2547

FLOOD HAZARD ANALYSES

COTTONWOOD CREEK
in the vicinity of

Buena Vista
Colorado

P L A N O F S T U D Y

Prepared by the

COLORADO WATER CONSERVATION BOARD
CHAFFEE COUNTY
TOWN OF BUENA VISTA
USDA - SOIL CONSERVATION SERVICE

December 1976

C O N T E N T S

INTRODUCTION

This flood hazard analyses plan of study for Cottonwood Creek in the vicinity of Buena Vista was jointly prepared by representatives of the Colorado Water Conservation Board, Chaffee County, the Town of Buena Vista, and the Soil Conservation Service.

The purpose of the Plan of Study is to describe the objective of the study, the intended uses of the data and report, the intensity of investigations, inter-agency coordination involved, study responsibilities, scheduling, and funding arrangement.

In Colorado, the Soil Conservation Service and other federal agencies are currently engaged in flood hazard studies in cooperation with the Colorado Water Conservation Board. As coordinator for all water studies in the state, the Colorado Water Conservation Board establishes priorities and schedules these studies on a priority basis. The Colorado Water Conservation Board and the Soil Conservation Service entered into a joint coordination agreement for flood hazard analyses on January 27, 1972.

The Soil Conservation Service, United States Department of Agriculture, carries out flood hazard analyses under the authority of Section 6 of Public Law 83-566, Recommendation 9(c) Regulation of Land Use of House Document No. 465, 89th Congress, 2nd Session and in compliance with Executive Order 11296, dated August 10, 1966.

STUDY AREA

The area of study includes the flood plains of Cottonwood Creek in the vicinity of the Town of Buena Vista. The study begins at the confluence of Cottonwood Creek with the Arkansas River and extends upstream through Buena Vista and in a westerly direction to the San Isabel National Forest boundary. Located in the west central part of Chaffee County, Cottonwood Creek drains about 104 square miles. Flood plains in the study vary in width from about 100 feet to over three-quarters of a mile. Total length of the study reach is approximately 6 miles. The Arkansas River is a major tributary to the Arkansas-White-Red, Water Resources Council Region. Location map showing the study area is on page 3.

OBJECTIVES

The primary objective of this study is to prepare flood plain maps for flood plain zoning ordinances and other land use controls, as needed, to reduce potential flood damages and unwise development in the flood plain. The engineering and hydrologic information to be developed during the study will be of use in developing a master drainage plan, in road and bridge planning and design, and in the planning of flood control structures, if needed.

INTENSITY OF INVESTIGATIONS

Studies will be undertaken to develop flood hazard information for the 10-, 50-, 100-, and 500-year frequency floods under existing channel and flood plain conditions. Photogrammetric maps with topography, planimetry, and flood plain information for the 100- and 500-year frequency floods will be prepared on a scale of 1" = 400'. The contour interval will be two feet in the flatter flood plain areas and an appropriate contour interval will be used in the steeper areas compatible to the scale of mapping.

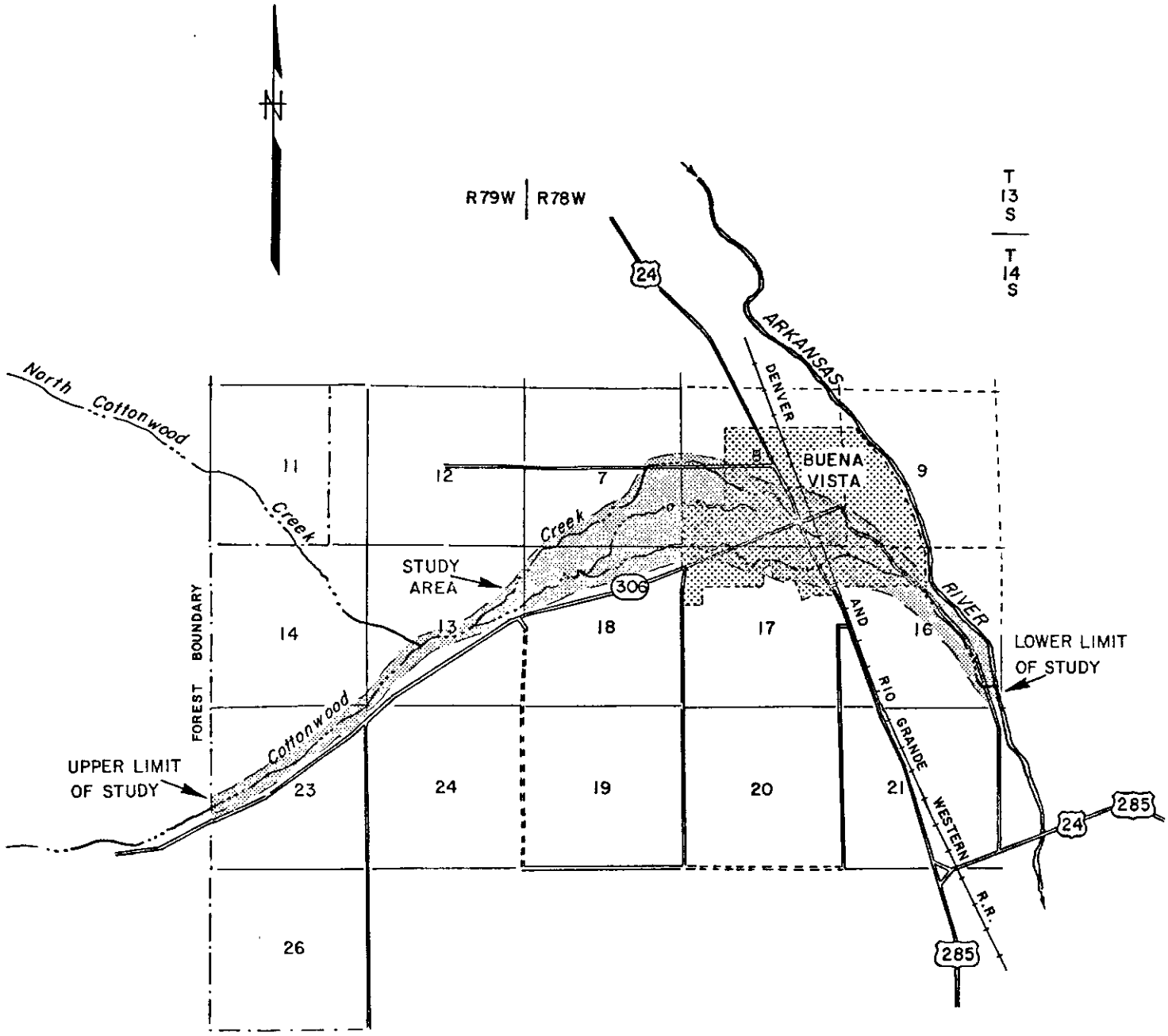
Available basic data such as flooding history, photos, land use, and existing survey data will be collected. Pertinent data from this information will be used in the study.

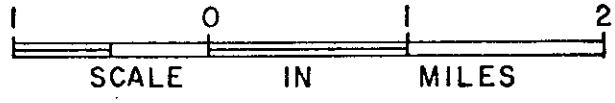
Engineering field surveys will be conducted to establish vertical and horizontal ground control and to obtain dimensions of bridges and culverts. About 130 flood plain cross-sections will be needed to adequately define the hydraulic relationships. Cross-section data will be obtained photogrammetrically where feasible.

The magnitude, elevation, and location of flooding for the designated frequency floods will be developed from hydrologic and hydraulic analyses using standard Soil Conservation Service techniques and procedures.

INTERAGENCY COORDINATION

Close coordination will be maintained through the representatives of the Colorado Water Conservation Board, Chaffee County, the Town of Buena Vista, and the Soil Conservation Service to assure the completion of the study in a timely manner. Coordination with other concerned state, federal, and local agencies will be maintained throughout the study by the Colorado Water Conservation Board.





STUDY AREA MAP
COTTONWOOD CREEK
IN THE VICINITY OF
BUENA VISTA

Chaffee County, Colorado

STUDY RESPONSIBILITIES

The Colorado Water Conservation Board will:

1. Provide leadership in coordinating all activities.

2. Provide technical assistance.

3. Designate the location for reference monuments.

4. Install approximately 20 permanent reference monuments in the same location and elevation as used in the photogrammetric ground control survey as designated.

5. Provide photogrammetric cross-section data.

Chaffee County and the Town of Buena Vista will:

1. Provide photogrammetric maps in accordance with the Colorado Water Conservation Board specifications (Specifications are in accordance with National Mapping Standards.)

2. Secure all necessary rights of ingress and egress for engineering field surveys.

3. Collect historic flooding data.

4. Provide maps showing estimated location and density of future urbanization and upstream watershed development.

5. Provide meeting room facilities for presentation of final report.

The Soil Conservation Service will:

1. Conduct engineering field surveys for hydrologic and hydraulic studies.

2. Conduct hydraulic and hydrologic studies, and develop water surface profile and cross-section data.

3. Develop flood plain outlines on the photogrammetric maps for the 100- and 500-year frequency floods. Flood plain outlines will be based on existing channel and flood plain conditions.

4. Prepare and distribute review draft of the Flood Hazard Analyses Report.

5. Provide one set of photo positive mylars with flood plain outlines on a scale of 1" = 200'.

6. Prepare Flood Hazard Analyses Report for publication.

REPORT PREPARATION AND CONTENTS

A preliminary draft of the report on the study will be prepared by the Soil Conservation Service and submitted for review to the officials of Chaffee County, the Town of Buena Vista, and the Colorado Water Conservation Board. After reviews are made, a final copy of the cooperative report will be prepared for publication.

The report will include the following:

I. An introduction giving background information on authorities and reasons for the study.

II. A discussion of historic and current flooding, and flood plain conditions.

III. A section on sources of data and methods used in the analyses.

IV. Narrative describing the results of the study. This section will include exhibits of water surface profiles and representative cross-sections for the selected flood frequencies.

V. Photogrammetric maps with flood plain outlines for the 100- and 500-year frequency floods on a scale of 1" = 400'.

VI. Interpretations and recommendations for appropriate flood plain land use and management. Suggestions for reducing potential flood damages.

The size of the reports will be 11" x 8-1/2" with appropriate 11" x 17" foldout sheets for the flood plain maps and engineering drawings.

SCHEDULING

Scheduling of the major activities will be as shown on page 7.

There are several elements involved in each activity and work will be done concurrently between activities. It is expected, however, that the duration of the study would not exceed 10 months, and that the report should be completed by September 30, 1977.

FUNDING

Total estimated cost for the study is $40,900. The costs will be shared by Chaffee County, the Town of Buena Vista, the Colorado Water Conservation Board (CWCB), and the Soil Conservation Service (SCS). The estimated cost share for Chaffee County and Buena Vista is $13,800. Estimated costs for the Colorado Water Conservation Board is $4,500.

The Soil Conservation Service cost share is $22,600. The Soil Conservation Service will conduct this flood hazard analyses under authority of Section 6 of Public Law 83-566. Funding for the Flood Hazard Analyses Program is through regular agency appropriations.

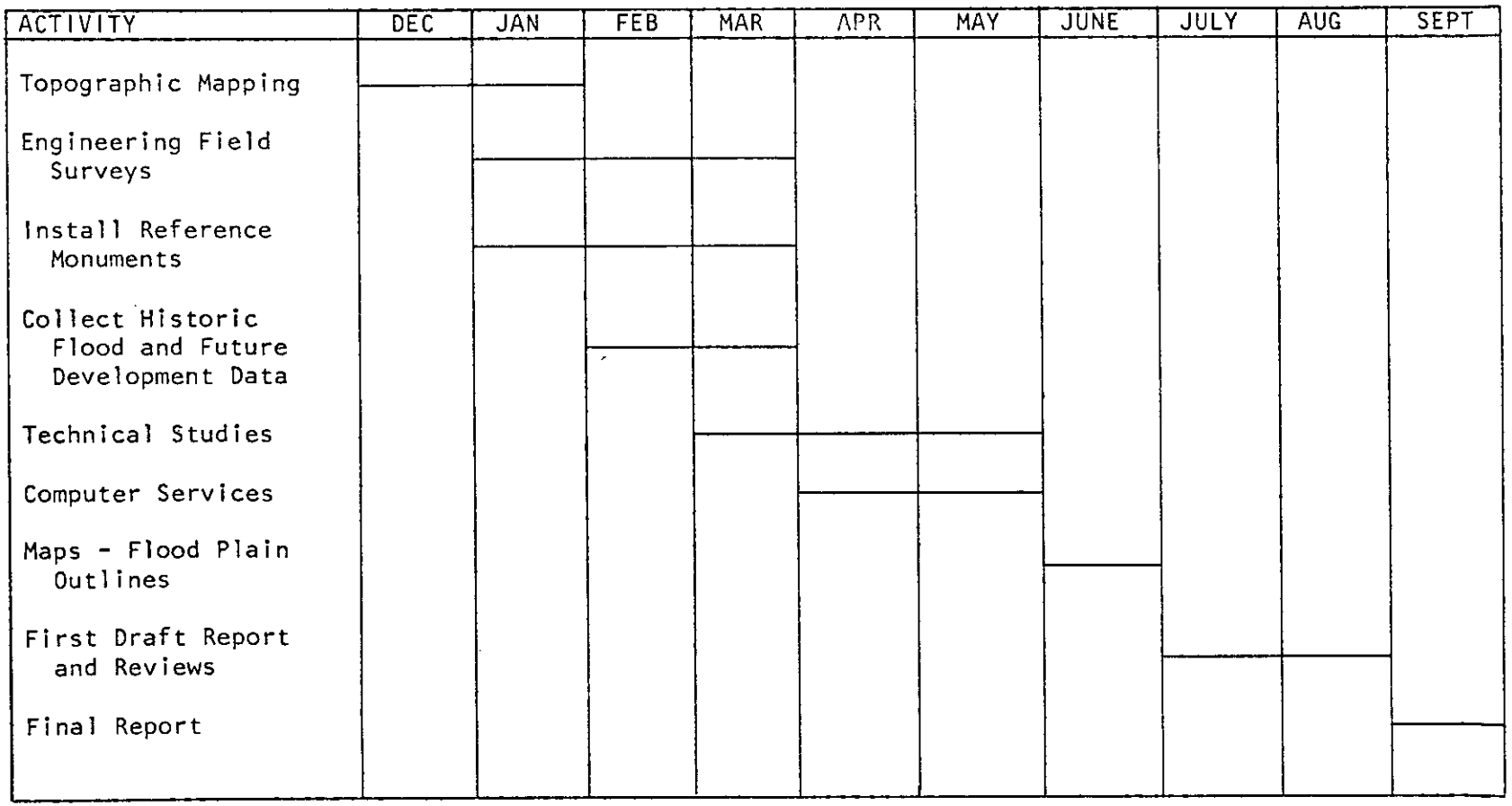
Cost estimates are based on items listed under the section Study Responsibilities in this Plan of Study. Itemized cost estimates are shown below:

Item	CWCB	Chaffee County & Buena Vista	SCS
Photogrammetric Maps	0	0	0
Cross-Section Data	2,000	13,000	1,200
Engineering Field Surveys		600	1,900
Reference Monuments	2,000	0	0
Technical Studies	500	0	2,800
Computer Services	0	0	1,200
Printing Preliminary Report	0	0	400
Photo Positive Mylars	0	0	200
Printing Final Report	0	0	4,000
Other Personnel Services:			
(a) Ingress & Egress Rights	0	100	0
(b) Historic Flooding and Future Development Data	0	100	0
Travel	0	0	900
TOTAL	$4,500	$13,800	$22,600

FLOOD HAZARD ANALYSES
USDA-SCS

COTTONWOOD CREEK
in the vicinity of
Buena Vista, Colorado

Activity Schedule 1976 - 1977



It is mutually agreed that this Plan of Study will be in effect only to the extent that appropriated funds are available to all four parties.

COLORADO WATER CONSERVATION BOARD:

By Larry F. Lang

Title Chief, Flood Control Section

Date 12/7/76

CHAFFEE COUNTY:

By R C Tuttle

Title Chairman, Bd of Commissioners

Date 12/3/76

BUENA VISTA:

By Bernard J. Weber

Title Mayor Pro-Tem

Date 12-2-76

SOIL CONSERVATION SERVICE:

By Edward E. Hadland

Title St. Con

Date 12/8/76

COTTONWOOD CRK

FLOOD HAZARD STUDY

TECHNICAL

SUPPLEMENT

speedimemo®

CAMP DRESSER & McKEE, Inc.
1660 SOUTH ALBION - SUITE 1100
DENVER, COLORADO 80222
PHONE 303 758-4351

TO LARRY LANG AT CWCB

SUBJECT DATE 2-20-80

HERE IS A COPY OF THE S.C.S. TECHNICAL SUPPLEMENT TO THE COTTONWOOD CREEK FLOOD HAZARD STUDY YOU REQUESTED AT OUR 2-19-80 MEETING.

PLEASE REPLY TO → SIGNED Dave Bulkley

DATE SIGNED

Rediform ®
4S 469
Poly Pak (50 sets) 4P469

SEND PARTS 1 AND 3 WITH CARBON INTACT.
PART 3 WILL BE RETURNED WITH REPLY.

DESCRIPTION OF STUDY AREA

The study area is located in Central Colorado in the vicinity of Buena Vista, Chaffee County. Approximately 6 miles of Cottonwood Creek main channel and 3.3 miles of overflow secondary channels make up the study area, see location map. The contributing drainage area includes the South, middle and North Forks of Cottonwood Creek, approximately 100 square miles. The drainage originates at the Continental Divide and is tributory to the Arkansas River near Buena Vista.

SCOPE

Cottonwood Creek flows in an Easterly direction through the town of Buena Vista. During flood stage a considerable portion of the town is susceptible to flood damage. The intent of this study is to develop maps and water surface profiles showing flood lines and elevation that might be expected from the 500 year, 100 year, 50 year, and 10 year frequency events. Maps are on a scale of 1 inch equals 200 feet with 2.0 feet contour intervals.

HYDROLOGY

The hydrology phase of this study includes the development of peak discharge values for various desired flood frequencies at selected locations.

A frequency analysis of streamgage records was made in accordance with Water Resources Council Bulletin 17, see included computation sheets. The values were compared with data from Colorado Water Conservation Board Technical Manual No. 1. Technical Manual No. 1 discharges are slightly higher, however considering it accounts for affects of mixed population, it was selected for use in the study. See percent Chance vs discharge Chart and letter from the Water Conservation Board.

This procedure provided necessary peak discharge frequency values at the streamgage site. Values at other locations along the stream were determined from a procedure in Colorado Water Conservation Board Technical Manual No. 1, pg. 4 - Flood Information Near Gage Sites on the Same Stream. Subsequently a drainage area vs peak discharge curve (figure 1) was developed for convenience and to maintain consistency in selecting flows at several selected locations.

An overflow channel comes into operation at a location 1.1 mile downstream from the North Fork confluence. At this point out of bank flows from the main channel continue in a Easterly direction following several secondary channels. The main channel heads in a Northeasterly direction. Discharge values continuing in the main channel remain nearly the same for all discharge-frequency values equal to or greater than the capacity of the channel, approximately 600 c.f.s.

Another division of flow occurs along the secondary channels at a point about 1500 feet downstream from the first location. Consequently flood

flows proceed into Buena Vista in three different locations and several individual channels. Figure 2 shows the selected distribution of flows based on channel hydraulics and to some extent estimations.

HYDRAULICS

The hydraulic analysis consisted of computing water surface profiles along the main and secondary channels. Soil Conservation Service WSP-2 computer program was used to develop the profiles. Necessary data includes flood plain cross section information (digitized from 1"= 200 ft topographic maps), reach lengths, channel and flood plain hydraulic roughness coeffcients, and discharge values from the hydrologic analysis. Specific information such as hydraulic roughness coefficients, cross section data, etc, are available at the Soil Conservation Service State Office in Denver, Colorado. It should be noted that through much of the flood plain perched channel flow exists. This is an elevated channel which receives inflow from some location upstream and maintains a flatter slope than the primary channel.

Flood plain maps, plotted profiles, and a table of peak discharge vs elevation are shown in the main report and therefore not repeated here.

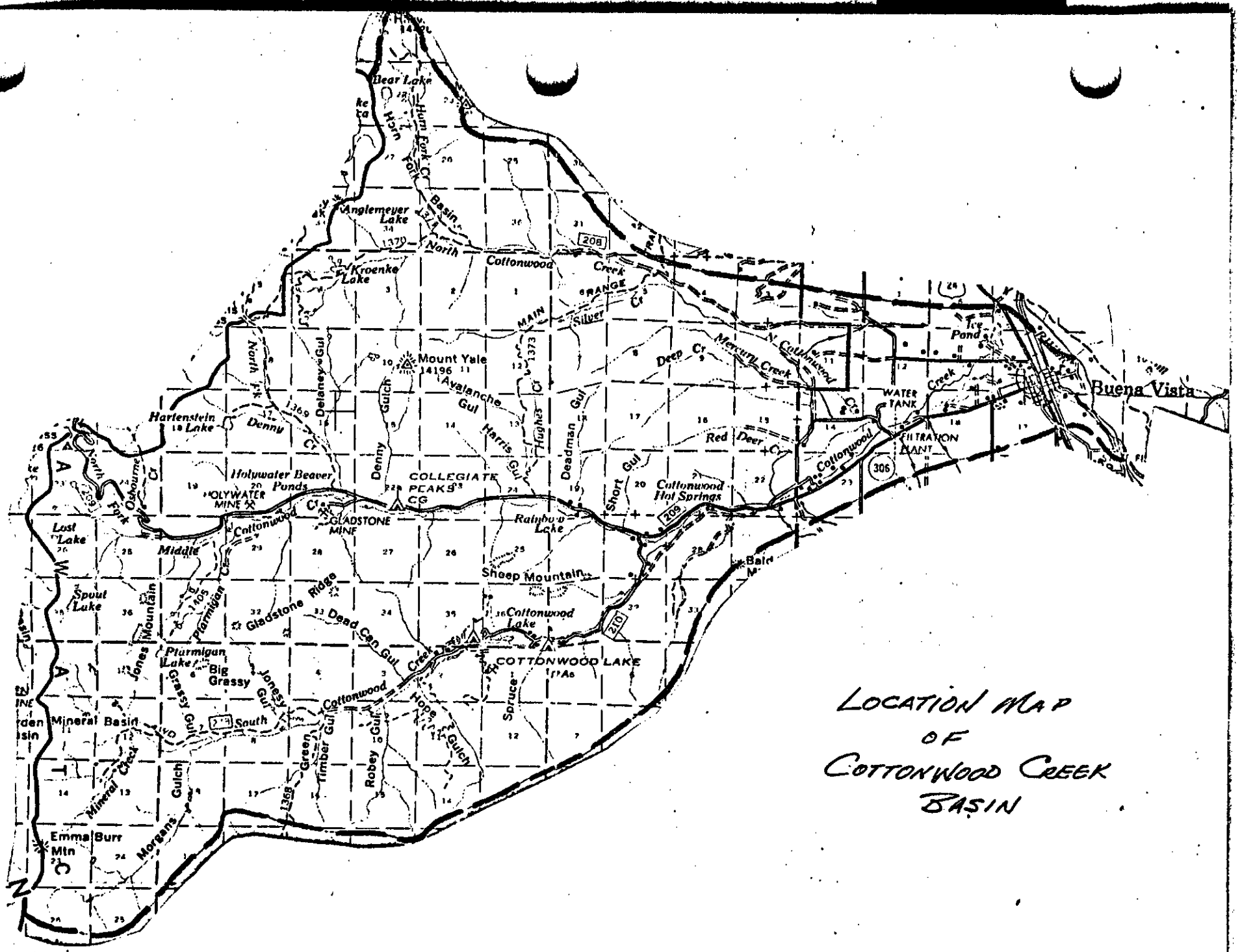
ATTACHMENTS

1. Location Map.

2. Frequency Analysis Computations.

3. Figure 1, Peak Discharge vs Drainage Area.

4. Figure 2, Flow Distribution.


Bear Lake
Horn Fork
Hunt Fork Cr
Fork Basin
Anglemeyer Lake
North
Cottonwood
Creek
Kroenke Lake
RANGE
Cr
Silver
MAIN
Mount Yale
14196
Avalanche Gul
Deep Cr
Mercury Creek
N Colchuckwood
Pond
WATER TANK
Creek
Buena Vista
Hartenstein Lake
Denny
Cr
Delaney Gul
Denny Gulch
Harris Gul
Hughes
Deadman Gul
Red Deer Cr
FILTRATION PLANT
Cottonwood
306
Holywater Beaver Ponds
HOLYWATER MINE
COLLEGIATE PEAKS
CG
Short Gul
Cottonwood Hot Springs
209
Osborne Cr
South Fork
Cottonwood Cr
GLADSTONE MINE
Rainbow Lake
Lost Lake
Middle
Sheep Mountain
Spout Lake
Jones Mountain
Ptarmigan
Gladstone Ridge
Dead Can Gul
Cottonwood Lake
210
Ptarmigan Lake
Big Grassy
Jonesy Gul
Creek
COTTONWOOD LAKE
Spruce
Grassy Gulch
Cottonwood
Hope Gulch
Mineral Basin
South
Green Timber Gul
Robey Gulch
Mineral Creek
Gulch
Emma Burr Mtn
Morgans
LOCATION MAP
OF
COTTONWOOD CREEK
BASIN

COMPUTATION SHEET
SCS-ENG-523A Rev 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT: COTTONWOOD CRK. FLOOD HAZARD

BY WRC DATE 2/77 | CHECKED BY | DATE

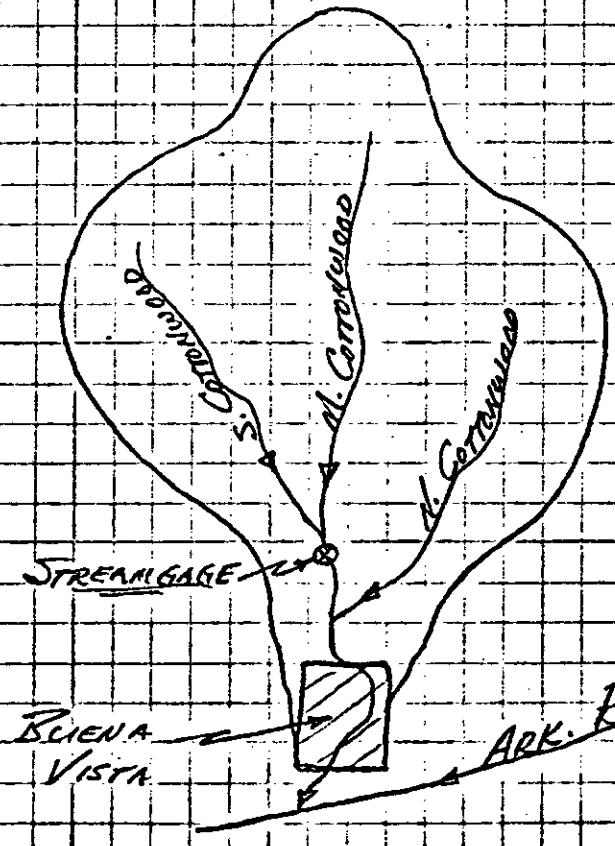
SUBJECT: STREAMFLOW RECORD STATISTICS - WRC BUL. 17 SHEET OF

COTTONWOOD CRK
STATION 07089000

DA = 65 Sq. Mi. @ STREAMGAGE

ELEV. = 8532 @ STREAMGAGE

PERIOD OF RECORD 1912 - 1923
1949 - 1975 (1969 MISSING)



NOTE:

AVG. ELEV. OF WATERSHED = 11000 FT. +

MOST ANNUAL PEAK FLOWS ARE FROM SNOWMELT, HOWEVER GREATEST RECORDED PEAK WAS FROM RAIN, JULY 1, 1957

AVG. ANN. PRECIP = 25"

SCS-MGT-4a (REV. 5-70)
(FORMERLY SCS-344a)

Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

COTTONWOOD CREEK BELOW HOT SPR. NEAR BUENA VISTA

7-0890 DR. AREA = 65 SQ. MI ELEV. = 8532

N = 37 YRS. BROKEN RECORD 1924-49 (26 YRS.)

DATE	ANN. PEAK cfs.		DATE	ANN. PEAK cfs.		DATE	ANN PEAK cfs	
6-1912	300		1943			6-1972	291	
6-1913	220		43			6-1973	370	
6-1914	380		44			5-1974	163	
6-1915	398		45			7-1975	343	
6-1916	437		46					
6-1917	467		47					
6-1918	467		48					
5-1919	240		49					
6-1920	342		6-1950	243				
6-1921	495		6-1951	335				
6-1922	328		6-1952	496				
6-1923	372		6-1953	378				
24			5-1954	150				
25			6-1955	314				
26			6-1956	370				
27			7-1957	1180 *				
28			6-1958	373				
29			6-1959	264				
30			6-1960	382				
31			6-1961	305				
32			6-1962	400				
33			5-1963	138 *				
34			6-1964	279				
35			6-1965	495				
36			5-1966	217				
37			6-1967	272				
38			6-1968	400				
39			1969	—				
40			6-1970	308				
41			6-1971	283				

Cottonwood Creek Streamflow Record Analysis

HISTORIC DATA/HIGH OUTLIER TEST (see page 16)

1. Using your judgment, do the highest peaks in the systematic record depart from the trend of the data?

   Yes ✓ (Year 1957) No ____

2. Are there any known high peaks outside the systematic record?

   Yes ____ No ✓

3. If answer to question 1 or 2 is yes, can the high peaks be assigned an historic return period?

   Yes ____ No ✓ If yes make historic data/high outlier adjustment.

Retain 1957 event in systematic record

LOW OUTLIER TEST (see page 16)

Known: X_n = 2.13988 (Year 1963) N = 37

$\bar{X}$ = 2.51794 $\bar{G}$ = −0.1 (Map Skew)

S = 0.16598

$$\left|X_n - \bar{X} / S\right| > [2.5 + 1.2 \log (N/10)](1.0 - 0.4\bar{G}) \qquad \text{Eq. 5}$$

$$\frac{2.13988 - 2.51794}{0.16598} = 2.27774$$

$$[2.5 + 1.2 \log(\tfrac{37}{10})][1 - 0.4(-0.1)] = 3.30912$$

$2.27774 \not> 3.30912$ ∴ No Outlier

Retain 1963 event in systematic record

If inequality is true, X_n is a low outlier; test next lowest peak as a low outlier.

COMPUTE BASIC STATISTICS (See page 10)

Known: ΣX = 93.16539 $\quad \Sigma(X-\bar{X})^2$ =

ΣX^2 = 235.5808 $\quad \Sigma(X-\bar{X})^3$ =

ΣX^3 = 598.24057 $\quad N$ = 37

FROM PROGRAMABLE CALCULATOR

ARITHMETIC MEAN : $\Sigma\bar{X} = \Sigma X/N$ = 3.51794 Eq. 2

STANDARD DEVIATION $S = [\Sigma(X-\bar{X})^2/(N-1)]^{0.5}$ Eq. 3a

$S = \{[\Sigma X^2-(\Sigma X)^2/N]/(N-1)\}^{0.5}$ = 0.16598 Eq. 3b

SKEW $G = N\,\Sigma(X-\bar{X})^3/(N-1)(N-2)\,S^3$ Eq. 4a

$G = [N^2\,\Sigma X^3-3N\,\Sigma X\,\Sigma X^2+2\,(\Sigma X)^3]/N\,(N-1)\,(N-2)S^3$ = Eq. 4b

0.3662

USE G = 0.4

C) NWOOD CRK. STATISTICS

1912 - 1975 - 37 YRS. DATA AVAILABLE

..... No RECORD

300.00000 1924-49
2.47712 26 YRS.
& 1969

220.00000
2.34242

380.00000
2.57978

398.00000
2.59988

437.00000
2.64048

467.00000
2.66931

467.00000
2.66931

240.00000
2.38021

341.00000
2.53275

495.00000
2.69460

328.00000
2.51587

372.00000
2.57054

243.00000 < 1924-49 MISSING
2.38560

335.00000
2.52504

406.00000
2.69548

378.00000
2.57749

150.00000
2.17609

314.00000
2.49692

370.00000
2.56820

1,180.00000 1959 TEST FOR HIGH OUTLIER
3.07188

373.00000
2.57170

264.00000
2.42160

382.00000
2.58206

305.00000
2.48429

400.00000
2.60205

138.00000
2.13987

279.00000
2.44560

495.00000
2.69460

217.00000
2.33645

272.00000
2.43456

400.00000
2.60205

< 1969 missing

308.00000
2.48855

283.00000
2.45178

291.00000
2.46389

370.00000
2.56820

163.00000
2.21218

313.00000
2.49554

.....

37.00000 n
2.51794 M
0.16598 S

0.36620 G
USE G. = 0.4

.....

3.36566 K-VALUE
1,192.88569 500 YR. Y

2.61539 K 100 YR.
895.49905 Y

~~2.26000~~
~~781.76399~~ Y

2.26133 K 50 YR
782.16148 Y

1.88039 K 25 YR.
676.18577 Y

1.31671 K 10 YR
545.13430 Y

0.81638 K 5 YR
450.25251 Y

-0.06651 K 2 YR
321.29909 Y

FREQUENCY CURVE (See page 9)

Known: $\bar{X}$ = 2.51794 G_A = 0.4

S = 0.16598 K values from Appendix 3

Log Q = $\bar{X}$ + KS Eq. 1

EXCEEDANCE PROBABILITY	K	Log Q	Q
0.90			
0.80			
0.50	-0.06651		321 cfs
0.10	1.31671		545
0.04	1.88039		676
0.02	2.26133		782
0.01	2.61539		895
0.005			
0.002	3.36566		1192

Plot on Log Probability paper.

COMPUTATION SHEET
SCS-ENG-523A Rev. 9-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT: COTTONWOOD CRK. FLOOD HAZARD
BY: SJH | DATE: 2/77 | CHECKED: CWR 2-28-77
SUBJECT: CWCB TECHNICAL MANUAL No. 1 | SHEET ___ OF ___

WATERSHED IN MOUNTAIN REGION

USE PROCEEDURES FOR GAGED SITE & ALSO

SITES NEAR GAGED SITES.

AT GAGE - COTTONWOOD CRK NEAR BUENA VISTA
07089000

DR. AREA = 65 Sq. mi.

WEIGHTED DISCHARGES, TABLE 6

Q_{10} = 572 cfs.
Q_{50} = 822
Q_{100} = 936
Q_{500} = 1230

} @ 65 Sq. mi.

NEAR GAGE (BELOW CONFLUENCE OF NORTH COTTONWOOD CRK)

DR. AREA = 98 Sq. mi. EXPONENT X = 0.79 ✓

$$\frac{A_U}{A_G} = \frac{98}{65} = 1.51 < 2.0 \therefore \text{O.K.} \checkmark$$

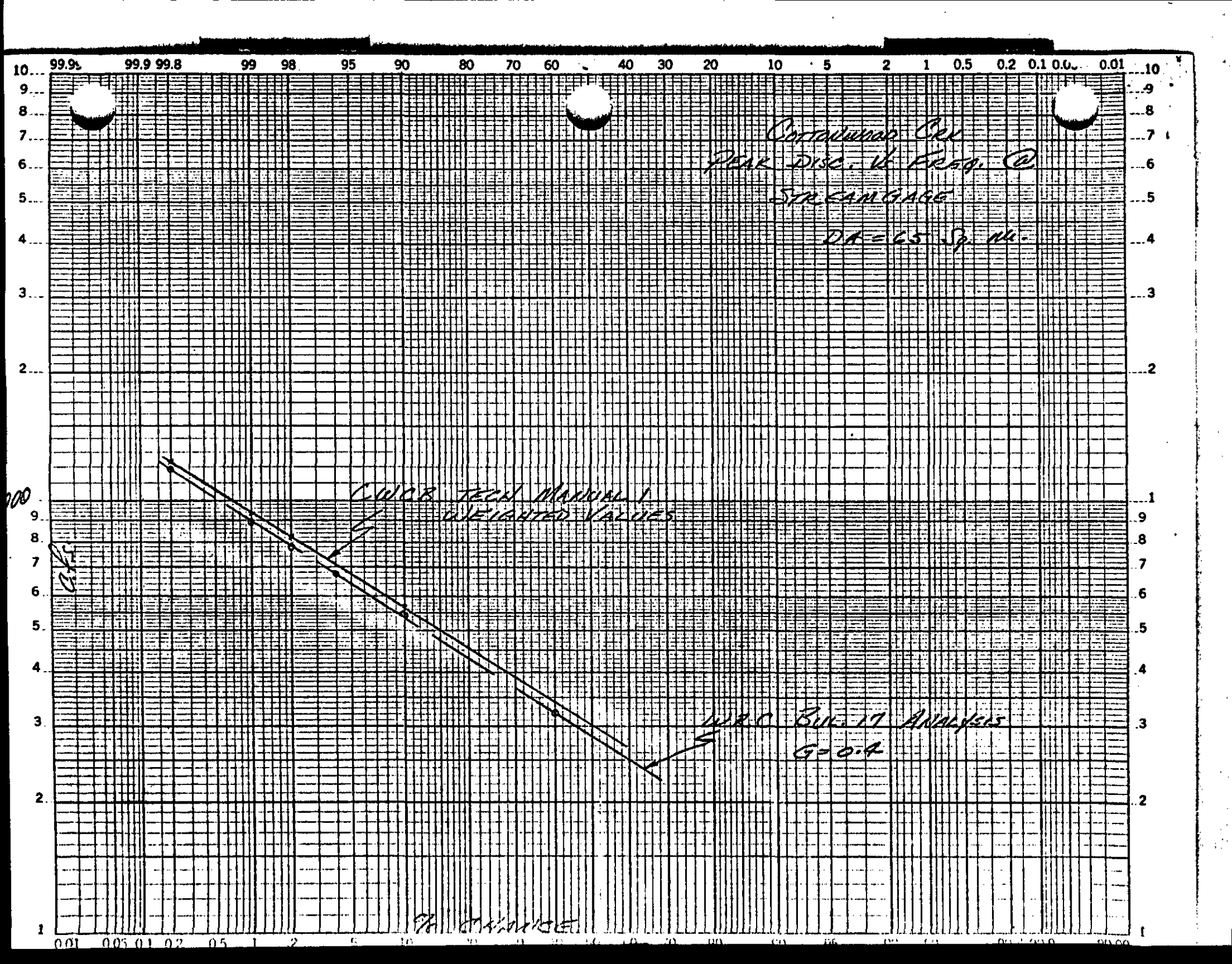
$$Q_{TU} = \left(\frac{A_U}{A_G}\right)^X Q_{TG}$$

$$Q_{TU} = (1.51)^{.79} Q_{TG} = 1.385\, Q_{TG}$$

Q_{10} = 1.385 × 572 = 792 cfs.
Q_{50} = 1.385 × 822 = 1139
Q_{100} = 1.385 × 936 = 1296
Q_{500} = 1.385 × 1230 = 1703

} @ 98 Sq. mi

USE SAME EQUATIONS FOR OTHER DRAINAGE AREAS FOR $\frac{A_U}{A_G}$ FROM 0.50 TO 2.0


99.9% 99.9 99.8 99 98 95 90 80 70 60 40 30 20 10 5 2 1 0.5 0.2 0.1 0.0 0.01
Cottonwood Crk
Peak Disc. vs Freq. @
Streamgage
DA = 65 Sq. Mi.
CWCB Tech Manual
Weighted Values
WRC Bul. 17 Analyses
G=0.4
0.01 0.05 0.1 0.2 0.5 1 2

RICHARD D. LAMM
Governor

DEPARTMENT OF NATURAL RESOURCES

COLORADO WATER CONSERVATION BOARD

823 STATE CENTENNIAL BUILDING

1313 SHERMAN STREET

DENVER, COLORADO 80203

FELIX L. SPARKS
Director

LAREN D. MORRL
Deputy Direct

TELEPHONE
(303) 892-34

May 20, 1977

Mr. Wayne Smith
U. S. Soil Conservation Service
P.O. Box 17107
Denver, Colorado 80217

Dear Mr. Smith:

The Colorado Water Conservation Board has reviewed the hydrologic analysis for the Buena Vista - Cottonwood Creek flood hazard study submitted by your office.

After discussions with the U. S. Geological Survey, Mr. Wilkes from your staff and our own analysis of the available data we recommend that the methods and values published in the CWCB Technical Manual #1 should be used for the following reasons:

1) The upper Arkansas River Valley is an area of mixed population floods. Technical Manual #1 takes this into account to some degree whereas the single station analysis did not.

2) Based on a strict interpretation of Water Resource Council Bulletin 17, the 1957 peak 1180 cfs would have had a recurrence interval of about 10,000 years which does not appear to be very reasonable based on other available data.

3) Using Technical Manual #1, the 1957 peak would have a recurrence interval of 300 years - 400 years.

Based on Technical Manual #1 the values we recommend for the Cottonwood Creek station are:

Q_{10} = 572 cfs

Q_{50} = 822 cfs

Q_{100} = 936 cfs

Q_{500} = 1230 cfs

To compute the discharges at Buena Vista either the regression equations or the equation on page 4 of the Technical Manual should be used.

Please contact me if you have any questions about our recommendations.

Sincerely,

E. J. Jencsok

E. I. JENCSOK, P.E.
Supv. Water Resource

EIJ:ajt

K&E LOGARITHMIC 359-111
KEUFFEL & ESSER CO. MADE IN U.S.A.
2 X 2 7 CYCLES

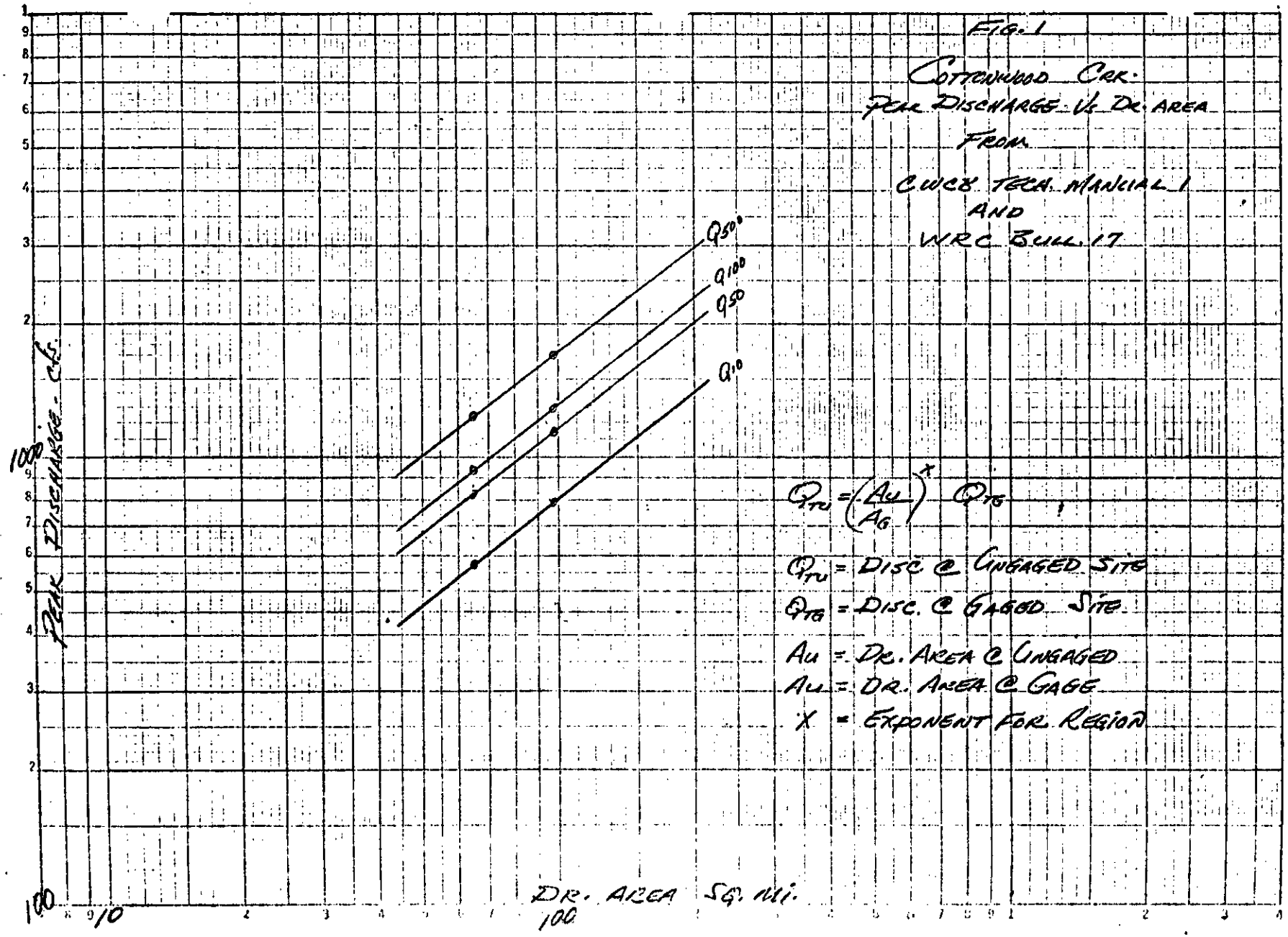


FIG. 1

COTTONWOOD CRK.

PEAK DISCHARGE VS DR. AREA

FROM

CWCB TECH. MANUAL I

AND

WRC BULL. 17

$$Q_{TU} = \left(\frac{A_U}{A_G}\right)^X Q_{TG}$$

Q_{TU} = DISC @ UNGAGED SITE

Q_{TG} = DISC. @ GAGED SITE

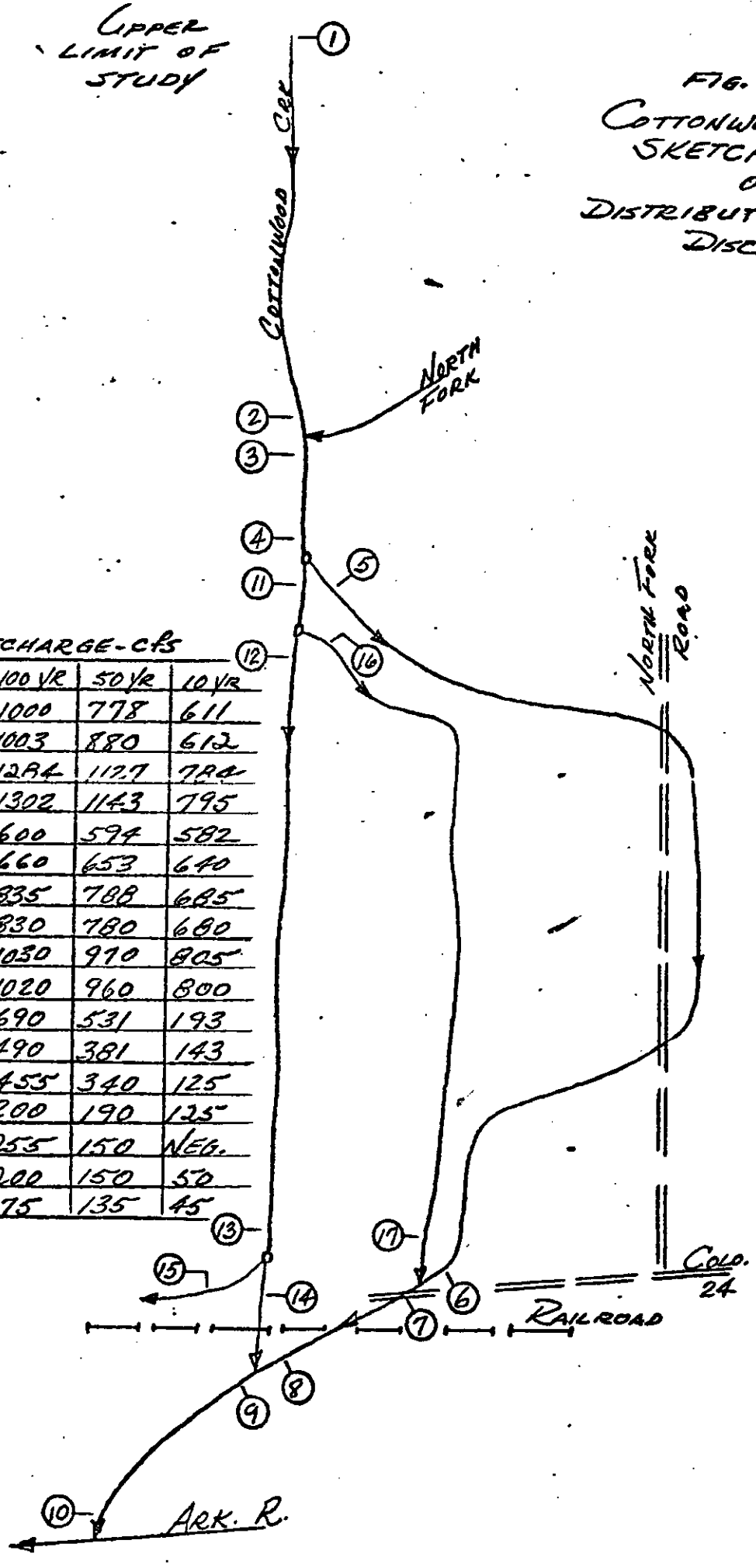
A_U = DR. AREA @ UNGAGED

A_U = DR. AREA @ GAGE

X = EXPONENT FOR REGION

FIG. 2

COTTONWOOD CREEK SKETCH MAP OF DISTRIBUTION OF DISCHARGE



Pt.	DISCHARGE-cfs 500 YR	100 YR	50 YR	10 YR
1	1314	1000	778	611
2	1318	1003	880	612
	687	1284	1127	784
	711	1302	1143	795
5	612	600	594	582
6	673	660	653	640
7	880	835	788	685
8	875	830	780	680
9	1115	1030	970	805
10	1100	1020	960	800
11	1090	690	531	193
12	860	490	381	143
13	774	455	340	125
14	240	200	190	125
15	534	255	150	NEG.
16	230	200	150	50
17	207	175	135	45