MASTER DEVELOPMENT DRAINAGE PLAN
FOR
CONEXUS PHASES 2 AND 3

Prepared For:

CONEXUS, LLC
2 North Cascade, Ste. 1280
Colorado Springs, CO 80903

January 2022
Project No. 25247.00

Prepared By:
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Colorado Springs, CO 80919
719-593-2593

CONEXUS PHASES 2 AND 3
DRAINAGE PLAN STATEMENTS

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 established criteria for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

_____

Bryan T. Law, P.E.
Registered Professional Engineer State of Colorado No. 25043

DEVELOPER STATEMENT

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

_____
Name of Developer

_____
Authorized Signature Date

_____
Printed Name

_____
Title

2 N. Cascade Ave. Suite 1280, Colorado Springs, CO, 80903
Address

_____
Director of Development Services Date

Conditions:

J·R ENGINEERING

PURPOSE

This document is a Master Development Drainage Plan (MDDP) for the Preliminary PUD submittal for Conexus Phases 2 & 3. The purpose of this MDDP is to describe the proposed storm water management intent for the overall development. General flow patterns, impervious areas, pond locations, and general routing of flows are described to present a conceptual understanding of how storm water management is proposed.

GENERAL SITE LOCATION AND DESCRIPTION

LOCATION

Conexus Phases 2 and 3 development is located approximately 5,500 feet north of Baptist Road along the west side of Interstate 25 and east of Old Denver Highway in southwest, Monument Colorado. The site consists of approximately 146 acres of currently vacant land. The site is located within Sections 14 and 23, Township 11 South, Range 67 West of the 6th P.M., El Paso County, Colorado (see Figure 1). Conesus Phase 2 and 3 development is bound on the south by Teachout Creek, on the east by Interstate 25, on the west by Old Denver Road and on the north by Dirty Woman Creek and the north bound I-25 access ramp.

The site generally slopes from east to west toward Old Denver Highway at grades of approximately 2% to 5%. Teachout Creek is located at the south end of the development. Dirty Woman Creek is located at the north end of the site. Well established native grasses exist across the site. The Santa Fe Trail runs along the westerly boundary line of the site.

The exact type of proposed development is unknown at this time, but generally the land uses will consist of commercial, civic, office, light industrial, multi-use and medium to high density residential development. Old Denver Road will be realigned to direct through traffic through the proposed development, while the existing Old Denver Road will be converted to a local road way for residential access. Two access points to the existing Old Denver road are proposed.

SOIL CONDITIONS

According to the Soil Survey of El Paso County Area, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, the soil underlying this parcel consists of Tomah Crowfoot (Soil Type 92) as shown in the Appendix. The Tomah Crowfoot Soil type falls under hydrological group B soils. Runoff coefficients were selected based on the B type soils.

CLIMATE

This area of El Paso County can be described as the foothills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry.

Precipitation ranges from 12 to 14 inches per year, with the majority of this moisture occurring in the spring and summer in the form of rainfall. Thunderstorms are common during the summer months.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panels #08041C0278 G, dated December 7, 2019, 100 year flood plains exist just to the north and south of the proposed development (See Appendix). Note that it is the intent of this development to stay out of the floodplain limits.

DRAINAGE CRITERIA

Storm Drainage Analysis and Design Criteria for this project were implemented from the City of Colorado Springs "Drainage Criteria Manual Volumes 1 & 2" (DCM) and the "Urban Storm Drainage Criteria Manual" by Urban Drainage and Flood Control District (USDCM).

HYDROLOGIC CRITERIA

All hydrologic data was obtained from the "City of Colorado Springs Drainage Criteria Manual" Volumes 1 and 2, and the "Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual" Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. Runoff was calculated using the Rational Method, and rainfall intensities for the 5-year and the 100-year storm return frequencies were obtained from Table 6-2 of the Colorado Springs Criteria. One hour point rainfall data for the storm events is identified in the chart below. Runoff coefficients were determined based on proposed land use and from data in Table 6-6 from the DCM. Time of concentrations were developed using equations from the DCM. All runoff calculations and applicable charts and graphs are included in Appendix B. The Urban Drainage detention spreadsheet was used to identify detention discharge and storage. Refer to Appendix C for the applicable detention and discharge calculations.

Table 1 - 1-hr Point Rainfall Data

Storm	Rainfall (in.)
5-year	1.50
100-year	2.52

HYDRAULIC CRITERIA

The Rational Method and USDCM's SF-2 and SF-3 forms were used to determine the runoff from the minor and major storms on the site. The Manning's equation has been utilized as a preliminary sizing check for the proposed storm system. Refer to Appendix C for a pipe capacity calculation for the maximum flow rate in the proposed storm sewer system.

EXISTING DRAINAGE CONDITIONS

The site is split by a major basin boundary. The norther portion of the site is located in the Dirty Woman Creek Drainage basin, while the southern portion lies within the Teachout Drainage Basin. The existing terrain in the Dirty Woman Creek Drainage Basin generally slopes from east to west from I-25 to Old Denver Highway. The remaining portion of the site that lies within the Teachout Drainage basin generally flows west to Old Denver Road and then southerly to Teachout Creek.

At the time of writing this report no Drainage Basin Planning Study has been prepared for Teachout Creek. Flows form the proposed South Pond will be limited to historic rates in order to prevent downstream degradation of the creek. A field investigation will be necessary to analyze the current conditions of Teachout Creek for stability. If Teachout Creek is found to be unstable in its present condition, then improvements such as armament or drop structures may be warranted subject to environmental impacts including the Preble's Meadow Jumping Mouse Habitat.

Existing conditions of Dirty Woman Creek have been analyzed in *Dirty Woman Creek and Crystal Creek Drainage Bain Planning* prepared by Kiowa Engineering Corporation in 1993. This study found that in its current condition that Dirty Woman Creek will overtop the roadway when crossing I-25, causing potential for erosion and localized roadway destruction. To address this concern it is recommend that improvements to the creek and its associated infrastructure be made. For the reach of Dirty Woman Creek that transverses the site the DBPS recommends the addition of three drop structures, an additional 10'x8' concrete box culvert under I-25 and twin 10'x11' concrete box culverts under Old Denver Road. These improvements are subject to environmental impacts including the Preble's Meadow Jumping Mouse Habitat. Applicable excerpts and maps from the report are included in Appendix D.

Basin EX-1 contains Dirty Woman Creek major drainage way and is approximately 24.07 acres. Runoff generated from this basin is 5.57 cfs and 37.32 cfs for the 5 and 100 year storms respectively. Runoff from this basin overland flow directly into Dirty Women Creek at DP1.

Basin EX-2 is 8.22 acres of spares native vegetation. Runoff generated from this basin is 2.01 cfs and 13.49 cfs for the 5 and 100 year storms respectively. Runoff sheet flows to DP2 where flow enters Basin EX-1 and eventually outfall into Dirty Woman Creek.

Bain EX-3 in covered by native grasses and has a dirt trail that transvers the basin from north to south. This 38.03 acre basin generates 5.98 cfs in the 5 year storm and 40.16 cfs in the 100 year storm. Runoff sheet flows to the western property line before entering the existing swale that runs along Santa Fe Trail. Flow continues in the swale to DP4.

Basin EX-4 is 48.77 acres and is covered in spares native grasses. Runoff generated from this basin is 7.65 cfs and 51.36 cfs for the 5 and 100 year storms respectively. Runoff sheet flows to the western

property line before entering the existing swale along Santa Fe Trail. Flow continues in the swale to DP5.

Basin EX-5 is 13.15 acres of spares native vegetation. Runoff generated from this basin is 2.70 cfs and 18.19 cfs for the 5 and 100 year storms respectively. Runoff sheet flows to the western property line before entering the existing swale along Santa Fe Trail. Flows outfall to Teachout creak at DP5.

Basin EX-6 contains Teachout Creek and native vegetation. This 13.74 acres basin generates 3.01 cfs during the 5 year storm and 20.14 cfs during the 100 year storm. Runoff overland flows directly into Teachout Creek.

DEVELOPED DRAINAGE CONDITIONS

The Conexus development will consist of medium to high density residential, commercial, flex-office and light industrial developments. A proposed conditions drainage map is presented in Appendix E that depicts proposed drainage patterns and detention facilities.

Basin A comprises the existing Dirty Women Creek drainage way and consists of 23.8 acres that is open space. Runoff rates of 13.24 cfs and 49.99 cfs during the 5 and 100 year storms respectively. Flow generated by the basin will follow existing drainage patterns, by overland flowing into Dirty Women Creek, where flow exists the site at DP1.

Basin B consists of 2.9 acres of detention (North Pond). Runoff generated by this basin is 1.55 cfs and 5.89 cfs during the 5 and 100 year storms respectively. The North Pond is a proposed full spectrum water quality and detention pond. The pond will be sized and designed to release flow below historic rates into Dirty Woman Creek.

Basin C1 consists of 9.6 acre of commercial development with buildings, drive aisles, parking lot, sidewalks and landscaping. Runoff generated by this basin is 34.23 cfs and 62.42 cfs during the 5 and 100 year storms respectively. Runoff from this basin will be routed via sheet flow, curb and gutter, and possibly private storm sewer systems internal to Lot 4 that will outfall into the proposed North Pond. The North Pond is a proposed full spectrum water quality and detention pond. The pond will be sized and designed to release flow below historic rates into Dirty Woman Creek.

Basin C2 consists of 9.5 acre of commercial development with buildings, drive aisles, parking lot, sidewalks and landscaping. Runoff generated by this basin is 31.57 cfs and 57.55 cfs during the 5 and 100 year storms respectively. Runoff from this basin will be routed via sheet flow, curb and gutter, and enters the proposed storm sewer system at DP3.The proposed storm sewer system will carry flow south along the proposed Old Denver Road Re-alignment to the proposed South Pond. The South Pond is a proposed full spectrum water quality and detention pond. The pond will be sized and designed to release flow below historic rates into Teachout Creek.

Basin D consists of 42.4 acres of mix uses defined as flex-office and light industrial with buildings, drive aisles, parking lot, sidewalks, and landscaping. Runoff generated by this basin is 79.61 cfs and 158.52 cfs during the 5 and 100 year storms respectively. Runoff from this basin will be routed via sheet flow, curb and gutter, and enters the proposed storm sewer system at DP4. The proposed storm sewer carries flows to the proposed South Pond at DP5. The South Pond is a proposed full spectrum water quality and detention pond. The pond will be sized and designed to release flow below historic rates into Teachout Creek.

Basin E is 26.3 acres of medium density residential with buildings, drive aisles, parking lot, sidewalks, and landscaping. Runoff generated by this basin is 44.48 cfs and 97.88 cfs during the 5 and 100 year storms respectively. Runoff from this basin will be routed via sheet flow, curb and gutter, and enters the proposed storm sewer system. The proposed storm sewer carries flows to the proposed South Pond at DP6. The South Pond is a proposed full spectrum water quality and detention pond. The pond will be sized and designed to release flow below historic rates into Teachout Creek.

Basin F is 20.5 acres of high density residential with apartment buildings, drive aisles, parking lot, sidewalks, and landscaping. Runoff generated by this basin is 46.86 cfs and 97.35 cfs during the 5 and 100 year storms respectively. Runoff from this basin will be routed via sheet flow, curb and gutter, and then enters the proposed storm sewer system. The proposed storm sewer carries flows to the proposed South Pond at DP5. The South Pond is a proposed full spectrum water quality and detention pond. The pond will be sized and designed to release flow below historic rates into Teachout Creek.

Basin G consists of 5.6 acres of detention (South Pond). Runoff generated by this basin is 3.31cfs and 12.47 cfs during the 5 and 100 year storms respectively. Runoff from this basin is routed into the proposed South Pond via overland flow. The South Pond is a proposed full spectrum water quality and detention pond. The pond will be sized and designed to release flow below historic rates into Teachout Creek.

Basin H is 5.4 acres of open space. No development is proposed with in basin H and therefore runoff will follow existing drainage patterns. Runoff will sheet flow across the basin before entering Teachout creek in the middle of the basin. Flow will exit the site at DP7 through the existing box culvert (size unknown) under the existing Santa Fe Trail.

WATER QUALITY

Two full spectrum and water quality extended detention basins are proposed on the site to provide water quality for the proposed development. Ponds will be designed to release WQCV within 40 hours, the EURV will be released within 72 hours, and the 100-year will be released at or below the

pre-development flow rate. Both ponds will include forebays, trickle channel, outlet structure, emergency spillway and outlet pipe. These EDB/FSD's Ponds will be constructed to provide the necessary water quality capture volume (WQCV), Excessive Urban Runoff Volume (EURV), and Full Spectrum Detention.

The Urban Drainage and Flood control District's UD Detention Spreadsheet was used in determining WQCV, EURV and FSD requirements. These calculations are presented in Appendix C of this report.

DRAINAGE FEES

Drainage fees will be paid per The City of Monument requirements based on impervious area. The exact fees to be paid will be determined at the time of final platting of the property.

SUMMARY

Runoff from the Conexus Phase 2 and 3 Development will be collected on site and conveyed to the two proposed FSD/EDB's as shown. Outfalls from the proposed Ponds will release flow at or below historic rates into the adjacent Creeks. No negative downstream impacts to drainage ways, facilities, or properties are expected with the development of Conexus Phases 2 &3. Final sizing, location, and sizing of these facilities will be determined later once more detailed land use and density information becomes available. At the time of development of individual parcels within the area identified in this MDDP, separate Final Drainage Reports will be required to be review and approved by the Town of Monument.

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual (Volumes I & II), City of Colorado Springs, Colorado, Updated May, 2014.

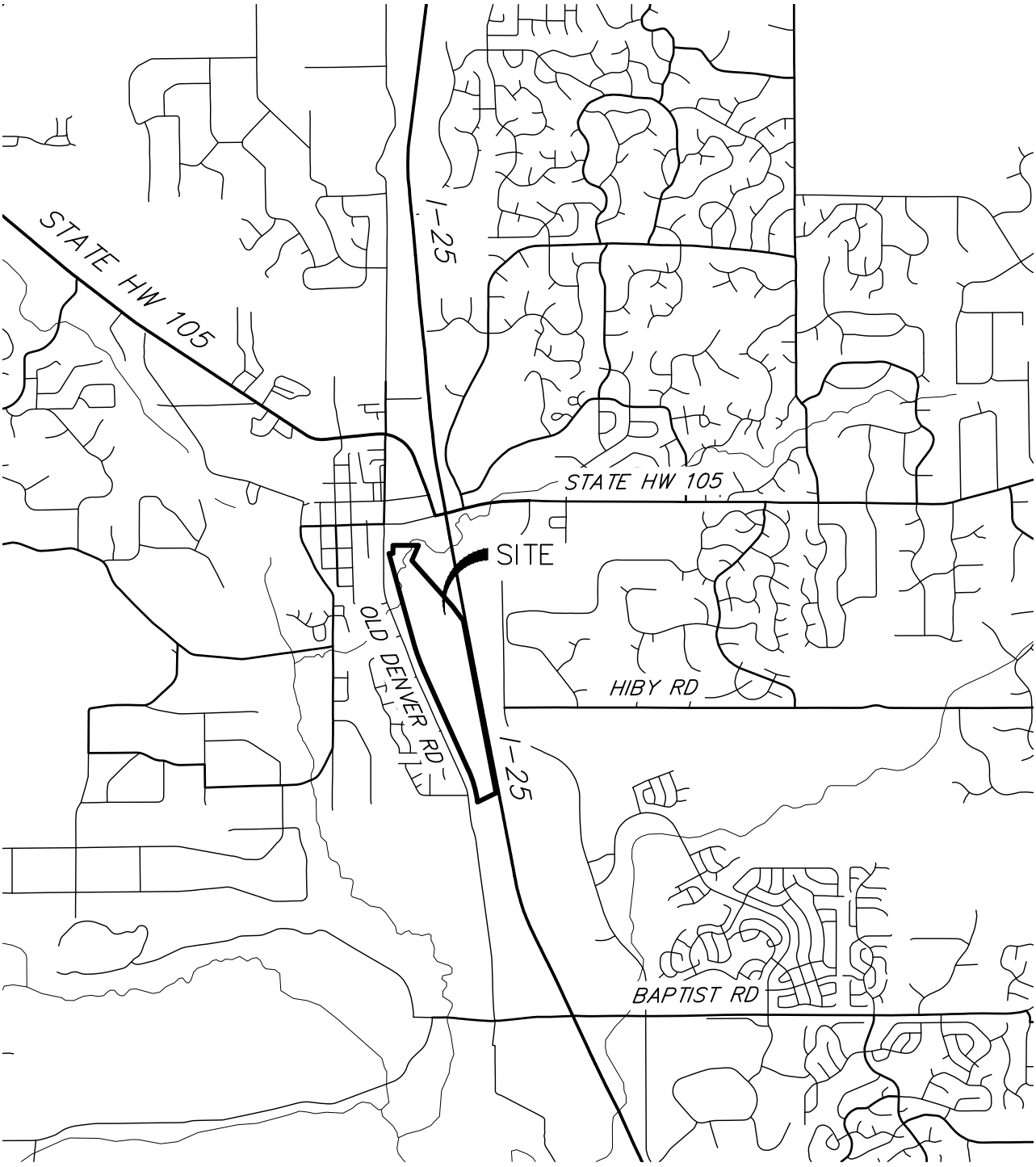
2. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.

3. "Hydrologic Group Rating for El Paso County Area, Colorado", USDA-Natural Resources Conservation Service, National Cooperative Soil Survey. Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov.

4. "Flood Insurance Studies for Colorado springs and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), 1985.

5. "Dirty Woman Creek and Crystal Creek Drainage Bain Planning Study" prepared by Kiowa Engineering Corporation, 1993.

Appendix A



N

4000 2000 0 4000

ORIGINAL SCALE: 1" = 4000'

VICINITY MAP
CONEXUS PHASE 2 & 3
JOB NO. 25247.00
01/06/2022
SHEET 1 OF 1

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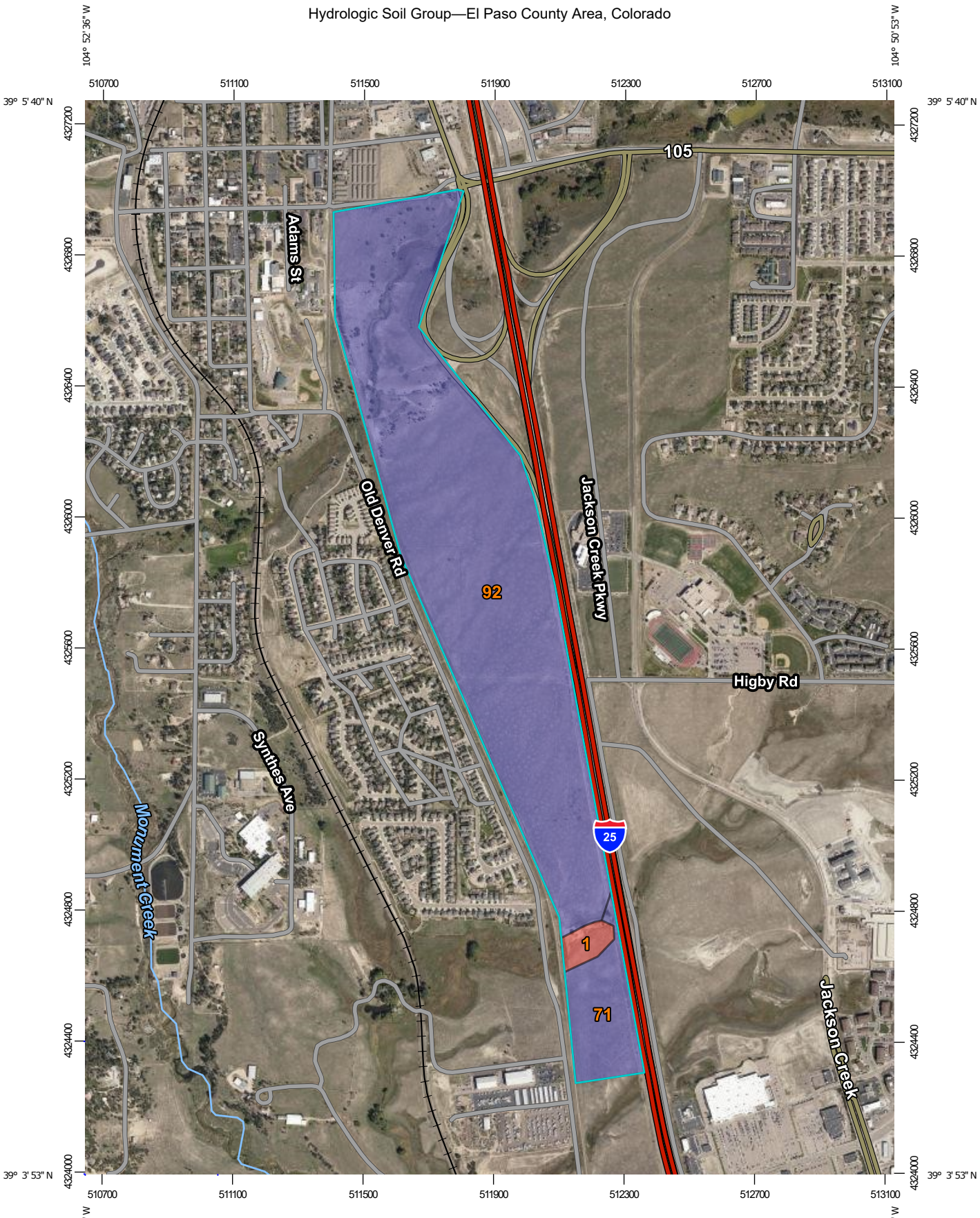


Map Scale: 1:16,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 200 400 800 1200

Feet
0 500 1000 2000 3000

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Alamosa loam, 1 to 3 percent slopes	D	3.9	1.9%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	19.1	9.1%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	186.2	89.0%
Totals for Area of Interest			**209.2**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

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

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

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

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

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

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

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

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

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

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

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

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

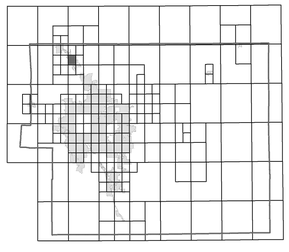
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

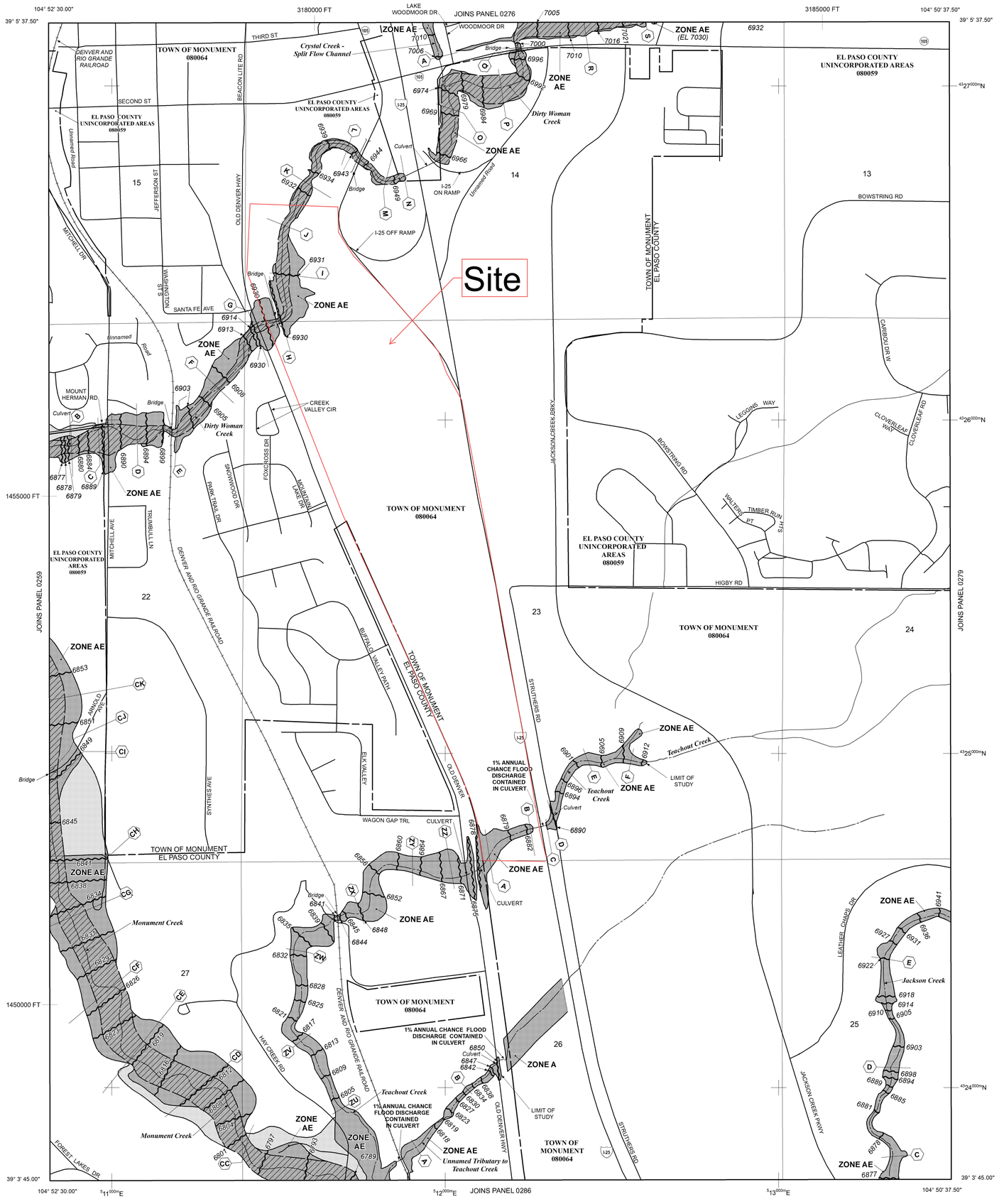
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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

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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 SOUTH, RANGE 67 WEST.

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

A — A	Cross section line
23 — 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0278G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 278 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0278	G
MONUMENT, TOWN OF	080064	0278	G

Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

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

MAP NUMBER 08041C0278G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

Appendix B

EXISTING COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Conexus
Location: El Paso County

CONEXUS
25247.00
APL

1/5/22

Basin ID	Total Area (ac)	Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	
EX-1	24.07	0.09	0.36	2.0%
EX-2	8.22	0.09	0.36	2.0%
EX-3	38.03	0.09	0.36	2.0%
EX-4	48.77	0.09	0.36	2.0%
EX-5	13.15	0.09	0.36	2.0%
EX-6	13.74	0.09	0.36	2.0%
TOTAL	**145.98**			**2.0%**

EXISTING STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: CONEXUS
Location: El Paso County

Project Name: CONEXUS
Project No.: 25247.00
Calculated By: APL
Checked By:
Date: 1/5/22

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
EX-1	24.07	B	2%	0.09	0.36	300	10.2%	14.7	575	1.0%	7.0	0.7	13.7	28.4	875.0	36.0	28.4
EX-2	8.22	B	2%	0.09	0.36	300	2.7%	22.8	265	5.0%	7.0	1.6	2.8	25.6	565.0	27.8	25.6
EX-3	38.03	B	2%	0.09	0.36	300	2.1%	24.7	1530	1.4%	7.0	0.8	30.8	55.5	1830.0	48.9	48.9
EX-4	48.77	B	2%	0.09	0.36	300	2.5%	23.3	1485	1.3%	7.0	0.8	31.0	54.4	1785.0	49.1	49.1
EX-5	13.15	B	2%	0.09	0.36	300	3.0%	22.0	800	2.5%	7.0	1.1	12.0	34.0	1100.0	34.7	34.0
EX-6	13.74	B	2%	0.09	0.36	300	3.1%	21.7	690	3.0%	7.0	1.2	9.4	31.2	990.0	32.8	31.2

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \quad \text{Equation 6-4}$$

Where:

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

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

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \quad \text{Equation 6-2}$$

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

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

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Equation 6-3

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

EXISTING STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: CONEXUS
Location: El Paso County
Design Storm: 5-Year

Project Name: CONEXUS
Project No.: 25247.00
Calculated By: APL
Checked By:
Date: 1/5/22

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	EX-1	24.07	0.09	28.4	2.17	2.57	5.6	28.4	2.91	2.57	7.5											Overland flows to Dirty Women Creek and continues to the exsting box culvert at DP1
	2	EX-2	8.22	0.09	25.6	0.74	2.72	2.0															Overland flows to DP2 then enters Basin EX-1 Flows combine in Dirty Woman Creek at DP1
	3	EX-3	38.03	0.09	48.9	3.42	1.75	6.0															Overland flows west to exisiting swale along Santa Fe Trail to DP3 & then to DP4
	4	EX-4	48.77	0.09	49.1	4.39	1.74	7.7	49.1	7.81	1.74	13.6											Overland flows southwest to exisiting swale along Santa Fe Trail to DP4 & then to DP5
	5	EX-5	13.15	0.09	34.0	1.18	2.29	2.7	49.1	8.99	1.74	15.7											Overland flows southwest to exisiting swale along Santa Fe Trail to DP5 & then to DP6
	6	EX-6	13.74	0.09	31.2	1.24	2.42	3.0	49.1	10.23	1.74	17.8											Overland flows to exising swale, Flows enter Teachout Creek at DP6

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

EXISTING STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: CONEXUS
Location: El Paso County
Design Storm: 100-Year

Project Name: CONEXUS
Project No.: 25247.00
Calculated By: APL
Checked By:
Date: 1/5/22

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	EX-1	24.07	0.36	28.4	8.67	4.30	37.3	28.4	11.63	4.30	50.1											Overland flows to Dirty Women Creek and continues to the exsting box culvert at DP1
	2	EX-2	8.22	0.36	25.6	2.96	4.56	13.5															Overland flows to DP2 then enters Basin EX-1 Flows combine in Dirty Woman Creek at DP1
	3	EX-3	38.03	0.36	48.9	13.69	2.93	40.2															Overland flows west to exisiting swale along Santa Fe Trail to DP3 & then to DP4
	4	EX-4	48.77	0.36	49.1	17.56	2.92	51.4	49.1	31.25	2.92	91.4											Overland flows southwest to exisiting swale along Santa Fe Trail to DP4 & then to DP5
	5	EX-5	13.15	0.36	34.0	4.73	3.85	18.2	49.1	35.98	2.92	105.2											Overland flows southwest to exisiting swale along Santa Fe Trail to DP5 & then to DP6
	6	EX-6	13.74	0.36	31.2	4.95	4.07	20.1	49.1	40.93	2.92	119.7											Overland flows to exising swale, Flows enter Teachout Creek at DP6

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

PROPOSED COMPOSITE % IMPERVIOUS/C VALUE CALCULATIONS

Subdivision: Conexus
Location: El Paso County

CONEXUS
25247.00
APL

1/5/22

Basin ID	Total Area (ac)	Basin Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	
A	32.80	0.16	0.36	2.0%
B	2.90	0.16	0.36	2.0%
C1	9.60	0.81	0.88	95.0%
C2	9.50	0.81	0.88	95.0%
D	42.40	0.59	0.70	80.0%
E	26.30	0.45	0.59	65.0%
F	20.50	0.63	0.78	75.0%
G	5.60	0.16	0.36	2.0%
H	5.40	0.16	0.36	2.0%
TOTAL	**155.00**			**55.1%**
TOTAL POND N	**12.50**			**73.4%**
TOTAL POND S	**104.30**			**72.4%**

PROPOSED STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: CONEXUS
Location: El Paso County

Project Name: CONEXUS
Project No.: 25247.00
Calculated By: APL
Checked By:
Date: 1/5/22

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A	32.80	B	2%	0.16	0.36	300	19.00%	11.1	1150.00	0.5%	15.0	1.1	18.1	29.2	1450.0	54.9	29.2
B	2.90	B	2%	0.16	0.36	150	2.0%	16.5	0.00	0.0%	7.0	0.0	0.0	16.5	150.0	25.7	16.5
C1	9.60	B	95%	0.81	0.88	100	2.5%	3.9	850.00	2.5%	20.0	3.2	4.5	8.3	950.0	13.9	8.3
C2	9.50	B	95%	0.81	0.88	100	2.5%	3.9	1200.00	2.5%	20.0	3.2	6.3	10.2	1300.0	15.5	10.2
D	42.40	B	80%	0.59	0.70	100	2.7%	6.6	2400.00	2.7%	20.0	3.3	12.2	18.8	2500.0	24.5	18.8
E	26.30	B	65%	0.45	0.59	150	2.8%	10.2	380.00	1.5%	20.0	2.4	2.6	12.8	530.0	17.8	12.8
F	20.50	B	75%	0.63	0.78	100	3.3%	5.7	1800.00	3.3%	20.0	3.6	8.3	14.0	1900.0	21.7	14.0
G	5.60	B	2%	0.16	0.36	100	2.0%	13.5	0.00	0.0%	7.0	0.0	0.0	13.5	100.0	25.7	13.5
H	5.40	B	2%	0.16	0.36	300	4.0%	18.6	400	2.0%	7.0	1.0	6.7	25.3	700.0	30.7	25.3

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Where:

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

Equation 6-2

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

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

Equation 6-4

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

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

Equation 6-3

Equation 6-5

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: CONEXUS
Location: El Paso County
Design Storm: 5-Year

Project Name: CONEXUS
Project No.: 25247.00
Calculated By: APL
Checked By:
Date: 1/5/22

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	A	32.80	0.16	29.2	5.25	2.52	13.2															Overland flows to Dirty Women Creek and exits site at DP1
		B	2.90	0.16	16.5	0.46	3.37	1.6															Overland flows to Proposed North Pond
	2	C1	9.60	0.81	8.3	7.78	4.40	34.2	16.5	8.24	3.37	27.8											Overland flows to internal c&g, flows from Basin B and C1 combine at North Pond, DP2
	3	C2	9.50	0.81	10.2	7.70	4.10	31.6															Flow is routed via overland flow to c&g to DP3, flow continues to DP4 via storm sewer
	4	D	42.40	0.59	18.8	25.02	3.18	79.6	18.8	32.72	3.18	104.1											Flow is routed via overland flow and c&g to DP4 and contuies to DP5 via storm sewer
	5	E	26.30	0.45	12.8	11.84	3.76	44.5	18.8	44.56	3.18	141.8											Flow is routed via c&g and storm sewer to DP5 where flow continues to South Pond
	6	F	20.50	0.63	14.0	12.92	3.63	46.9															Flow is routed via c&g and storm sewer to DP6 where flow continues to South Pond
	7	G	5.60	0.16	13.5	0.90	3.68	3.3	18.8	58.38	3.18	185.7											Overland flows to South Pond , flows from Basin G, DP5 & DP6 combine at DP7
	8	H	5.40	0.16	25.3	0.86	2.73	2.4															Follows existing drainage pattern and enters exisitng swale ast DP8

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

PROPOSED STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: CONEXUS
Location: El Paso County
Design Storm: 100-Year

Project Name: CONEXUS
Project No.: 25247.00
Calculated By: APL
Checked By:
Date: 1/5/22

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	A	32.80	0.36	29.2	11.81	4.23	50.0															Overland flows to Dirty Women Creek and exits site at DP1
		B	2.90	0.36	16.5	1.04	5.66	5.9															Overland flows to Proposed North Pond
	2	C1	9.60	0.88	8.3	8.45	7.39	62.4	16.5	9.49	5.66	53.8											Overland flows to internal c&g, flows from Basin B and C1 combine at North Pond, DP2
	3	C2	9.50	0.88	10.2	8.36	6.88	57.6															Flow is routed via overland flow to c&g to DP3, flow continues to DP4 via storm sewer
	4	D	42.40	0.70	18.8	29.68	5.34	158.5	18.8	38.04	5.34	203.2											Flow is routed via overland flow and c&g to DP4 and contuies to DP5 via storm sewer
	5	E	26.30	0.59	12.8	15.52	6.31	97.9	18.8	53.56	5.34	286.1											Flow is routed via c&g and storm sewer to DP5 where flow continues to South Pond
	6	F	20.50	0.78	14.0	15.99	6.09	97.4															Flow is routed via c&g and storm sewer to DP6 where flow continues to South Pond
	7	G	5.60	0.36	13.5	2.02	6.18	12.5	18.8	71.57	5.34	382.2											Overland flows to South Pond , flows from Basin G, DP5 & DP6 combine at DP7
	8	H	5.40	0.36	25.3	1.94	4.59	8.9															Follows existing drainage pattern and enters exisitng swale ast DP8

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

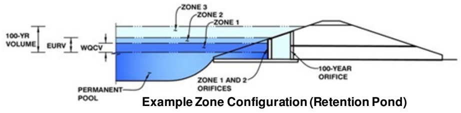
Appendix C

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **Conexus Ph 2-3**

Basin ID: **North Pond**



Example Zone Configuration (Retention Pond)

Depth Increment = 1.00 ft

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	12.50	acres		
Watershed Length =	1,000	ft		
Watershed Length to Centroid =	250	ft		
Watershed Slope =	0.030	ft/ft		
Watershed Imperviousness =	73.40%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.303	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.011	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.856	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.146	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.389	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.670	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.923	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.220	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	2.860	acre-feet		inches
Approximate 2-yr Detention Volume =	0.794	acre-feet		
Approximate 5-yr Detention Volume =	1.054	acre-feet		
Approximate 10-yr Detention Volume =	1.323	acre-feet		
Approximate 25-yr Detention Volume =	1.419	acre-feet		
Approximate 50-yr Detention Volume =	1.476	acre-feet		
Approximate 100-yr Detention Volume =	1.572	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.303	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.708	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.560	acre-feet
Total Detention Basin Volume =	1.572	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
	--	0.50	--	--	--	21,570	0.495	5,394	0.124
	--	1.50	--	--	--	24,307	0.558	28,332	0.650
	--	2.50	--	--	--	27,142	0.623	54,057	1.241
	--	3.50	--	--	--	30,079	0.691	82,667	1.898
	--	4.50	--	--	--	33,116	0.760	114,265	2.623
	--	5.50	--	--	--	36,254	0.832	148,950	3.419
	--	6.50	--	--	--	39,492	0.907	186,823	4.289
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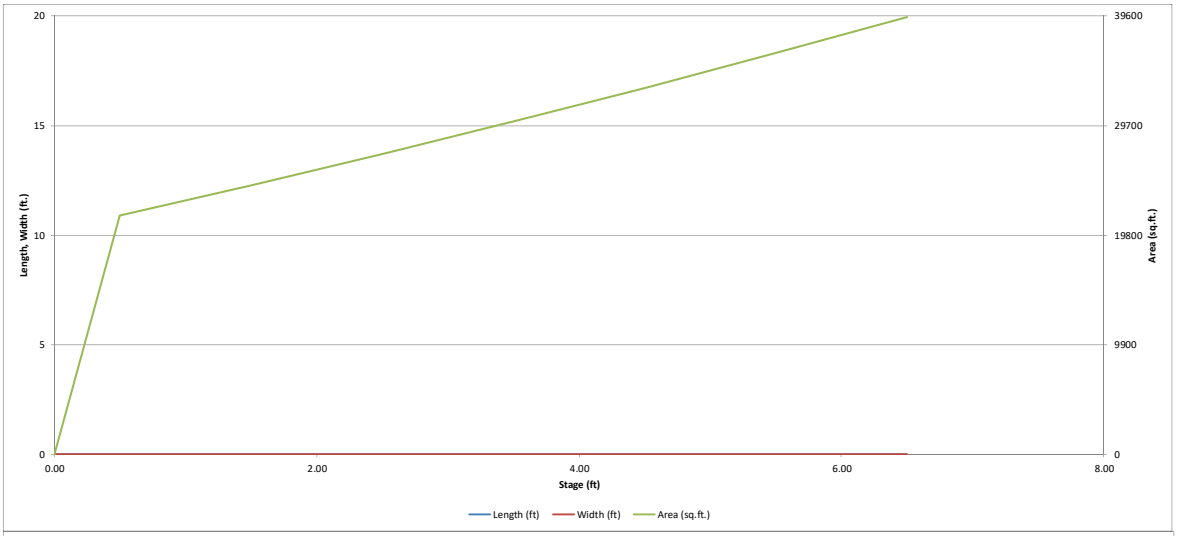
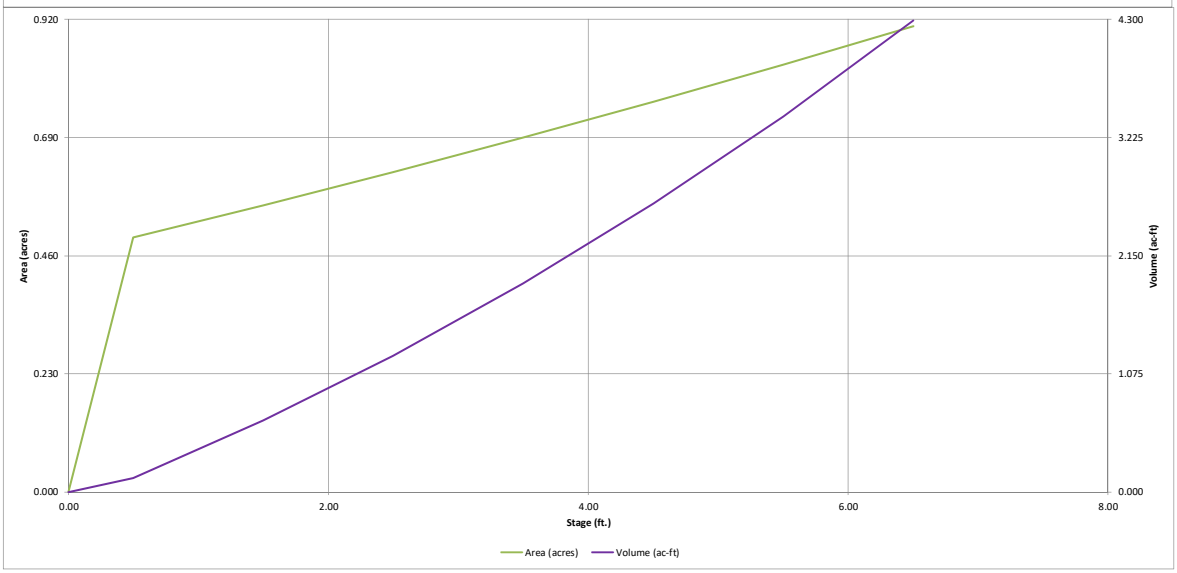
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)



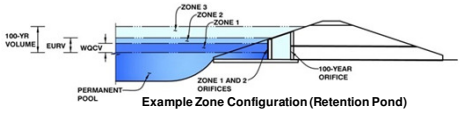


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: Conexus Ph 2-3

Basin ID: South Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	104.30	acres
Watershed Length =	4,000	ft
Watershed Length to Centroid =	2,000	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	72.40%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	2.488 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	8.315 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	7.573 acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	10.160 acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	12.331 acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	14.858 acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	17.121 acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	19.789 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	25.525 acre-feet		inches
Approximate 2-yr Detention Volume =	6.520 acre-feet		
Approximate 5-yr Detention Volume =	8.664 acre-feet		
Approximate 10-yr Detention Volume =	10.889 acre-feet		
Approximate 25-yr Detention Volume =	11.690 acre-feet		
Approximate 50-yr Detention Volume =	12.156 acre-feet		
Approximate 100-yr Detention Volume =	12.967 acre-feet		

Define Zones and Basin Geometry

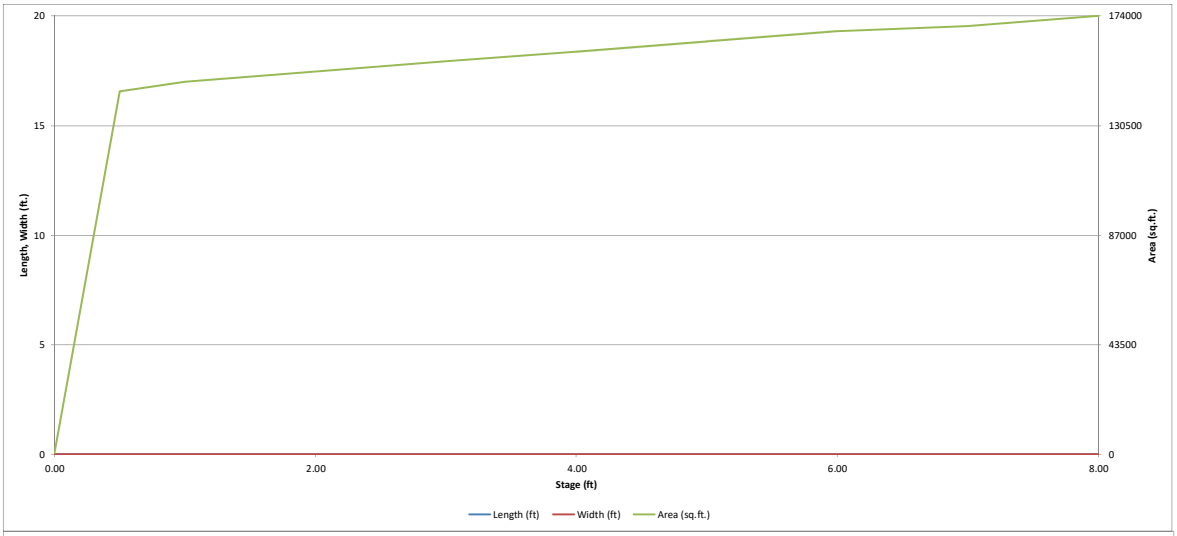
Zone 1 Volume (WQCV) =	2.488	acre-feet
Zone 2 Volume (EURV - Zone 1) =	5.827	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.652	acre-feet
Total Detention Basin Volume =	12.967	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

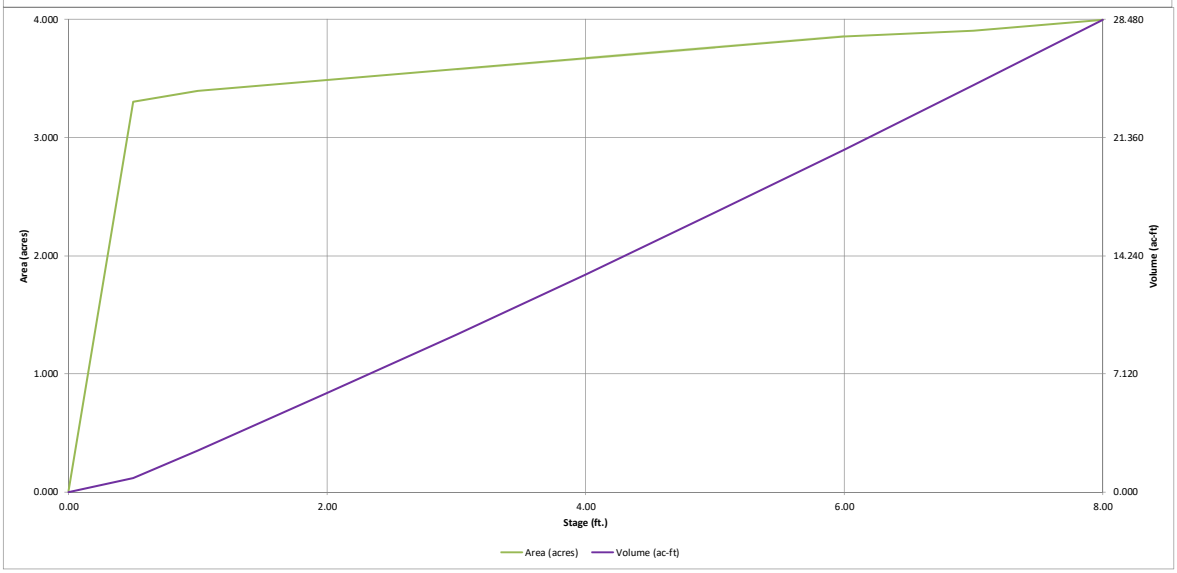
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	477	0.011		
	--	0.50	--	--	--	144,000	3.306	36,113	0.829
	--	1.00	--	--	--	148,000	3.398	109,113	2.505
	--	2.00	--	--	--	152,000	3.489	259,113	5.948
	--	3.00	--	--	--	156,000	3.581	413,113	9.484
	--	4.00	--	--	--	160,000	3.673	571,113	13.111
	--	5.00	--	--	--	164,000	3.765	733,113	16.830
	--	6.00	--	--	--	168,000	3.857	899,113	20.641
	--	7.00	--	--	--	170,000	3.903	1,068,113	24.520
	--	8.00	--	--	--	174,000	3.994	1,240,113	28.469

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)





Channel Report

Max Flow Check

Circular

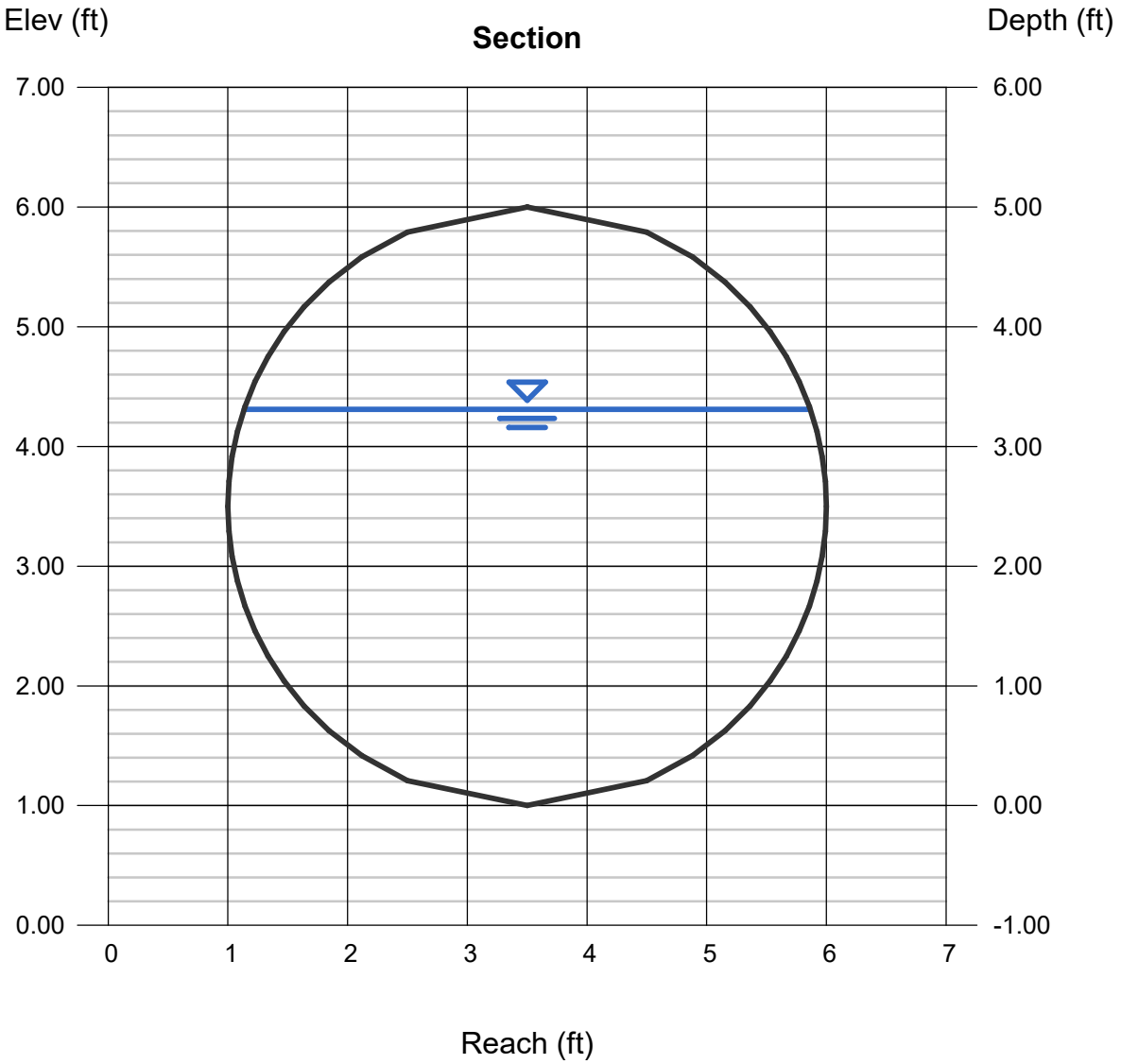
Diameter (ft)	= 5.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 286.10

Highlighted

Depth (ft)	= 3.31
Q (cfs)	= 286.10
Area (sqft)	= 13.84
Velocity (ft/s)	= 20.67
Wetted Perim (ft)	= 9.52
Crit Depth, Yc (ft)	= 4.61
Top Width (ft)	= 4.72
EGL (ft)	= 9.95



Appendix D

Approved
El Paso County
Planning Commission
This 27 day of July 19 93
Barbara E. Smith
Chairman
Elaine Nelson, Secretary

DIRTY WOMAN CREEK
and
CRYSTAL CREEK
DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN REPORT

Prepared for:

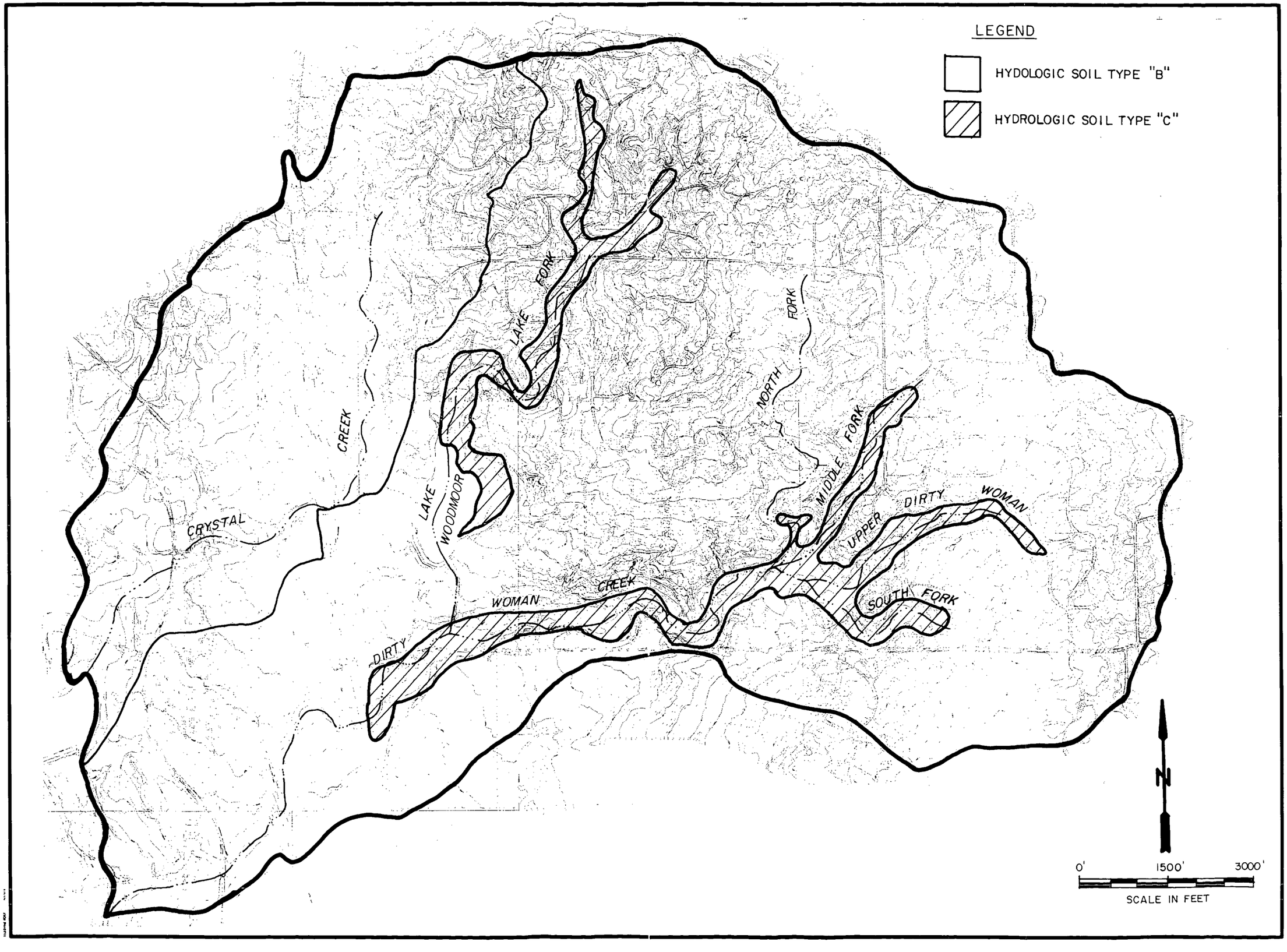
El Paso County Department of Public Works
Stormwater Management Division
3105 North Stone
Colorado Springs, CO 80907

Prepared by:

Kiowa Engineering Corporation
419 West Bijou Street
Colorado Springs, CO 80905-1308

KIOWA Project No. 91.07.17
D22/R191

February 1993
Revised April 1993
Revised May 1993
Revised June 1993

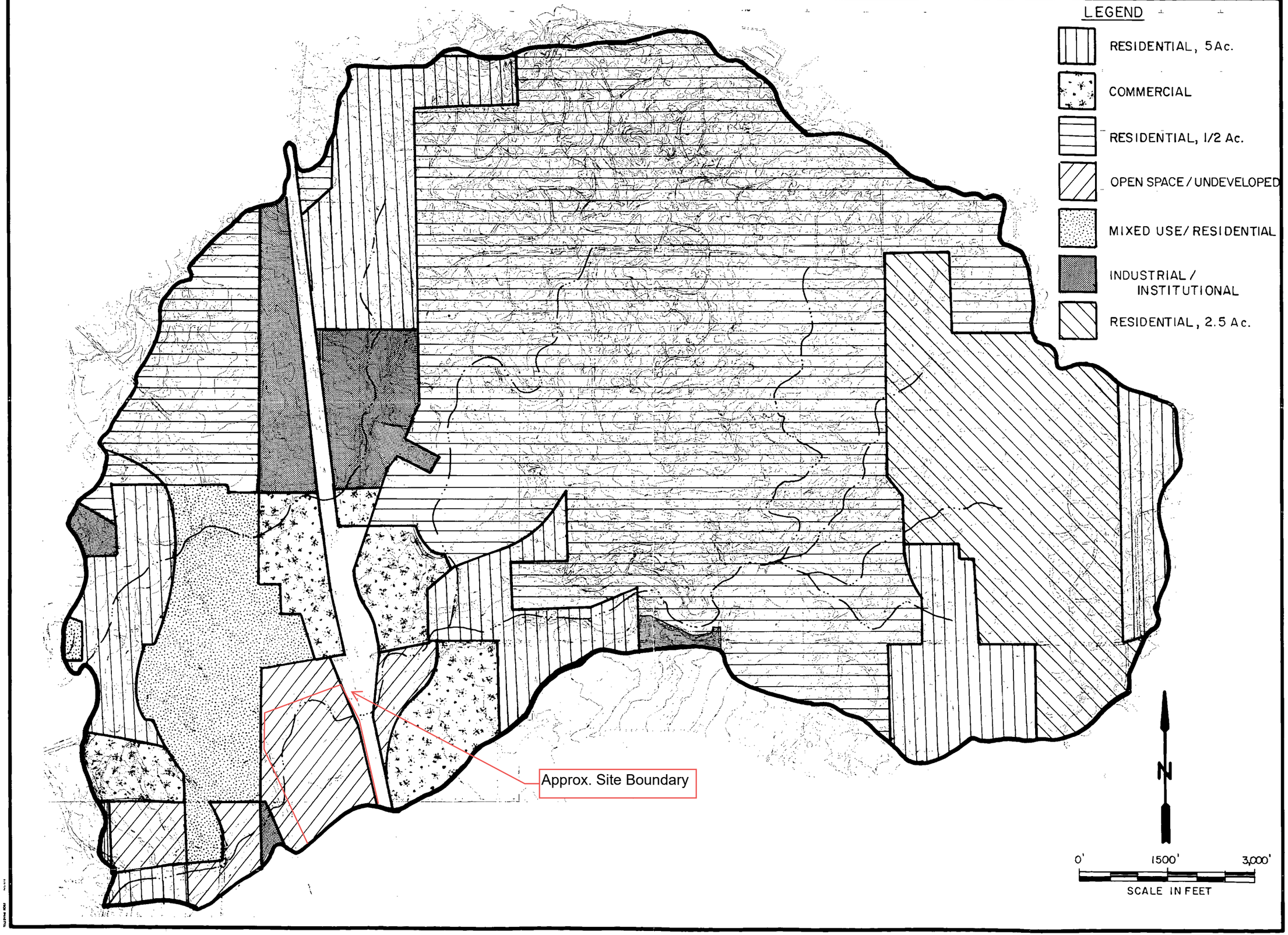


Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

DIRTY WOMAN CREEK & CRYSTAL CREEK
DRAINAGE BASIN PLANNING STUDY
HYDROLOGIC SOILS MAP

Project No.	91-07-17
Date:	12/91
Design:	AWMc
Drawn:	EAK
Check:	RNW
Revisions:	

FIG 2



Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

DIRTY WOMAN CREEK & CRYSTAL CREEK
DRAINAGE BASIN PLANNING STUDY
PROPOSED LAND USE MAP

Project No.	91-07-17
Date:	12/91
Design:	AW Mc
Drawn:	EAK
Check:	RNW
Revisions:	

FIG 3

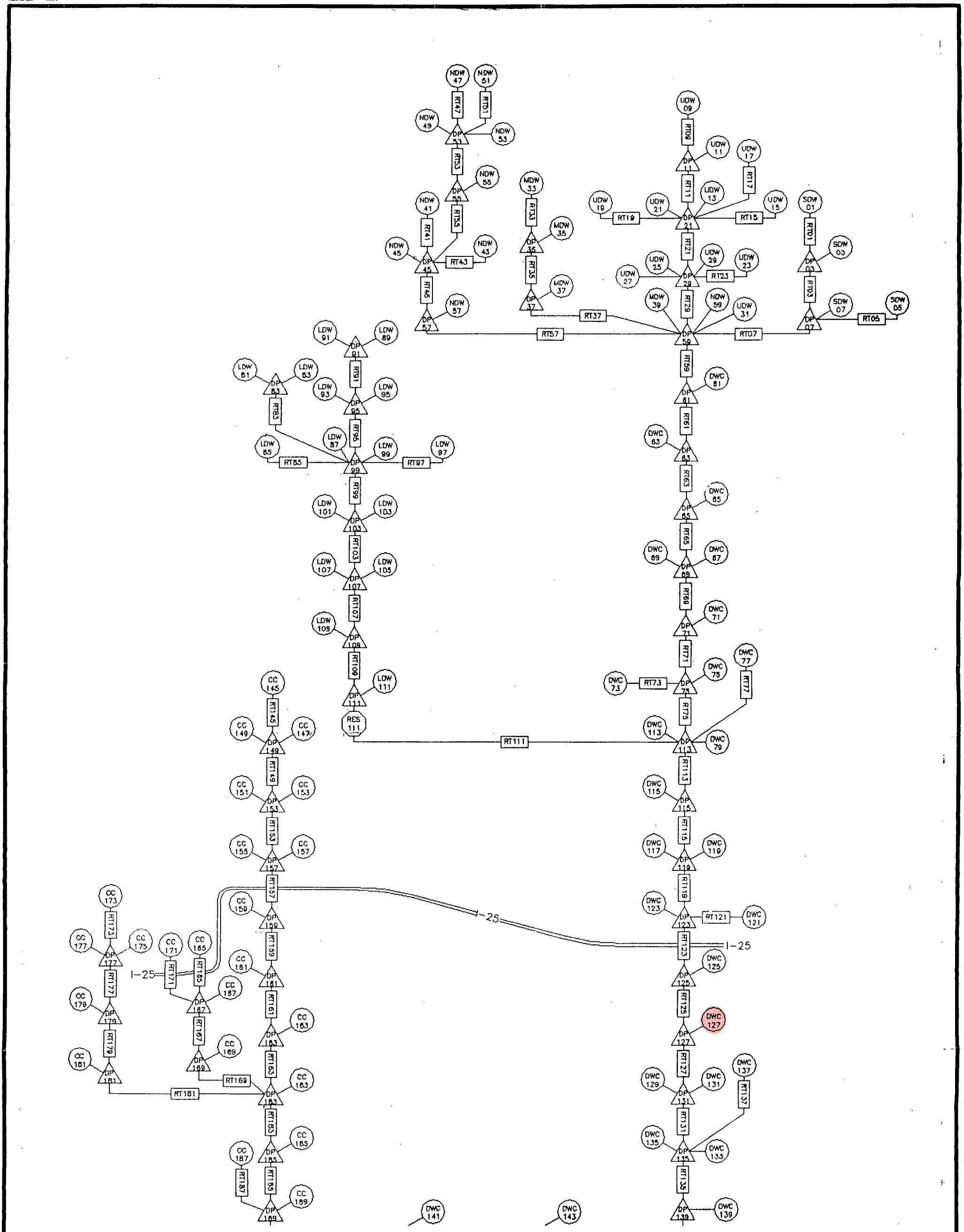


FIG. 4

Project No. 91-07-18
Date: 12/91
Design: AWMc
Drawn: AWMc
Check: RNW
Revisions:

DIRTY WOMAN CREEK & CRYSTAL CREEK
DRAINAGE BASIN PLANNING STUDY

HYDROLOGIC FLOW CHART

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

TABLE 1
Summary of Sub-basin Peak Discharges

Basin Designation	Future 100 Year 2 Hour	Future 10 Year 2 Hour	Basin Designation	Future 100 Year 2 Hour	Future 10 Year 2 Hour	Basin Designation	Future 100 Year 2 Hour	Future 10 Year 2 Hour
SDW01	147	49	DWC79	118	42	CC157	111	46
SDW03	90	31	LDW81	136	54	CC159	22	9
SDW05	120	40	LDW83	74	28	CC161	132	57
SDW07	91	38	LDW85	47	18	CC163	127	51
UDW09	103	34	LDW87	112	43	CC165	121	52
UDW11	57	20	LDW89	94	35	CC167	116	49
UDW13	32	12	LDW91	26	10	CC169	119	37
UDW15	76	25	LDW93	46	18	CC171	90	40
UDW17	26	9	LDW95	53	20	CC173	56	24
UDW19	33	11	LDW97	50	19	CC175	46	15
UDW21	47	16	LDW99	57	25	CC177	89	32
UDW23	24	8	LDW101	170	66	CC179	42	13
UDW25	44	15	LDW103	136	50	CC181	49	15
UDW27	80	29	LDW105	95	38	CC183	136	50
UDW29	80	27	LDW107	47	18	CC185	111	36
UDW31	82	35	LDW109	131	53	CC187	96	37
MDW33	131	47	LDW111	215	89	CC189	64	23
MDW35	33	11	DWC113	44	15			
MDW37	81	29	DWC115	91	40			
MDW39	116	46	DWC117	198	84			
NDW41	146	56	DWC119	72	31			
NDW43	61	23	DWC121	211	88			
NDW45	87	33	DWC123	77	34			
NDW47	62	23	DWC125	73	31			
NDW49	14	5	DWC127	102	32			
NDW51	32	12	DWC129	137	58			
NDW53	17	6	DWC131	58	18			
NDW55	18	7	DWC133	102	38			
NDW57	153	57	DWC135	81	26			
NDW59	129	50	DWC137	65	25			
DWC61	76	29	DWC139	117	47			
DWC63	130	50	DWC141	79	32			
DWC65	59	23	DWC143	101	38			
DWC67	42	15	CC145	89	33			
DWC69	41	17	CC147	103	35			
DWC71	72	29	CC149	69	22			
DWC73	81	30	CC151	114	38			
DWC75	153	61	CC153	77	29			
DWC77	50	19	CC155	43	19			

TABLE 2
Summary of Peak Discharges

Design Point	Creek Symbol	Existing 100 Year 2 Hour	Existing 10 Year 2 Hour	Future 100 Year 2 Hour	Future 10 Year 2 Hour
Dirty Woman Creek					
11	UDW	150	50	150	50
21	UDW	308	103	308	103
29	UDW	514	172	514	172
53	NFDW	108	40	108	40
55	NFDW	117	43	117	43
45	NFDW	354	132	354	132
57	NFDW	501	186	501	186
35	MFDW	156	55	156	55
37	MFDW	235	84	235	84
3	SFDW	229	77	229	77
7	SFDW	377	127	377	127
59	DWC	1,876	663	1,876	663
61	DWC	1,952	692	1,952	692
63	DWC	2,075	735	2,075	735
65	DWC	2,126	756	2,126	756
69	DWC	2,175	777	2,175	777
71	DWC	2,202	791	2,202	791
75	DWC	2,335	836	2,337	838
91	DWC	112	41	112	41
95	DWC	198	74	198	74
83	DWC	195	75	195	75
99	DWC	594	226	594	226
103	DWC	883	334	883	334
107	DWC	1016	381	1016	381
109	DWC	1107	417	1107	417
111	DWC	1240	413	1240	413
113	DWC	2,513	896	2,515	898
115	DWC	2,539	908	2,541	910
119	DWC	2,679	960	2,686	694
123	DWC	2,810	1,000	2,868	1,031
125	DWC	2,850	1,015	2,909	1,046
127	DWC	2,879	1,028	2,943	1,057
131	DWC	2,989	1,068	3,055	1,098
135	DWC	3,142	1,124	3,212	1,154
139	DWC	3,192	1,136	3,258	1,170
Crystal Creek					
149	CC	260	90	260	90
153	CC	416	142	416	142
157	CC	527	185	527	185
159	CC	536	188	536	188
161	CC	594	211	594	211
163	CC	644	231	644	231
177	CC	188	70	188	70
179	CC	202	74	202	74
181	CC	232	81	232	81
167	CC	303	126	317	135
169	CC	397	148	412	157
183	CC	1,213	423	1,223	430
185	CC	1,277	442	1,288	450
189	CC	1,394	481	1,406	487

TABLE 3
Major Structure Inventory
Dirty Woman/Crystal Creek Drainage Basin Planning Study

Reach No.	Creek/ Station	Roadway	Existing Culvert Size	Q100 Q10 (cfs)
DW-A	Dirty Woman 11+30	Mitchell Street	72" CMP	3,258 1,170
	Dirty Woman 18+20	D&RGW RR	16'x18' Stone Arch	3,212 1,154
	Dirty Woman 32+30	Old Denver Highway	64" CMP	3,055 1,098
	Dirty Woman 34+30	Santa Fe Trail	23'x30' Stone Arch	3,055 1,098
	Dirty Woman 65+40	I-25	8'x8' CBC	2,868 1,031
	Dirty Woman 85+60	Colorado Hwy 105	4'x64' Conc. Bridge	2,541 910
DW-B	Dirty Woman 107+70	Knollwood Drive	36" CMP	2,337 838
	Dirty Woman 142+80	South Park Drive	24" CMP	2,126 756
	Dirty Woman 148+60	Lake Woodmoor Drive	(2)-24" CMP	2,075 735
	Dirty Woman 155+00	Augusta Drive	(2)-24" CMP	2,075 735
UPDW-A	Upper Dirty Woman 188+30	Furrow Road	(3)-48" RCP	514 172
NFDW-A	North Fork Dirty Woman 5+80	Augusta Drive	? CMP Plugged	627 186
NFDW-B	North Fork Dirty Woman 60+50	Tam-O-Shanter Way	? Plugged	117 43
	North Fork Dirty Woman 69+70	Woodmoor Drive	? Plugged	108 40
MFDW-A	Middle Fork Dirty Woman 14+00	Will O The Wisp Way	18" CMP	349 129
	Middle Fork Dirty Woman 33+00	Lost Creek way	24" CMP	235 84
	Middle Fork Dirty Woman 37+30	Furrow Road	24" CMP	235 84
	Middle Fork Dirty Woman 45+00	Ajo Way	18" CMP	235 84
SFDW-A	South Fork Dirty Woman 10+30	Winding Meadows Way	24" CMP	377 127
	South Fork Dirty Woman 10+90	Winding Meadows Way	14"x22" Arch CMP	377 127
	South Fork Dirty Woman 26+20	Furrow Road	36" CMP	229 77
	South Fork Dirty Woman 42+00	Martingale Road	18" CMP	90 31
LFDW-B	Lake Fork Dirty Woman 52+60	Autumn Way	24" CMP	1,016 381
	Lake Fork Dirty Woman 63+50	Deer Creek Road	24" CMP	1,016 381
	Lake Fork Dirty Woman 87+60	Deer Creek Road	18" CMP	883 334
	Lake Fork Dirty Woman 93+20	Woodmoor Drive	24" CMP	594 226
CC-A	Crystal Creek 5+90	N. Monument Lake Road	(2)-72" CMP	1,288 450
	Crystal Creek 25+20	D&RGW RR	14'x16' Stone Arch	644 231
CC-B	Crystal Creek 28+70	Washington Street	(2)-90" CMP	644 231
	Crystal Creek 31+70	Colorado Hwy 105	8.5'x30' Conc. Bridge	644 231
	Crystal Creek 34+50	Santa Fe Trail	10'x10' Stone Arch	644 231
	Crystal Creek 43+00	Beaconlite Road	36" CMP	594 211
	Crystal Creek 56+40	I-25	10'x14' CBC	536 188
CC-C	Crystal Creek 58+50	Frontage Road	24" RCP	527 185
	Crystal Creek 63+30	Willow Park Way	42" CMP	527 185
	Crystal Creek 83+70	Deer Creek Road	60" CMP	527 185
	Crystal Creek 89+80	Immigrant Trail East	(2)-24" CMP	416 139

Floodplains

Floodplains for the 100-year existing and future condition discharges have been delineated for Dirty Woman Creek and Crystal Creek. The floodplain was estimated in order to assess where hydraulic inadequacies exist along the major drainageways. Floodways were also delineated as part of the hydraulic analysis. This analysis assumed rigid boundary conditions to exist along the channel cross sections. The field inventory supplied roughness and bridge opening data for use in the HEC-2 modeling. These floodplains are presented on the Preliminary Design drawings. The previously mentioned technical addendum contains input and output data for the hydrology, floodplain and floodway analyses.

The most significant areas of existing flood hazard occurs along I-25, between Crystal Creek and Dirty Woman Creek. An inadequate capacity culvert under the I-25 Frontage Road forces the 100-year discharge in Crystal Creek to be diverted south along I-25 and into Dirty Woman Creek. Though no structures are threatened, Colorado Highway 105 and the northbound I-25 embankment could be eroded. The crossing of I-25 by Dirty Woman Creek will overtop the roadway in its current configuration. No structures are threatened, but the potential for erosion and localized roadway destruction is great. Elsewhere along Dirty Woman Creek, a single family residence in the vicinity of Augusta Drive lies within the 100-year floodplain. The floodplain at this location is wide because of the inadequate culverts under Augusta Drive and Lake Woodmoor Drive. Along Crystal Creek, there are two locations in which flooding potentially threatens a structure. The crossings of Crystal Creek at both Willow Park Way and Emigrant Trail East pose potential flooding problems. In general, habitable structures adjacent to Dirty Woman and Crystal Creeks have been elevated above the 100-year water surface.

TABLE 4: Evaluation of Channel Alternatives

Major Drainageway: Dirty Woman Creek / Crystal Creek
Alternative Concept: Floodplain Preservation (do-nothing)

Parameter	Flood Hazard		Habitat				Operations and Maintenance		Open Space/Aesthetics			Water Quality		Comments
Impact	No Impact	Reduced Hazard/ Increased Hazard	Impact			Mitigation/Enhancement Opportunities	Reduced effort	Increased effort	Low Visual Quality	No Impact	Visually Enhanced	Degrades Quality	No Impact or Enhancement	
Reach No.			Minimal	Moderate	Major									
DW-A	Parkland lies within 100-yr Flood plain. Structures are currently outside 100-yr floodplain	Unstable channel banks could create flood damage in this reach		X		Bank instability negates potential for enhancement.		Channel bank erosion in areas with resulting sedimentation will cause higher annual maintenance costs as this area develops	Area between RR & I-25 could become visually blighted if left alone		Opportunities exist to enhance the entire length of the reach. Portions of the reach are of high visual value currently	Area between RR & I-25 could cause water quality problems due to erosion	Existing wetland areas provide significant water quality enhancement	Portions of the reach, upper & lower, have excellent wetland habitats. The middle portion of the reach is currently experiencing bank erosion. Future CDoT plans could destroy prime wetland areas.
DW-B	One residence is currently within the 100-year floodplain	Future flood hazards can be reduced using floodplain regulation	X					Maintenance costs could increase as development occurs in lower portion of reach	Development without floodplain control in lower portion of reach could reduce aesthetics		Opportunities exist to enhance the Open Space & aesthetics of the reach. High quality currently exists in the reach		Existing wetland areas provide significant water quality enhancement	The lower portion of the reach is subject to development which could encroach upon the creek
UFDW-A	No structures are currently within the 100-year floodplain	Undersized culverts are potentially dangerous	X					Increased O & M costs due to undersized roadway culverts		Buildout is nearly complete. Most of the floodplain is privately owned		Short term construction activity & roadway erosion impact water quality	Existing wetland areas provide significant water quality enhancement	Areas tributary to this reach are near complete buildout. Undersizing of roadway culverts is biggest problem
SFDW-A	No structures are currently within the 100-year floodplain	Undersized culverts are potentially dangerous	X					Increased O & M costs due to undersized roadway culverts		Floodplain is privately owned	Opportunities exist to enhance the Open Space & aesthetics of the reach afforded by this concept	Short term construction activity & roadway erosion impact water quality	Existing wetland areas provide water quality enhancement	Undersizing of roadway culverts is biggest problem in this reach
MFDW-A	No structures are currently within the 100-year floodplain	Undersized culverts are potentially dangerous. Purrow Road is constraint to flood flow	X					Increased O & M costs due to undersized roadway culverts		Floodplain is privately owned	Opportunities exist to enhance the Open Space & aesthetics of the reach afforded by this concept	Short term construction activity & roadway erosion impact water quality	Existing wetland areas provide water quality enhancement	Undersized & improperly located culverts are detrimental to flood flow in this reach particularly at Purrow Road
NFDW-A	No structures are currently within the 100-year floodplain	Undersized culvert at Augusta Dr. creates flooding hazard.	X			Existing floodplain well vegetated and stable.		Increased O & M costs due to undersized roadway culverts & inlets.		Floodplain is within drainage/preservation easement.			Existing wetland areas provide water quality enhancement	
NFDW-B	Golf course occupies the majority of floodplain in this reach	Undersized culverts are constraints and are potentially hazardous	X					Increased O & M costs due to undersized roadway culverts & inlets		Floodplain is privately owned, majority by Woodmoor CC	Opportunities exist to enhance the Open Space & aesthetics of the reach afforded by this concept		Existing wetland areas provide water quality enhancement	Most of the reach is within Woodmoor CC and is currently a golf course. Undersized culverts are detrimental to flood flow particularly at Woodmoor Drive
LFDW-A	Lake Woodmoor reduces the flood hazard in this reach. Some structures have been built on stilts over the lake	Lake Woodmoor spillway is potentially hazardous at road crossing		X				Increased O & M costs caused by spillway erosion	Low water level in Lake Woodmoor	Lake Woodmoor is privately owned & operated	Opportunities exist to enhance the Open Space & aesthetics of the reach afforded by this concept		Lake Woodmoor is water supply reservoir	Spillway and area below Lake Woodmoor is actively headcutting
LFDW-B	No structures are currently within the 100-year floodplain	Undersized & improperly located culverts are potentially hazardous	X					Increased O & M costs due to undersized & improperly located roadway & driveway culverts		Buildout is nearly complete Most of the floodplain is privately owned		Opportunities exist to increase water quality which directly enters reservoir	Existing wetland areas provide water quality enhancement	Roadway and driveway culverts currently are detrimental to flood flow in the reach. Since water directly enters water storage reservoir, water quality should be a major concern
CC-A	No structures are currently within the 100-year floodplain	Undersized culverts at N. Monument Lake Rd are construction	X					Increased O & M costs due to roadway crossings		Floodplain is privately owned	Opportunities exist to enhance the Open Space & aesthetics of the reach afforded by this concept		Existing wetland areas provide water quality enhancement	If farmland develops floodplain regulation is essential. Culverts at N. Monument Lake Road are not adequate for 100-year flow
CC-B	Future flood hazards can be reduced using floodplain regulation	Future development will increase flows	X				O & M costs should remain relatively the same		Development without floodplain control could reduce aesthetics		Opportunities exist to enhance the Open Space & aesthetics of the reach afforded by this concept	Development in area could result in loss of water quality		Monument currently has a detention and "no build" in floodplain policy in effect
CC-C	No structures are currently within the 100-year floodplain	Existing dam embankments could cause localized flooding if breached. Roadway crossings are undersized	X					Increased O & M costs due to roadway crossings			Opportunities exist to enhance the Open Space & aesthetics of the reach afforded by this concept		Existing wetland areas provide water quality enhancement	Undersized culvert at Frontage Road is single biggest concern in the reach

TABLE 5: Evaluation of Channel Alternatives

Major Drainageway: Dirty Woman Creek / Crystal Creek

Alternative Concept: Selective Channel Improvememts

Parameter / Impact	Flood Hazard		Habitat				Operations and Maintenance			Open Space/Aesthetics		Water Quality		Comments
	No Impact	Reduced Hazard/ Increased Hazard	Impact			Mitigation/Enhancement Opportunities	Reduced effort	Increased effort	Low Visual Quality	No Impact	Visually Enhanced	Degrades Quality	No Impact or Enhancement	
Reach No.			Minimal	Moderate	Major									
DW-A	Structures are currently outside 100-yr floodplain	Potential exists to reduce bank erosion at middle portion of the reach	X			Migration of degraded segments possible by stabilization of banks and invert.	Channel bank erosion can be reduced or eliminated			Portions of the reach are of high visual quality currently	Area between RR & I-25 can be enhanced using selective improvements		Erosion can be reduced considerably which will create better water quality. Existing wetland areas should remain	Selective improvements would be concentrated in the middle portion of the reach where the creek is relatively unstable
DW-B		One structure within 100-yr floodplain may be removed from floodplain with improvements	X					Maimenance costs could increase as development occurs in lower portions of the reach		Portions of the reach are of high visual quality currently	Opportunities exist to enhance the Open Space & aesthetics of the reach		Existing wetland areas provide significant water quality enhancement. Wetland areas should remain	This reach appears relatively stable, however there is potential for high intensity development in lower portion of reach
UFDW-A	Structures are currently outside 100-yr floodplain	Providing properly sized culverts will reduce floodine potential	X				Reduced O & M costs due to proper roadway culvert sizing			Buildout is nearly complete. Most of the floodplain is privately owned		Short term construction activity & roadway erosion impact water quality	Existing wetland areas provide significant water quality enhancement. Wetland areas should remain	Roadway culvert sizing needs to be evaluated Roadway erosion and sedimentation needs to be addressed. Minimal improvements appear necessary
SFDW-A	Structures are currently outside 100-yr floodplain	Providing properly sized culverts will reduce flooding potential. Pond outlet improvements would reduce flood hazard	X				Reduced O & M costs due to proper roadway culvert sizing			Most of the floodplain is privately owned	High quality Open Space & aesthetics exist within the reach currently	Short term construction activity & roadway erosion impact water quality	Existing wetland areas provide significant water quality enhancement. Wetland areas should remain	Roadway culvert sizing should be increased. The overflow of the pond should be improved to reduce flooding potential. Minimal improvements appear necessary
MFDW-A	Structures are currently outside 100-yr floodplain	Providing properly sized culverts will reduce flooding potential	X				Reduced O & M costs due to proper roadway culvert sizing			Most of the floodplain is privately owned	High quality Open Space & aesthetics exist within the reach currently	Short term construction activity & roadway erosion impact water quality	Existing wetland areas provide significant water quality enhancement. Wetland areas should remain	Minimal improvements appear necessary within the reach. Roadway culverts should be upsized
NFDW-A	No structures within 100-year floodplain.		X				Culvert at Augusta Dr. would reduce O & M costs.			Most of floodpain within easement or private property.				Culvert at Augusta Drive should be replaced.
NFDW-B	Structures are currently outside 100-yr floodplain		X				Reduced O & M costs due to proper roadway culvert sizing. Most of the floodplain is owned by Woodmoor CC			Most of the floodplain is privately owned	High quality Open Space & aesthetics exist within the reach currently	Short term construction activity & roadway erosion impact water quality	Relatively fewer wetland areas in this reach, however the ponds provide a positive impact on water quality	Culverts at Woodmoor Drive should be improved. Most of the reach is controlled by Woodmoor CC
LFDW-A	Lake Woodmoor reduces the flood hazard in this reach. Some structures have been built on stilts over the lake		X				Improvements to spillway & channel could reduce O & M costs				Improvements to the spillway channel would improve aesthetics		Improvements to spillway channel would reduce erosion	Headcutting (erosion) of the spillway channel should be stopped. Habitat, aesthetics & water quality would all be increased
LFDW-B	Structures are currently outside 100-yr floodplain	Providing properly sized culverts will reduce flooding potential	X				Reduced O & M costs due to proper roadway culvert sizing			Most of the floodplain is privately owned	High quality Open Space & aesthetics exist within the reach currently	Opportunities exist to enhance water quality which directly enter reservoir	Existing wetland areas provide significant water quality enhancement Wetland areas should remain	Water quality should be a major concern in this reach. Roadway & driveway culverts are a hinderance to flood flow and should be upsized
CC-A	Structures are currently outside 100-yr floodplain	Improvements through the existing farmland would improve flood hazards as that area develops		X		Replacement of disturbed vegetation/habitat is possible throughout reach		As the undeveloped land develops, O & M costs will increase	Development without floodplain control could could reduce aesthetics		Opportunities exist to enhance the Open Space & aesthetics of the reach	Development in the reach could result in loss of water quality	Existing wetland areas provide significant water quality enhancement Wetland areas should remain	Existing farm/ranch land in reach is key. The reach is relatively stable as it exists, however development could change that. Culverts at N. Monument Lake Road will not pass the 100-yr flow
CC-B	Structures are currently outside 100-yr floodplain	Future development will increase flood flows		X		Replacement of disturbed vegetation/habitat is possible throughout reach	O & M costs should remain the same or lower slightly			The reach is currently channelized with areas of Open Space & good habitat	Opportunities exist to enhance the Open Space & aesthetics of the reach	Development in the reach could result in loss of water quality	Existing wetland areas provide significant water quality enhancement Wetland areas should remain	Monument's detention policy should keep the flood flows near existing. Culvert sizing at Beacon Lite Road needs to be evaluated
CC-C	Structures are currently outside 100-yr floodplain	Improvements at existing embankments & roadway culverts will reduce flooding hazards	X				Reduced O & M costs due to proper roadway culvert sizing				Opportunities exist to enhance the Open Space & aesthetics of the reach	Development in the reach could result in loss of water quality	Existing wetland areas provide significant water quality enhancement Wetland areas should remain	The characteristics of this reach closely resemble the characteristics of the forks of Dirty Woman Creek. The Frontage Road culvert is grossly undersized & needs replacement

TABLE 6: Evaluation of Channel Alternatives

Major Drainageway: Dirty Woman Creek / Crystal Creek
Alternative Concept: Channelization

Parameter	Flood Hazard		Habitat				Operations and Maintenance		Open Space/Aesthetics			Water Quality		Comments
Impact	No Impact	Reduced Hazard/ Increased Hazard	Impact			Mitigation/Enhancement Opportunities	Reduced effort	Increased effort	Low Visual Quality	No Impact	Visually Enhanced	Degrades Quality	No Impact or Enhancement	
Reach No.			Minimal	Moderate	Major									
DW-A	Structures are currently outside 100-yr floodplain; No structural flood hazard exists	Property flood hazards will be reduced by confining the flow to the channel and culverts.		X			Proper sizing of culverts for new channels will reduce O & M	Increased O & M costs due to channel construction	In the upper & lower segments, channel construction could lower the visual quality		In the middle portion of the reach, channel construction could enhance visual quality	Construction of channels could reduce the impact of the existing wetlands on water quality	The reduction of the channel erosion would increase water quality in the middle portion of the reach	Channel improvements are seen to be concentrated in the middle portion of the reach where the stream is unstable
DW-B		Property flood hazards & one residential structure will be reduced by confining flow to the channel and culverts.			X	Toe vegetation & overbank vegetation can be used to to provide habitat areas along channels		Increased O & M costs due to channel construction	Channel construction could lower the high visual quality of the creek			Construction of channels could reduce the impact of the existing wetlands on water quality		100-year channel would negatively impact the existing wetlands, open space and aesthetics of the reach. 10-year channel would reduce negative impacts.
UFDW-A	Structures are currently outside 100-yr floodplain; No structural flood hazard exists	Property flood hazards will be reduced by confining the flow to the channel and culverts.			X	Toe vegetation & overbank vegetation can be used to to provide habitat areas along channels	Proper sizing of culverts for new channels will reduce O & M	Increased O & M costs due to channel construction	Channel construction could lower the high visual quality of the creek			Construction of channels could reduce the impact of the existing wetlands on water quality		The problems with this reach are associated with roadway culverts not the main channel. Full channelization would not address this problem
SFDW-A	Structures are currently outside 100-yr floodplain; No structural flood hazard exists	Property flood hazards will be reduced by confining flow to the channel and culverts.			X	Toe vegetation & overbank vegetation can be used to to provide habitat areas along channels	Proper sizing of culverts for new channels will reduce O & M	Increased O & M costs due to channel construction	Channel construction could lower the high visual quality of the creek			Construction of channels could reduce the impact of the existing wetlands on water quality		Channelization of the main stream will not address the main problem of undersized roadway culverts
MFDW-A	Structures are currently outside 100-yr floodplain; No structural flood hazard exists	Property flood hazards will be reduced by confine the flow to the channel and road culverts.			X	Toe vegetation & overbank vegetation can be used to to provide habitat areas along channels	Proper sizing of culverts for new channels will reduce O & M	Increased O & M costs due to channel construction	Channel construction could lower the high visual quality of the creek			Construction of channels could reduce the impact of the existing wetlands on water quality		Channelization of the main stream will not address the main problem of undersized roadway culverts. Most of the reach is privately owned
NFDW-A	No structures in 100-year floodplain.	Property flood hazards will be reduced by confow to channels and culverts.			X									
NFDW-B	Structures are currently outside 100-yr floodplain; No structural flood hazard exists	Limited flood hazards within golf course.		X		Toe vegetation & overbank vegetation can be used to to provide habitat areas along channels	Proper sizing of culverts for new channels will reduce O & M	Increased O & M costs due to channel construction	Channel construction could lower the high visual quality & hurt the aesthetics of the golf course in this reach			Construction of channels could reduce the impact of the existing wetlands on water quality		Most of the reach is privately owned. Channelization already exists through most of the golf course.
LFDW-A	Structures are currently outside 100-yr floodplain; No structural flood hazard exists	Property flood hazards will be reduced by confow to the channel and road culverts.		X		Toe vegetation & overbank vegetation can be used to provide stabilization & habitat areas along and near the channel	Spillway maintenance would be reduced with the construction of a channel				Construction of a spillway channel would enhance the reach		The reduction of the channel erosion would increase water quality	Headcutting (erosion) of the channel spillway should be stopped, this would increase aesthetics, water quality and flooding hazards
LFDW-B	Structures are currently outside 100-yr floodplain; No structural flood hazard exists	Property flood hazards will be reduced by confining flows to the channel and culverts.		X			Proper sizing of culverts for new channels will reduce O & M	Increased O & M costs due to channel construction	Channel construction could lower the high visual quality of the creek			Construction of channels could reduce the impact of the existing wetlands on water quality		Channel construction does not address the problem of water quality and culvert undersizing in this reach
CC-A	Structures are currently outside 100-yr floodplain; No structural flood hazard exists	Property flood hazards will be reduced by confow to the channel and culverts.			X	Toe vegetation & overbank vegetation can be used to to provide habitat areas along channels		As this reach develops O & M costs will increase	Channel construction could lower the visual quality of the creek			Construction of channels could reduce the quality of water in the reach		As development of the existing farmland proceeds, channelization becomes more feasible
CC-B	Structures are currently outside 100-yr floodplain; No structural flood hazard exists				X	Toe vegetation & overbank vegetation can be used to to provide habitat areas along channels		As this reach develops O & M costs will increase	Channel construction could lower the high visual quality of the creek	A portion of the reach is already channelized. The remaining portion deeply incised			Relatively no impact on quality	Existing lined channel and the depth of the existing channel lends itself to channelization.
CC-C	Structures are currently outside 100-yr floodplain; No structural flood hazard exists	Property flood hazards will be reduced by confining the flood flow to the channel			X	Toe vegetation & overbank vegetation can be used to to provide habitat areas along channels	Proper sizing of culverts for new channels will reduce O & M	Increased O & M costs due to channel construction				Construction of channels could reduce the impact of the existing wetlands on water quality		Channelization does not address the problems of this reach.

TABLE 7
Calculated Acreage for Resources Along Dirty Woman and Crystal Creeks

REACH	MRW (acres)	IRW (acres)	RS (acres)	RG (acres)	HW (acres)	TOTAL (acres)
DW-A	6.91		5.47		1.03	13.41
DW-B	1.03		6.10		12.78	19.91
UFDW-A			3.05		11.97	15.02
SFDW-A					7.90	7.90
MFDW-A			0.15		6.02	6.17
NFDW-A			2.94			2.94
LFDW-A			0.44		3.75	4.19
LFDW-B			0.15		1.95	2.10
CC-A		0.37			4.66	5.03
CC-B	0.29		1.76		1.91	3.96
CC-C			0.59		2.17	2.76
TOTAL	8.23	0.37	20.65	0.00	54.14	83.39

LEGEND

MRW	Mature Riparian Woodland
	Riparian - hydrologically associated with a waterway
IRW	Immature Riparian Woodland
	Immature trees - typically less than 5 years old
RS	Riparian Shrubland
	Shrubland - very little or no tree overstory
RG	Riparian Grassland
	Mostly grasses, some forbs
HW	Herbaceous Wetland
	Mostly forbs (sedges, spike rushes, etc.), some grasses

recommended plan. The selected culvert improvements are presented in Section VIII. Shown on Figure 9 are the locations of the various recommended channel treatments. Contained within the Technical Addendum to the *Development of Alternatives* report, is the alternative hydrologic, hydraulic and cost data used in the development and comparison of each of the alternatives.

Discussion of Recommended Plan

The recommendation of a particular method of treatment for each channel segment has been based upon the qualitative and quantitative data presented. For each segment the flood hazard, habitat impacts, operations and maintenance, visual impact, water quality, and cost aspects have been weighed for each alternative concept. The channel segment designations (e.g., DW-A-01, etc.), are coded with the drainageway name (DW or CC for Dirty Woman and Crystal creeks, respectively), the reach, and the channel segment number as shown on the Hydrology Map, Exhibit 1. Section VII Preliminary Design provides a discussion on the implementation of the final plan.

DW-A-01 through DW-A-03: For these segments selective improvements are recommended. Improvements to these segments include a 10'x10' triple concrete box culvert under Mitchell Avenue and an 10'x11' twin concrete box culvert under the Old Denver Highway to carry the 100-year flow. Inlet and outlet improvements are included for the culverts. Inlet improvements in the form of bank slope protection is proposed for the Denver & Rio Grande Western Railroad bridge. The segments also include the installation of five drop structures and four check structures.

DW-A-04: For this segment the floodplain preservation or do-nothing alternative is recommended.

DW-A-05 through DW-A-06: For these segments selective improvements are recommended. Improvements to these segments include 1,620 feet of bank slope protection along with four drop structures and nine check structures. Outlet stabilization at the Highway 105 bridge is also proposed.

DW-B-07 through DW-B-11: For these segments selective improvements are recommended. The improvements proposed for these segments include a 10'x5' twin concrete box culvert at South Park Drive to carry the 10-year flow. In order to carry the 10-year flows. A 10'x4' twin concrete box culvert at Lake Woodmoor Drive and a 12'X4' triple at Augusta Drive has been proposed. Outlet stabilization has been proposed for the South Park and Augusta Drive crossings. Outlet protection along with an 8'X6' twin concrete box culvert with a drop inlet with an overflow grate has been proposed for the Knollwood Drive crossing. Approximately 570 feet of bank slope protection is recommended along with three drop structures and eight check structures. In segment

TABLE 8: Matrix of Recommended Plan

Reach (1)	Channel Alternative		
	Floodplain Preservation	Channelization 10 or 100-year	Selective Improvements
DW-A-01			❁
DW-A-02			❁
DW-A-03			❁
DW-A-04	❁		
DW-A-05			❁
DW-A-06			❁
DW-B-07			❁
DW-B-08			❁
DW-B-09			❁
DW-B-10			❁
DW-B-11			❁
UFDW-A-12			❁
UFDW-A-13	❁		
SFDW-A-14			❁
SFDW-A-15			❁
SFDW-A-16			❁
MFDW-A-17			❁
MFDW-A-18			❁
MFDW-A-19			❁
MFDW-A-20			❁
NFDW-A-21			❁
NFDW-B-22	❁		
NFDW-B-23			❁
NFDW-U-46	❁		
LFDW-A-24			❁
LFDW-A-25			❁
LFDW-B-26			❁
LFDW-B-27			❁
LFDW-B-28			❁
LFDW-B-29			❁
LFDW-U-44		❁	
LFDW-U-45	❁		
CC-A-31		❁	
CC-A-32	❁		
CC-B-33		❁	
CC-B-34		❁	
CC-B-35		❁	
CC-B-36			❁
CC-B-37	❁		
CC-C-38			❁
CC-C-39			❁
CC-C-40			❁
CC-U-41	❁		
CC-U-42	❁		
CC-U-43	❁		

(1) Creek - Reach - channel segment # (See Exhibit 1)

The sizing of the drainageway improvements will need to be verified during the final design and layout of the proposed facilities. Land development activities may alter the location of design points, and therefore slight alterations in a sub-basin's length, slope and area may occur. The methods outlined in the *City/County Drainage Criteria Manual* should be adhered to during final design analysis. The rational method should be used to check the peak flow rates for all drainageways and drainage structures draining areas less than 100 acres in size.

Channels

The recommended drainageway improvements for each reach of Dirty Woman and Crystal Creeks have been outlined in Section VI of this report and are shown in the drawings contained in this report. In general, the Dirty Woman Creek and Crystal Creek channels will be lined with selectively located riprap bank protection such as at outside bends, bridge or culvert outlets, at confluences with side drainages and at dam spillways as shown on the Preliminary Drawings. In conjunction with the selective improvement measures, the 100-year floodplain should be preserved and regulated. Wherever the existing drainageways were judged to be adequate and relatively stable, no improvements have been recommended.

Drop Structures and Check Structures

Drop and check structures have been sited along Dirty Woman and Crystal Creeks in order to slow the channel velocity to the recommended 7 feet per second, and to prevent localized and long-term stream degradation from affecting the drainageway. In localized situations it may be necessary to limit velocities to less than 7 fps. Additional drop structures and checks may be used in these locations to provide adequate protection. In the reaches to be selectively lined, drops and check structures will protect the native vegetation from the detrimental effects of stream invert headcutting. Different types of structures may be considered for these drainageways, however the performance of these structures should be adequate to maintain the intent of this plan. For most channels reinforced concrete drops and checks are recommended. **A maximum drop height of four feet is recommended. The methodology recommended for use when designing vertical structures is contained within the *City of Colorado Springs and El Paso County Drainage Criteria Manual* and *Volume II of the Urban Storm Drainage Criteria Manual.***

and horse back riding trails. The size and location of trail, if necessary, will be mostly dependent upon the type of development adjacent to that particular drainageway.

Maintenance and Revegetation

Maintenance of drainageway facilities is essential in preventing long term degradation of the creek and its environs. Along the drainageway, clearing of debris and dead vegetation should be considered within the low flow area of the creek and its tributaries. Trimming and thinning of shrubs and trees should be carried out if greater physical access to the creek is desired. On the overbanks and in most drainageways in Dirty Woman Creek and the upper portions of Crystal Creek, limited maintenance of the existing vegetative cover is recommended. Yearly clearing of trash and debris at roadway crossings is strongly recommended to ensure the culvert maintains its full design capacity, and to enhance the surroundings of the area. Sediment removed from all cleaning and maintenance operations should be disposed of properly, not left in an area such as on the stream overbank. This disturbs the native vegetation and creates a potential water quality concern if the dredgings are subsequently washed into the drainageway by natural erosion. In those reaches designated to be selectively lined and the floodplain preserved, maintenance activities should be carried out while minimizing the disturbances to native vegetation.

Right-of-Way

For the most part the main channels within the basin which pass through the developed portions of the basin are contained within previously dedicated drainage tracts, easements or right-of-ways. Where appropriate right-of-ways have not as yet been dedicated such as within the undeveloped portions of the basin, the required right-of-way can be obtained through the land development process. For those segments of the drainageway where floodplain preservation is the recommended plan, a combination of open space dedication (such as parklands and greenbelts), in combination with a more narrow dedicated right-of-way along the low flow area of the drainageway should be obtained through the land development process.

Roadway Bridge and Culvert Replacements

Bridge and culvert replacements shown on the preliminary design drawings have been sized in accordance with the *City/County Drainage Criteria Manual.* Bridges (major crossings) are defined as those structures conveying at least 1500 cubic feet per second, having a flow area

of at least 200 square feet or a span of 20 feet. There are two bridges within this study area, Mitchell Avenue over Dirty Woman Creek and Old Denver Highway over Dirty Woman Creek. Road crossings conveying flows less than 1500 cubic feet per second, smaller than 200 square feet in flow area and less than a 20 foot span have been included in the drainage basin fee evaluation and calculation. Structures over arterial roadways which have been defined as bridges have been included into the bridge fee evaluation and calculation.

Erosion and Sedimentation Control

Areas within the basin are subject to varying degrees of hazard resulting from sediment being transported to the drainageway(s). During the collection of field and drainage inventory data, areas were noted which were being impacted by either erosion (of one form or another), or sediment deposition. The areas impacted ranged from localized bank failures to roadway embankments and crossings The soils of the basin are generally very erodible when exposed, and this is particularly the case in the upper portions of the drainage basins. The disturbance of the native vegetation and failure to properly revegetate areas has in some cases negatively affected downstream portions of the basin.

In general, it is the responsibility of the entity conducting any land disturbance activity to properly control surface runoff, erosion and sedimentation during and after the activity. Technical criteria identifying measures which help mitigate the impacts of erosion and sedimentation is available and is being used throughout the Front Range area. Minimum requirements must be developed to properly control erosion.

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

1. Any land disturbing activity shall be conducted so as to effectively reduce unacceptable erosion and resulting sedimentation.

2. All land disturbing activities shall be designed, constructed, and completed in such a manner that the exposure time of disturbed land shall be limited to the shortest possible period of time.

TABLE 12: DIRTY WOMAN & CRYSTAL CREEKS DRAINAGE BASIN PLANNING STUDY
COST ESTIMATE -- SELECTIVE DRAINAGEWAY IMPROVEMENTS
SELECTED ALTERNATIVE

REACH NUMBER	REACH LENGTH (FT)	NUMBER CHECK STRUCTURES	CHECK LENGTH (FT)	NUMBER DROP STRUCTURES	DROP LENGTH (FT)	LENGTH BANK SLOPE PROTECT (FT)	LENGTH OF 100 YR CHANNEL (FT)	LENGTH OF 10 YR CHANNEL (FT)	LENGTH OF CHNL STAB. & REPAIR (FT)	LENGTH OF OUTLET PROTECT (FT)	LENGTH OF SPILLWAY PROTECT (FT)	LENGTH OF BERM PROTECT (FT)	MITIGATION (AC)	LAND ACQUISTION (AC)	TOTAL COST
DW-A-01	1,095	3	245	1	85	300	130			95			0.70		$144,182
DW-A-02	625			1	60	300		125					0.38		$45,672
DW-A-03	1,335	1	60	3	290	1530				80					$158,690
DW-A-04	120														$0
DW-A-05	2,870	3	220	3	290	1020				100			0.61		$190,316
DW-A-06	1,820	6	785	1	65	700							0.71		$236,752
DW-B-07	2,150	2	185	1	120	370				90	100		0.94		$129,645
DW-B-08	3,455	5	610	1	120			100		50			0.46		$211,935
DW-B-09	520			1	120	200				50			0.22	0.742	$62,391
DW-B-10	585	1	120	1	160					110			0.25	1.265	$114,250
DW-B-11	490			1	80						50	240	0.16		$48,512
UFDW-A-12	2,800	6	480	1	40	400				50			0.52		$148,924
UFDW-A-13	2,335	1	75												$18,600
SFDW-A-14	1,010	1	95							60			0.11		$29,290
SFDW-A-15	1,540	1	160							90			0.06		$47,857
SFDW-A-16	1,905	1	40	3	100					65					$50,140
MFDW-A-17	1,375	1	100			400				60			0.30		$40,874
MFDW-A-18	1,855	1	100	1	90	200				60			0.11		$66,389
MFDW-A-19	375	1	120	1	40	170				70			0.23		$54,727
MFDW-A-20	1,105	2	80	3	130	520				50			0.23		$82,488
NFDW-A-21	560	2	190	1	130					70			0.23		$99,039
NFDW-B-22	5,275	2	140	1	50	200				70	80		0.14		$80,921
NFDW-B-23	850	2	95	2	80					40			0.07		$54,955
NFDW-U-46	1,060														$0
LFDW-A-24	1,265	3	160	6	280					70					$142,440
LFDW-A-25	1,170	4	490							60	100		0.18		$149,335
LFDW-B-26	1,035	2	220	1	80					60			0.24		$88,404
LFDW-B-27	845	1	200	1	110					80	50		0.18		$106,225
LFDW-B-28	1,460	2	240	1	150					90			0.07		$119,465
LFDW-B-29	505			3	140			410		90		150			$115,370
LFDW-B-30	200			1	100										$34,500
LFDW-U-44	1,560							1250							$162,500
LFDW-U-45	1,450														$0
TOTAL DIRTY WOMAN CREEK															$3,034,789
CC-A-31	565	2	160					450		60			0.92		$107,129
CC-A-32	1,880														$0
CC-B-33	290						290								$79,750
CC-B-34	250						250								$68,750
CC-B-35	235								230				0.40		$59,084
CC-B-36	780	1	140							70			0.14		$41,459
CC-B-37	1,045														$0
CC-C-38	45														$0
CC-C-39	2,445	4	330	1	80					90	75		0.22		$134,605
CC-C-40	550	1	80							60					$25,120
CC-U-41	4,050	3	300												$74,400
CC-U-42	3,325														$0
CC-U-43	3,375	3	300												$74,400
TOTAL CRYSTAL CREEK															$664,696

TABLE 13: Recommended Culvert Improvements
Dirty Woman/Crystal Creek Drainage Basin Planning Study

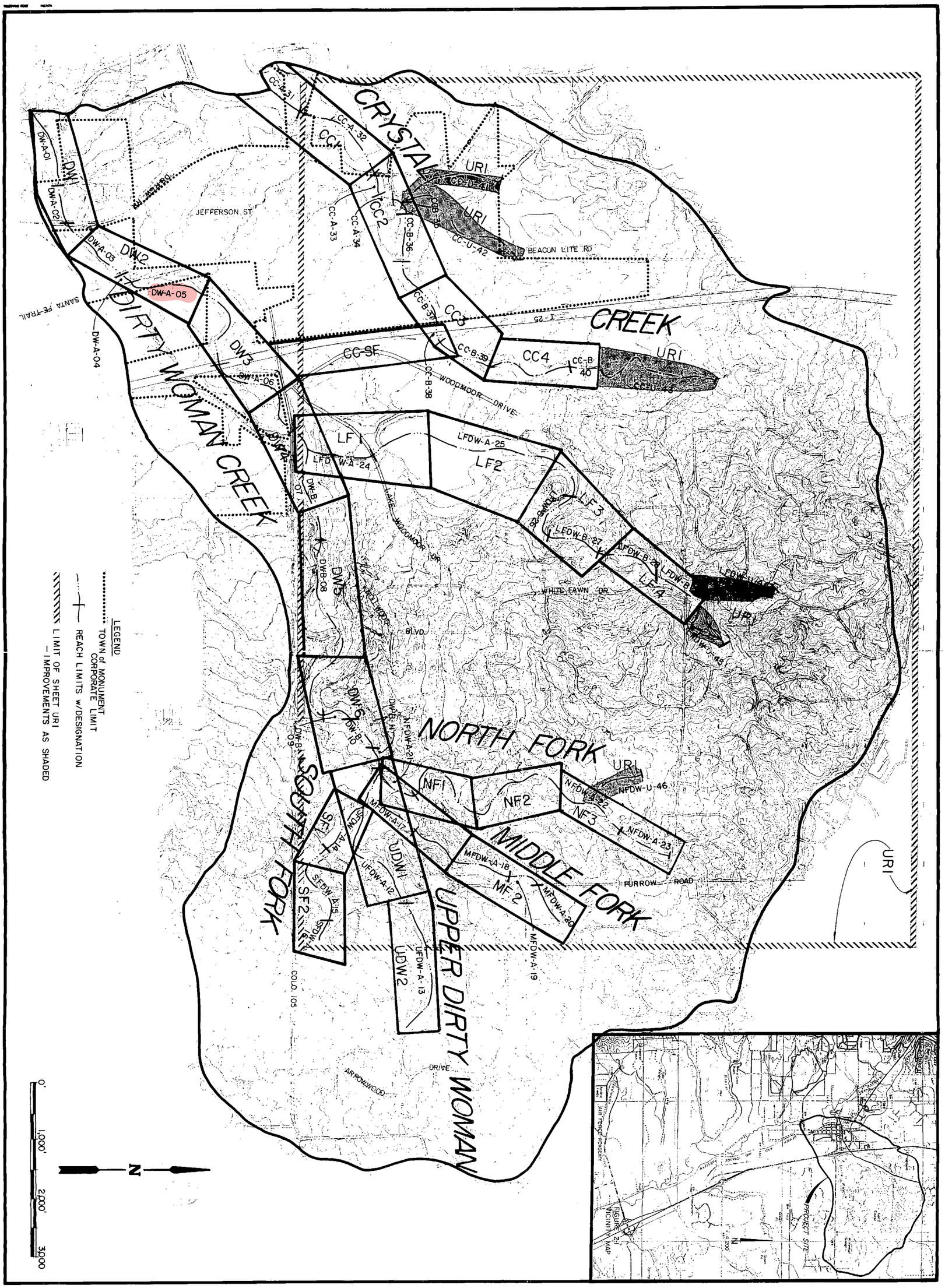
Roadway Location	Reach Number	Creek/ Station	Existing Culvert	Q100 Q10	Description	Quantit	Unit	Unit Cost	Amount
Mitchell Avenue	DW-A-01	Dirty Woman 11+30	72" CMP	3,258 1,170	Triple 10'X10' CBC	80	lf	$1,323	$105,800
Old Denver Highway	DW-A-03	Dirty Woman 32+30	64" CMP	3,055 1,098	Twin 10'x11' CBC	95	lf	$1,303	$123,750
I-25	DW-A-05	Dirty Woman 65+40	8'x8' CBC	2,868 1,031	Additional 10'x8' CBC	375	lf	$363	$136,250
Knollwood Drive	DW-B-07	Dirty Woman 107+70	36" CMP	2,337 838	Twin 12'x8' CBC w/ Drop Ilt & Ovrf	60	lf	$1,433	$86,000
South Park Drive	DW-B-08	Dirty Woman 142+80	24" CMP	2,126 756	Twin 10'x6' CBC	50	lf	$1,225	$61,250
Lake Woodmoo Drive	DW-B-09	Dirty Woman 148+60	(2) 24" CMP	2,075 735	Twin 10'x6' CBC	95	lf	$1,441	$136,875
Augusta Drive	DW-B-11	Dirty Woman 155+00	(2) 24" CMP	2,075 735	Trinle 12'x4' CBC	60	lf	$1,193	$71,600
Furrow Road	UFDW-A-12	Upper Dirty Woman 188+30	(3) 48" RCP	514 172	2-36" RCP (Additional)	60	lf	$116	$6,960
Augusta Drive	NFDW-A-21	North Fork Dirty Wo 5+80	? CMP Plugged	627 186	3-42" CMP	45	lf	$351	$15,800
Tam-O-Shanter Way	NFDW-A-23	North Fork Dirty Wo 60+50	? CMP Plugged	117 43	53"x34" Ell. RCP	210	lf	$110	$23,100
Woodmoor Drive	NFDW-A-23	North Fork Dirty Wo 69+70	? Plugged	108 40	48" RCP	60	lf	$80	$4,800
Heatherdown	NFDW-U-46	North Fork Dirty Wo 60+50	24" CMP	87 33	3-24" CMP	60	lf	$75	$4,500
Tam-O-Shanter Way	NFDW-U-46	North Fork Dirty Wo 69+70	18" CMP	87 33	3-24" CMP	60	lf	$75	$4,500
Will O The Wis Way	MFDW-A-17	Middle Fork Dirty W 14+00	18" CMP	349 129	2-60" CSP	80	lf	$303	$24,200
Lost Creek Way	MFDW-A-18	Middle Fork Dirty W 33+00	24" CMP	235 84	54" CSP	80	lf	$100	$8,000
Furrow Road	MFDW-A-19	Middle Fork Dirty W 37+30	24" CMP	235 84	3-42" RCP	50	lf	$325	$16,250
Ato Way	MFDW-A-20	Middle Fork Dirty W 45+00	18" CMP	235 84	Twin 48" CMP	70	lf	$160	$11,200
Winding Mead Way	SFDW-A-15	South Fork Dirty Wo 10+30	24" CMP	377 127	3-42" RCP w/ Otlt & Flow Cn	100	lf	$725	$72,500
Furrow Road	SFDW-A-16	South Fork Dirty Wo 26+20	36" CMP	229 77	Twin 54" RCP	70	lf	$200	$14,000
Martingale Road	SFDW-A-16	South Fork Dirty Wo 42+00	18" CMP	90 31	36" CSP	60	lf	$58	$3,480
Lake Woodmoo Drive	LFDW-A-24	Lake Fork Dirty Wom 12+50	---	480 0	16'x4' CBC	80	lf	$1,013	$81,000
Autumn Way	LFDW-A-25	Lake Fork Dirty Wom 52+60	24" CMP	1,016 381	3-60" CSP	80	lf	$360	$28,800
Deer Creek Road	LFDW-B-26	Lake Fork Dirty Wom 63+50	24" CMP	1,016 381	Twin 12'x5' CBC	80	lf	$1,190	$95,200
Deer Creek Road	LFDW-B-27	Lake Fork Dirty Wom 72+50	24" CMP	1,016 381	4-60" CSP	60	lf	$563	$33,800
Deer Creek Road	LFDW-B-28	Lake Fork Dirty Wom 87+60	18" CMP	883 334	3-72" RCP	50	lf	$700	$35,000
Woodmoor Drive	LFDW-B-29	Lake Fork Dirty Wom 93+20	24" CMP	594 226	2-60" RCP 1-72" RCP	50	lf	$540	$27,000
Broken Fence Way	LFDW-U-44	Upper Lake Fork Dirty Wom	24" CMP	195 75	4-30" RCP	50	lf	$168	$8,400
Fawnwood Road	LFDW-U-44	Upper Lake Fork Dirty Wom	24" CMP	195 75	4-30" RCP	50	lf	$168	$8,400
					Dirty Woman Creek Total Culvert Costs				**$1,248,415**

Roadway Location	Reach Number	Creek/ Station	Existing Culvert	Q100 Q10	Description	Quantit	Unit	Unit Cost	Amount
N. Monument L Road	CC-A-31	Crystal Creek 5+90	(2) 72" CMP	1,288 450	2-72" CSP (Additional)	40	lf	$400	$16,000
Beaconlite Road	CC-B-36	Crystal Creek 43+00	36" CMP	594 211	2-66" CSP	210	lf	$364	$76,400
Frontage Road	CC-C-38	Crystal Creek 58+50	24" CMP	527 185	10'x5' CBC	120	lf	$1,042	$125,000
Willow Park Way	CC-C-39	Crystal Creek 63+30		527 185	42" CSP 2-72" CSP	60	lf	$400	$24,000
Deer Creek Road	CC-C-39	Crystal Creek 83+70	60" CMP	527 185	84" CSP (Additional)	70	lf	$350	$24,500
Emmigrant Trail East	CC-C-40	Crystal Creek 89+80	(2) 24" CMP	416 139	3-48" CSP	60	lf	$240	$14,400
Highway 105	CC-U-41	Upper Crystal Creek	5'x7' CB	630 235	5'x7' CBC (Additional)	120	lf	$542	$65,000
Santa Fe Trail	CC-U-41	Upper Crystal Creek	24" Stl	202 74	3-30" CSP	120	lf	$126	$15,120
Beaconlite Road	CC-U-42	Upper Crystal Creek	48" CMP	317 135	Twin 7'x4' CBC	80	lf	$613	$49,000
					Crystal Creek Total Culvert Costs				**$409,420**

TABLE 14: DIRTY WOMAN & CRYSTAL CREEKS DRAINAGE BASIN PLANNING STUDY
OVERALL COST ESTIMATE
SELECTED ALTENATIVE

REACH NUMBER	DRAINAGEWAY SUBTOTAL COSTS	CULVERT SUBTOTAL COSTS	OVERALL REACH COSTS	SUGGESTED NON-REIMBURSIBLE COST ALLOCATION			REIMBURSIBLE COSTS
				TOWN OF MONUMENT	CDoT	EL PASO COUNTY	
DW-A-01	$144,182	$105,800	$249,982	$105,800			$144,182
DW-A-02	$45,672	$0	$45,672	$45,672			$0
DW-A-03	$158,690	$123,750	$282,440			$123,750 (1)	$158,690
DW-A-04	$0	$0	$0				$0
DW-A-05	$190,316	$136,250	$326,566	$73,490	$136,250 (2)		$116,826
DW-A-06	$236,752	$0	$236,752	$236,752			$0
DW-B-07	$129,645	$86,000	$215,645			$135,320	$80,325
DW-B-08	$211,935	$61,250	$273,185			$107,050	$166,135
DW-B-09	$62,391	$136,875	$199,266			$199,266	$0
DW-B-10	$114,250	$0	$114,250			$114,250	$0
DW-B-11	$48,512	$71,600	$120,112			$120,112	$0
UFDW-A-12	$148,924	$6,960	$155,884			$155,884	$0
UFDW-A-13	$18,600	$0	$18,600			$18,600	$0
SFDW-A-14	$29,290	$0	$29,290			$29,290	$0
SFDW-A-15	$47,857	$72,500	$120,357			$120,357	$0
SFDW-A-16	$50,140	$17,480	$67,620			$67,620	$0
MFDW-A-17	$40,874	$24,200	$65,074			$65,074	$0
MFDW-A-18	$66,389	$8,000	$74,389			$74,389	$0
MFDW-A-19	$54,727	$16,250	$70,977			$70,977	$0
MFDW-A-20	$82,488	$11,200	$93,688			$93,688	$0
NFDW-A-21	$99,039	$15,800	$114,839			$114,839	$0
NFDW-B-22	$80,921	$0	$80,921			$80,921	$0
NFDW-B-23	$54,955	$27,900	$82,855			$82,855	$0
NFDW-U-46	$0	$9,000	$9,000			$9,000	$0
LFDW-A-24	$142,440	$81,000	$223,440				$223,440
LFDW-A-25	$149,335	$28,800	$178,135			$178,135	$0
LFDW-B-26	$88,404	$95,200	$183,604			$183,604	$0
LFDW-B-27	$106,225	$33,800	$140,025			$140,025	$0
LFDW-B-28	$119,465	$35,000	$154,465			$154,465	$0
LFDW-B-29	$115,370	$27,000	$142,370			$142,370	$0
LFDW-B-30	$34,500	$0	$34,500			$34,500	$0
LFDW-U-44	$162,500	$16,800	$179,300			$179,300	$0
LFDW-U-45	$0	$0	$0				$0
TOTAL DIRTY WOMAN CREEK			$4,283,203	$461,714	$136,250	$2,795,641	$889,598
CC-A-31	$107,129	$16,000	$123,129	$123,129			$0
CC-A-32	$0	$0	$0				$0
CC-B-33	$79,750	$0	$79,750	$79,750			$0
CC-B-34	$68,750	$0	$68,750	$68,750			$0
CC-B-35	$59,084	$0	$59,084	$59,084			$0
CC-B-36	$41,459	$76,400	$117,859	$117,859			$0
CC-B-37	$0	$0	$0				$0
CC-C-38	$0	$125,000	$125,000		$125,000		$0
CC-C-39	$134,605	$53,300	$187,905				$187,905
CC-C-40	$25,120	$14,400	$39,520				$39,520
CC-U-41	$74,400	$80,120	$154,520	$107,800			$46,720
CC-U-42	$0	$49,000	$49,000	$49,000			$0
CC-U-43	$74,400	$0	$74,400				$74,400
TOTAL CRYSTAL CREEK			$1,078,917	$605,372	$125,000	$0	$348,545

(1) A portion of this amount is reimbursible under County Bridge Fee
(2) Considered a bridge by El Paso County



Project No.	91.07.17
Date:	1/93
Design:	
Drawn:	EAK
Check:	
Revisions:	

Dirty Woman and Crystal Creeks Drainage Basin Planning Study

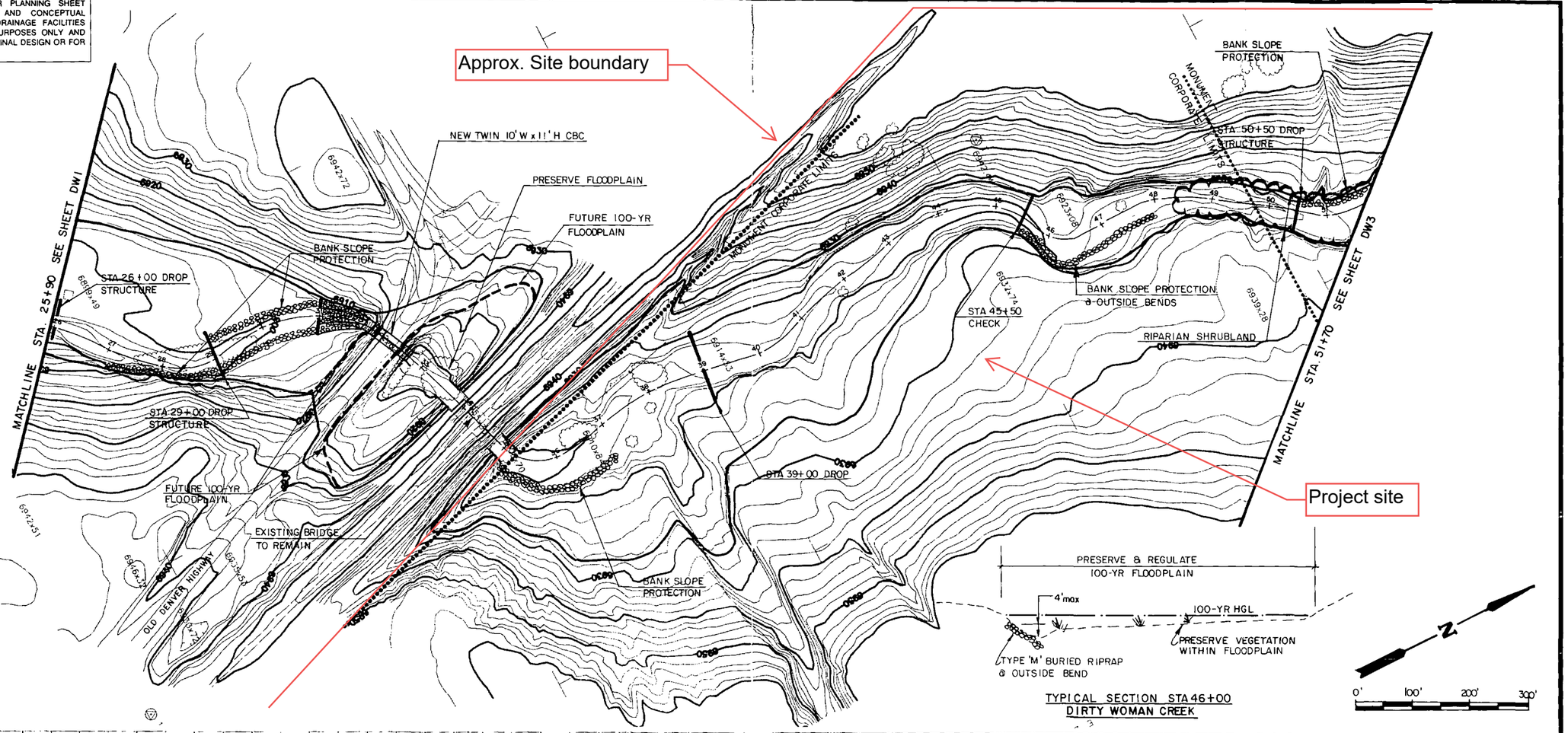
PRELIMINARY DESIGN

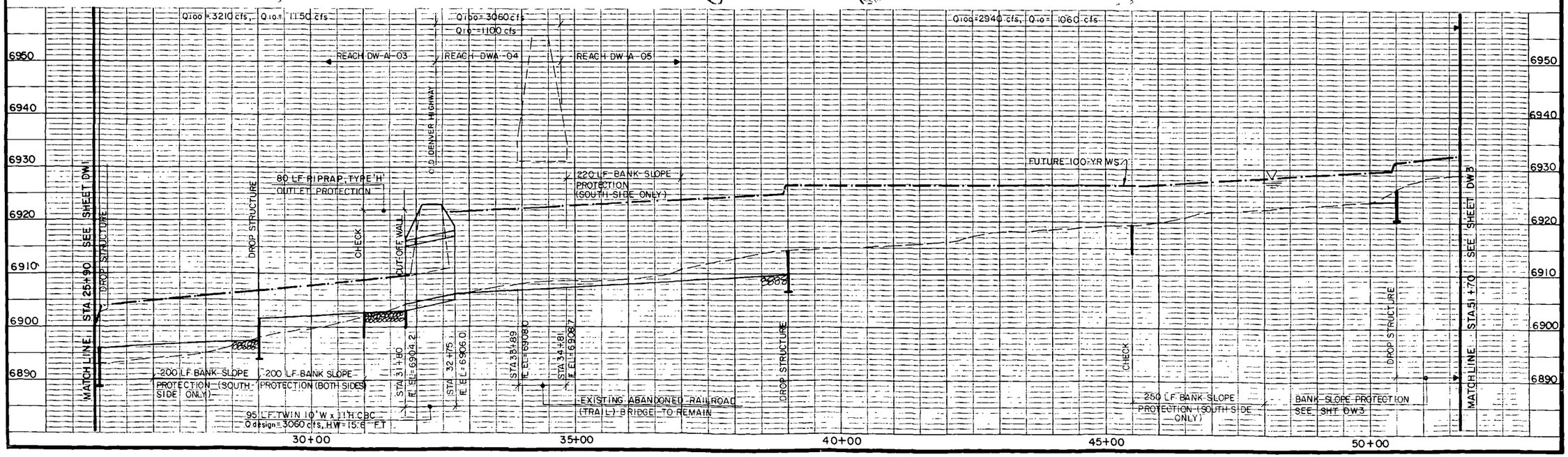
Index Sheet

El Paso County Department of Public Works Stormwater Management Division

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL DESIGN ENGINEERING. ALL DRAINAGE FACILITIES SHOWN ARE FOR PLANNING PURPOSES ONLY AND SHOULD NOT BE USED AS THE FINAL DESIGN OR FOR CONSTRUCTION.





Kiowa Engineering Corporation
419 West Bijou Street
Colorado Springs, Colorado
80905-1308

Dirty Woman and Crystal Creeks Drainage Basin Planning Study

PRELIMINARY DESIGN

Dirty Woman Creek
Sta. 25+90 to Sta. 51+70

El Paso County Department of Public Works Stormwater Management Division

Project No.	91-07-17
Date:	1/93
Design:	AWMc
Drawn:	EAK
Check:	RNW
Revisions:	

DW2

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Project Site

Approx. Site Boundary

BANK SLOPE PROTECTION

STA 56+00 CHECK

STA 59+00 CHECK

STA 62+50 DROP STRUCTURE

RIPRAP OUTLET PROTECTION, TYPE 'L'

NEW 10'W x 8'H CBC EXISTING CBC TO REMAIN

EXISTING 10' x 8' CBC

WOODMOOR DR

COLO. 105

BANK SLOPE PROTECTION

STA 77+00 CHECK

STA 74+50 CHECK

STA 71+00 CHECK

STA 69+50 DROP STRUCTURE

MATCHLINE STA. 51+70 SEE SHEET DW2

MATCHLINE STA. 77+90 SEE SHEET DW4

RIPARIAN SHRUBLAND

FUTURE 100-YR FLOODPLAIN

MATURE RIPARIAN WOODLAND

CORPORATE LIMIT

MONUMENT

N 18500

E 21000

N 18000

E 21500

N

0' 100' 200' 300'

Q100=2940 cfs, Q10=1060 cfs

Q100=2910 cfs, Q10=1050 cfs

Q100=2870 cfs, Q10=1030 cfs

Q100=2690 cfs, Q10=960 cfs

REACH-DW-A-05

REACH-DW-A-06

FUTURE 100-YR WS

CHECK

CHECK

DROP STRUCTURE

STA 63+50 ELL=6946.0

STA 67+25 ELL=6948.0

DROP STRUCTURE

CHECK

CHECK

CHECK

6970

6960

6950

6940

6930

6980

6970

6960

6950

6940

MATCHLINE STA. 51+70 SEE SHEET DW2

MATCHLINE STA. 77+90 SEE SHEET DW4

550 LF BANK SLOPE PROTECTION (NORTH SIDE ONLY)

100 LF RIPRAP OUTLET PROTECTION

375 LF EXSTG 8'x8' CBC & PROPOSED 10'x8' CBC, Qdesign=2870 cfs HW=19.3

250 LF BANK SLOPE PROTECTION (NORTH SIDE ONLY)

55+00 60+00 65+00 70+00 75+00

Kiowa Engineering Corporation
419 West Bijou Street
Colorado Springs, Colorado
80905-1308

Dirty Woman and Crystal Creeks Drainage Basin Planning Study

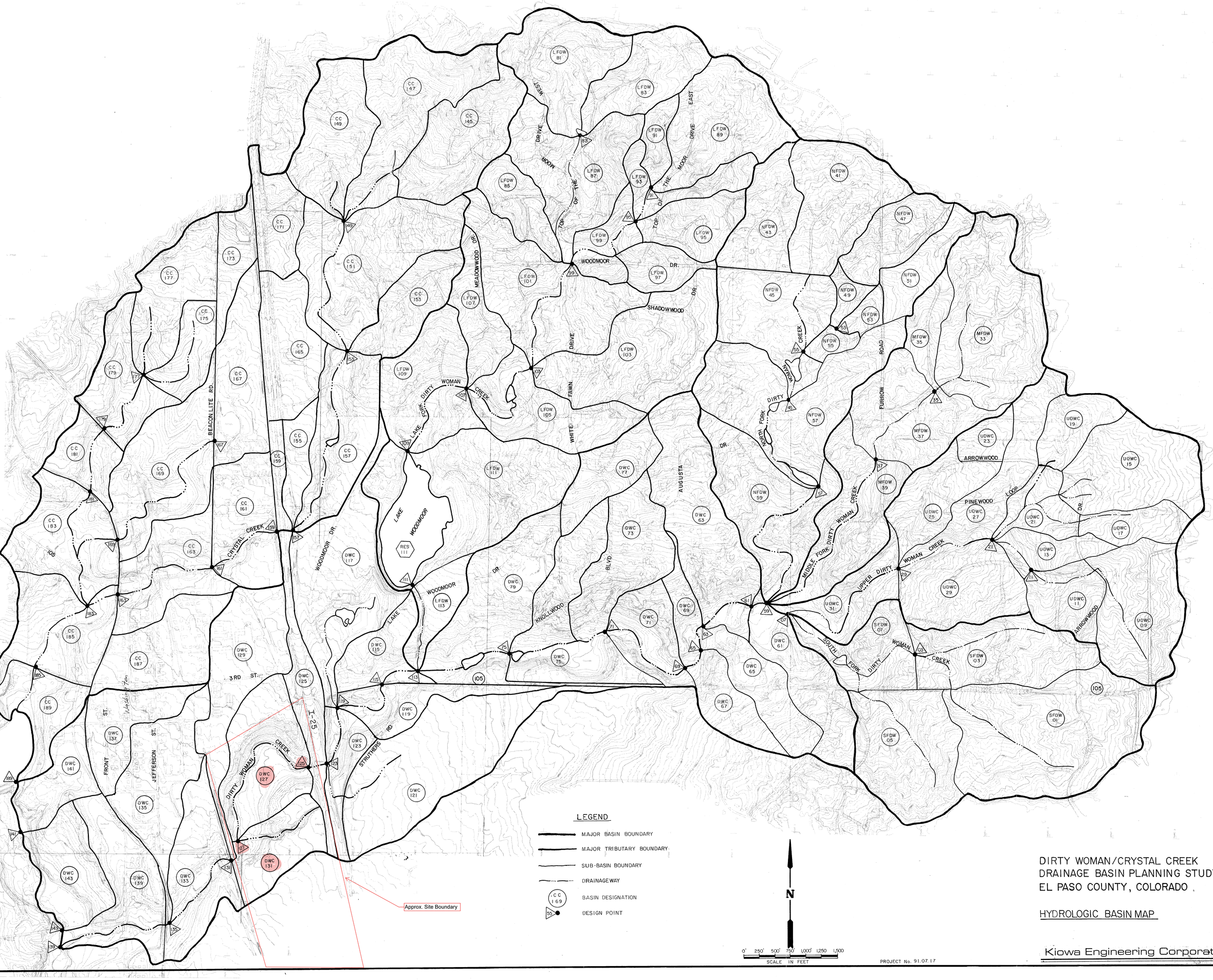
PRELIMINARY DESIGN

Dirty Woman Creek
Sta. 51+70 to Sta. 77+90

El Paso County Department of Public Works Stormwater Management Division

Project No.	91-07-17
Date:	1/93
Design:	AWMc
Drawn:	EAK
Check:	RNW
Revisions:	

DW3



DIRTY WOMAN/CRYSTAL CREEK DRAINAGE BASIN PLANNING STUDY EL PASO COUNTY, COLORADO

HYDROLOGIC BASIN MAP

PROJECT No. 91.07.17

Kiowa Engineering Corporation

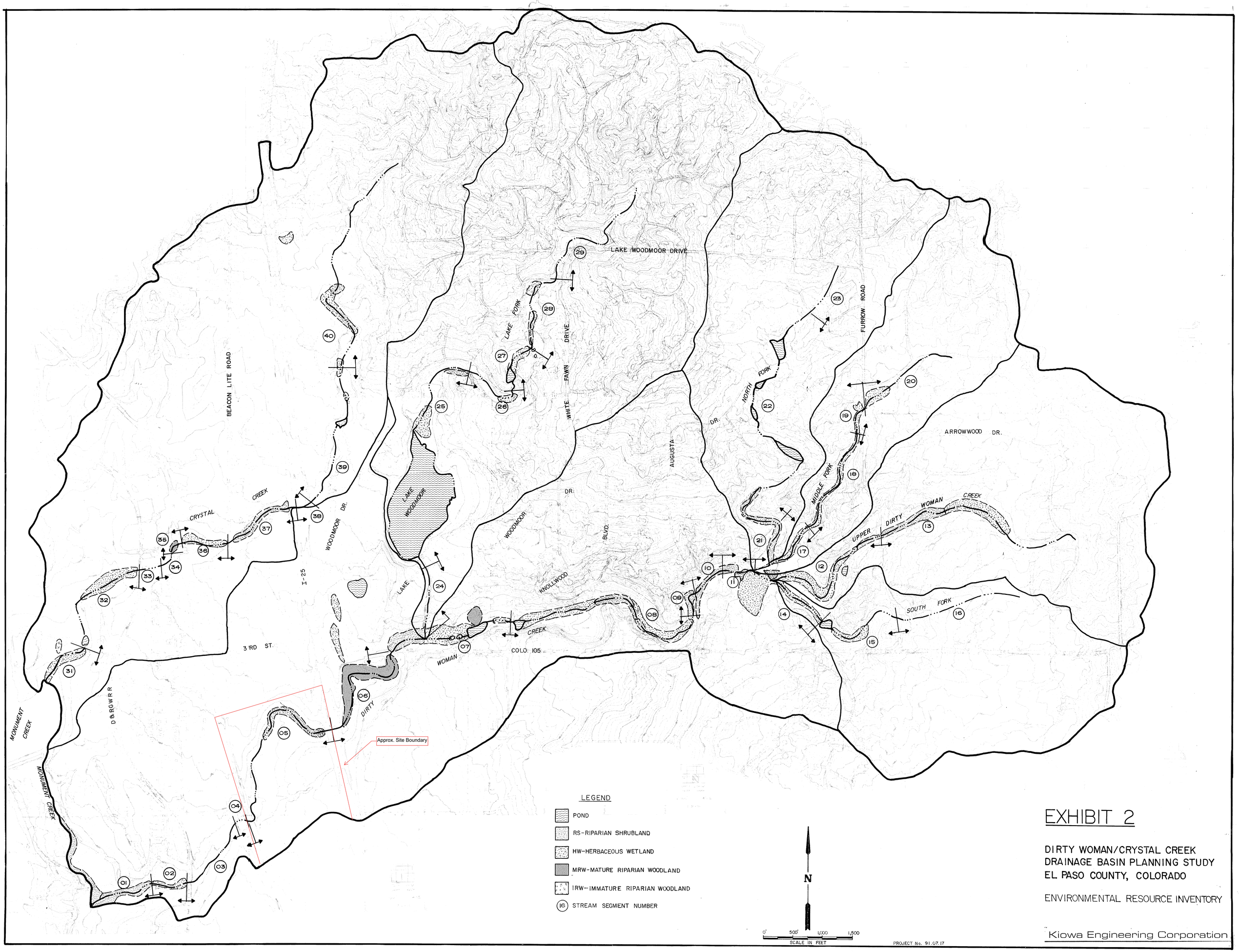


EXHIBIT 2

DIRTY WOMAN/CRYSTAL CREEK
DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

ENVIRONMENTAL RESOURCE INVENTORY

Kiowa Engineering Corporation

Appendix E

CONEXUS PHASE 2 & 3
EXISTING DRAINAGE MAP

LEGEND

A / B	BASIN ID A: SUB–BASIN DESIGNATION B: AREA (AC)
?	DRAINAGE DISCHARGE DESIGN POINT
	HISTORIC FLOW DIRECTION
5000	EXISTING MINOR CONTOUR
	EXISTING MAJOR CONTOUR

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX-1	24.07	2%	0.09	0.36	28.4	5.57	37.32
EX-2	8.22	2%	0.09	0.36	25.6	2.01	13.49
EX-3	38.03	2%	0.09	0.36	48.9	5.98	40.16
EX-4	48.77	2%	0.09	0.36	49.1	7.65	51.36
EX-5	13.15	2%	0.09	0.36	34.0	2.70	18.19
EX-6	13.74	2%	0.09	0.36	31.2	3.01	20.14

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	7.46	50.07
2	2.01	13.49
3	5.98	40.16
4	13.62	91.41
5	15.68	105.24
6	17.84	119.72

N

200 100 0 200 400

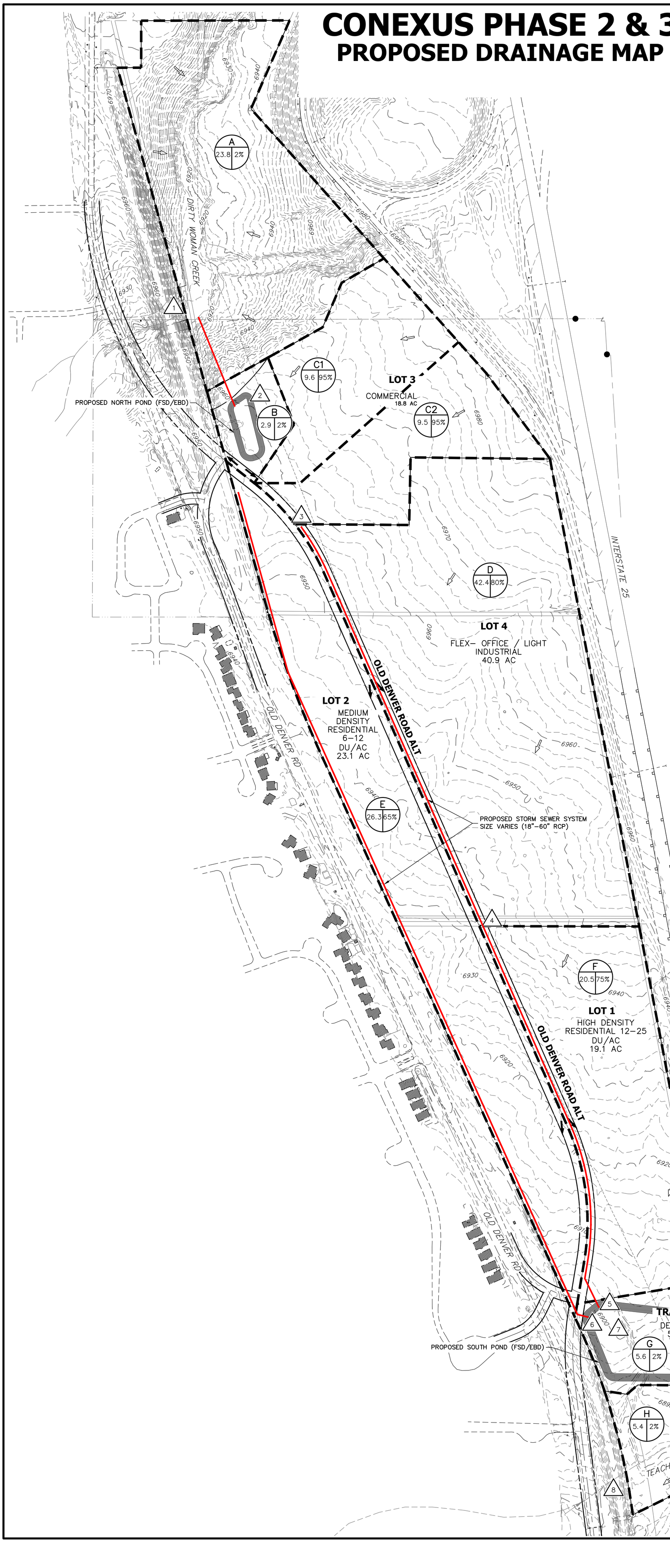
ORIGINAL SCALE: 1" = 200'

EXISTING DRAINAGE MAP
CONEXUS PHASE 2 & 3
JOB NO. 25247.00
1/05/22
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

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

CONEXUS PHASE 2 & 3
PROPOSED DRAINAGE MAP



LEGEND

- A / B / C — BASIN ID
  - A: SUB–BASIN DESIGNATION
  - B: AREA (AC)
  - C: % IMPERVIOUS
- ? — DRAINAGE DISCHARGE DESIGN POINT
- PROPOSED FLOW DIRECTION
- HISTORIC FLOW DIRECTION
- EXISTING MINOR CONTOUR (5000)
- EXISTING MAJOR CONTOUR

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	32.80	2%	0.16	0.36	29.2	13.24	49.99
B	2.90	2%	0.16	0.36	16.5	1.55	5.89
C1	9.60	95%	0.81	0.88	8.3	34.23	62.42
C2	9.50	95%	0.81	0.88	10.2	31.57	57.55
D	42.40	80%	0.59	0.70	18.8	79.61	158.52
E	26.30	65%	0.45	0.59	12.8	44.48	97.88
F	20.50	75%	0.63	0.78	14.0	46.86	97.35
G	5.60	2%	0.16	0.36	13.5	3.31	12.47
H	5.40	2%	0.16	0.36	25.3	2.35	8.90

DESIGN POINT SUMMARY TABLE

DP#	Q_5	Q_{100}
1	13.24	49.99
2	27.81	53.76
3	34.23	62.42
4	104.11	203.17
5	141.78	286.06
6	44.48	97.88
7	185.75	382.24
8	2.35	8.90

N

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

PROPOSED DRAINAGE MAP
CONEXUS PHASE 2 & 3
JOB NO. 25247.00
1/05/22
SHEET 1 OF 1

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