteria. Seeding will be the primary erosion control method within the on-site ditches and channels. Erosion control blankets have been specified where necessary. Proposed drainage facilities outside the public right-of-way will be owned and maintained by the subdivision HOA or individual lot owners.

V. EROSION CONTROL / SEDIMENT CONTROL

Best management practices (BMP's) will be implemented for erosion control during construction. Erosion control measures include straw mulch, straw wattles, silt fences, and other BMP's, minimizing adverse drainage impacts to downstream areas.

<u>Drainage Basins:</u>				
disturbed slopes, straw	Chico Creek	Book Ranch	\$19,830	\$2,871
access points, and rev	Chico Creek	Upper East Chico	\$10,803	\$313
excavation as necessary	Chico Creek	Telephone Exchange	\$11,870	\$278
of the graded areas. T	Chico Creek	Livestock Company	\$19,552	\$233
	Chico Creek	West Squirrel	\$10,192	\$4,229
	Chico Creek	Solberg Ranch	\$21,134	\$0

Update per current 2022 drainage fees.

VI. COST ESTIMATE AND DRAINAGE

The estimated cost for drainage improvements serving the Falcon Acres Subdivision is approximately \$36,800, as detailed in Appendix D.

The site lies completely within the Livestock Company Drainage Basin (CHWS-0400), which has a 2007 basin fee of \$11,842 per impervious acre and a bridge fee of \$141 per impervious acre. The calculation of applicable drainage basin fees is summarized as follows:

Average residential lot size = 5 acre/lot (gross density)
 Residential Area = 47.577 acres
 Percent impervious = 7% (per El Paso County guidelines, Table 3-1)
 Total Impervious area = (7% * 47.577) = 3.33 ac.
 Adjusted Impervious area = (3.33 ac) * 75% = 2.50 ac.
 (Includes 25% reduction on drainage fees for 5-acre lots)
Drainage Basin Fee = (2.5 ac.) @ \$11,842/ac. = \$29,605.00
Bridge Fee = (3.33 ac.) @ \$141/ac. = \$ 469.53
Total Calculated Fee = \$30,074.53

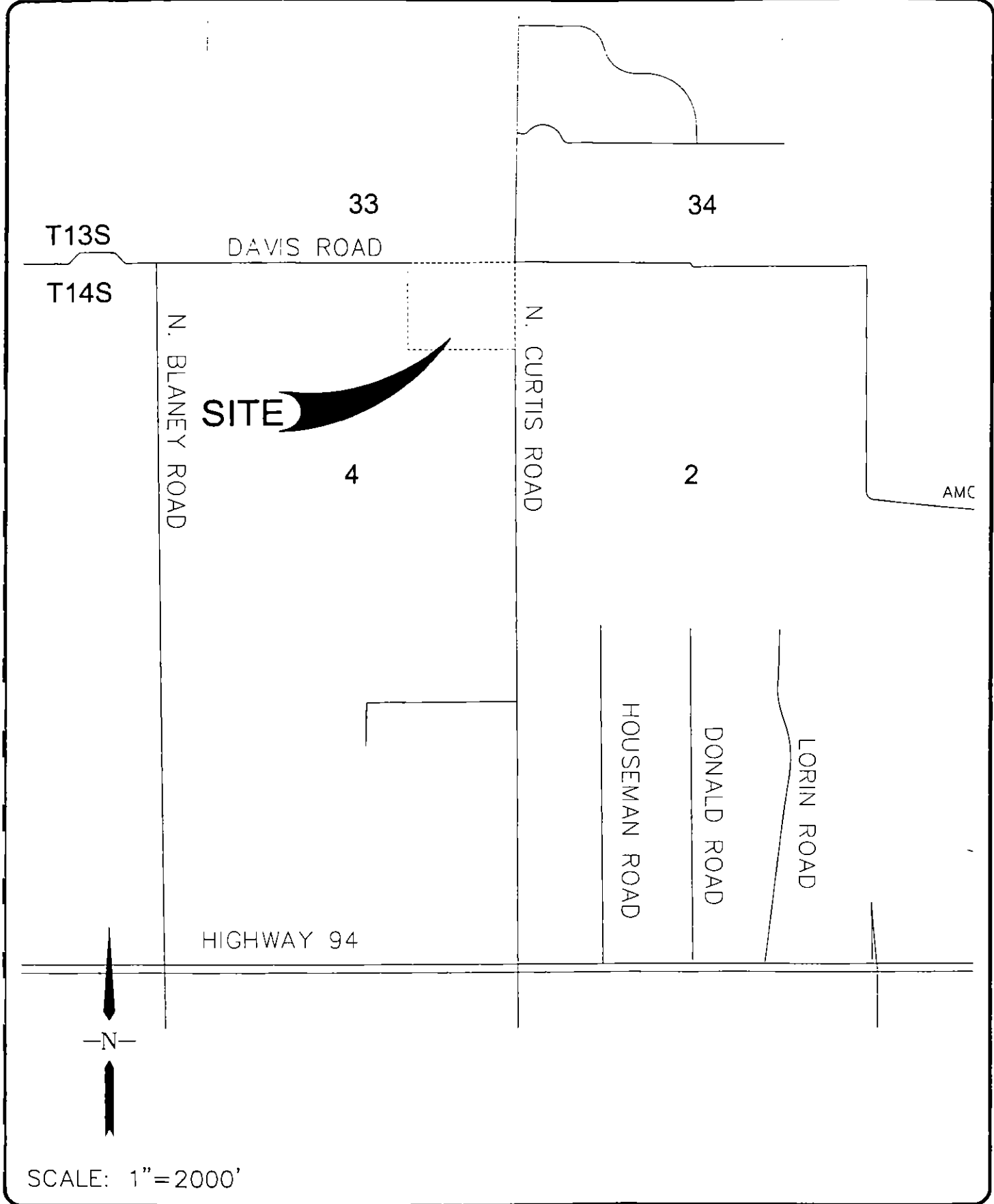
VI. SUMMARY

Falcon Acres is a proposed subdivision consisting of 8 rural residential lots located south of Falcon in El Paso County, Colorado. Development of the proposed 47.6-acre Falcon Acres Subdivision will result in a negligible increase in undetained developed runoff from the site, which will be mitigated by maintaining two existing drainage retention areas within the site.

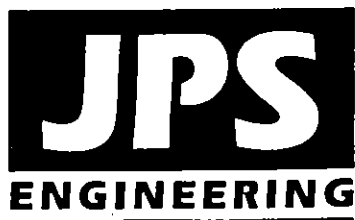
The proposed drainage patterns will remain consistent with historic conditions, and new drainage facilities will be constructed on-site to El Paso County standards to safely convey runoff to adequate outfalls. Maintenance of the existing drainage retention areas, in conjunction with proper erosion control measures, will ensure that there will be no adverse drainage impacts from this development to downstream landowners or parcels.

APPENDIX A

FIGURES



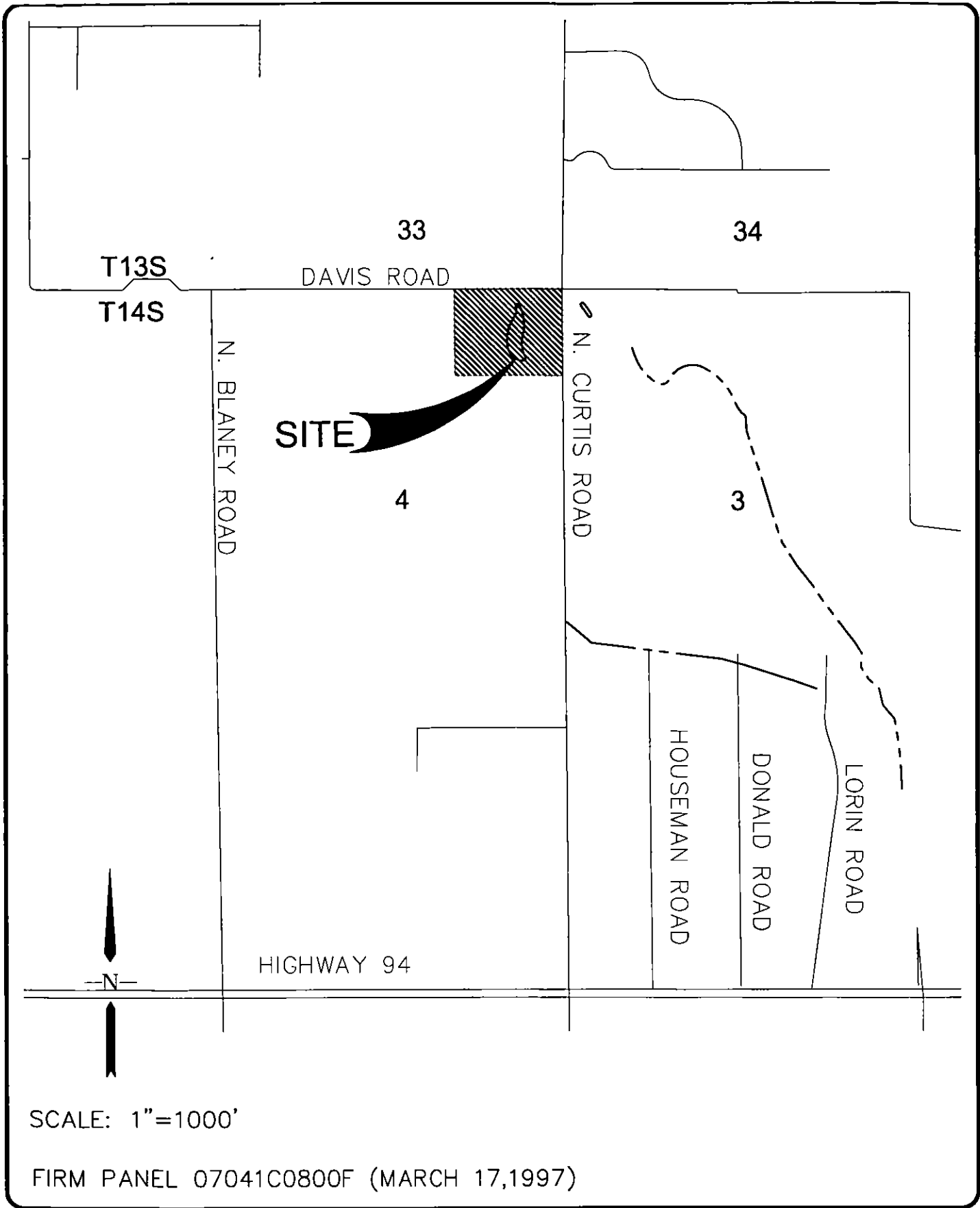
VICINITY MAP



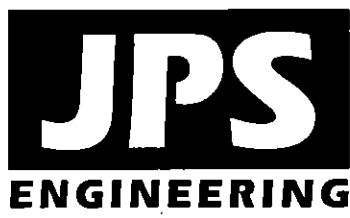
FALCON ACRES
SUBDIVISION

FIGURE A1

JPS PROJ NO. 020506



FLOODPLAIN MAP

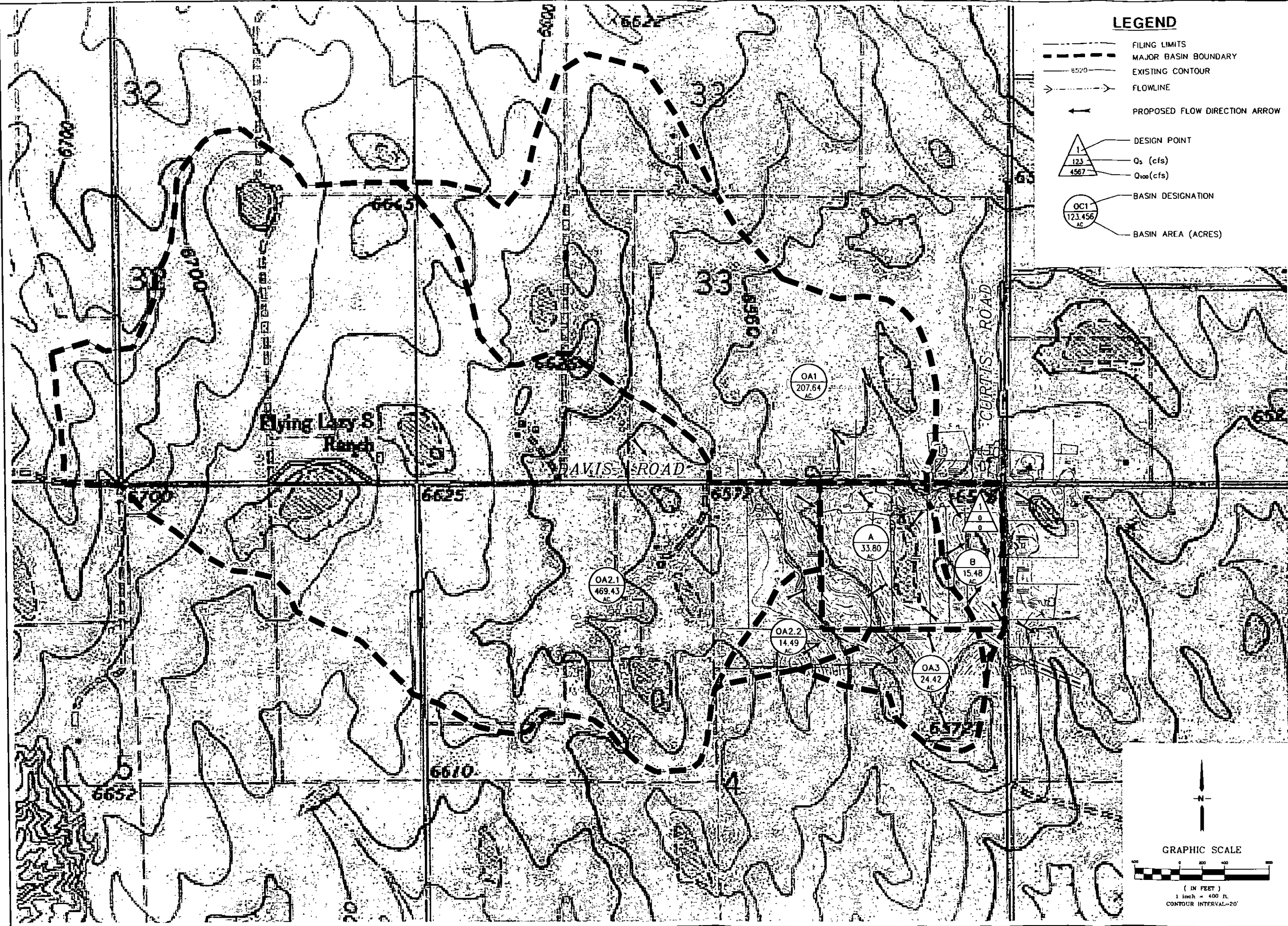


FALCON ACRES
SUBDIVISION

FIGURE A2

JPS PROJ NO. 020506

J:\projects\020506.curtis.dwg (C:\EX1.dwg, 12/11/2007 10:10:03 AM)



FALCON ACRES

No.	REVISION	BY	DATE

MAJOR BASIN / HISTORIC DRAINAGE PLAN

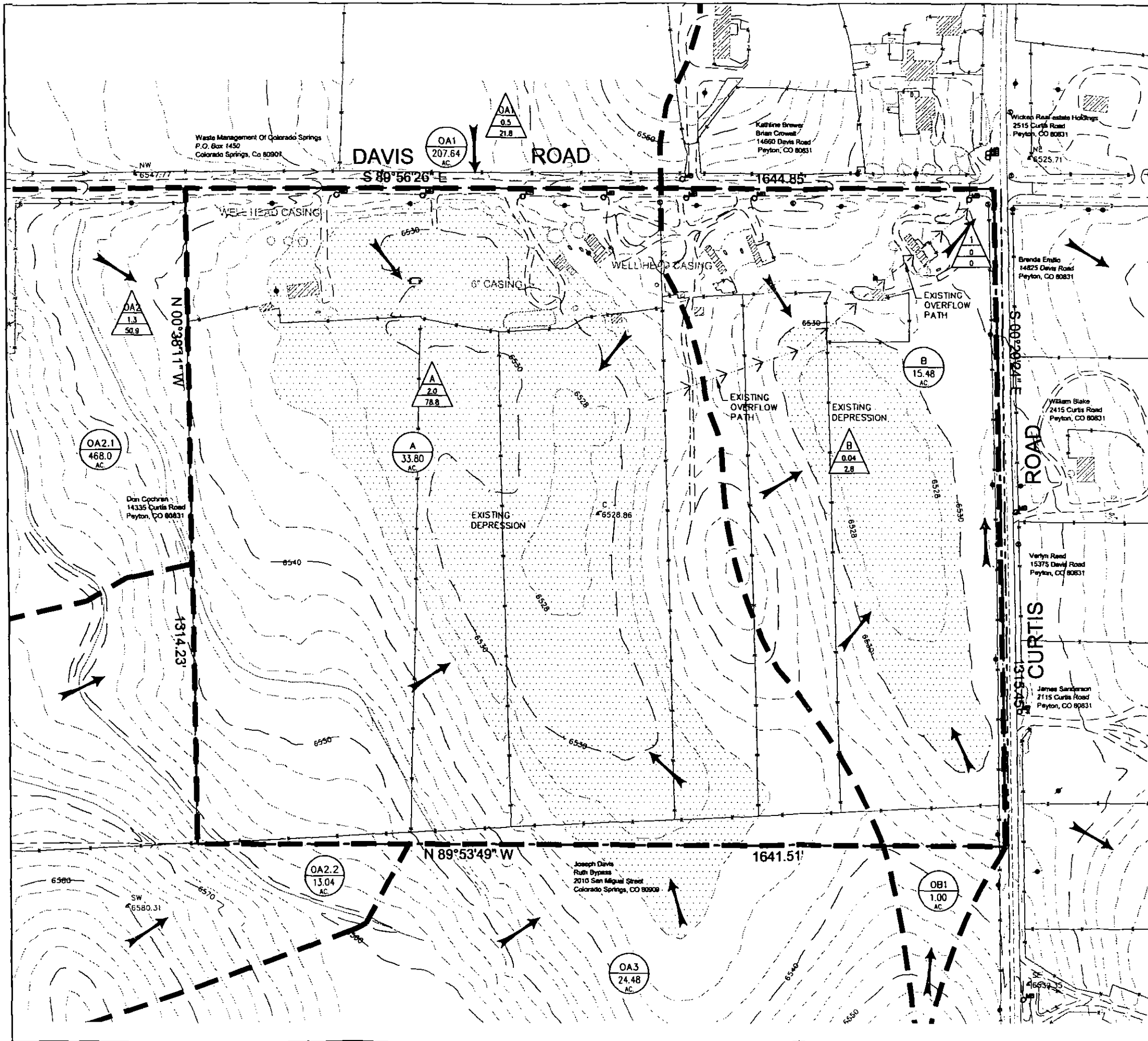
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VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: JPS	CHECKED: JPS
CREATED: 4/21/05	LAST MODIFIED: 9/04/07
PROJECT NO: 020506	MODIFIED BY: BJJ
SHEET:	EX1

JPS
ENGINEERING

19 E. Willamette Ave.
Colorado Springs, CO
80903

PH: 719-477-9429
FAX: 719-471-0766

J:\projects\020506_curtis.dwg Civil.dwg, 12/17/2007 10:10:37 AM



LEGEND

- FILING LIMITS
- MAJOR BASIN BOUNDARY
- EXISTING CONTOUR
- FLOWLINE
- PROPOSED FLOW DIRECTION ARROW
- DESIGN POINT
- Q_s (cfs)
- Q_{100} (cfs)
- BASIN DESIGNATION
- BASIN AREA (ACRES)

FALCON ACRES

HISTORIC DRAINAGE PLAN



19 E. Wilmamette Ave.
Colorado Springs, CO
80903
PH: 719-477-9429
FAX: 719-471-0766

DATE

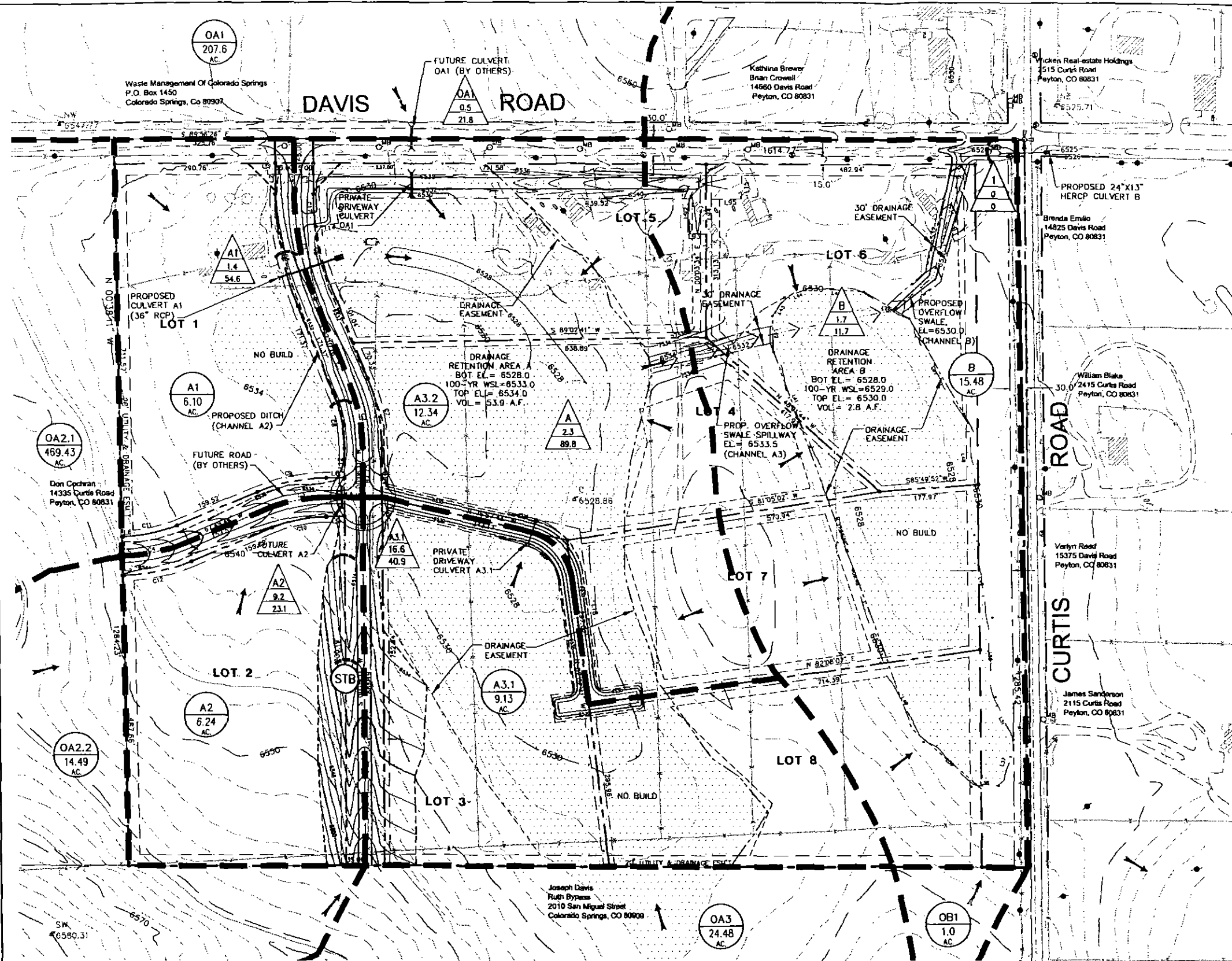
BY

REVISION

No.

HORIZ. SCALE: 1"=100'
VERT. SCALE: N/A
SURVEYED: JPS
CREATED: 4/21/05
PROJECT NO: 020506
SHEET: EX2
DRAWN: BJJ
DESIGNED: JPS
CHECKED: JPS
LAST MODIFIED: 9/04/07
MODIFIED BY: BJJ

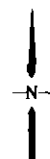
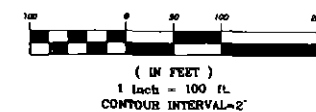
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LEGEND

- FILING LIMITS
- MAJOR BASIN BOUNDARY
- MINOR BASIN BOUNDARY
- EXISTING CONTOUR
- DRAINAGE CHANNEL
- CALCULATED 100-YEAR FLOODPLAIN LIMIT
- PRELIMINARY PRUDENT LINE SETBACK
- PROPOSED FLOW DIRECTION ARROW
- PROPOSED CULVERT (RCP OR HDPE) W/ FLARED END SECTIONS
- DESIGN POINT
- Q_s (cfs)
- Q_{100} (cfs)
- BASIN DESIGNATION
- BASIN AREA (ACRES)

GRAPHIC SCALE



FALCON ACRES SUBDIVISION

DEVELOPED DRAINAGE PLAN



19 E. Wilmamette Ave.
Colorado Springs, CO
80903
PH: 719-477-9429
FAX: 719-471-0766

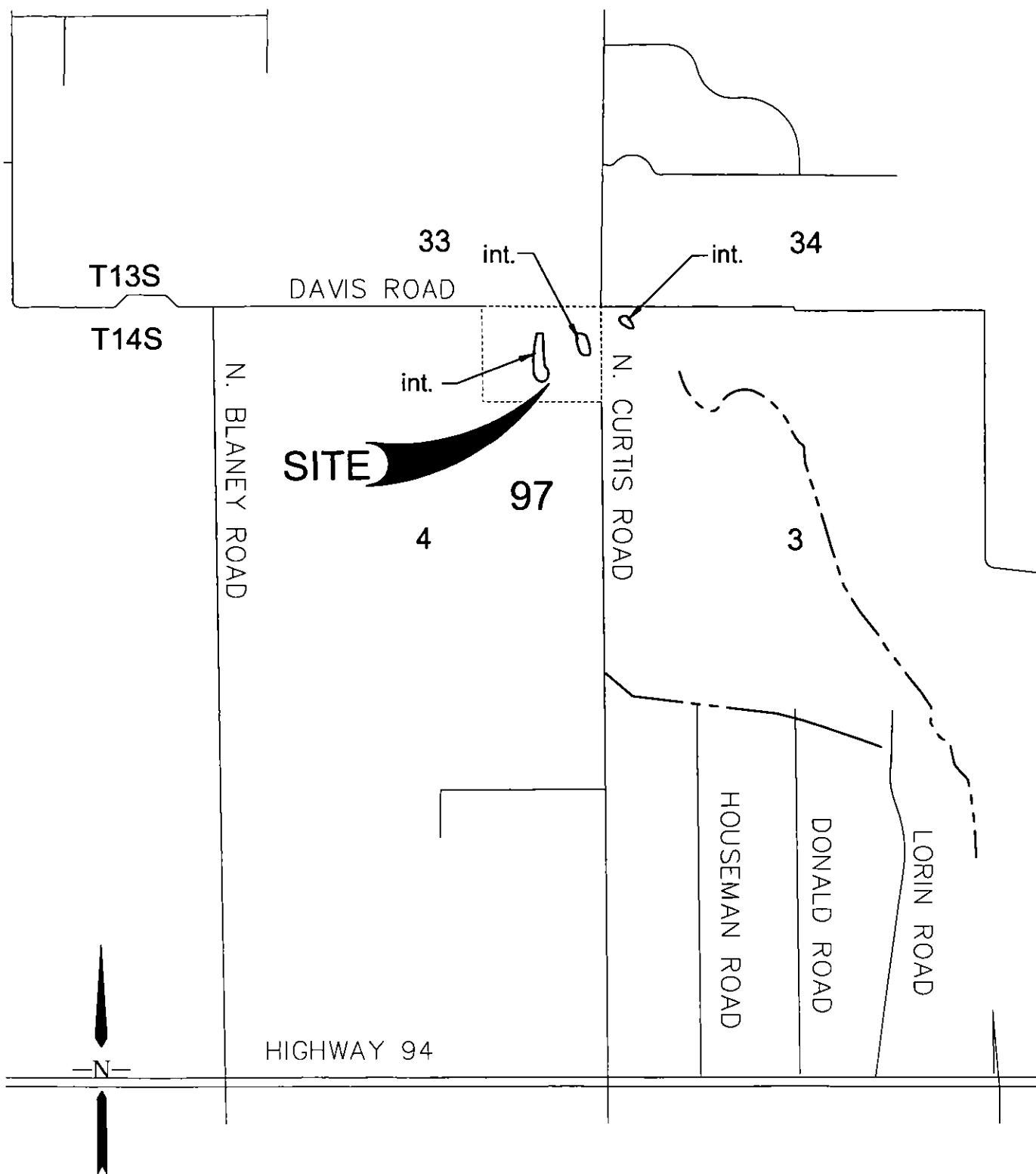
NO.	DATE	BY	REVISION	COUNTY COMMENTS
1	2/06/05	JPS		

HORIZ. SCALE: 1"=100'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: UP&E	CHECKED: JPS
CREATED: 3/29/06	LAST MODIFIED: 2/7/07/05
PROJECT NO. 020506	MODIFIED BY: BJJ

SHEET:

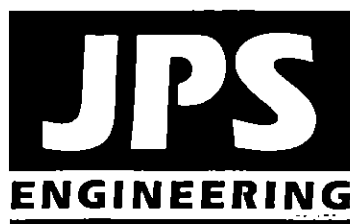
D1

APPENDIX B
HYDROLOGIC CALCULATIONS



(EL PASO COUNTY SOILS MAP NO. 18)

SCS SOILS MAP



**FALCON ACRES
SUBDIVISION**

FIGURE B

JPS PROJ NO. 020506

Almost all areas of this soil are used as rangeland. A few areas of crops such as alfalfa and corn are grown under sprinkler irrigation.

This soil is well suited to the production of native vegetation suitable for grazing. It is best suited to deep-rooted grasses. The native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, side-oats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of the plant cover. Interseeding is used to improve the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand is the main limitation for the establishment of trees and shrubs. The soil is so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to openland and rangeland wildlife habitat. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for use as homesites. The main limitation of this soil for roads and streets is frost action potential. Special designs for roads are needed to minimize this limitation. Practices are needed to control soil blowing and water erosion on construction sites where the plant cover has been removed. Capability subclass VIe, nonirrigated.

96—Truckton sandy loam, 0 to 3 percent slopes. This deep, well drained soil formed in alluvium and residuum derived from arkosic sedimentary rock on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 5 inches thick. The next layer is dark grayish brown sandy loam about 3 inches thick. The subsoil is brown sandy loam about 16 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Blakeland loamy sand, 1 to 9 percent slopes; Bresser sandy loam, 0 to 3 percent slopes; Ellicott loamy coarse sand, 0 to 5 percent slopes; and Ustic Torrifluvents, loamy.

Permeability of this Truckton soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazards of erosion and soil blowing are moderate.

This soil is used mainly for cultivated crops. It is also used for livestock grazing, for wildlife habitat, and as homesites.

Crops are commonly grown in combination with summer fallow because moisture is insufficient for annual cropping. Alfalfa can also be grown on this soil. When this soil is used as cropland, crop residue management and minimum tillage are necessary conservation practices.

This soil is well suited to the production of native vegetation suitable for grazing (fig. 7). It favors deep-rooted grasses. The native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, side-oats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of the plant cover. Interseeding is used to improve the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings generally are suited to this soil. Soil blowing is the main limitation to the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing areas for nesting and escape cover. For pheasant, undisturbed nesting cover is vital and should be provided in plans for habitat development. This is especially true in areas of intensive farming. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for use as homesites. The main limitation of this soil for roads and streets is frost-action potential. Special designs for roads are needed to overcome this limitation. Capability subclasses IIIe, nonirrigated, and IIe, irrigated.

97—Truckton sandy loam, 3 to 9 percent slopes. This deep, well drained soil formed in alluvium and residuum derived from arkosic sedimentary rock on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 5 inches thick. The next layer is dark grayish brown sandy loam about 3 inches thick. The subsoil is brown sandy loam about 16 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Blakeland loamy sand, 1 to 9 percent slopes; Bresser sandy loam, 3 to 5 percent slopes; and Truckton sandy loam, 0 to 3 percent slopes. Also included are small areas of soils that have arkosic sandstone or shale at a depth of less than 40 inches.

Permeability of this Truckton soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow to medium, and the hazards of erosion and soil blowing are moderate.

More than half of this soil is used as rangeland, for wildlife habitat, and as homesites. The rest, consisting of the less sloping areas, is used for wheat and sorghum. Rangeland or pastureland is the most suitable use because the permanent plant cover protects the soil.

This soil is well suited to the production of native vegetation suitable for grazing. Native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, side-oats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of the plant cover from this soil. Interseeding improves the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings generally are well suited to this soil. Soil blowing is the main limitation to the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing areas for nesting and escape cover. For pheasant, undisturbed nesting cover is vital and should be provided for in plans for habitat development. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

The main limitation of this soil for construction is frost-action potential. Special designs for roads are needed to overcome this limitation. Because of the sandy nature of the soil, practices must be provided to minimize surface runoff and thus keep erosion to a minimum. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff. Capability subclasses are, nonirrigated, and IVe, irrigated.

18—Truckton-Blakeland complex, 9 to 20 percent slopes. These strongly sloping to moderately steep soils

are on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

The Truckton soil makes up about 60 percent of the complex, the Blakeland soil about 25 percent, and other soils about 15 percent.

Included with these soils in mapping are areas of Bresser sandy loam, 5 to 9 percent slopes, and Yoder gravelly sandy loam, 8 to 25 percent slopes.

The Truckton soil is deep and well drained. It formed in alluvium and residuum weathered from arkosic sedimentary rock. Typically, the surface layer is grayish brown sandy loam about 5 inches thick. The next layer is dark grayish brown sandy loam about 3 inches thick. The subsoil is brown sandy loam about 16 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

Permeability of the Truckton soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium to rapid, and the hazard of erosion is moderate to high. Soil slippage is common on the upper part of slopes.

The Blakeland soil is deep and somewhat excessively drained. It formed in arkosic sandy alluvium and eolian sediment derived from arkosic sedimentary rock. Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The underlying material is brown loamy sand about 16 inches thick; it grades to pale brown sand that extends to a depth of 60 inches or more.

Permeability of the Blakeland soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is medium, and the hazard of erosion is moderate to high, and the hazard of soil blowing is high. Soil slippage is common on the upper part of slopes.

The soils in this complex are used for grazing livestock and wildlife habitat.

These soils are suited to the production of native vegetation suitable for grazing. The native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of the plant cover from these soils. Interseeding improves the existing vegetation. Deferment of grazing in spring improves plant vigor and soil stability. Properly locating livestock watering facilities helps to control grazing.

Soil blowing is the main limitation for the establishment of trees and shrubs on these soils. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Trees need to be planted in shallow furrows on the Blakeland soil because of its loose, sandy surface layer. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Hardness	
					<u>In</u>		
Tomah: 192, 193:							
Tomah part-----	B	None-----	---	---	>60	---	Moderate.
Crowfoot part--	B	None-----	---	---	>60	---	Moderate.
Travessilla: 194:							
Travessilla part-----	D	None-----	---	---	6-20	Hard	Low.
Rock outcrop part-----	D	---	---	---	---	---	---
Truckton: 95, 96, 97	B	None-----	---	---	>60	---	Moderate.
198:							
Truckton part--	B	None-----	---	---	>60	---	Moderate.
Blakeland part-	A	None-----	---	---	>60	---	Low.
199, 1100:							
Truckton part--	B	None-----	---	---	>60	---	Moderate.
Bresser part---	B	None-----	---	---	>60	---	Low.
Ustic Torrifluvents: 101-----	B	Occasional----	Very brief----	Mar-Aug	>60	---	Moderate.
Valent: 102, 103-----	A	None-----	---	---	>60	---	Low.
Vona: 104, 105-----	B	None-----	---	---	>60	---	Moderate.
Wigton: 106-----	A	None-----	---	---	>60	---	Low.
Wiley: 107, 108-----	B	None-----	---	---	>60	---	Low.
Yoder: 109, 110-----	B	None-----	---	---	>60	---	Low.

¹This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior characteristics of the map unit.

TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

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

* Hydrologic Soil Group

9/30/90

Replace with current
criteria

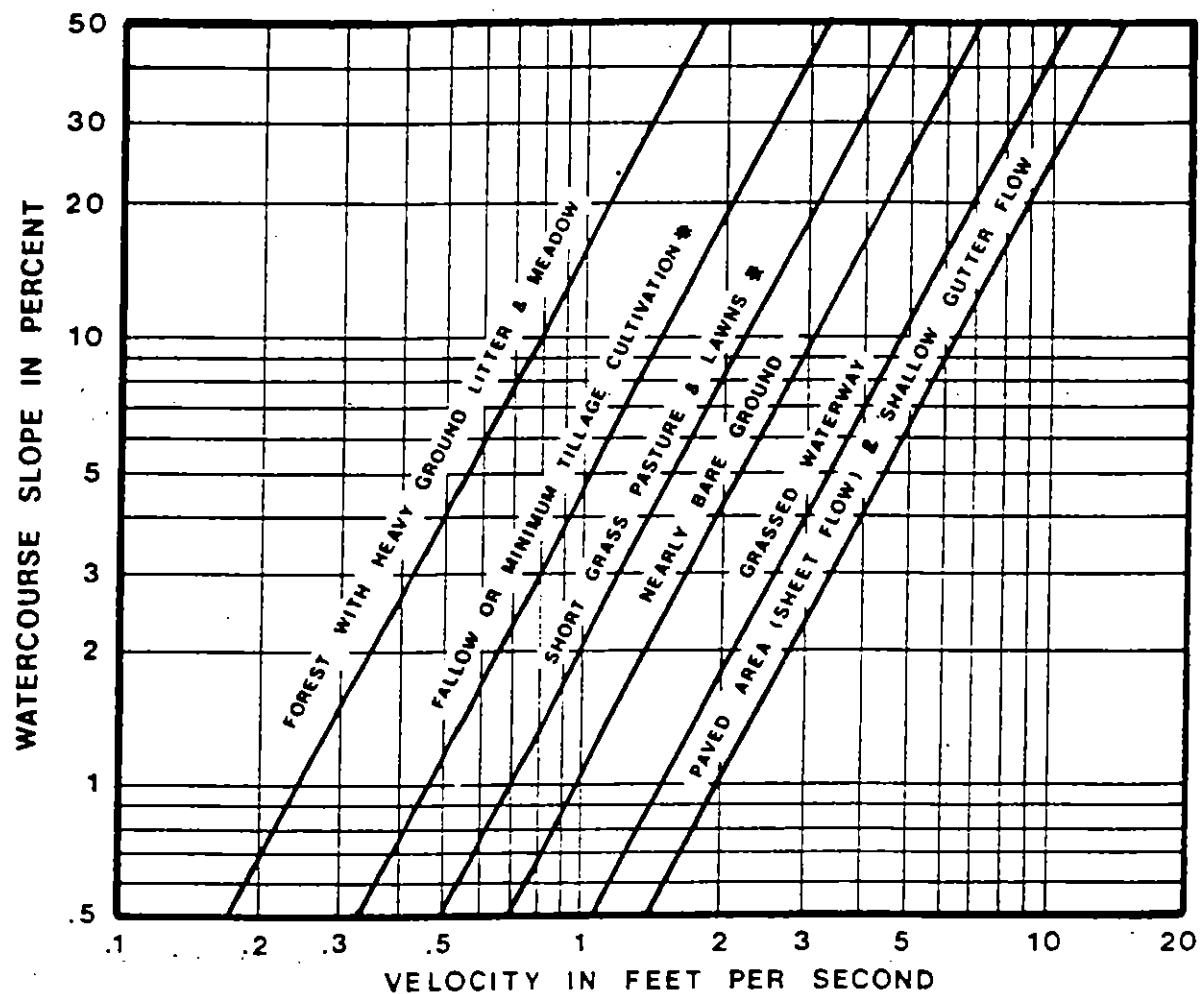


FIGURE 3-2. ESTIMATE OF AVERAGE FLOW VELOCITY FOR USE WITH THE RATIONAL FORMULA.

* MOST FREQUENTLY OCCURRING "UNDEVELOPED" LAND SURFACES IN THE DENVER REGION.

REFERENCE: "Urban Hydrology For Small Watersheds" Technical Release No. 55, USDA, SCS Jan. 1975.

Replace with current
criteria

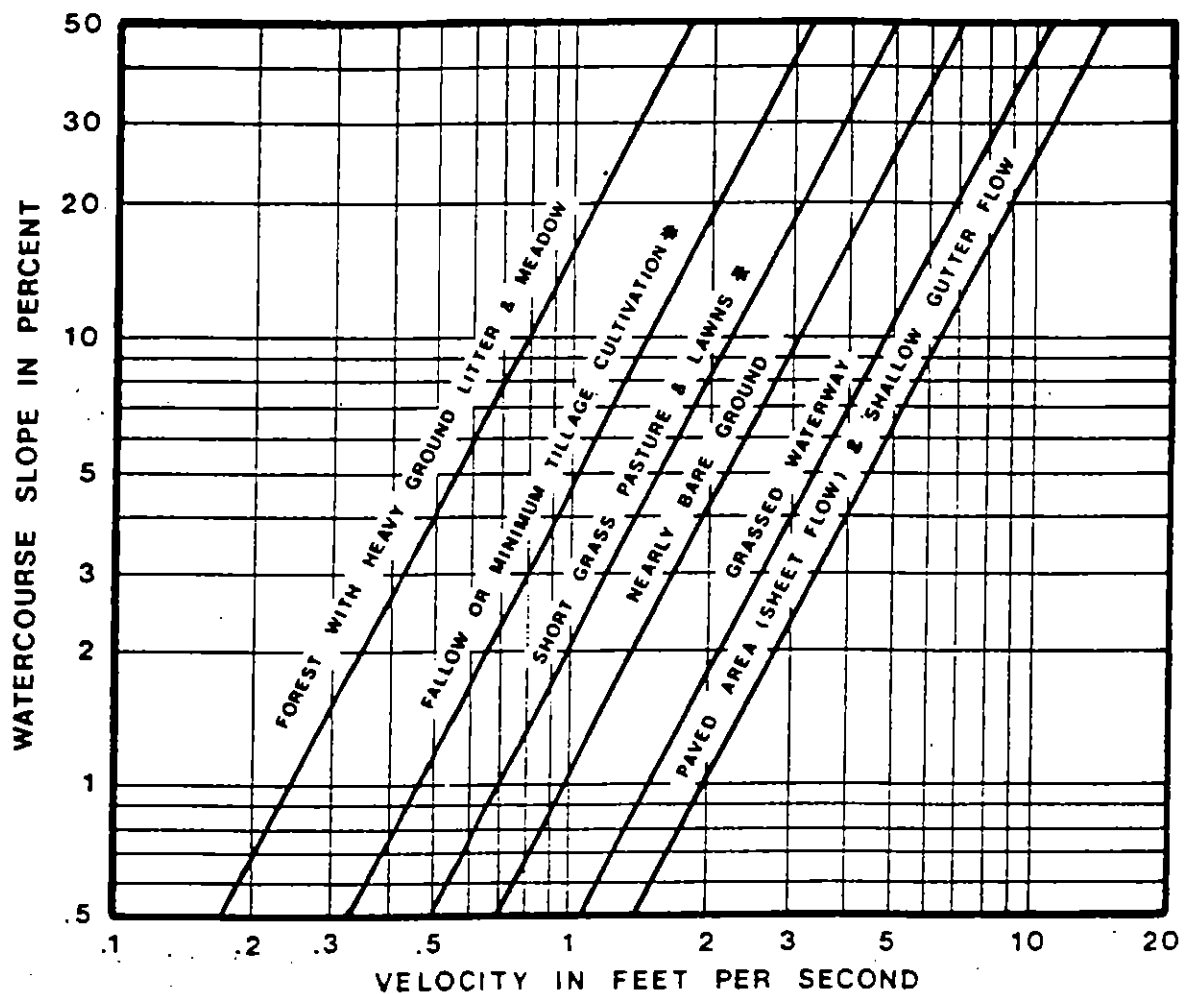
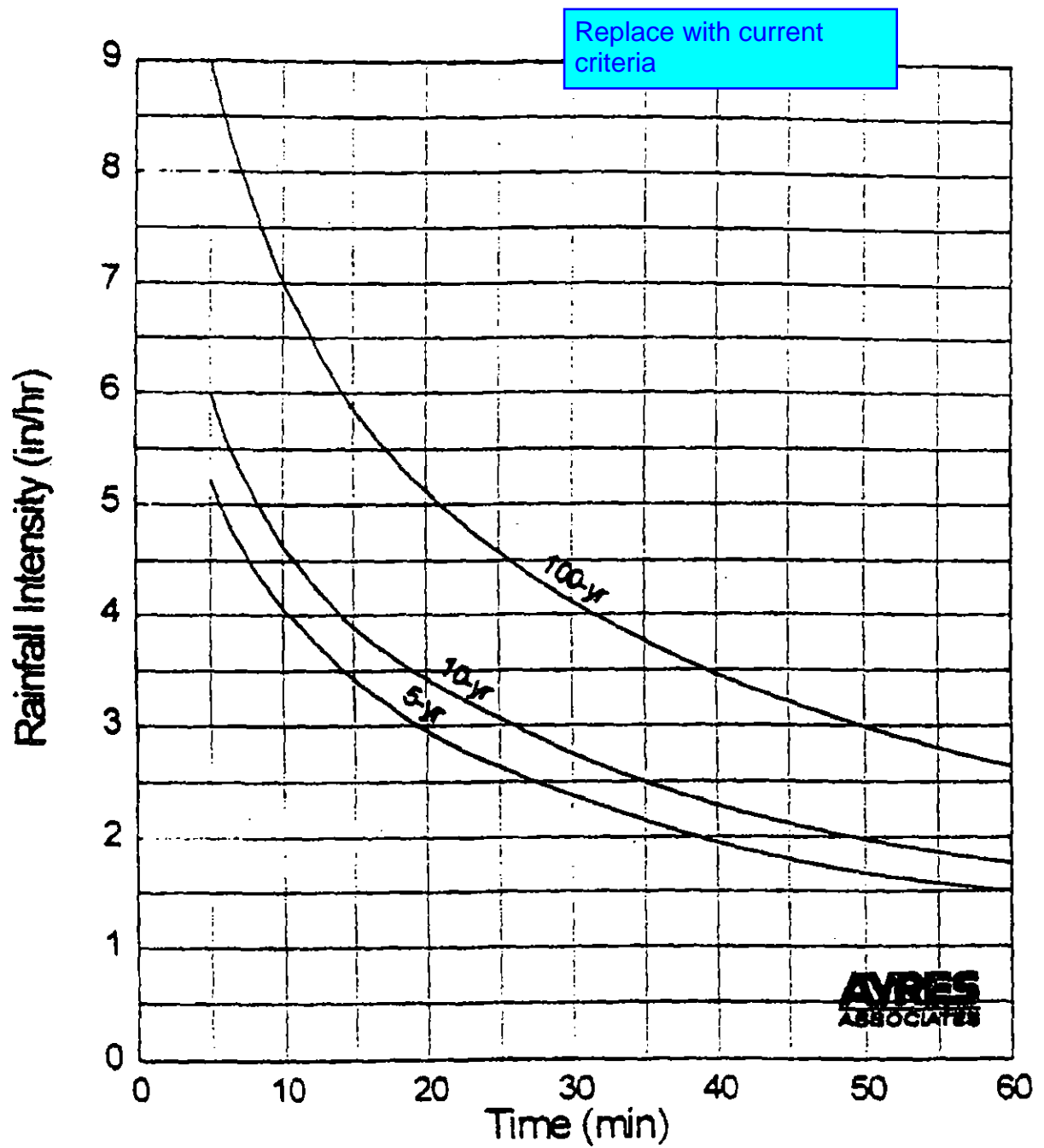


FIGURE 3-2. ESTIMATE OF AVERAGE FLOW VELOCITY FOR
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REFERENCE: "Urban Hydrology For Small Watersheds" Technical
Release No. 55, USDA, SCS Jan 1975.



Interim Release October 12, 1994 , Rainfall Intensity Curves
City Of Colorado Springs Drainage Criteria Manual

Hydrologic/hydraulic calculations will be reviewed on the resubmittal once all the input variables/criteria identified in the narrative have been updated to current standards.

JPS ENGINEERING

FALCON ACRES SUBDIVISION

COMPOSITE RUNOFF COEFFICIENTS - TYPICAL 5-ACRE DEVELOPED RURAL RESIDENTIAL AREA

DEVELOPED CONDITIONS

100-YEAR C VALUES

BASIN	TOTAL AREA (AC)	SOIL TYPE	AREA (%)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 2 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
5-ACRE LOTS	5.00	B	5.50	BLDG/DRIVEWAY	0.9	94.50	LAWN/MEADOW	0.25				0.286

100-YEAR C VALUES

BASIN	TOTAL AREA (AC)	SOIL TYPE	AREA (%)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 2 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
5-ACRE LOTS	5.00	B	5.50	BLDG/DRIVEWAY	0.95	94.50	LAWN/MEADOW	0.35				0.383

FALCON ACRES
RATIONAL METHOD

HISTORIC FLOWS

BASIN	DESIGN POINT	AREA (AC)	C		OVERLAND		T _{co} ⁽¹⁾ (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT K	SLOPE (%)	SCS ⁽²⁾ VELOCITY (FT/S)	T _i ⁽³⁾ (MIN)	TOTAL T _c ⁽⁴⁾ (MIN)
			5-YEAR ⁽⁷⁾	100-YEAR ⁽⁷⁾	LENGTH (FT)	SLOPE (%)							
OA1	OA1	207.64	0.250	0.350	1000	1.0	48.4	4000	1.50	1.5	1.84	36.3	84.7
OA2	OA2	483.90	0.250	0.350	1000	2.0	38.4	6400	1.50	2.5	2.37	45.0	83.4
OA3		24.40	0.250	0.350	1000	3.8	31.0	200	1.50	1	1.50	2.2	33.2
A		33.80	0.250	0.350	0		0.0	700	1.50	1.14	1.60	7.3	7.3
OA1-OA3,A	A	749.74	0.250	0.350									92.0
CB1		1.00	0.250	0.350	380	5.3	17.1					0.0	17.1
B		15.48	0.250	0.350	0		0.0	700	1.50	0.5	1.06	11.0	11.0
OB1,B	B	16.48	0.250	0.350									28.1
T _c from A TO DP1								900	1.50	0.9	1.42	10.5	10.5
OA1-OA3,OB1,A,B	1	766.22	0.250	0.350									102.5

Max overland flow is
300 ft for non-urban
land uses

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i , may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

t_i = overland (initial) flow time (min)

C_s = runoff coefficient for 5-year frequency (see Table 6-6)

L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)

S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

DEVELOPED FLOWS

BASIN	DESIGN POINT	AREA (AC)	C		OVERLAND		T _{co} ⁽¹⁾ (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT K	SLOPE (%)	SCS ⁽²⁾ VELOCITY (FT/S)	T _i ⁽³⁾ (MIN)	TOTAL T _c ⁽⁴⁾ (MIN)	Q (MGD)	Q (MGD)	Q (MGD)	Q (MGD)
			5-YEAR ⁽⁷⁾	100-YEAR ⁽⁷⁾	LENGTH (FT)	SLOPE (%)											
OA2.2		14.50	0.250	0.350	1000	2.0	38.4	300	1.50	5	3.35	1.5	39.9	1.95	3.50	7.07	17.76
A2		6.24	0.286	0.383	0		0.0	700	1.50	1.14	1.60	7.3	7.3				
OA2.2,A2	A2	20.74	0.261	0.360									47.2	1.70	3.10	9.20	23.14
OA2.1		469.40	0.250	0.350	1000	2.0	38.4	6400	1.50	2.5	2.37	45.0	83.4	1.50	2.65	176.03	435.37
A1		6.10	0.286	0.383	0		0.0	700	1.50	1.14	1.60	7.3	7.3				
OA2.1-OA2.2,A1-A2	A1	496.24	0.251	0.351									90.7	1.50	2.65	186.76	461.34
OA1	OA1	207.64	0.250	0.350	1000	1.0	48.4	4000	1.50	1.5	1.84	36.3	84.7	1.50	2.65	77.87	192.59
OA3		24.40	0.250	0.350	1000	3.8	31.0	200	1.50	1	1.50	2.2	33.2	2.20	3.85	13.42	32.88
A3.1		9.13	0.286	0.383	0		0.0	580	1.50	0.69	1.25	7.8	7.8				
OA3,A3.1	A3.1	33.53	0.260	0.359									41.0	1.90	3.40	16.55	40.93
A3.2		12.34	0.286	0.383	0		0.0	700	1.50	1.14	1.60	7.3	7.3				
OA1-OA3,A1-A3	A	749.75	0.252	0.351									98.0	1.50	2.65	282.98	698.35
CB1		1.00	0.250	0.350	380	5.3	17.1					0.0	17.1				
B		15.48	0.286	0.383	0		0.0	700	1.50	0.5	1.06	11.0	11.0				
OB1,B	B	16.48	0.284	0.381									28.1	2.50	4.20	11.69	26.37
T _c from A TO DP1								900	1.50	0.9	1.42	10.5	10.5				
OA1-OA3,OB1,A,B	1	766.23	0.252	0.352									108.5	1.50	2.65	290.00	714.99

1) OVERLAND FLOW T_{co} = (1.87*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^{0.5}/(SLOPE^{0.333})))

2) SCS VELOCITY = K * ((SLOPE(%))^{0.5})

K = 0.25 FOR MEADOW

K = 1.0 FOR BARE SOIL

K = 1.5 FOR GRASS CHANNEL

K = 2.0 FOR PAVEMENT

3) GUTTER/SWALE FLOW, T_i = (GUTTER LENGTH/ SCS VELOCITY) / 60 SEC

4) T_c = T_{co} + T_i

*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED

5) INTENSITY BASED ON I-D-F CURVE IN EL PASO COUNTY DRAINAGE CRITERIA MANUAL

6) Q = CIA

7) WEIGHTED AVERAGE C VALUES FOR COMBINED BASINS

TABLE 5-4
 RUNOFF CURVE NUMBERS FOR HYDROLOGIC
 COVER COMPLEXES - RURAL COND
 (Antecedent Moisture Condition II, a
 (From: U.S. Dept. of Agriculture,
 Soil Conservation Service, 1977)

Replace with current
criteria

Land Use	Cover Treatment or Practice	Hydrologic Condition	Runoff Curve Number by Hydrologic Soil Group			
			A	B	C	D
Fallow	Straight Row	----	77	86	91	94
Row Crops	Straight Row	Poor	72	81	88	91
	Straight Row	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	Contoured	Good	65	75	82	86
	Cont. & Terraced	Poor	66	74	80	82
	Cont. & Terraced	Good	62	71	78	81
Small Grain	Straight Row	Poor	65	76	84	88
	Straight Row	Good	63	75	83	87
	Contoured	Poor	63	74	82	85
	Contoured	Good	61	73	81	84
	Cont. & Terraced	Poor	61	72	79	82
	Cont. & Terraced	Good	59	70	78	81
Close- seeded legumes 1/ or rotation meadow	Straight Row	Poor	66	77	85	89
	Straight Row	Good	58	72	81	85
	Contoured	Poor	64	75	83	85
	Contoured	Good	55	69	78	83
	Cont. & Terraced	Poor	63	73	80	83
	Cont. & Terraced	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	Contoured	Poor	47	67	81	88
	Contoured	Fair	25	59	75	83
	Contoured	Good	6	35	70	79
Meadow		Good	30	58	71	78
Woods		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		----	59	74	82	86
Roads (dirt) 2/ (hard surface) 2/		----	72	82	87	89
		----	74	84	90	92

CN 50
Used For
Off-site
Existing
w/Retention
Storage

1/ Close-drilled or broadcast
 2/ Including right-of-way

TABLE 5-5
RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL
COVER COMPLEXES - URBAN AND SUBURBAN CONDITIONS 1/
(Antecedent Moisture Condition II)
(From: U.S. Dept. of Agriculture,
Soil Conservation Service, 1977)

Land Use	Hydrologic Soil Group			
	A	B	C	D
Open spaces, lawns, parks, golf courses, cemeteries, etc.				
Good condition: grass cover on 75% or more of the area	39*	(61)	74	80
Fair condition: grass cover on 50% to 75% of the area	49*	69	79	84
Commercial and Business areas (85% Impervious)	89*	92	94	95
Industrial Districts 72% Impervious)	81*	88	91	93
Residential: <u>2/</u>				
<u>Acres per Dwelling Unit</u>	<u>Average %</u>	<u>Impervious</u>		
		<u>3/</u>		
1/8 acre or less	65	77*	85	90
1/4 acre	38	61*	75	83
1/3 acre	30	57*	72	81
1/2 acre	25	54*	70	80
1 acre	20	51*	68	79
Paved parking lots, roofs, driveways, etc.	98	98	98	98
Streets and Roads:				
paved with curbs and storm sewers	98	(98)	98	98
gravel	76*	85	89	91
dirt	72*	82	87	89

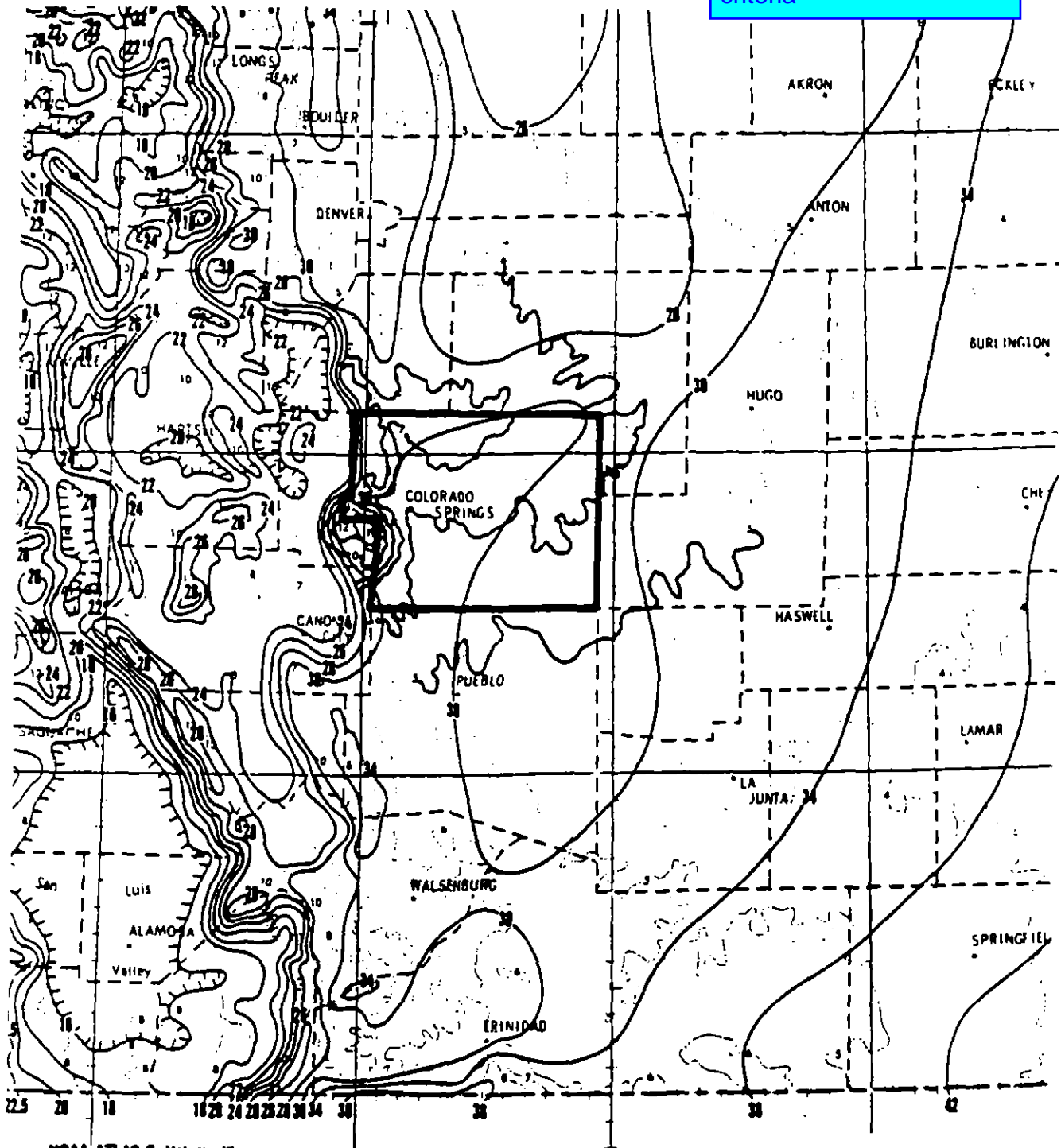
1/ For a more detailed description of agricultural land use curve numbers, refer to the National Engineering Handbook (U.S. Dept. of Agriculture, Soil Conservation Service, 1972).

2/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

3/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

* Not to be used wherever overlot grading or filling is to occur.

Replace with current
criteria



NOAA ATLAS 2, Volume III
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH



HDR Infrastructure, Inc.
A Centerra Company

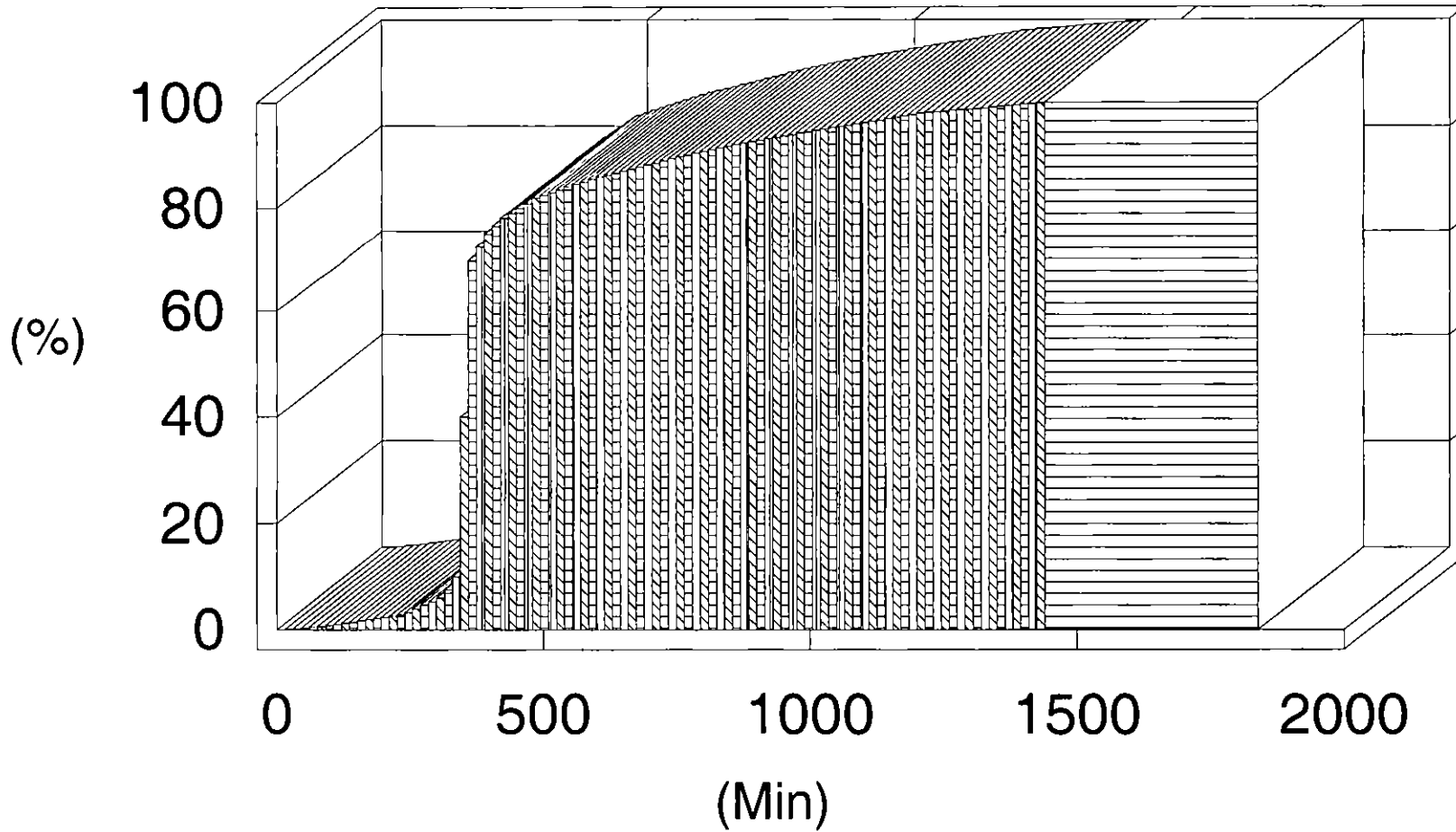
The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date
OCT. 1987
Figure
5-4d

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

5-40

Design Storm - TYPE IIA.CDS, Time int. = 15 min



Hydrograph Plot

English

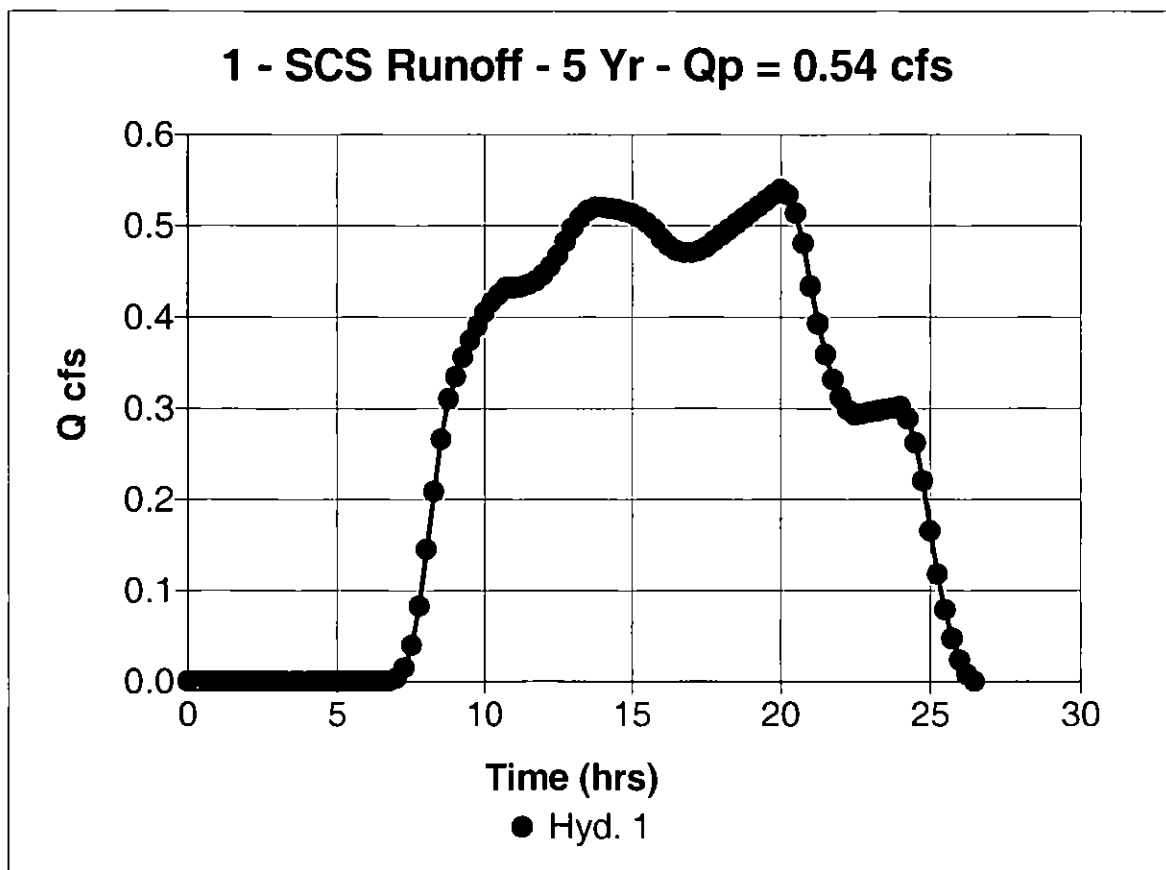
Hyd. No. 1

OA1-H

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Drainage area = 207.64 ac
Basin Slope = 1.4 %
Tc method = USER
Total precip. = 2.60 in
Storm duration = TYPE IIA.CDS

Peak discharge = 0.54 cfs
Time interval = 15 min
Curve number = 50
Hydraulic length = 6530 ft
Time of conc. (Tc) = 84.7 min
Distribution = Custom
Shape factor = 484

Total Volume = 0.606 acft



Hydrograph Plot

English

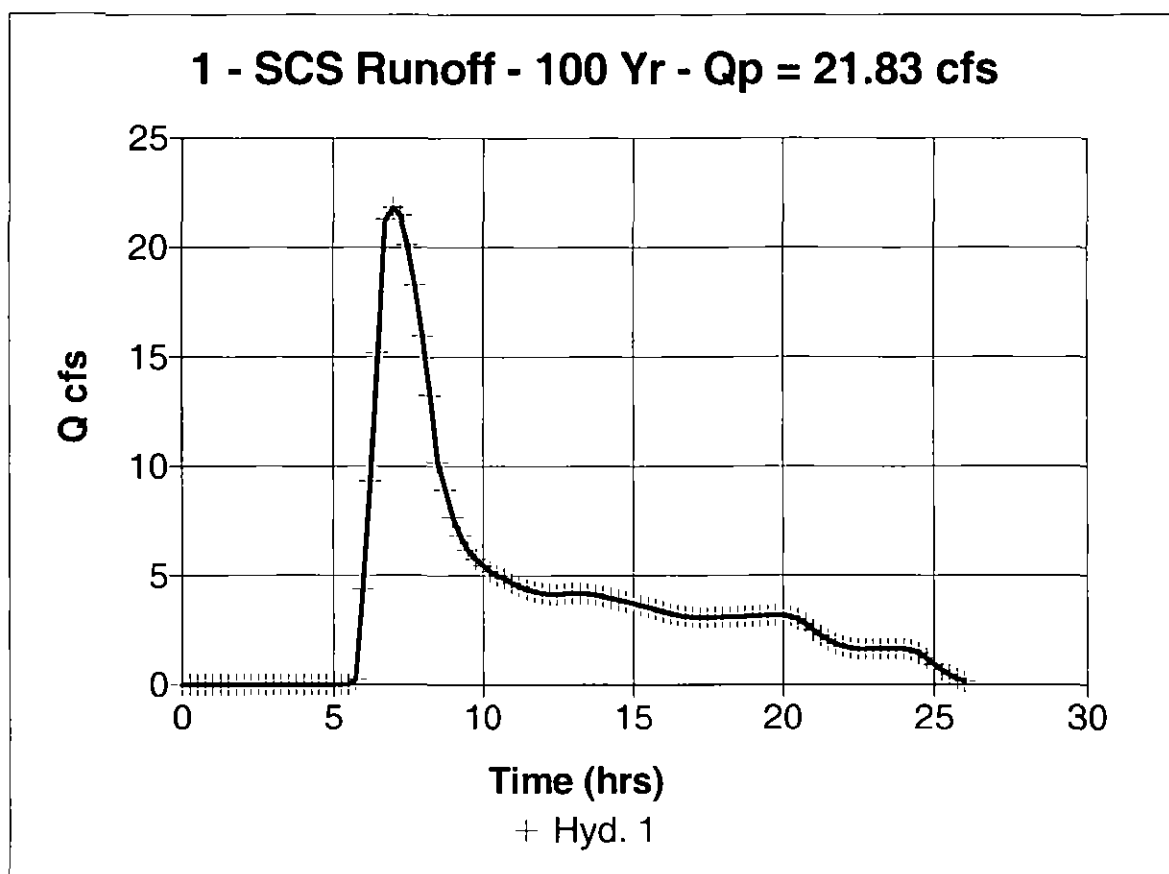
Hyd. No. 1

OA1-H

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 207.64 ac
Basin Slope = 1.4 %
Tc method = USER
Total precip. = 4.40 in
Storm duration = TYPE IIA.CDS

Peak discharge = 21.83 cfs
Time interval = 15 min
Curve number = 50
Hydraulic length = 6530 ft
Time of conc. (Tc) = 84.7 min
Distribution = Custom
Shape factor = 484

Total Volume = 8.289 acft



Hydrograph Plot

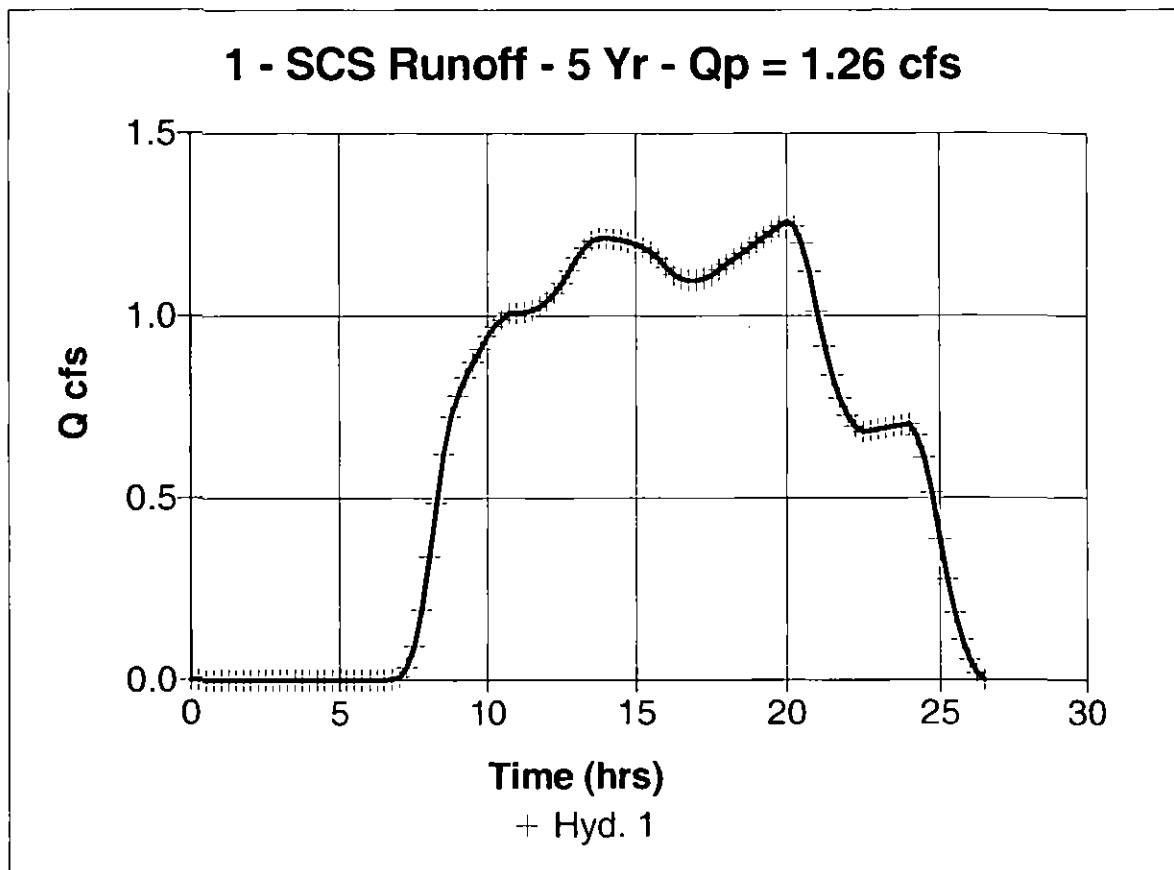
English

Hyd. No. 1

OA2-H

Hydrograph type	= SCS Runoff	Peak discharge	= 1.26 cfs
Storm frequency	= 5 yrs	Time interval	= 15 min
Drainage area	= 483.90 ac	Curve number	= 50
Basin Slope	= 2.4 %	Hydraulic length	= 7400 ft
Tc method	= USER	Time of conc. (Tc)	= 92 min
Total precip.	= 2.60 in	Distribution	= Custom
Storm duration	= TYPE IIA.CDS	Shape factor	= 484

Total Volume = 1.412 acft



Hydrograph Plot

English

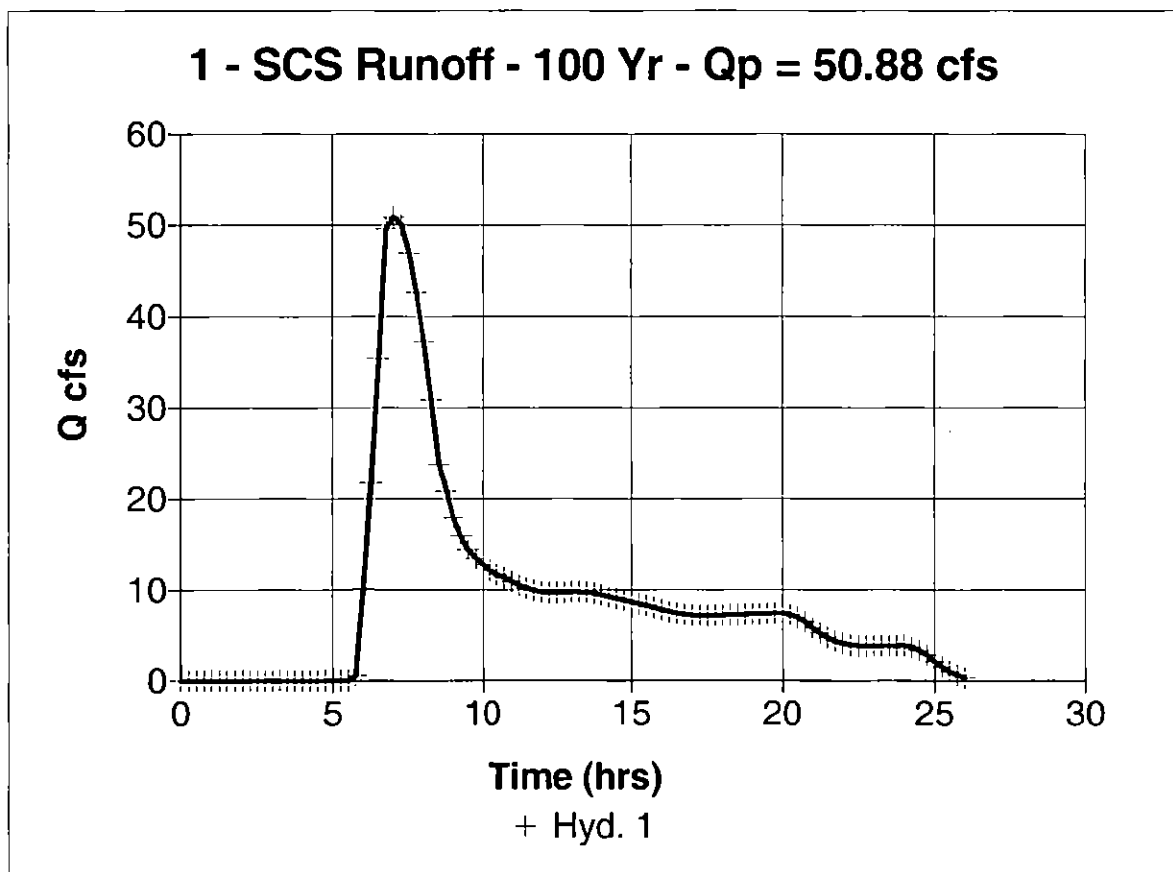
Hyd. No. 1

OA2-H

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 483.90 ac
Basin Slope = 2.4 %
Tc method = USER
Total precip. = 4.40 in
Storm duration = TYPE IIA.CDS

Peak discharge = 50.88 cfs
Time interval = 15 min
Curve number = 50
Hydraulic length = 7400 ft
Time of conc. (Tc) = 83.4 min
Distribution = Custom
Shape factor = 484

Total Volume = 19.317 acft



Hydrograph Plot

English

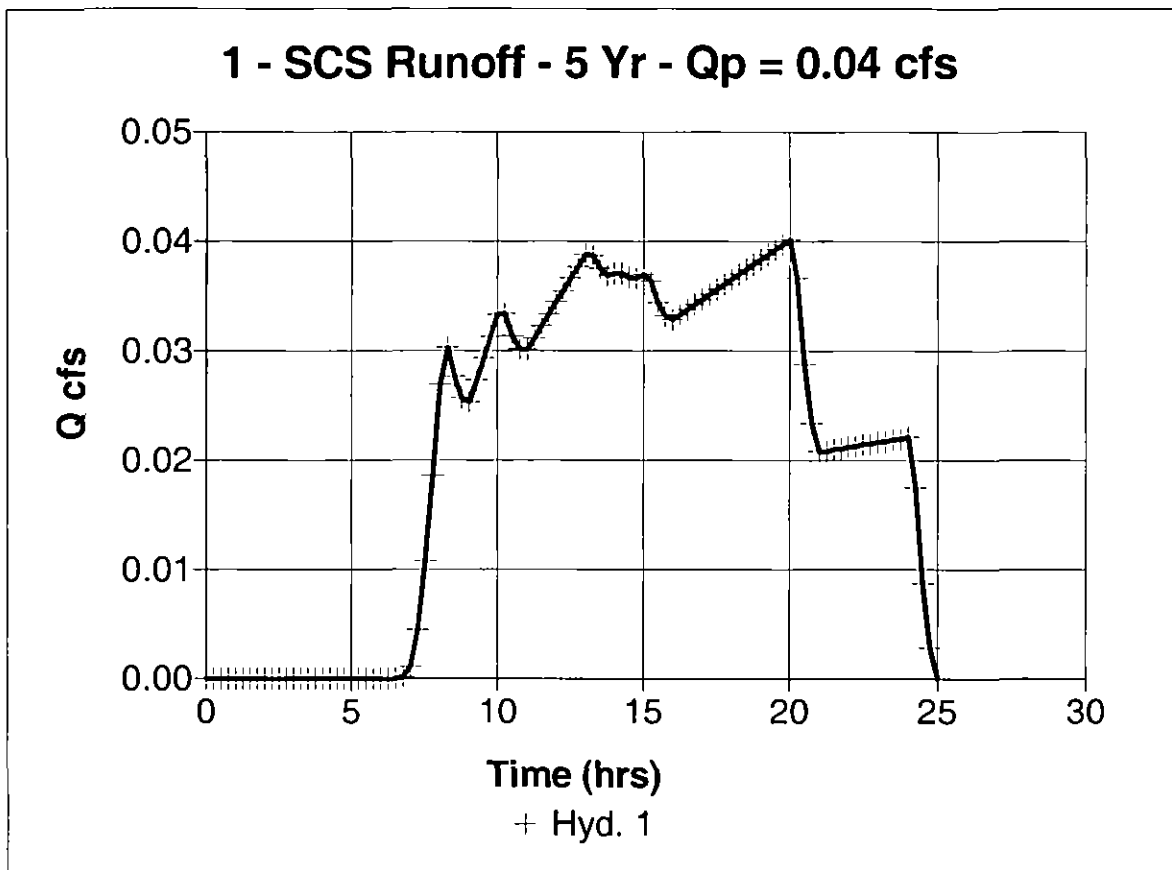
Hyd. No. 1

B-H

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Drainage area = 16.48 ac
Basin Slope = 2.6 %
Tc method = USER
Total precip. = 2.60 in
Storm duration = TYPE IIA.CDS

Peak discharge = 0.04 cfs
Time interval = 15 min
Curve number = 50
Hydraulic length = 1080 ft
Time of conc. (Tc) = 28.1 min
Distribution = Custom
Shape factor = 484

Total Volume = 0.044 acft



Hydrograph Plot

English

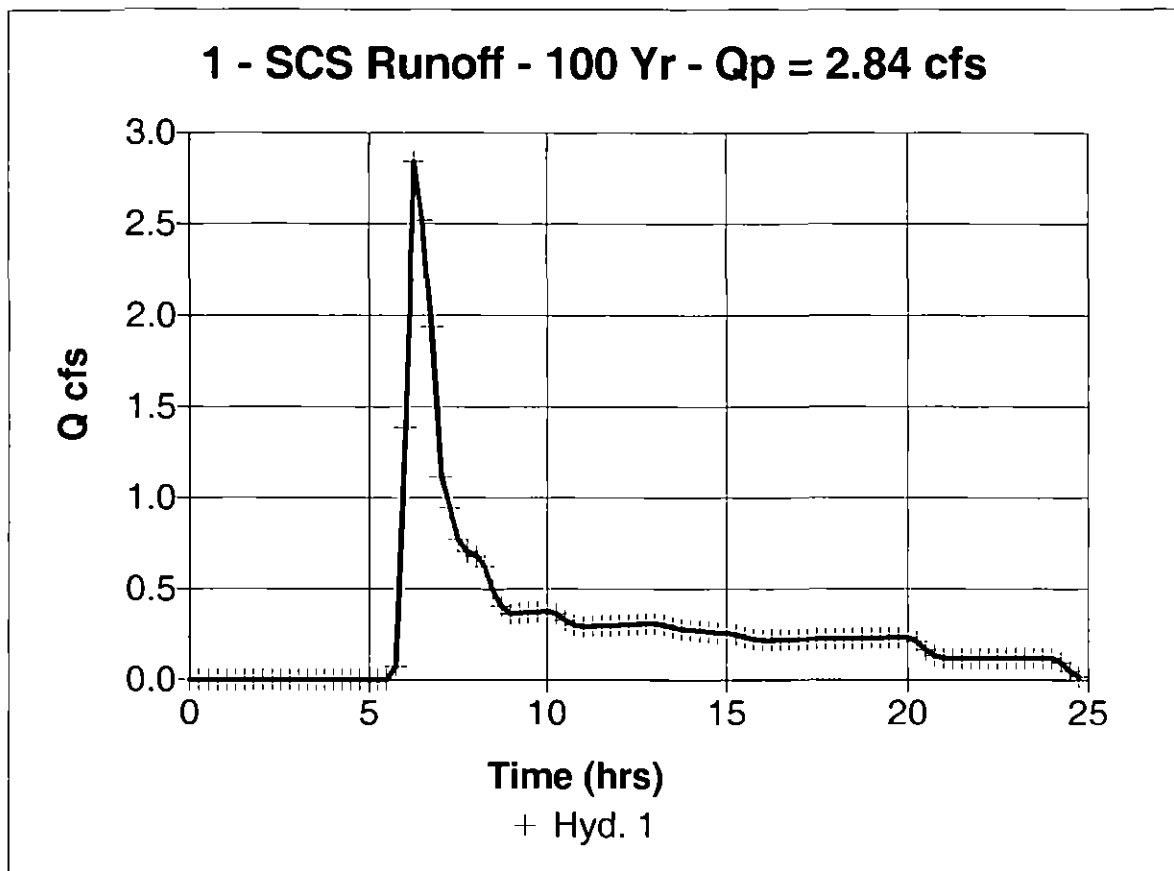
Hyd. No. 1

B-H

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 16.48 ac
Basin Slope = 2.6 %
Tc method = USER
Total precip. = 4.40 in
Storm duration = TYPE IIA.CDS

Peak discharge = 2.84 cfs
Time interval = 15 min
Curve number = 50
Hydraulic length = 1080 ft
Time of conc. (Tc) = 28.1 min
Distribution = Custom
Shape factor = 484

Total Volume = 0.598 acft



Hydrograph Plot

English

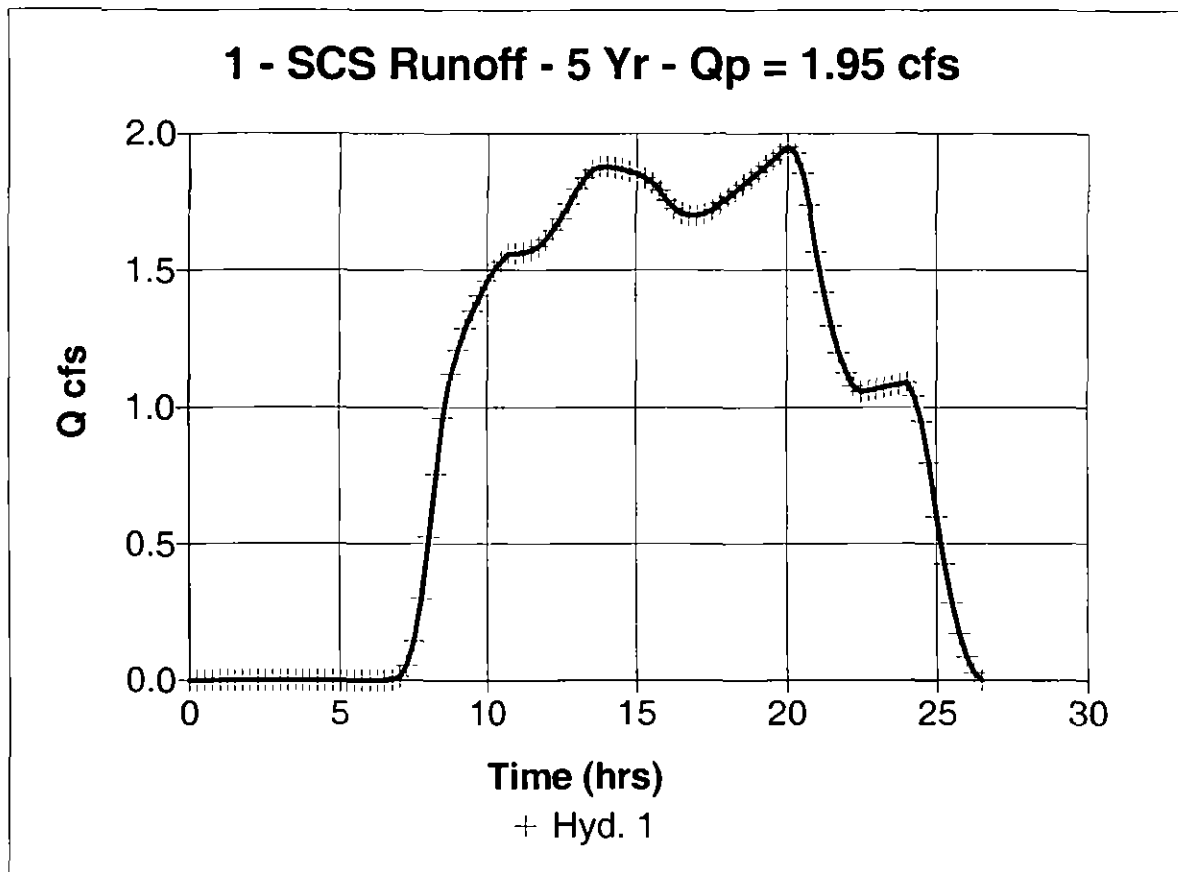
Hyd. No. 1

A-H

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Drainage area = 749.70 ac
Basin Slope = 1.3 %
Tc method = USER
Total precip. = 2.60 in
Storm duration = TYPE IIA.CDS

Peak discharge = 1.95 cfs
Time interval = 15 min
Curve number = 50
Hydraulic length = 5700 ft
Time of conc. (Tc) = 92 min
Distribution = Custom
Shape factor = 484

Total Volume = 2.188 acft



Hydrograph Plot

English

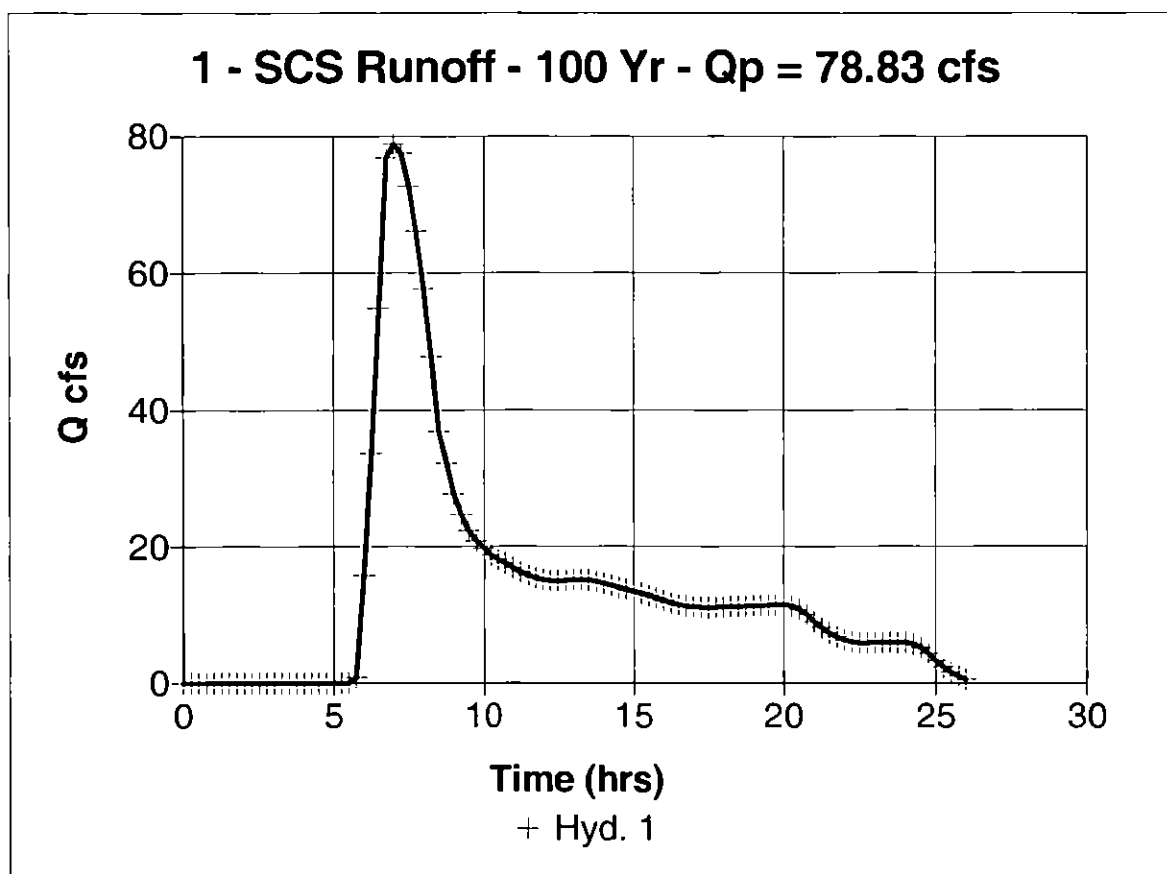
Hyd. No. 1

A-H

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 749.70 ac
Basin Slope = 1.3 %
Tc method = USER
Total precip. = 4.40 in
Storm duration = TYPE IIA.CDS

Peak discharge = 78.83 cfs
Time interval = 15 min
Curve number = 50
Hydraulic length = 5700 ft
Time of conc. (Tc) = 92 min
Distribution = Custom
Shape factor = 484

Total Volume = 29.928 act



Hydrograph Plot

English

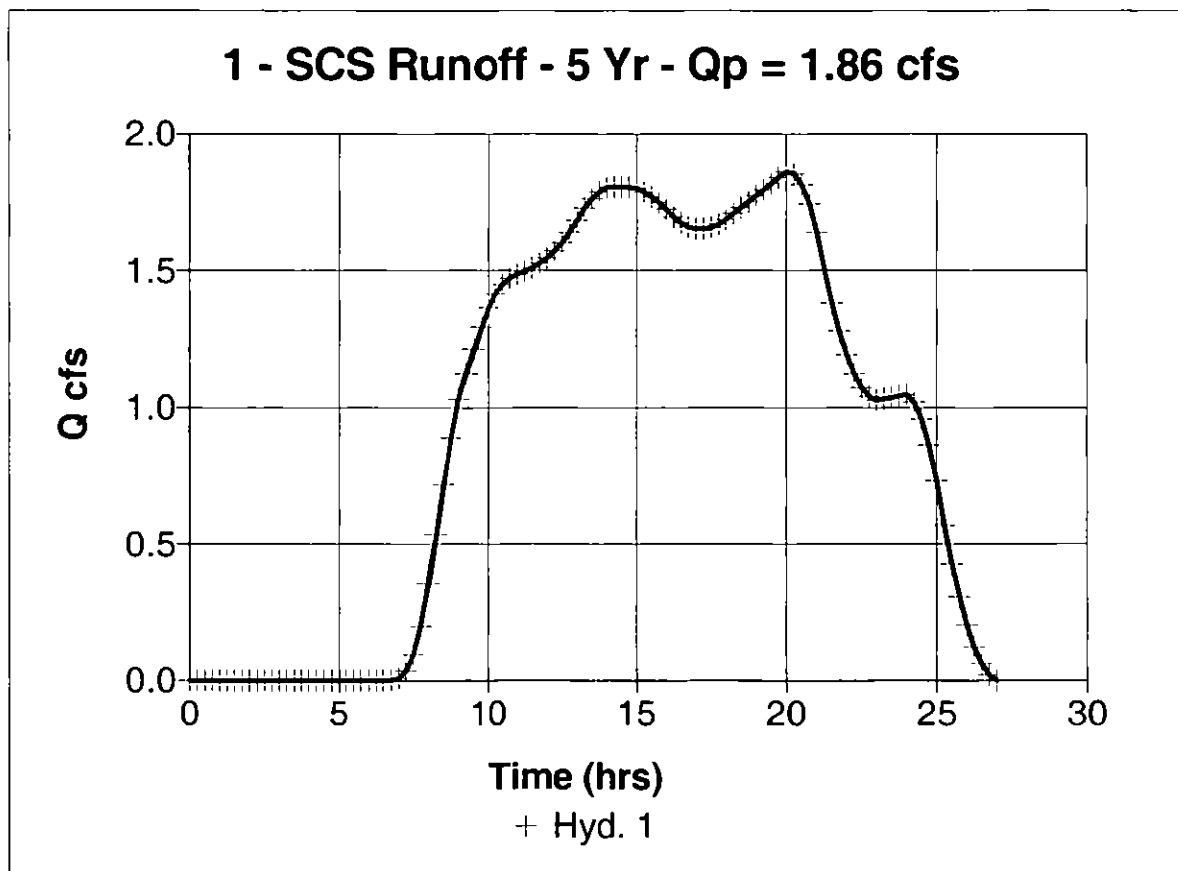
Hyd. No. 1

DP1-H

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Drainage area = 766.20 ac
Basin Slope = 2.1 %
Tc method = USER
Total precip. = 2.60 in
Storm duration = TYPE IIA.CDS

Peak discharge = 1.86 cfs
Time interval = 15 min
Curve number = 50
Hydraulic length = 9070 ft
Time of conc. (Tc) = 102.5 min
Distribution = Custom
Shape factor = 484

Total Volume = 2.114 acft



Hydrograph Plot

English

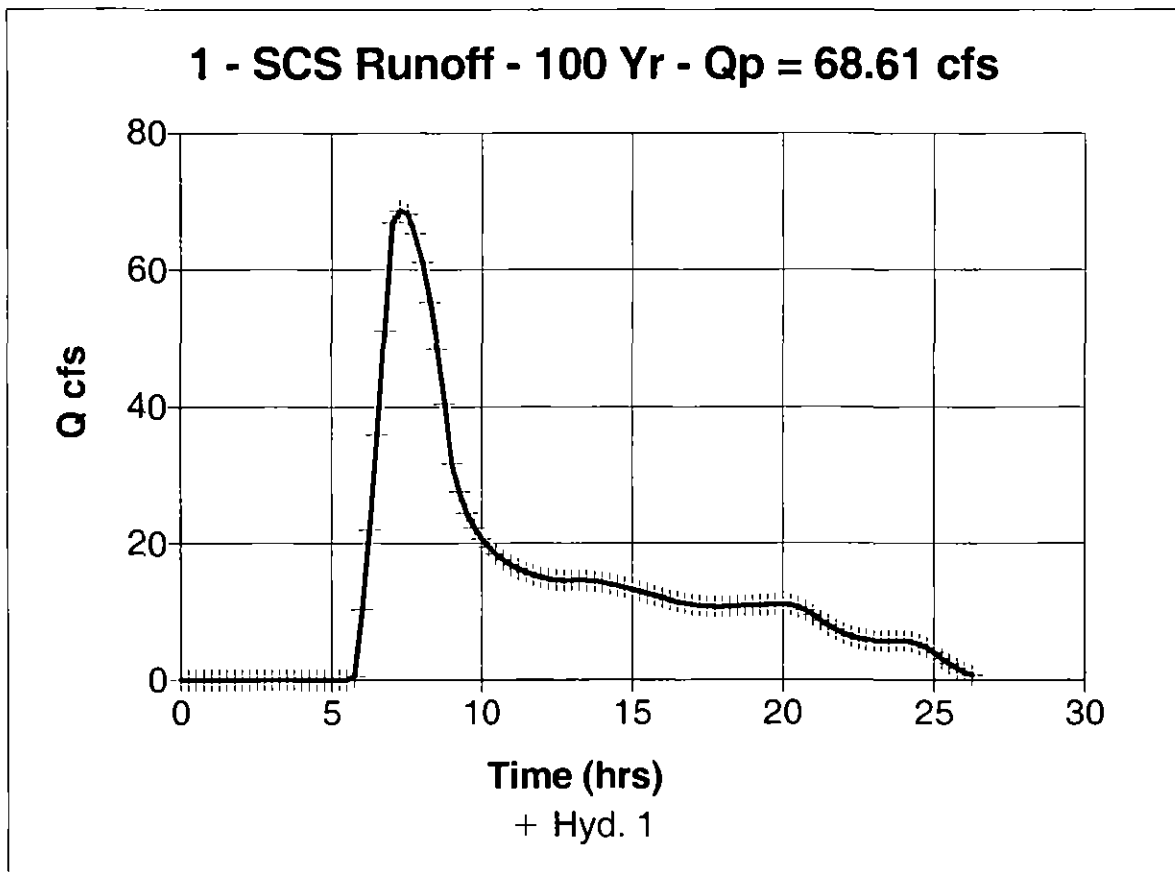
Hyd. No. 1

DP1-H

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 766.20 ac
Basin Slope = 2.1 %
Tc method = USER
Total precip. = 4.40 in
Storm duration = TYPE IIA.CDS

Peak discharge = 68.61 cfs
Time interval = 15 min
Curve number = 50
Hydraulic length = 9070 ft
Time of conc. (Tc) = 102.5 min
Distribution = Custom
Shape factor = 484

Total Volume = 28.918 acft



Hydrograph Plot

English

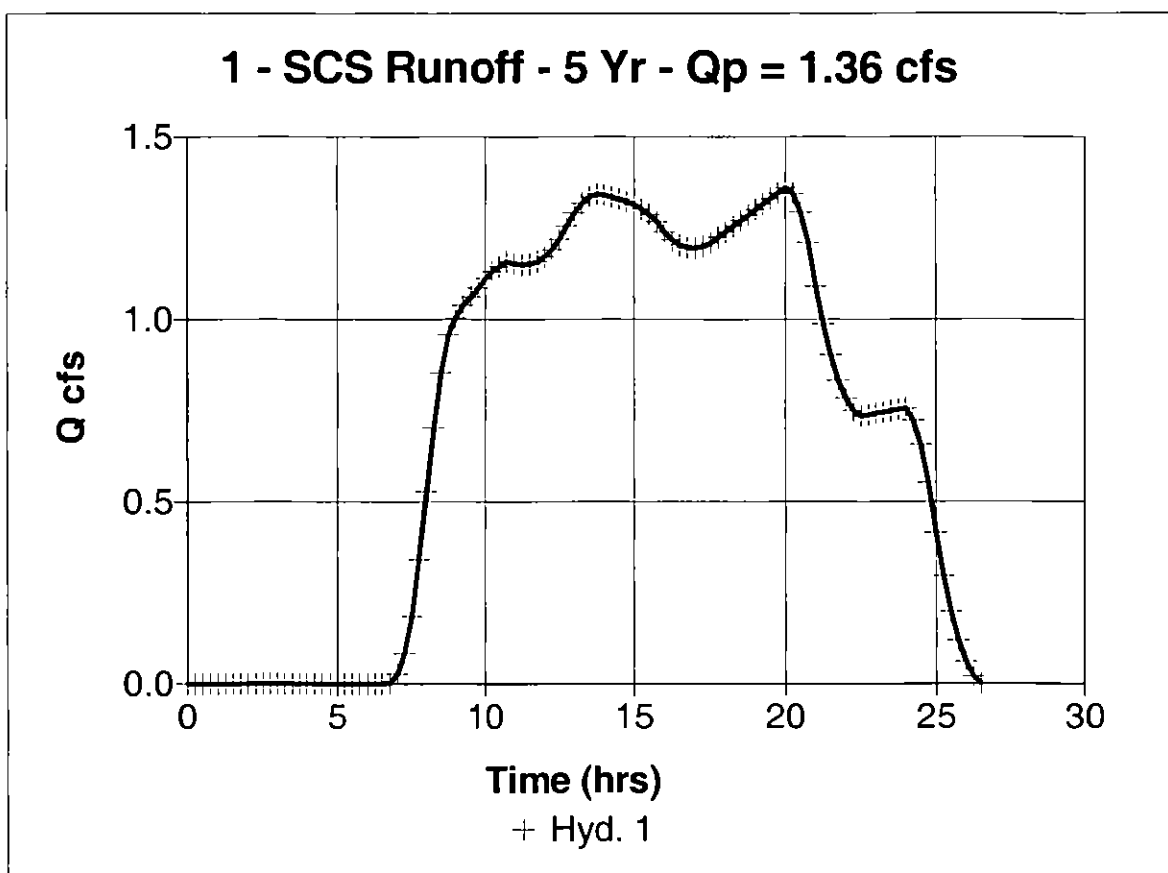
Hyd. No. 1

A1-D

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Drainage area = 496.20 ac
Basin Slope = 1.4 %
Tc method = USER
Total precip. = 2.60 in
Storm duration = TYPE IIA.CDS

Peak discharge = 1.36 cfs
Time interval = 15 min
Curve number = 50.3
Hydraulic length = 7400 ft
Time of conc. (Tc) = 83.4 min
Distribution = Custom
Shape factor = 484

Total Volume = 1.580 acft



Hydrograph Plot

English

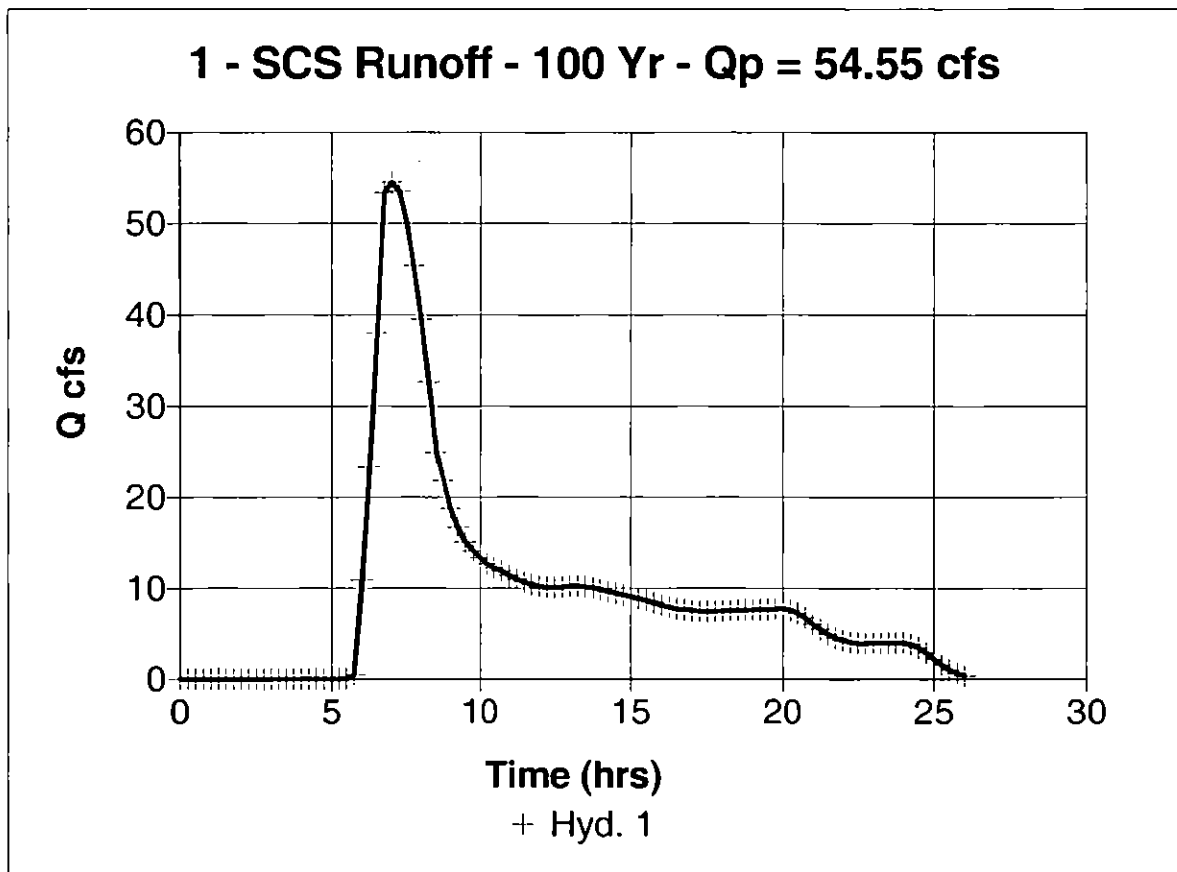
Hyd. No. 1

A1-D

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 496.20 ac
Basin Slope = 1.4 %
Tc method = USER
Total precip. = 4.40 in
Storm duration = TYPE IIA.CDS

Peak discharge = 54.55 cfs
Time interval = 15 min
Curve number = 50.3
Hydraulic length = 7400 ft
Time of conc. (Tc) = 83.4 min
Distribution = Custom
Shape factor = 484

Total Volume = 20.360 acft



Hydrograph Plot

English

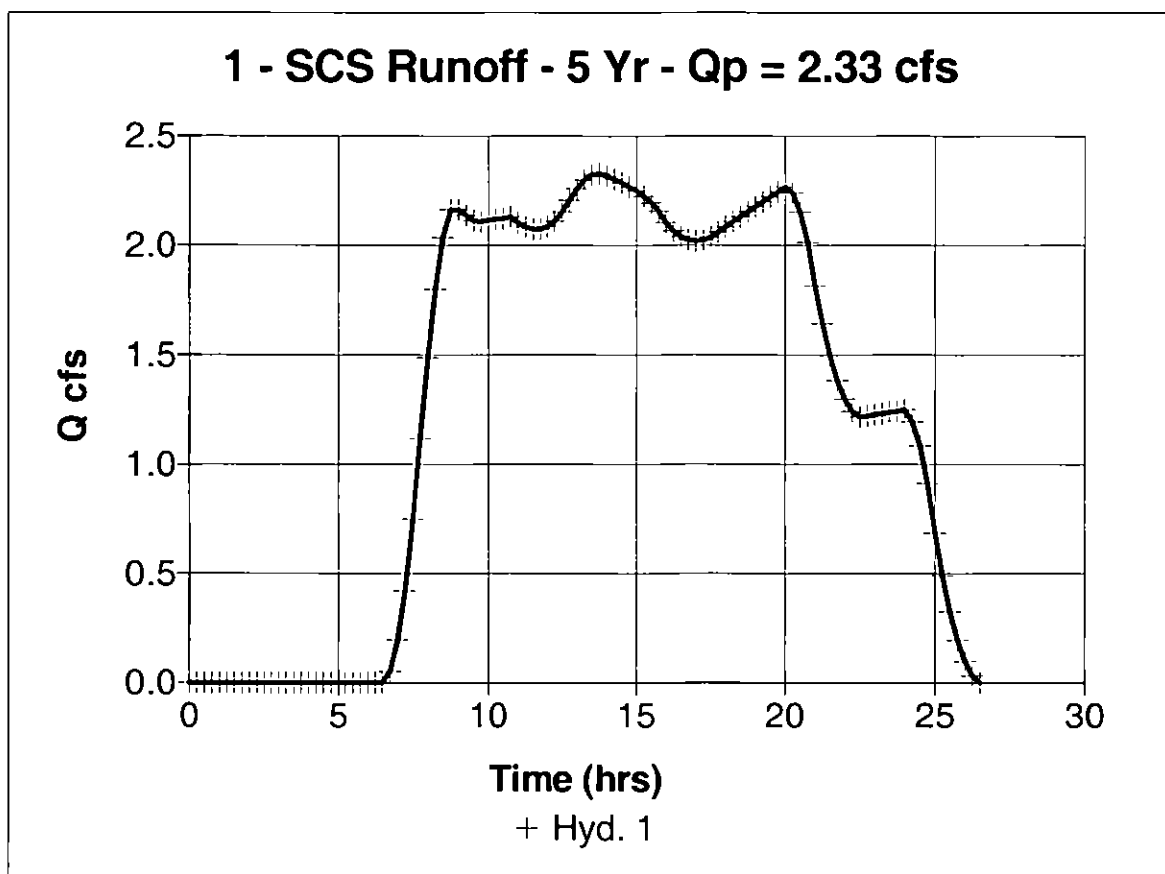
Hyd. No. 1

A-D

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Drainage area = 749.80 ac
Basin Slope = 1.1 %
Tc method = USER
Total precip. = 2.60 in
Storm duration = TYPE IIA.CDS

Peak discharge = 2.33 cfs
Time interval = 15 min
Curve number = 50.9
Hydraulic length = 5700 ft
Time of conc. (Tc) = 92 min
Distribution = Custom
Shape factor = 484

Total Volume = 2.810 acft



Hydrograph Plot

English

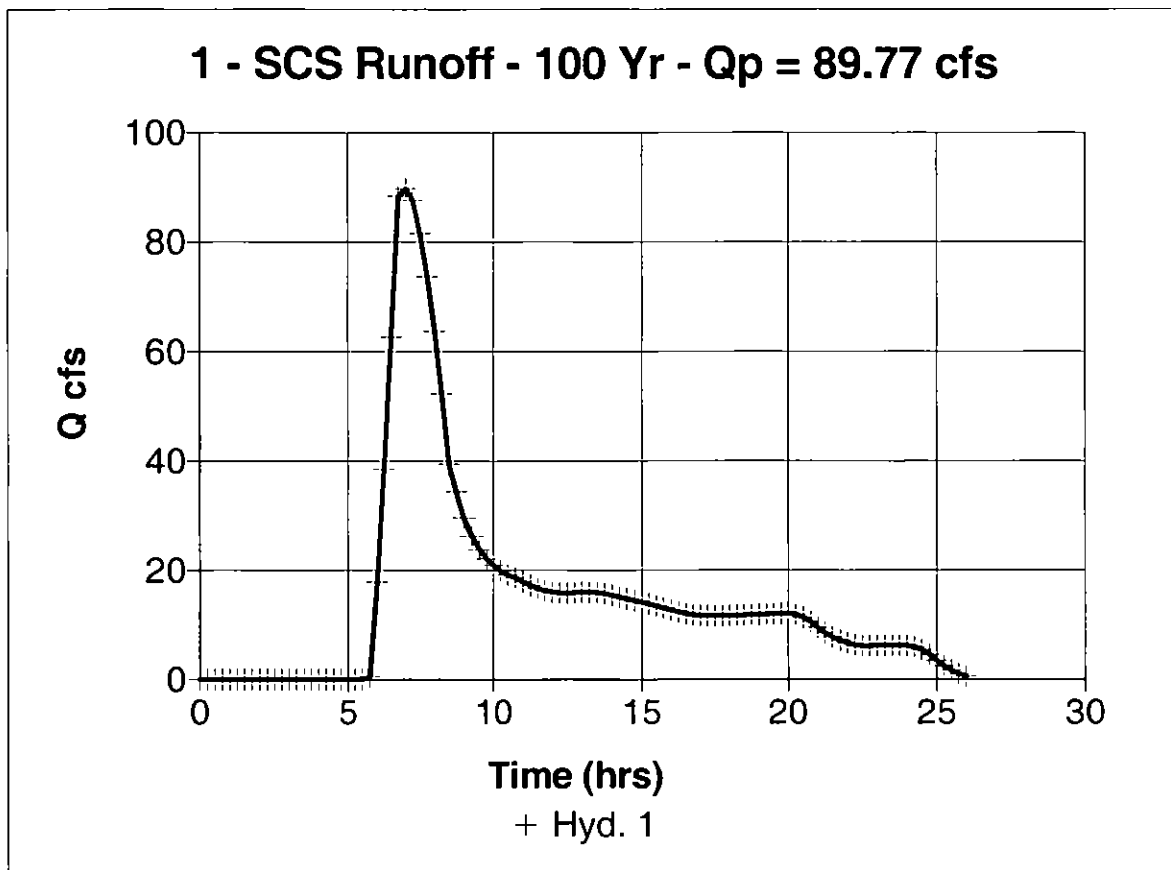
Hyd. No. 1

A-D

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 749.80 ac
Basin Slope = 1.1 %
Tc method = USER
Total precip. = 4.40 in
Storm duration = TYPE IIA.CDS

Peak discharge = 89.77 cfs
Time interval = 15 min
Curve number = 50.9
Hydraulic length = 5700 ft
Time of conc. (Tc) = 92 min
Distribution = Custom
Shape factor = 484

Total Volume = 32.462 acft



Hydrograph Plot

English

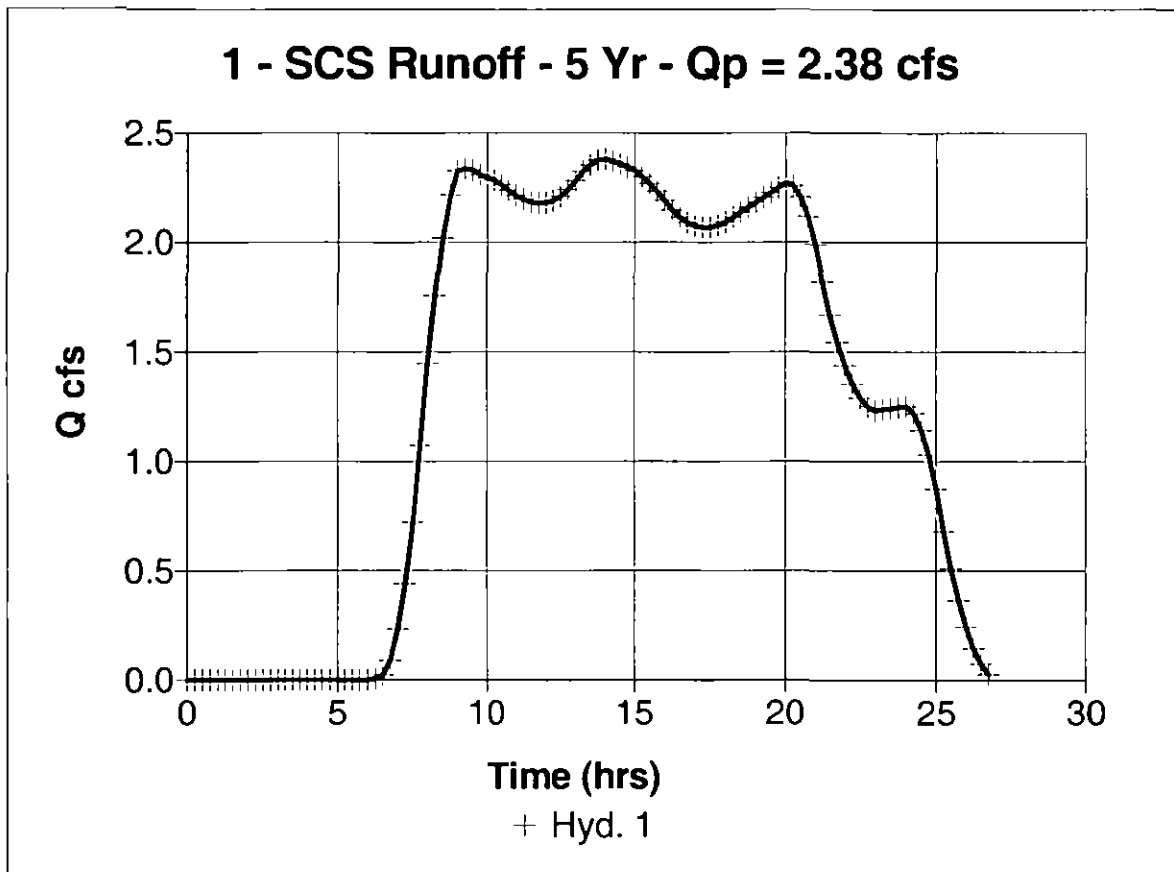
Hyd. No. 1

DP1-D

Hydrograph type = SCS Runoff
Storm frequency = 5 yrs
Drainage area = 766.20 ac
Basin Slope = 2.1 %
Tc method = USER
Total precip. = 2.60 in
Storm duration = TYPE IIA.CDS

Peak discharge = 2.38 cfs
Time interval = 15 min
Curve number = 51.2
Hydraulic length = 1080 ft
Time of conc. (Tc) = 102.5 min
Distribution = Custom
Shape factor = 484

Total Volume = 2.930 acft



Hydrograph Plot

English

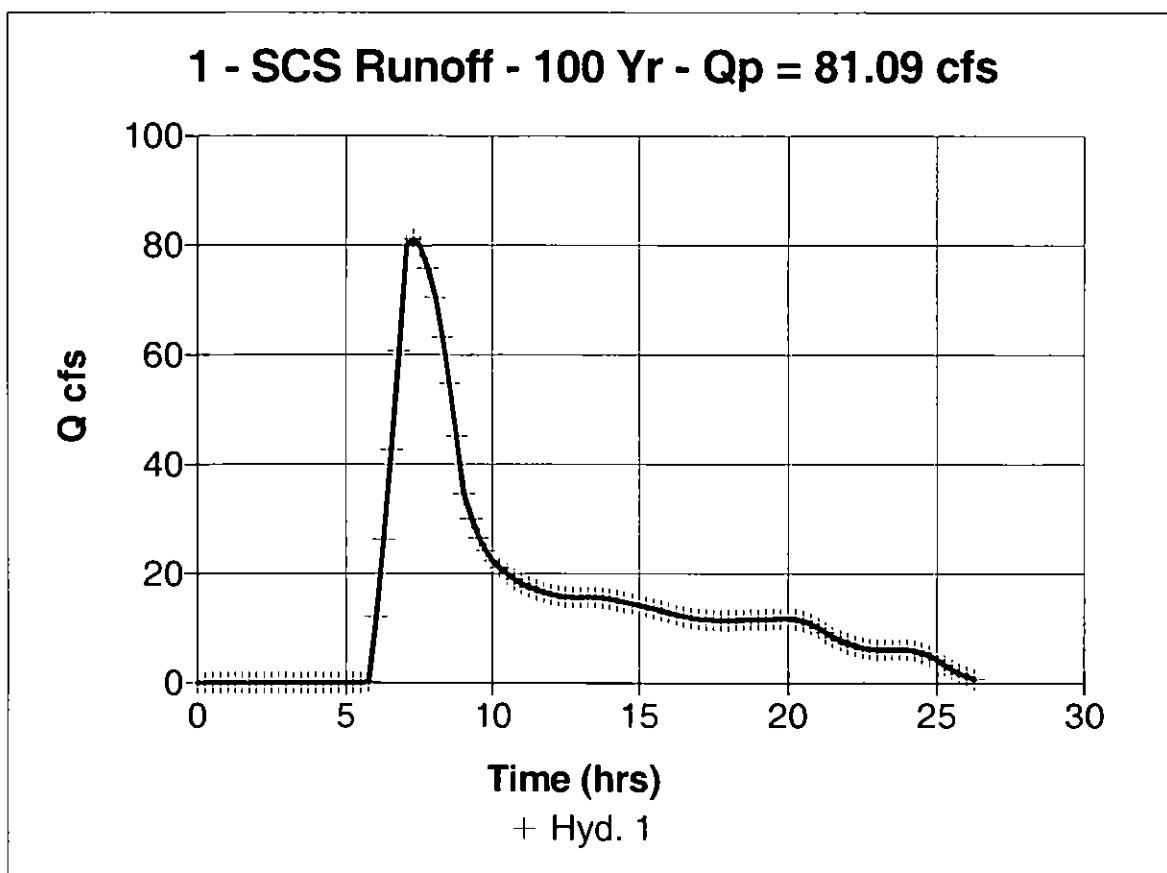
Hyd. No. 1

DP1-D

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 766.20 ac
Basin Slope = 2.1 %
Tc method = USER
Total precip. = 4.40 in
Storm duration = TYPE IIA.CDS

Peak discharge = 81.09 cfs
Time interval = 15 min
Curve number = 51.2
Hydraulic length = 1080 ft
Time of conc. (Tc) = 102.5 min
Distribution = Custom
Shape factor = 484

Total Volume = 32.195 acft



FALCON ACRES SUBDIVISION

COMPOSITE RUNOFF CURVE NUMBERS - TYPICAL 5-ACRE DEVELOPED RURAL RESIDENTIAL LOT

DEVELOPED CONDITIONS

BASIN	TOTAL AREA (AC)	SOIL TYPE	AREA (%)	SUB-AREA 1 DEVELOPMENT/ COVER	CN	AREA (%)	SUB-AREA 2 DEVELOPMENT/ COVER	CN	AREA (%)	SUB-AREA 3 DEVELOPMENT/ COVER	CN	WEIGHTED C VALUE
5-ACRE LOTS	5.00	B	5.50	BLDG/DRIVEWAY	98	94.50	LAWN/MEADOW	61				63.035

FALCON ACRES COMPOSITE RUNOFF CURVE NUMBERS												
DEVELOPED CONDITIONS												
BASIN	TOTAL AREA (AC)	SOIL TYPE	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	CN	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	CN	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	CN	WEIGHTED CN-VALUE
OA2.1,OA2.2	483.90	B	483.90	MEADOW	50							50.000
A1,A2	12.30	B	12.30	5-AC LOTS	63.035							63.035
OA2, A1	496.20	B										50.323
OA1	207.64	B	207.64	MEADOW	50							50.000
OA3	24.48	B	24.48	MEADOW	61							61.000
A3	21.50	B	21.50	5-AC LOTS	63.035							63.035
OA1-OA3,A1,A2	749.82	B										50.947
OB1	1.00	B	1.00	MEADOW	61							61.000
B	15.48	B	15.48	5-AC LOTS	63.035							63.035
OB1,B	16.48	B										62.912
OA1-OA3,OB1,A1,A2,B	766.30	B										51.204

**FALCON ACRES SUBDIVISION
SCS METHOD - HYDROLOGY SUMMARY**

HISTORIC FLOWS

BASIN	DESIGN POINT	AREA (AC)	AREA (SM)	CURVE NUMBER (CN)	HIGH ELEV. (FT)	LOW ELEV. (FT)	H (FT)	CHANNEL LENGTH (FT)	CHANNEL LENGTH (MI)	SLOPE (%)	T _c ⁽¹⁾ (MIN)	PEAK FLOW	
												Q ₅ ⁽²⁾ (CFS)	Q ₁₀₀ ⁽²⁾ (CFS)
OA1	OA1	207.64	0.32	50	6600	6530	70	5000	0.95	1.4%	84.70	0.5	21.8
OA2	OA2	483.9	0.76	50	6720	6540	180	7400	1.40	2.4%	83.40	1.3	50.9
OA1-OA3,A	A	749.74	1.17	50	6600	6528	72	5700	1.08	1.3%	92.00	2.0	78.8
OB1, B	B	16.48	0.03	50	6556	6528	28	1080	0.20	2.6%	28.10	0.04	2.8
OA1-OA3,OB1,A,B	1	766.2	1.20	50	6720	6528	192	9070	1.72	2.1%	102.50	1.9	68.6

DEVELOPED FLOWS

BASIN	DESIGN POINT	AREA (AC)	AREA (SM)	CURVE NUMBER (CN)	HIGH ELEV. (FT)	LOW ELEV. (FT)	H (FT)	CHANNEL LENGTH (FT)	CHANNEL LENGTH (MI)	SLOPE (%)	T _t ⁽¹⁾ (HR)	PEAK FLOW	
												Q ₅ ⁽³⁾ (CFS)	Q ₁₀₀ ⁽³⁾ (CFS)
OA2.1-OA2.2,A1-A2	A1	496.24	0.78	50.323	6720	6540	180	7400	1.40	2.4%	83.40	1.4	54.6
OA1-OA3,A1-A3	A	749.78	1.17	50.947	6600	6528	72	5700	1.08	1.3%	92.00	2.3	89.8
OB1, B	B	16.48	0.03	62.91	6556	6528	28	1080	0.20	2.6%	28.10	1.7	11.7
OA1-OA3,OB1,A,B	1	766.2	1.20	51.204	6720	6528	192	9070	1.72	2.1%	102.50	2.4	81.1

* Refer to Rational Method Calculations for Developed Flows at Design Points A2 and A3.1

1) DESIGN RAINFALL: 5-YR, 24-HR = 2.6 IN; 100-YR, 24-HR = 4.4 IN

2) T_c FROM RATIONAL METHOD CALCULATION TABLE

3) PEAK FLOWS CALCULATED BY INTELISOLVE "HYDRAFLOW" PROGRAM

APPENDIX C
HYDRAULIC CALCULATIONS

**FALCON ACRES SUBDIVISION
CHANNEL CALCULATIONS
DEVELOPED FLOWS**

PROPOSED CHANNELS

CHANNEL	DESIGN POINT	PROPOSED SLOPE (%)	BOTTOM WIDTH (B, FT)	SIDE SLOPE (Z)	CHANNEL DEPTH (FT)	FRICTION FACTOR (n)	Q100 FLOW (CFS)	Q100 DEPTH (FT)	Q100 VELOCITY (FT/S)	CHANNEL LINING
A2 (WEST DITCH)	A2	0.50	0	6:1/3:1	2.5	0.030	23.1	1.4	2.7	GRASS
A2 (WEST DITCH)	A2	3.71	0	6:1/3:1	2.5	0.030	23.1	1.0	5.7	GRASS/ECB
A3	A1	0.50	4	4:1	3.0	0.030	54.6	1.6	3.4	GRASS
A (OVERFLOW)	A	1.54	4	4:1	3.0	0.030	89.8	1.5	5.9	GRASS/ECB
B (OVERFLOW)	1	1.30	4	4:1	3.0	0.030	81.1	1.5	5.4	GRASS/ECB

- 1) Channel flow calculations based on Manning's Equation
- 2) Channel depth includes 1' minimum freeboard
- 3) $n = 0.03$ for grass-lined non-irrigated channels (minimum)
- 4) $n = 0.035$ for riprap-lined channels
- 5) $V_{max} = 5$ fps per El Paso County criteria (p. 10-13) for fescue (dry land grass) for 100-year flows

Add the product specification in the drainage report.

Worksheet

Worksheet for Trapezoidal Channel

Ditch A2
(West Side of ~~Peaceful Rain~~ Way)
Peaceful Rain

Project Description	
Worksheet	Trapezoidal Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coeff	0.030
Slope	005000 ft/ft
Left Side Slope	6.00 H : V
Right Side Slope	3.00 H : V
Bottom Width	0.00 ft
Discharge	23.10 cfs = Q_{100}

Results	
Depth	1.38 ft
Flow Area	8.6 ft ²
Wetted Perim	12.77 ft
Top Width	12.44 ft
Critical Depth	1.10 ft
Critical Slope	0.016572 ft/ft
Velocity	2.69 ft/s < 5 Fps ✓
Velocity Head	0.11 ft
Specific Energy	1.49 ft
Froude Number	0.57
Flow Type	Subcritical

Worksheet
Worksheet for Trapezoidal Channel

Ditch AR

Project Description	
Worksheet	Trapezoidal Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.030
Slope	<u>0.37100</u> ft/ft
Left Side Slope	6.00 H : V
Right Side Slope	3.00 H : V
Bottom Width	0.00 ft
Discharge	23.10 cfs = <i>Q₁₀₀</i>

Results	
Depth	0.95 ft
Flow Area	4.1 ft ²
Wetted Perim.	8.77 ft
Top Width	8.54 ft
Critical Depth	1.10 ft
Critical Slope	0.016572 ft/ft
Velocity	5.70 ft/s → <i>Use ECB Lining</i>
Velocity Head	0.51 ft
Specific Energy	1.45 ft
Froude Number	1.46
Flow Type	supercritical

Worksheet
Worksheet for Trapezoidal Channel

*Channel A3
(No. A1)*

Project Description	
Worksheet	Trapezoidal Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coeff	0.030
Slope	005000 ft/ft
Left Side Slope	4.00 H : V
Right Side Slope	4.00 H : V
Bottom Width	4.00 ft
Discharge	54.60 cfs <i>= Q₁₀₀</i>

Results	
Depth	1.57 ft
Flow Area	16.1 ft ²
Wetted Perim	16.93 ft
Top Width	16.55 ft
Critical Depth	1.22 ft
Critical Slope	0.014615 ft/ft
Velocity	3.39 ft/s ✓
Velocity Head	0.18 ft
Specific Energy	1.75 ft
Froude Number	0.61
Flow Type	Subcritical

Worksheet Worksheet for Trapezoidal Channel

*Basin A
Overflow Channel*

Project Description	
Worksheet	Trapezoidal Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coeff	0.030
Slope	015400 ft/ft
Left Side Slope	4.00 H : V
Right Side Slope	4.00 H : V
Bottom Width	4.00 ft
Discharge	89.80 cfs = <i>Q₁₀₀</i>

Results	
Depth	1.52 ft
Flow Area	15.4 ft ²
Wetted Perim	16.55 ft
Top Width	16.18 ft
Critical Depth	1.57 ft
Critical Slope	0.013653 ft/ft
Velocity	5.85 ft/s → <i>Use ECB Lining</i>
Velocity Head	0.53 ft
Specific Energy	2.05 ft
Froude Number	1.06
Flow Type	supercritical

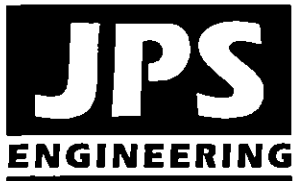
Worksheet
Worksheet for Trapezoidal Channel

Channel B

Project Description	
Worksheet	Trapezoidal Channel
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coeff	0.030
Slope	0.13000 ft/ft
Left Side Slope	4.00 H : V
Right Side Slope	4.00 H : V
Bottom Width	4.00 ft
Discharge	81.10 cfs = <i>Q₁₀₀</i>

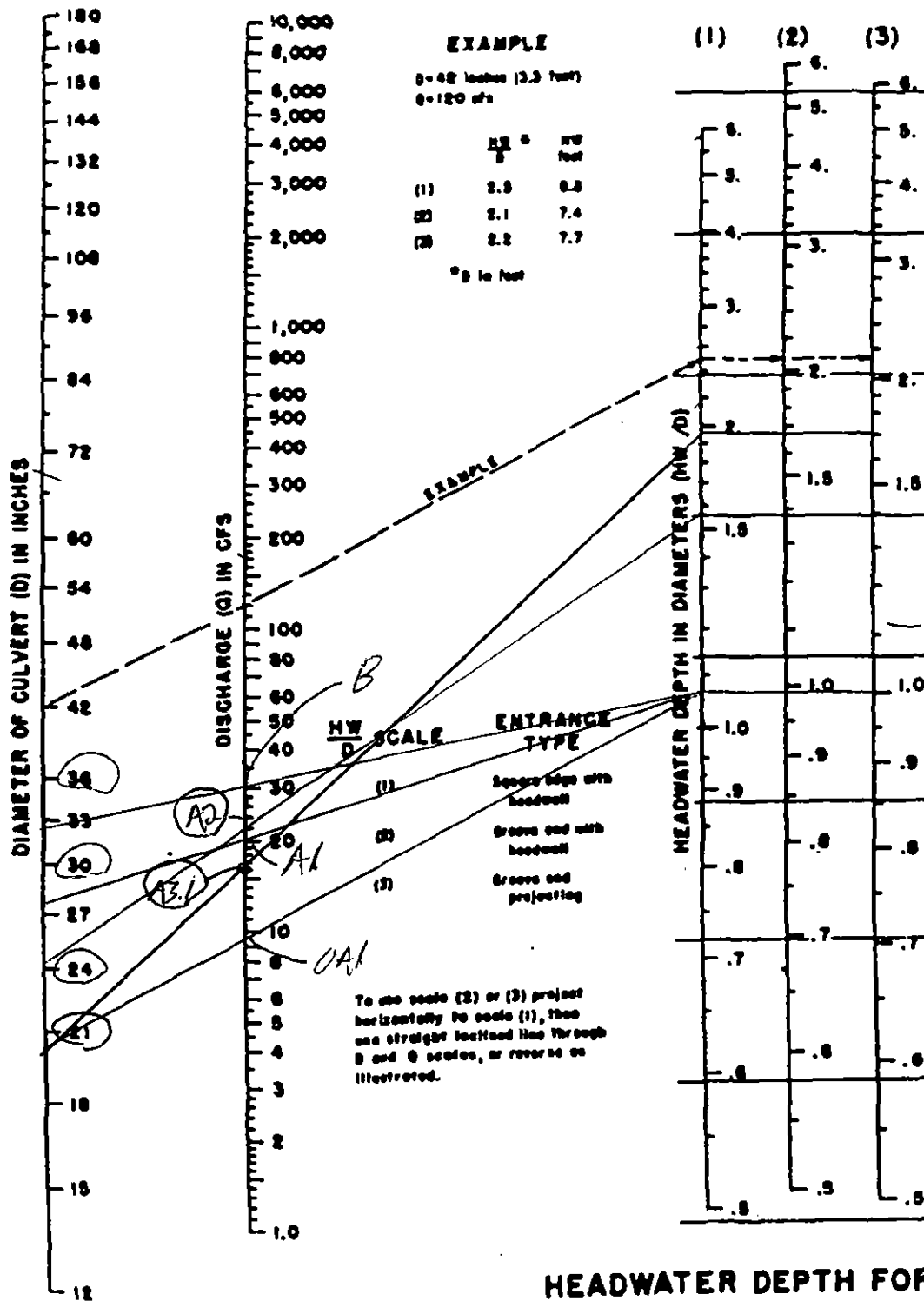
Results	
Depth	1.51 ft
Flow Area	15.2 ft ²
Wetted Perim	16.45 ft
Top Width	16.08 ft
Critical Depth	1.49 ft
Critical Slope	0.013843 ft/ft
Velocity	<u>5.35 ft/s</u> → <i>Use ECB Lining</i>
Velocity Head	0.44 ft
Specific Energy	1.95 ft
Froude Number	0.97
Flow Type	Subcritical



FALCON ACRES CULVERT SIZING SUMMARY

Design Point	Peak Flow (Q ₅ , cfs)	Maximum HW/D at Q ₅	Peak Flow (Q ₁₀₀ , cfs)	Culvert Size (in)	Riprap Size
OA1	0.5	1.0	21.8	24" RCP	Type M
A1	1.4	1.0	54.6	36" RCP	Type M
A2	9.2	1.0	23.1	24" RCP	Type M
A3.1	16.6	1.7	40.9	21" RCP *	Type M
B	7.4	**	7.4	14"x23" HERCP *	Type M

* Culvert B is nominally sized for overflow of retention areas only



HEADWATER SCALES 2 & 3
 REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN 1962

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

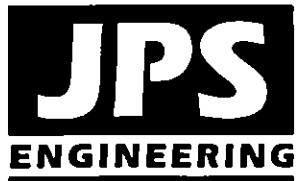


NDI Infrastructure, Inc.
 A Centerra Company

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

Date
 OCT. 1987

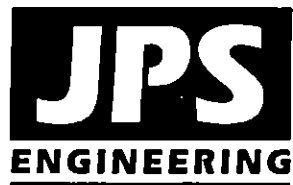
Figure
 9 - 32



FALCON ACRES DRIVEWAY CULVERT SIZING SUMMARY

Design Point	Drainage Basin	Basin Peak Flow (Q ₅ , cfs)	% of Basin at Driveway Culvert	Driveway Peak Flow (Q ₅ , cfs)	Culvert Size (in)
Private Culverts:					
Lot 1	A1	1.4	10%	0.14	18"
Lot 2	A2	9.2	100%	9.2	18"
Lot 3	A3	2.3	100%	2.3	18"
Lot 4, 7, 8	A3.1	16.6	100%	16.6	21"
Lot 5, 6	OA1	0.5	100%	0.5	18"

- Culvert Capacity based on Inlet Control Nomographs (Fig. 9-32, assuming RCP or HDPE Culverts)



**FALCON ACRES
CULVERT SIZING SUMMARY (HY8 PROGRAM INPUT/OUTPUT SUMMARY)**

Culvert	Selected Pipe Size	Road CL EL	Inv. In EL	Inv. Out EL	L (ft)	Q₅ (cfs)	Allowable ^a 5-Yr. HW	Calc. 5-Year HW	Q₁₀₀ (cfs)	Allowable ^b 100-Yr. HW	Calc. 100-Yr. HW	Riprap Size D₅₀ (in)
A1	36" RCP	6534.62	6529.00	6528.50	62	1.4	6530.50	6529.31	54.6	6534.44	6533.06	M (12")

^a Maximum allowable 5-year HW/D = 1.0.

^b Maximum allowable 100-year headwater depth is 6 inches above shoulder.

CURRENT DATE: 12-11-2007
CURRENT TIME: 14:24:38

FILE DATE: 12-11-2007
FILE NAME: CURT-A1

[illegible]

SUMMARY OF CULVERT FLOWS (cfs) FILE: CURT-A1 DATE: 12-11-2007

[illegible][illegible]

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CURT-A1 DATE: 12-11-2007

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
6529.31	0.000	0.00	0.00	0.00
6531.17	0.000	17.07	0.00	0.00
6531.50	0.000	22.60	0.00	0.00
6533.06	0.000	51.21	0.00	0.00
6534.32	0.000	68.28	0.00	0.00
6536.01	0.000	85.35	0.00	0.00
6538.06	0.000	102.42	0.00	0.00
6540.46	0.000	119.49	0.00	0.00
6543.27	0.000	136.56	0.00	0.00
6546.83	0.000	153.63	0.00	0.00
6551.80	0.000	170.70	0.00	0.00

[illegible]

CURRENT DATE: 12-11-2007

FILE DATE: 12-11-2007

CURRENT TIME: 14:24:38

FILE NAME: CURT-A1

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PERFORMANCE CURVE FOR CULVERT 1 - 1(3.00 (ft) BY 3.00 (ft)) RCP

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DIS- CHARGE FLOW (cfs)	HEAD- ELEV. (ft)	INLET DEPTH (ft)	OUTLET DEPTH (ft)	CONTROL TYPE <F4>	FLOW NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	6529.31	0.00	0.00	0-NF	0.00	0.00	0.00	%-6529.00	0.00	0.00
17.07	6531.17	1.86	1.86	1-S2n	1.24	1.31	1.25	%-6529.00	6.13	
22.60	6531.50	2.19	2.19	1-S2n	1.46	1.53	1.46	%-6529.00	6.63	
51.21	6533.06	3.73	3.75	2-M2c	3.00	2.32	2.32	%-6529.00	8.74	
68.28	6534.32	5.01	4.87	2-M2c	3.00	2.62	2.62	%-6529.00	10.46	
85.35	6536.01	6.70	6.39	2-M2c	3.00	2.89	2.89	%-6529.00	12.30	
102.42	6538.07	8.76	8.06	6-S2n	3.00	3.00	2.90	%-6529.00	14.75	
119.49	6540.46	11.15	9.99	6-S2n	3.00	3.00	2.90	%-6529.00	17.20	
136.56	6543.27	13.96	12.23	6-S2n	3.00	3.00	2.90	%-6529.00	19.66	
153.63	6546.83	17.52	14.76	6-S2n	3.00	3.00	2.90	%-6529.00	22.12	
170.70	6551.80	22.49	17.59	6-S2n	3.00	3.00	2.90	%-6529.00	24.58	

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El. inlet face invert 6529.31 ft El. outlet invert 6529.00 ft

El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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***** SITE DATA ***** CULVERT INVERT *****

INLET STATION	0.00 ft
INLET ELEVATION	6529.31 ft
OUTLET STATION	62.00 ft
OUTLET ELEVATION	6529.00 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0050
CULVERT LENGTH ALONG SLOPE	62.00 ft

***** CULVERT DATA SUMMARY *****

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

FILE DATE: 12-11-2007
FILE NAME: CURT-A1

[illegible]

***** REGULAR CHANNEL CROSS SECTION *****

BOTTOM WIDTH	0.00 ft
SIDE SLOPE H/V (X:1)	0.0
CHANNEL SLOPE V/H (ft/ft)	0.000
MANNING'S n (.01-0.1)	0.000
CHANNEL INVERT ELEVATION	0.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	6529.00 ft

***** UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	0.00	0.000	0.00	0.00	0.00
17.07	0.00	0.000	0.00	0.00	0.00
22.60	0.00	0.000	0.00	0.00	0.00
51.21	0.00	0.000	0.00	0.00	0.00
68.28	0.00	0.000	0.00	0.00	0.00
85.35	0.00	0.000	0.00	0.00	0.00
102.42	0.00	0.000	0.00	0.00	0.00
119.49	0.00	0.000	0.00	0.00	0.00
136.56	0.00	0.000	0.00	0.00	0.00
153.63	0.00	0.000	0.00	0.00	0.00
170.70	0.00	0.000	0.00	0.00	0.00

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH	34.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	6533.13 ft

[illegible]

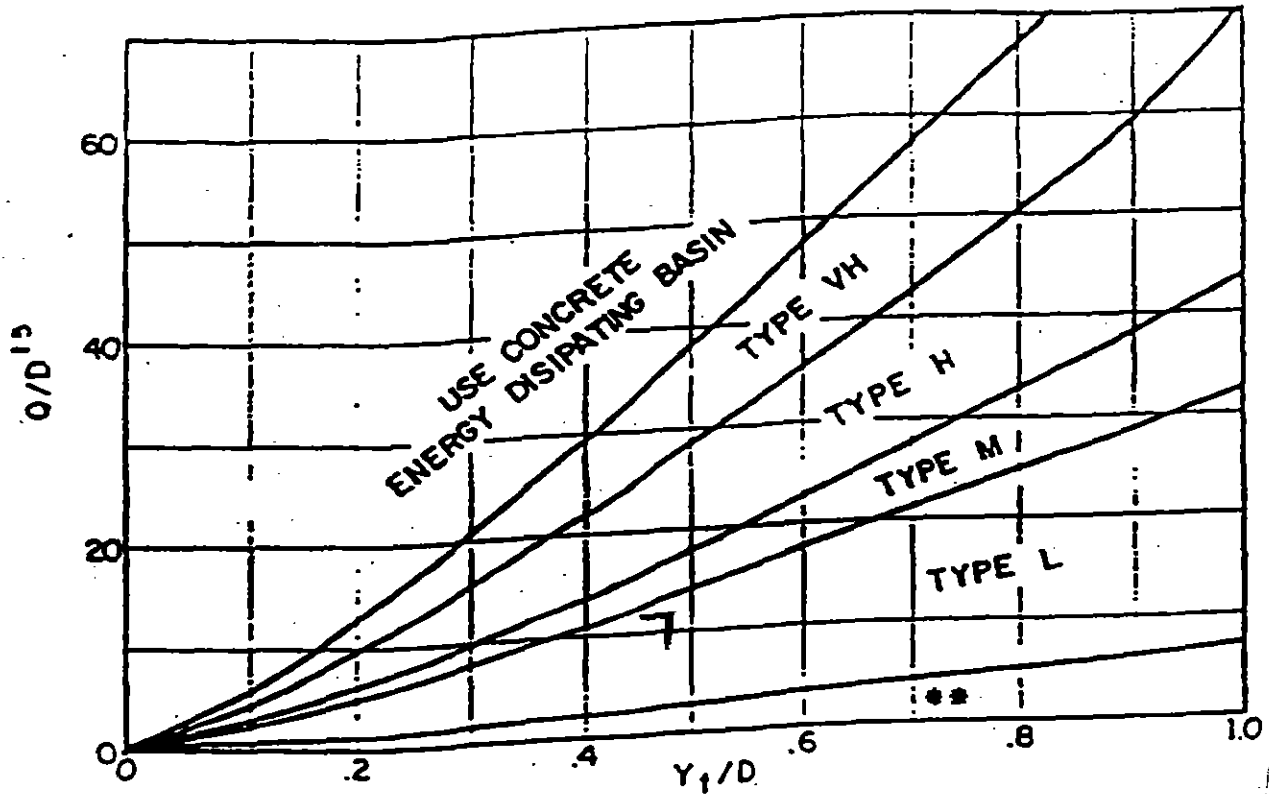
$$Q_{100} = 54.6 \text{ cfs}; \Delta = 3.0' (36" RCP)$$

$$\frac{Q}{\Delta^{1.5}} = \frac{54.6}{(3)^{1.5}} = 10.5$$

$$Y_t = 1.41' \text{ (From HY-8)}$$

$$\frac{Y_t}{D} = \frac{1.41}{3} = 0.47$$

Replace with current figure. typ all



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

→ Use Type M

FIGURE 5-7. RIPRAP EROSION PROTECTION AT CIRCULAR CONDUIT OUTLET.

Culvert A2
(Yellow Sun Lane)

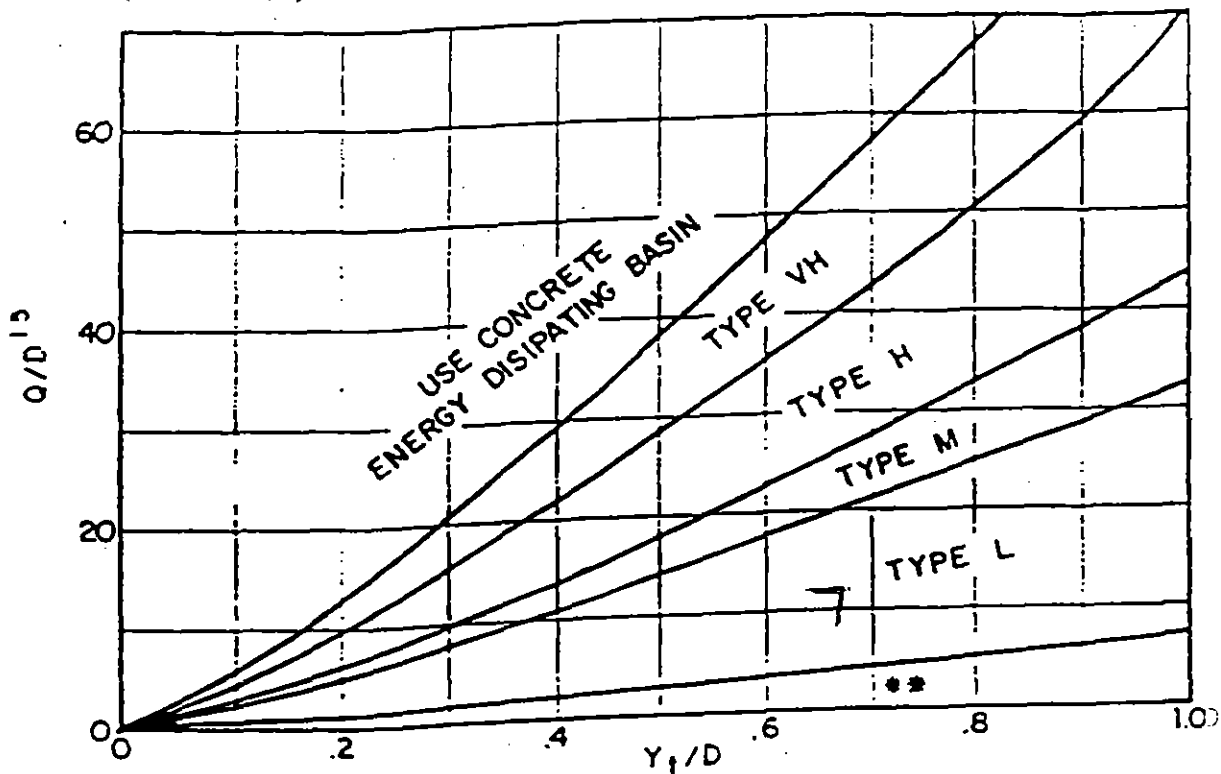
$$Q_{100} = 23.1 \text{ cfs (Basin A2)}$$

$$D = 18" = 1.5'$$

$$\frac{Q}{D^{1.5}} = \frac{23.1}{(1.5)^{1.5}} = 12.6$$

$$Y_t = 1.0' \pm$$

$$\frac{Y_t}{D} = \frac{1.0}{1.5} = 0.67$$



Use D_0 instead of D whenever flow is supercritical in the barrel.
 ** Use Type L for a distance of 3D downstream.

→ Use Type M

FIGURE 5-7. RIPRAP EROSION PROTECTION AT CIRCULAR CONDUIT OUTLET.

Culvert - Yellow Sun Court
 (Basin A3)

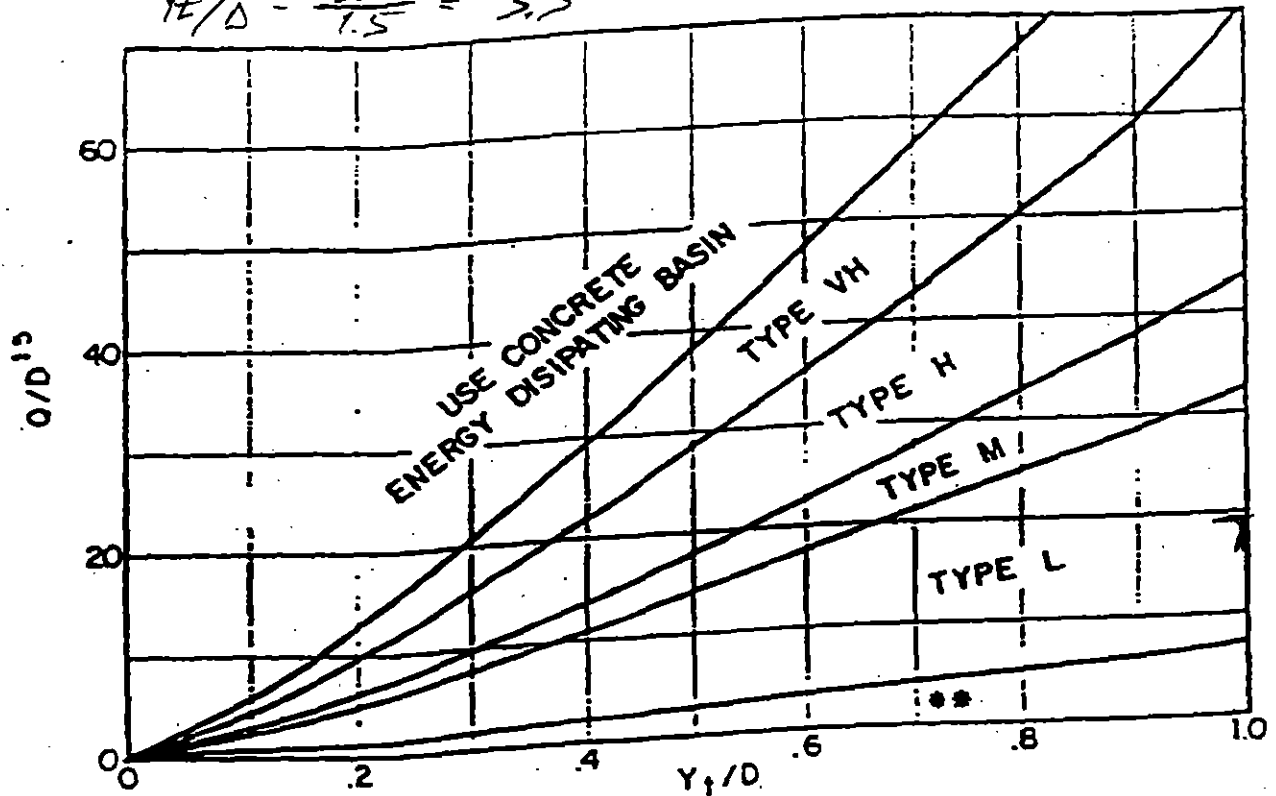
$$Q_{100} = 32.9 \text{ cfs (Basin A3)}$$

$$D = 18" = 1.5'$$

$$\frac{Q}{D^{1.5}} = \frac{32.9}{(1.5)^{1.5}} = 17.9$$

$$Y_t = 5.0' \text{ (Retention Pond A depth)}$$

$$Y_t/D = \frac{5.0}{1.5} = 3.3$$



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

→ Use Type M

FIGURE 5-7. RIPRAP EROSION PROTECTION AT CIRCULAR CONDUIT OUTLET:

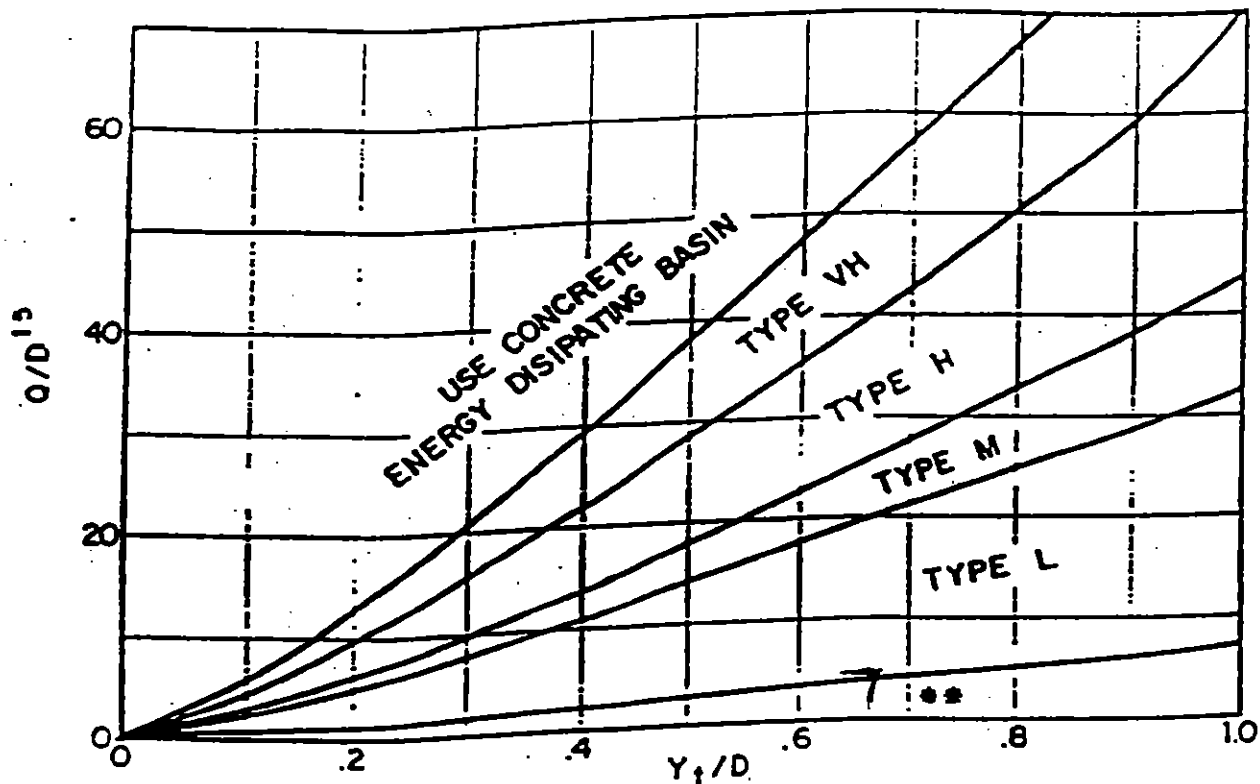
Culvert B
(Curtis Road)

$Q_{100} =$ (Nominally sized For overflow
of Retention Pond B)
 $\approx 7.0 \text{ cfs}$ ($H_N/D = 1.0$)

$$D = 18" = 1.5'$$

$$\frac{Q}{D^{1.5}} = \frac{7}{(1.5)^{1.5}} = 3.8$$

$$Y_E = 1.0' \text{ (assumed)}; \frac{Y_E}{D} = \frac{1.0}{1.5} = 0.67$$



Use D_0 instead of D whenever flow is supercritical in the barrel.
 ** Use Type L for a distance of $3D$ downstream.

→ Use Type M

FIGURE 5-7. RIPRAP EROSION PROTECTION AT CIRCULAR CONDUIT OUTLET.

FALCON ACRES POND A STAGE-STORAGE TABLE				
POND DEPTH (FT)	SURFACE AREA (SF)	INCREM. VOLUME (CF)	TOTAL VOLUME (CF)	TOTAL VOLUME (AF)
6528	45,179	0	0	0
6529	166,526	105852.5	105852.5	2.43
6530	287,872	227199	333051.5	7.65
6531	410178	349025	682076.5	15.66
6532	532,483	471330.5	1153407	26.48
6533	630062	581272.5	1734680	39.82
6533.5	678851	327228.3	2061908	<u>47.33</u>
6534	727640	654456.5	2716364	62.36

*AF (Required
Volume per
UAFCD
Criteria)*

FALCON ACRES POND B STAGE-STORAGE TABLE				
POND DEPTH (FT)	SURFACE AREA (SF)	INCREM. VOLUME (CF)	TOTAL VOLUME (CF)	TOTAL VOLUME (AF)
6528	96,750	0	0	0
6529	149,445	123097.5	123097.5	<u>2.83</u>
6530	202,139	175792	298889.5	<u>6.86</u>

> V₁₀₀ = 2.34 AF (Required)

DENVER URBAN DRAINAGE & FLOOD CONTROL DISTRICT CRITERIA:

RETENTION POND - BASIN A

REQUIRED 100-YEAR POND VOLUME, V:

$$V = Q * A * 1.5 \quad (\text{RETENTION POND VOLUME, ACRE-FEET})$$
$$= (100\text{-YEAR; 24-HOUR RUNOFF}) * (\text{BASIN AREA}) / (12 \text{ IN/FT}) * 1.5$$

ASSUMPTIONS:

$$A = 755.6 \text{ AC} \quad (\text{DRAINAGE BASIN AREA, AC})$$

$$CN = 51.065 \quad (\text{WEIGHTED CURVE NUMBER FROM CN-SPREADSHEET})$$

$$P = 4.4 \text{ IN} \quad (100\text{-YEAR; 24-HOUR STORM RAINFALL PER EL PASO COUNTY})$$

$$S = 9.58 \quad S = (1000/CN) - 10$$

$$Q = 0.51 \text{ IN} \quad Q = (P - 0.2S)^2 / (P + 0.8S)$$

(100-YEAR; 24-HOUR STORM RUNOFF PER SCS TR-55)

CALCULATED 100-YEAR POND VOLUME, V:

$$V = 48.28 \text{ AC-FT}$$

Replace with current criteria

FALCON ACRES
RETENTION POND SIZING

JPS ENGINEERING

DENVER URBAN DRAINAGE & FLOOD CONTROL DISTRICT CRITERIA:

RETENTION POND - BASIN B

REQUIRED 100-YEAR POND VOLUME, V:

$$V = Q * A * 1.5 \quad (\text{RETENTION POND VOLUME, ACRE-FEET})$$
$$= (100\text{-YEAR; 24-HOUR RUNOFF}) * (\text{BASIN AREA}) / (12 \text{ IN/FT}) * 1.5$$

ASSUMPTIONS:

$$A = 16.48 \text{ AC} \quad (\text{DRAINAGE BASIN AREA, AC})$$

$$CN = 62.91 \quad (\text{WEIGHTED CURVE NUMBER FROM CN-SPREADSHEET})$$

$$P = 4.4 \text{ IN} \quad (100\text{-YEAR; 24-HOUR STORM RAINFALL PER EL PASO COUNTY})$$

$$S = 5.90 \quad S = (1000/CN) - 10$$

$$Q = 1.14 \text{ IN} \quad Q = (P - 0.2S)^2 / (P + 0.8S)$$

(100-YEAR; 24-HOUR STORM RUNOFF PER SCS TR-55)

CALCULATED 100-YEAR POND VOLUME, V:

$$V = 2.34 \text{ AC-FT}$$

Replace with current
criteria

APPENDIX D
COST ESTIMATE

<p align="center">FALCON ACRES DRAINAGE IMPROVEMENTS COST ESTIMATE</p>					
Item No.	Description	Quantity	Unit	Unit Cost (\$\$)	Total Cost (\$\$)
	DRAINAGE IMPROVEMENTS				
203	Channel Grading	1050	LF	\$5	\$5,250
506	Riprap Aprons (d ₅₀ = 12")	17.5	CY	\$40	\$700
603	18" RCP Culvert w/ FES	28	LF	\$50	\$1,400
603	21" RCP Culvert w/ FES	41	LF	\$55	\$2,255
603	14"x23" HERCP Culvert w/ FES	34	LF	\$60	\$2,040
603	36" RCP Culvert w/ FES	62	LF	\$65	\$4,030
	SUBTOTAL				\$15,675
	EROSION CONTROL IMPROVEMENTS				
208	Straw Bales	20	EA	\$20	\$400
208	Vehicle Tracking Pad (Erosion Control)	1	EA	\$1,500	\$1,500
208	Silt Fence	1,900	LF	\$2	\$3,800
208	Erosion Control Blankets	1,500	SY	\$4	\$6,000
210	Seeding (incl. 3" topsoil & mulching)	3.0	AC	\$2,500	\$7,500
	SUBTOTAL				\$19,200
	Maintenance @ 10%				\$1,920
	SUBTOTAL				\$21,120
	TOTAL				\$36,795

Update

EXHIBIT A
Resolution No. 07-57, February 2007
El Paso County Drainage Basin Fees

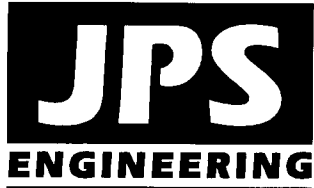
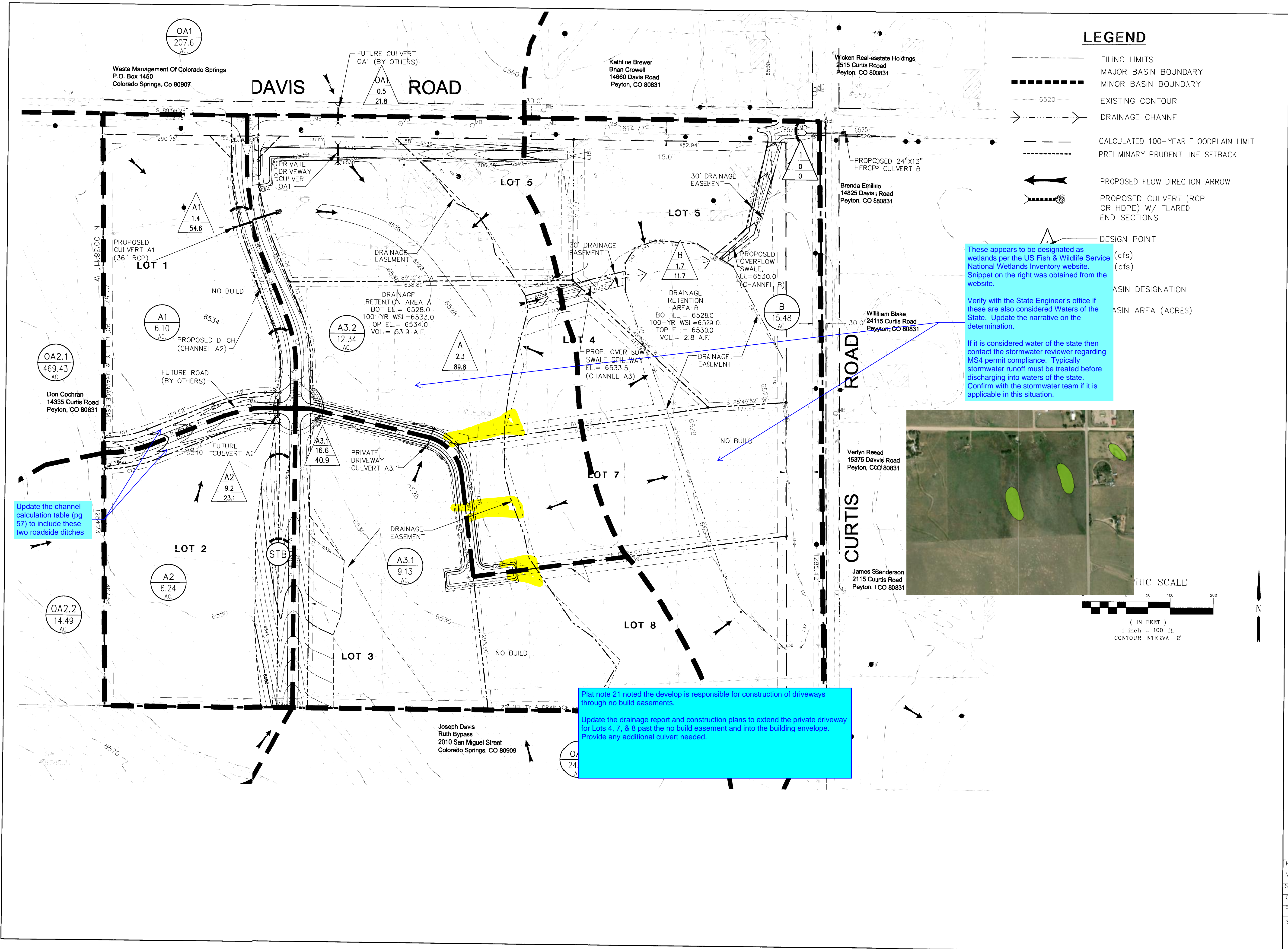
Basin Number	Receiving Waters	Year Studied	Drainage Basin Name	2007 Drainage Fee	2007 Bridge Fee
<u>Drainage Basins with DBPS's:</u>					
CHWS1200	Chico Creek	2001	Bennett Ranch	\$8,082	\$570
FOFO2000	Chico Creek	2001	Wool Fork Jimmy Camp Creek	\$8,764	\$2,593
CHWS1400	Chico Creek	2000	Falcon	\$8,925	\$2,959
FOFO2800	Fountain Creek	1991*	Big Johnson / Crows Gulch	\$15,000	\$1,853
FOFO2800	Fountain Creek	1988*	Wideland	\$14,083	\$0
FOFO2900	Fountain Creek	1988*	Security	\$14,071	\$0
FOFO3000	Fountain Creek	1991*	Windmill Gulch	\$15,000	\$192
FOFO3100 / FOFO3200	Fountain Creek	1988*	Carson Street / Little Johnson	\$7,807	\$0
FOFO3400	Fountain Creek	1984*	Peterson Field	\$9,232	\$700
FOFO3900	Fountain Creek	1981*	Fisher's Canyon	\$15,000	\$0
FOFO4000	Fountain Creek	1988	Sand Creek	\$15,000	\$1,853
FOFO4200	Fountain Creek	1977	Spring Creek	\$6,639	\$0
FOFO4600	Fountain Creek	1984*	Southwest Area	\$12,998	\$0
FOFO4800	Fountain Creek	1991	Beer Creek	\$15,000	\$700
FOFO5400	Fountain Creek	1977	21st Street	\$3,850	\$0
FOFO5800	Fountain Creek	1984	19th Street	\$2,520	\$0
FOFO5800	Fountain Creek	1984	Camp Creek	\$1,419	\$0
FOMO0400	Monument Creek	1988*	Moss	\$8,995	\$0
FOMO1000	Monument Creek	1981	Douglas Creek	\$8,049	\$177
FOMO1200	Monument Creek	1977	Templeton Gap	\$8,263	\$192
FOMO1400	Monument Creek	1978	Pope's Bluff	\$2,504	\$437
FOMO1800	Monument Creek	1978	South Rockströmman	\$3,010	\$0
FOMO1800	Monument Creek	1973	North Rockströmman	\$3,850	\$0
FOMO2000	Monument Creek	1971	Purple Rock	\$4,244	\$0
FOMO2200	Monument Creek	1984	Cottonwood Creek / S. Pine	\$15,000	\$700
FOMO2400	Monument Creek	1988	Dry Creek	\$10,104	\$366
FOMO3600	Monument Creek	1989*	Black Squirrel Creek	\$5,810	\$366
FOMO3700	Monument Creek	1987*	Middle Tributary	\$10,882	\$0
FOMO3800	Monument Creek	1987*	Monument Branch	\$15,000	\$0
FOMO4000	Monument Creek	1990	Smith Creek	\$5,216	\$700
FOMO4200	Monument Creek	1989*	Black Forest	\$15,000	\$349
FOMO6200	Monument Creek	1993*	Dirty Woman Creek	\$15,000	\$700
FOMO6300	Fountain Creek	1993*	Crystal Creek	\$15,000	\$700
<u>Miscellaneous Drainage Basins:</u>					
CHBS0800	Chico Creek		Book Ranch	\$12,010	\$1,738
CHEC0400	Chico Creek		Upper East Chico	\$8,544	\$190
CHMS0200	Chico Creek		Hoagler Ranch	\$13,178	\$0
CHWS0200	Chico Creek		Tatophano Exchange	\$7,189	\$188
CHWS0400	Chico Creek		Livestock Company	\$11,842	\$141
CHWS0800	Chico Creek		West Squirrel	\$5,173	\$2,561
CHWS0800	Chico Creek		Solberg Ranch	\$13,178	\$0
FOFO1200	Chico Creek		Crooked Canyon	\$3,864	\$0
FOFO1400	Chico Creek		Cather Reservoir	\$3,228	\$188
FOFO1800	Chico Creek		Sand Canyon	\$2,331	\$0
FOFO2000	Fountain Creek		Jimmy Camp Creek	\$15,000	\$598
FOFO2200	Fountain Creek		Fort Carson	\$10,104	\$366
FOFO2700	Fountain Creek		West Little Johnson	\$843	\$0
FOFO3800	Fountain Creek		Stratton	\$8,140	\$275
FOFO6000	Fountain Creek		Milbrand	\$10,104	\$366
FOFO6000	Fountain Creek		Palmer Trail	\$10,104	\$366
FOFO6800	Fountain Creek		Black Canyon	\$10,104	\$366
FOFO7200	Fountain Creek		Williams Canyon	\$10,104	\$366
FOMO4600	Monument Creek		Beaver Creek	\$7,852	\$0
FOMO3000	Monument Creek		Katila Creek	\$8,911	\$0
FOMO3400	Monument Creek		Elkham	\$1,181	\$0
FOMO6000	Monument Creek		Monument Rock	\$5,548	\$0
FOMO6400	Monument Creek		Palmer Lake	\$8,871	\$0
FOMO6600	Monument Creek		Raspberry Mountain	\$2,984	\$0
PLPL0200	Monument Creek		Bald Mountain	\$8,359	\$0
<u>Interim Drainage Basins:</u>					
FOFO1800	Fountain Creek		Little Fountain Creek	\$1,837	\$0
FOMO4400	Monument Creek		Jackson Creek	\$5,066	\$0
FOMO4800	Monument Creek		Tanchout Creek	\$3,518	\$528

- The miscellaneous drainage fee previous to September 1999 resolution was the average of all drainage fees for basins with Basin Planning Studies performed within the last 14 years.
- Interim Drainage Fees are based upon draft Drainage Basin Planning Studies or the Drainage Basin Identification and Fee Estimation Report. (Best available information available for setting a fee)
- This is an interim fee and will be adjusted when a DBPS is completed. In addition to the Drainage Fee of \$15,000 a surety in the amount of \$7,000 per impervious acre shall be provided to secure payment of additional fees in the event that the DBPS results in a fee greater than \$15,000. Fees paid in excess of the future revised fee will be reimbursed. See Resolution 08-325, September 14, 2008.

EPC Stormwater Management

Andra P. Brackin, P.E.

Upload a clearer drainage map. The existing contours are difficult to read. Unable to tell what elevation the drainage easement follows.



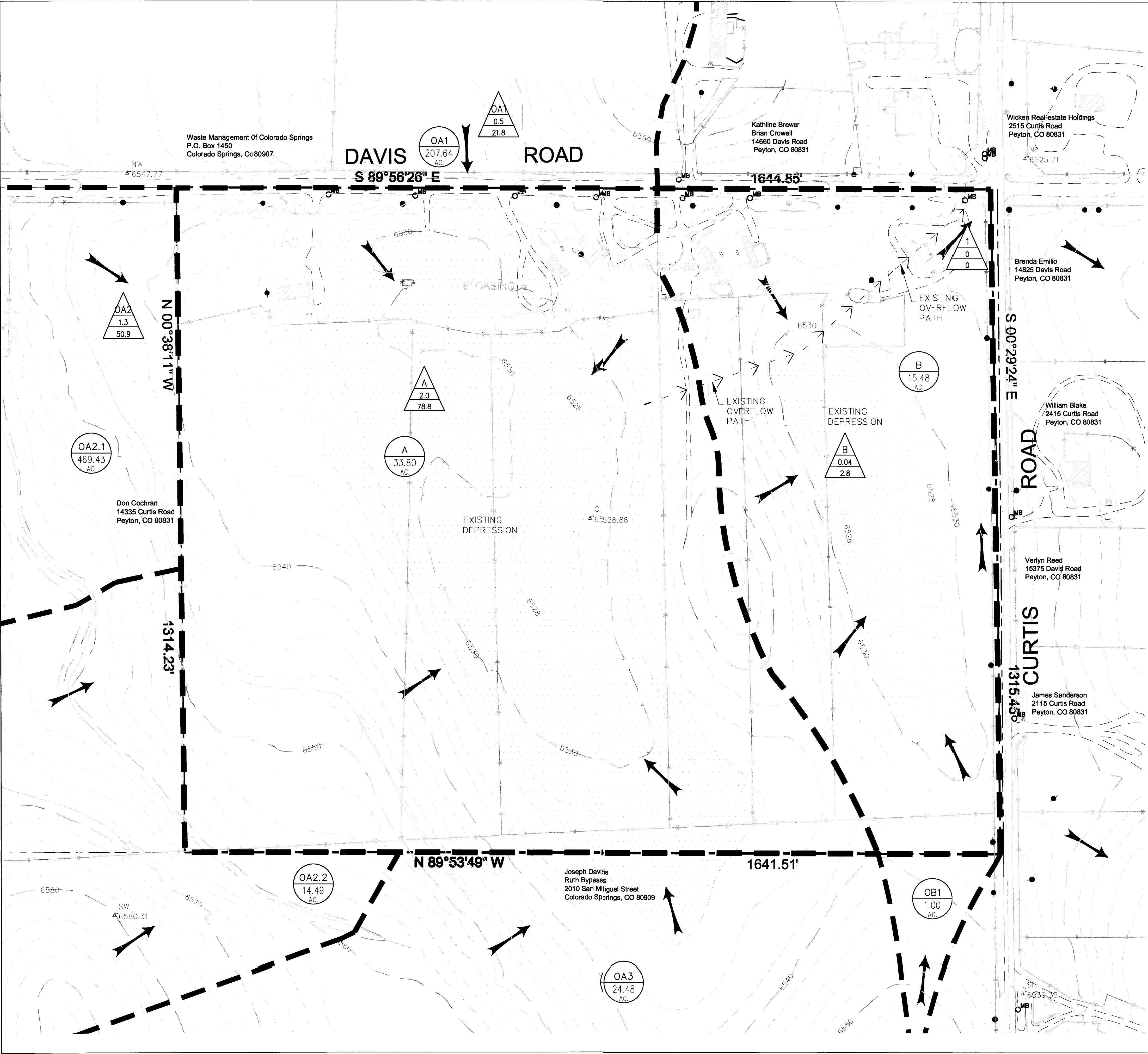
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766

FALCON ACRES SUBDIVISION

DEVELOPED DRAINAGE PLAN

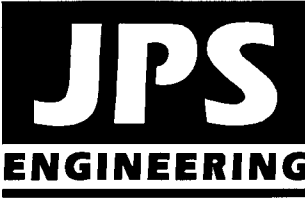
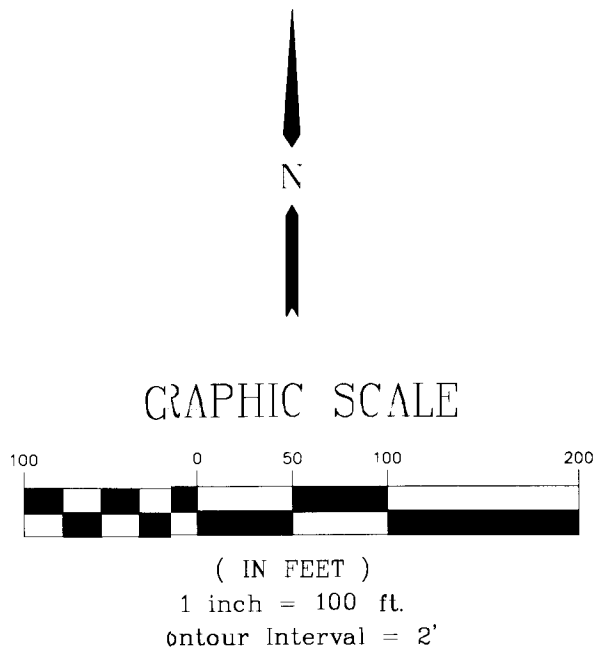
HORIZ. SCALE: 1"=100'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: UP&E	CHECKED: JPS
CREATED: 3/29/06	LAST MODIFIED: 12/11/07
PROJECT NO: 020506	MODIFIED BY: BJJ
SHEET:	

D1



LEGEND

- FILING LIMITS
- MAJOR BASIN BOUNDARY
- EXISTING CONTOUR
- FLOWLINE
- PROPOSED FLOW DIRECTION ARROW
- DESIGNPOINT
- Qs (cfs)
- Q100 (cfs)
- BASIN DESIGNATION
- BASIN AREA (ACRES)



19 E. Wilamette Ave.
Colorado Springs, CO
80903
PH: 719-477-9429
FAX: 719-471-0766

FALCON ACRES

HISTORIC DRAINAGE PLAN

HORIZ. SCALE: 1"=100'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED:	CHECKED: JPS
CREATED: 4/21/05	LAST MODIFIED: 12/11/07
PROJECT NO: 020506	MODIFIED BY: BJJ
SHEET:	

EX2

**FINAL DRAINAGE REPORT ADDENDUM #1 FOR
FALCON ACRES
EL PASO COUNTY, COLORADO**

AUGUST 2021

Prepared For:

Thousand Hills Land & Cattle Co LLC

812 E Monument Street
Colorado Springs, Colorado 80903
(719) 238-4234
Contact: Richard Elliott

Prepared By:

TERRA NOVA ENGINEERING, INC.

721 S. 23rd Street
Colorado Springs, CO 80904
(719) 635-6422

Job No. 2142.00

**FINAL DRAINAGE REPORT ADDENDUM #1 FOR
FALCON ACRES
EL PASO COUNTY, COLORADO**

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REQUIRED MAPS AND DRAWINGS

FEMA MAP

DRAINAGE REPORT STATEMENT

Design Engineer's Statement

This 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.

L DUCETT, P.E. 32339

Seal

Developers Statement

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

Business Name

By: _____

Title: _____

Address: _____

El Paso County Approval:

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

Jennifer Irvine,

Date

County Engineer / ECM Administrator

Conditions:

The extent of criteria change is significant therefore the provided addendum is insufficient. Provide an updated Final Drainage Report meeting current criteria.

FINAL DRAINAGE REPORT ADDENDUM #1 FOR FALCON ACRES EL PASO COUNTY, COLORADO

PURPOSE AND JUSTIFICATION

The purpose of this Final Drainage Report Addendum #1 is to update the construction cost opinion, drainage & bridge fees, and FEMA floodplain statement for the previously approved drainage report titled “Final Drainage Report for Falcon Acres Subdivision” dated June 25, 2007 prepared by JPS Engineering.

UPDATED CONSTRUCTION COST OPINION

	DRAINAGE IMPROVEMENTS	Quantity	Units	Unit Cost	Total Cost
506	Riprap Aprons (d ₅₀ = 12")	25	Tons	\$83	\$2,075
603	23"x14" HERCP Culvert w/ FES	88	LF	\$81	\$7,128
603	36" RCP Culvert w/ FES	62	LF	\$124	\$7,688
	SUBTOTAL				\$16,891

UPDATED DRAINAGE & BRIDGE FEES

This currently unplatted site is in the Livestock Company Drainage Basin. The site is 49.23 acres. Appendix L of the Drainage Criteria Manual 1 Addendum states that for single-family 5 acre lots, an impervious percentage of 7% can be used. The combined Drainage Fees (2021) are due prior to final plat recordation.

Fee Type	% Imp.	Parcel Area (acre)	Imp. Area (acre)	Fee per Imp Acre	Mod %	Fee Cost
Drainage	7	49.23	3.45	\$18,273	100	\$63,042
Bridge	7	49.23	3.45	\$217	100	\$749
				Total		\$114,165

UPDATED FLOODPLAIN STATEMENT

According to FEMA’s FIRM No. 08041CO785G (eff. 12/7/2018), the proposed development is within an area designated as Zone X, having minimal flood hazard.

FEMA MAP

National Flood Hazard Layer FIRMette



104°33'38"W 38°52'7"N



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

1:6,000

104°33'1"W 38°51'39"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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 Cross Sections with 1% Annual Chance Water Surface Elevation
		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
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



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 **8/1/2021 at 4:25 PM** 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.