FORT COBB DAM AND RESERVOIR
COBB CREEK, OKLAHOMA

WATER CONTROL MANUAL
APPENDIX C
TO
RESERVOIR REGULATION MASTER MANUAL
RED RIVER BASIN

ORIGINAL EDITION – MARCH 1961
REVISED EDITION - JULY 1998

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this water control manual be used in looseleaf form, and only those sections, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be made to keep the manual current. All elevations referred to in this manual, unless noted otherwise, are in feet, NGVD (National Geodetic Vertical Datum).

EMERGENCY REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during duty hours and at various hours during weekends and holidays, contact can be made by telephone to the Water Control Section, Tulsa District Office (918) 669-7094, or the District VHF-FM radio (call signal WUI-3, Hydraulics). If the above office cannot be contacted, assistance can be achieved by contacting, in the order listed, one of the persons on the following pages. Chapter 7 of this manual contains detailed instructions for emergency regulations. All project personnel associated with regulation of the project must be thoroughly familiar with the procedure outlined in this chapter. A separate copy of this chapter has been provided to the dam operator's office and must be displayed on the bulletin board at all times.

EMERGENCY PERSONNEL ROSTERS

CORPS OF ENGINEERS PERSONNEL

Title and Name		Telephone
Project Coordinator	Office Residence	
Backup Coordinator	Office Residence	
Backup Coordinator	Office Residence	
Chief, Water Control Section	Office Residence	
Natural Disaster Specialist	Office Cellular	

BUREAU OF RECLAMATION PERSONNEL

Title and Name		Telephone
Oklahoma-Texas Area Office		
Area Manager	Office Residence	
Oklahoma City Field Office		
Program Coordinator	Office Residence	
Engineering Technician	Office Residence	
Great Plains Region, Billings Office		
Chief, Water Management Branch	Office Residence	
Hydraulic Engineer	Office Residence	

FORT COBB RESERVOIR MASTER CONSERVANCY DISTRICT PERSONNEL

Title and Name	Telephone
Superintendent, Fort Cobb Reservoir Office [redacted] Residence Dam Tender [redacted]	[redacted]

SUPPLEMENTAL TELEPHONE LISTING

Title and Name	Telephone
U.S. Geological Survey	(405) 843-7570
Public Affairs Office	(918) 669-7366
Tulsa River Forecast Center	(918) 832-4109
National Weather Forecast Office-Tulsa	838-7838
National Weather Service	(405) 366-6583

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

IX - WATER CONTROL MANAGEMENT-(Cont'd)

TABLE INDEX

EXHIBIT INDEX

PLATE INDEX

PLATE INDEX-Cont'd)

Plate	Title
7-3	River Outlet Rating Curve - One Gate (Partial Gate Openings)
7-4	River Outlet Rating Curve - Two Gates (Partial Gate Openings)
8-1	Operational Hydrographs - Inflow Design Flood (Spillway Design Flood)
8-2	Operational Hydrographs - 1/2 Inflow Design Flood (Standard Project Flood)
8-3	Operational Hydrograph - Flood of May 1993
8-4	Peak Inflow Probability Curve
8-5	Pool Elevation Probability Curve
8-6	Pool Elevation Duration Curve

PERTINENT DATA

LOCATION:

Fort Cobb Dam is located in Caddo County, Oklahoma, RM 7.5 on Cobb Creek about 5 miles northwest of Fort Cobb, Oklahoma.

DRAINAGE AREA:

304 square miles
one inch of runoff = 16,213 acre-feet

DAM:

Type: Rolled earth
Length: 9,900 feet
Maximum Height: 101 feet above streambed
Top Width: 30 feet

SPILLWAY:

Type: Uncontrolled circular drop inlet
Crest Elevation: 1354.8 feet NGVD
Size: 9 feet 6 inches diameter

MUNICIPAL OUTLET WORKS:

Type and size: 2 26-inch diameter steel conduits
wyed to a 26-inch diameter steel conduit

Control: 24-inch sleeve valve
Crest: 1300.0 feet NGVD
1324.5 feet NGVD

LAND ACQUISITION:

	Guide Contour (feet NGVD)	Area (acres)
Fee simple	1344.0	8,648
Easement	1364.5	1,832

RIVER OUTLET WORKS:

Type and size: 9-foot diameter concrete conduit upstream and a flat-bottom conduit downstream
Control: Two double-gated 5'0"H x 5'0"W gates with 10-inch bypass
Invert: 1300.0 feet NGVD

LOW FLOW:

Type and size: 10-inch diameter steel conduit
Control: 10-inch angle valve

POWER FEATURES:

None

Feature	Elevation (feet-NGVD)	Reservoir Area (acres)	Reservoir Capacity Accumulative (acre-feet)	Runoff (inches) (1)	Incremental (acre-feet)	Runoff (inches) (1)	Discharge Capacity (cfs)
Top of dam	1380.0						
Maximum pool	1374.4	9,421	284,100	17.52	148,200	9.14	5,640 (2)
Top of flood control pool	1354.8 (3)	5,882	135,900	8.38	62,070	3.83	2,270 (4)
Top of conservation pool	1342.0	3,806	73,830	4.55	72,570	4.48	2,070 (4)
Top of inactive pool	1300.0 (5)	323	1,260	0.08	1,260	0.08	0
Streambed	1279.0	0	0	0	0	0	0
Sediment Storage (not distributed)	1300.0-1354.8		15,000				

(1) Contributing drainage area is 304 square miles.
(2) Total spillway and river outlet works.
(3) Spillway crest.
(4) River outlet works only.
(5) Invert elevation of river outlet works intake structure.

FORT COBB DAM AND RESERVOIR
WASHITA RIVER, OKLAHOMA

WATER CONTROL MANUAL
APPENDIX C
TO
WATER CONTROL MASTER MANUAL
RED RIVER BASIN

I - INTRODUCTION

1-01. Authorization. This manual is submitted in accordance with ER 1110-2-240 and ER 1110-2-241 and prepared in accordance with EM 1110-2-3600 and EC 1110-2-278.

1-02. Purpose and Scope. The purpose of this manual is to document the plan of water control; to present detailed information to a higher authority; and to give guidance to personnel who will become concerned with, or responsible for, regulation of the reservoir during the life of the project. This manual also updates the Fort Cobb Reservoir Regulation Manual, Appendix C to the Red River Basin Reservoir Regulation Master Manual, and supersedes regulations contained in the Reservoir Regulation Manual for Fort Cobb Reservoir dated November 1960.

1-03. Related Manuals. This manual is Appendix C to the Red River Basin Water Control Master Manual. Other manuals found in this referenced Master Manual are:

Appendix A -	Texoma	(Apr 1993)
Appendix B -	Altus	(Feb 1993)
Appendix D -	Foss	(Sep 1993)
Appendix E -	Little River System	
	Part I - Pine Creek	(May 1974)
	Part III - Broken Bow	(Nov 1974)
	Part IV - DeQueen	(May 1976)
	Part VI - Dierks	(May 1975)
	Part VII - Millwood	(Sep 1973)
Appendix F -	Arbuckle	(Nov 1966)
Appendix G -	Pat Mayse	(Nov 1966)
Appendix H -	Hugo	(May 1982)
Appendix J -	Lake Kemp	(May 1994)
Appendix K -	Mountain Park Dam and Tom Steed Reservoir	(Sep 1993)
Appendix L -	Waurika	(Apr 1977)
Appendix M -	Sardis Lake	(Jul 1984)
Appendix N -	McGee Creek	(Sep 1989)
Appendix DCP-1 -	Upper Red River Basin Drought Contingency Plan	(Feb 1993)

The locations of existing and authorized projects are shown on Plate 1-1.

1-04. Project Owner. U.S. Department of Interior, Bureau of Reclamation (Reclamation).

1-05. Operating Agency. The Fort Cobb Reservoir Master Conservancy District (District) is responsible for operation and maintenance (O&M) of Fort Cobb Dam. All operations are supervised by the Bureau of Reclamation from their Oklahoma City Field Office in Oklahoma City, Oklahoma which is an office belonging to the Oklahoma-Texas Area Office located in Austin, Texas. The Great Plains Regional Office, Billings, Montana, provides support for the Area Office. The Regional Office publishes the Standing Operating Procedures (SOP), and revisions must be approved by the Regional Director. The Regional Office coordinates the dam facility review examinations and provides technical O&M assistance.

O&M of the dam and reservoir are accomplished by District personnel under the direction of the Superintendent. The Superintendent supervises equipment operations at the dam, reservoir data recording and reporting, the reporting of any unusual occurrences, and the performance of routine maintenance work.

The District is responsible for reporting operational information to Reclamation and to the U.S. Army Corps of Engineers (Corps) District office, Tulsa, Oklahoma, in accordance with existing flood control regulations and the SOPs.

1-06. Regulating Agencies. The Bureau of Reclamation is responsible for regulation of Fort Cobb Reservoir above the flood control pool. Normal regulation procedures are established by Reclamation and carried out by the District.

Regulation of flood control storage, between elevations 1342.0 and 1354.8 feet National Geodetic Vertical Datum (NGVD), is directed by the Corps in accordance with approved flood control regulations as required by Section 7 of the Flood Control Act of 1944 (58 Stat. 890, 33 USC 709). When the pool is above elevation 1354.8 feet NGVD, Reclamation is responsible for directing storage and release of all waters. Assistance is provided by the Corps in evaluating the real-time situation at the request of, and is used at the discretion of, Reclamation.

II - DESCRIPTION OF PROJECT

2-01. Location. Fort Cobb Dam is located at river mile 7.4 on Cobb Creek in Caddo County, about 5 miles northwest of Fort Cobb, Oklahoma. The project location is shown on Plate 2-1.

2-02. Purpose. Fort Cobb Reservoir is part of a comprehensive plan of improvement for the Washita River Basin. The reservoir formed by the dam provides water for municipal and industrial (M&I) needs, flood control, fish and wildlife conservation, and associated recreation benefits.

2-03. Physical Components.

a. Embankment. The embankment is composed of rolled earth, with a crest length of 9,900 feet. The crest of the embankment has a top width of 30 feet and a maximum height of 101 feet above the streambed (crest elevation is 1380.0 feet NGVD). A general plan and profile of the embankment are shown on Plate 2-2.

b. Spillway. The uncontrolled spillway is located on the left abutment and consists of an uncontrolled circular drop inlet, a 9'6" diameter monolithic concrete outlet conduit, a concrete chute, a stilling basin with baffle blocks, and an outlet channel. The spillway crest is at elevation 1354.8 feet NGVD. The spillway has a capacity of 3,050 cubic feet per second (cfs) at the maximum pool elevation, 1374.4 feet NGVD. A plan with sections of the spillway is shown on Plate 2-3.

c. River Outlet Works. The river outlet works (located near the right abutment) consist of a concrete circular drop intake structure with trashracks; a 9-foot diameter concrete conduit upstream of the gate chamber; a gate chamber containing two 5'0"H x 5'0"W high-pressure emergency gates in tandem with two 5'0"H x 5'0"W high-pressure regulating gates; a 13-foot diameter modified free-flow conduit downstream of the gate chamber; a 5-foot 2-inch by 7-foot access conduit adjacent to the free-flow conduit; a control house; stilling basin; and a measuring flume. The intake crest elevation is 1300.0 feet NGVD. The outlet works has a capacity of 2,570 cfs at the maximum pool elevation, 1374.4 feet NGVD. A plan with sections of the outlet works is shown on Plate 2-4.

d. Municipal Outlet Works. The municipal outlet works consist of two 26-inch diameter concrete encased steel pipes from the river outlet works intake structure to the gate chamber, two 24-inch sleeve valves, a 24-inch by 26-inch wye, and a 26-inch steel outlet pipe from the gate chamber to the control house and stilling well at the downstream toe of the dam where the Anadarko water supply pipeline begins. A plan with

sections of the municipal outlet works is shown on Plate 2-4.

e. Sedimentation and Degradation Ranges. Twenty-three (23) sedimentation ranges were established from Fort Cobb Dam upstream to the upper limits of Fort Cobb Reservoir to establish a baseline for future determination of the rate and distribution of sedimentation taking place in the reservoir. The locations of the sedimentation ranges are shown on Plate 2-5. A sedimentation survey was completed in May 1993 and is what the current Area-Capacity Table (Table 7-3) is based on. Thirteen (13) degradation ranges were established downstream from Fort Cobb Dam for a distance of about 7 miles to establish a baseline for future degradation studies. The locations of the degradation ranges are shown on Plate 2-6.

2-04. Related Control Facilities. Municipal and industrial water supplies are transported from the reservoir to customers through a gravity-flow aqueduct system. This system is a precast concrete pipeline with a maximum diameter of 33 inches and a total length of almost 21 miles. The system extends south-southeasterly from the outlet works at Fort Cobb Dam to the vicinity of Anadarko. The United States owns a 66-foot-wide right of way (permanent pipeline easement) to accommodate this system.

2-05. Real Estate Acquisition. Fee simple title was acquired to 8,648 acres in the dam construction area and to the top of the 5-year flood frequency pool at elevation 1344.0 feet NGVD by tracts of 10-acre legal subdivisions, any part of which is below this elevation. Flowage easements were acquired for the 1,832 acres between the area acquired in fee simple and (as a general rule) the contour established as having a flooding frequency of once in 500 years (elevation 1364.5 feet NGVD). The reservoir taking line and flowage easements are shown on Plate 2-7.

2-06. Public Facilities. The United States, acting through Reclamation, owns all land and land rights in the Fort Cobb Project. The District has an O&M responsibility for the dam and aqueduct by virtue of the repayment contract with the United States. Subsequently, the reservoir was leased to the Oklahoma Tourism and Recreation Department for administration and maintenance of recreational features. In 1963, an agreement transferred 115 acres southwest of the dam to the Oklahoma State University for administration. In 1966, the upper portion of Fort Cobb Reservoir was transferred to the Oklahoma Department of Wildlife Conservation for operation and maintenance as a wildlife area. Fort Cobb is managed as follows:

Agency	Water Acres	Land Acres	Total Acres
Fort Cobb Reservoir Master Conservancy District	0	513	513
Oklahoma Tourism & Recreation Department, Division of State Parks	2,120	2,298	4,418
Oklahoma Department of Wildlife Conservation	1,802	1,800	3,602
Oklahoma State University	0	115	115

III - HISTORY OF PROJECT

3-01. Authorization. Fort Cobb Reservoir was authorized by Public Law 419, 84th Congress, 2nd Session, approved 25 February 1956.

3-02. Planning and Design. Fort Cobb Reservoir is part of Reclamation's comprehensive plan of improvement for the Washita River Basin. This plan, entitled "Plan of Improvement for Washita River Subbasin, Red River Basin, Oklahoma and Texas", was published in 1953 as House Document No. 219, 83rd Congress, 1st Session. This plan consists of a 7-reservoir system with an aggregate flood control storage of 738,000 acre-feet on the Washita River and its tributaries plus irrigation and water supply works. The reservoirs planned were Foss, Mountain View, and Durwood on the mainstem of the Washita River, Fort Cobb on Cobb Creek, Gracemont on Sugar Creek; Chickasha on the Little Washita River, and Purdy on Rush Creek.

The plan of improvement studied by Reclamation, as published in House Document 219, with certain exceptions, was authorized by Public Law 419, 84th Congress, 2nd Session, and was signed by the President on 25 February 1956. This law authorized the construction of Fort Cobb Reservoir (completed in November 1959) on Cobb Creek and Foss Reservoir (completed in February 1961) on the main stem of the Washita River. The locations of Fort Cobb and Foss Reservoirs are shown on Plate 1-1.

The flood control requirements were studied by the Corps and are contained in a report entitled: "Comprehensive Survey Report for Red River, Louisiana, Arkansas, Oklahoma, and Texas (above Fulton, Arkansas)" dated 15 January 1948. The flood control storage recommended in that report for Fort Cobb Reservoir was 62,500 acre-feet and was confirmed by a Tulsa District letter dated 28 June 1951 to the Area Engineer, Bureau of Reclamation, Oklahoma City, Oklahoma. Reclamation allocated 63,300 acre-feet for flood control storage initially, which included 800 acre-feet for 100 years of sediment deposition. Although House Document 219 proposed a concrete spillway with radial gates, later economic studies in connection with the definite plan report dated June 1957, concluded that a higher dam with a small uncontrolled drop inlet spillway in conjunction with a small capacity river outlet works would be more economical.

3-03. Construction. A resume of construction activities is given in Table 3-1.

TABLE 3-1

RESUME OF CONSTRUCTION ACTIVITIES

ACTIVITY	DATE
Construction Began	11 February 1958
Date of Diversion	30 March 1959
Final Storage Began	8 May 1959
Conservation Pool Filled	9 June 1962

3-04. Related Projects. Fort Cobb Reservoir acts in conjunction with Foss Reservoir and Arbuckle Reservoir to provide partial regulation of Washita River flows.

The Natural Resources Conservation Service (NRCS) has developed a comprehensive plan for the construction of numerous small detention structures in the Washita River Basin and has constructed 868 detention structures downstream of Foss Reservoir. These structures control, to some extent, the runoff from 2,150 square miles of the 6,449 square-mile drainage area downstream of Foss Dam. These structures fill, on average, once in 5 years to once in 25 years. They have a total of 465,000 acre-feet of storage at their conservation levels. These detention structures aid in the control of many minor and intermediate floods in the Washita River Basin. The large combined surface area increases evapotranspiration losses when these structures are near their conservation levels. The actual effect these structures have on the runoff characteristics of the basin cannot be determined with any degree of accuracy because information concerning the levels of the conservation storage is not available. There are also 199 detention structures above Foss Reservoir which are discussed in the Foss Dam and Reservoir Water Control Manual.

3-05. Modification to Regulation. No major changes have been made in the Fort Cobb Reservoir Regulations since the project began operation in 1959.

3-06. Principal Regulation Problems. No problems have been encountered in the regulation of Fort Cobb Dam and Reservoir.

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Cobb Creek watershed is a tributary of the Washita River and heads in the southeast corner of Custer County, Oklahoma. The creek flows in a south-southeast direction through the northeast corner of Washita County, Oklahoma and through Caddo County, Oklahoma, to its confluence with the Washita River near Fort Cobb, Oklahoma. Cobb Creek drains a total of 324 square miles. All but 20 square miles of the basin are above Fort Cobb Dam. The basin is long and narrow with a total length of 41.5 miles and an average width of eight miles. Slopes are mild averaging 11 feet per mile with basin elevations ranging from 1675 at the source to 1220 near the confluence with the Washita River. Vegetation consists mainly of pasture and cultivated crops. Stream profiles for Cobb Creek and the Washita River are shown on Plates 4-1 and 4-2, respectively.

4-02. Topography. Topography throughout most of the basin is erosional in character, and is principally associated with the entrenchment of the main stream and tributaries in the old plain surface. Terrain is rolling to hilly with mild slopes and matured streams. Major relief is afforded by the Wichita Mountains lying to the south of the basin. Drainage patterns in the area are dendritic with the Washita River forming the main stem.

4-03. Geology and Soils. Most of the basin is underlain by the Rush Springs sandstone formation except along the west edge where the Cloud Chief formation is found. The soils in Cobb Creek basin fall into two general soil association groups. The Windthorst-Nimrod soils group predominates, with a small area of the Miles-Vernon soils group in the northwest part of the basin. The soils of the Windthorst-Nimrod group are mostly light colored and sandy. They are developed primarily from fairly deeply weathered rock materials. Windthorst soils have light-colored surface soils over red clay subsoils. Nimrod soils are very sandy soils with light-colored surface soils and soft, pervious subsoil. They are subject to blowing and drifting in places, and are called blow sand locally. The soils of the Miles-Vernon group vary in color from red to reddish brown or grayish brown, and range in texture from sand to clay. The Miles soils have fairly deep surface soils, usually rather sandy and mellow. The Vernon soils are thin, red, immature soils and have crumbly clay subsoils.

4-04. Sediment. The Bureau of Reclamation initially allocated 15,000 acre-feet of storage for 100 years of sediment deposition below the top of flood control pool. However, only 800 acre-feet of sediment is expected to be deposited within

the flood control pool between elevations 1342.0 and 1354.8.

4-05. Climate. The Fort Cobb area experiences subhumid climate conditions. Most weather patterns are under continental controls characteristic of the Great Plains Region. The continental effect produces pronounced daily and seasonal temperature changes and considerable variation in seasonal and annual precipitation. Summers are long and usually hot. Winters are mild and short. During an average year, skies are clear approximately 40 percent of the time, partly cloudy 25 percent, and cloudy 35 percent of the time.

a. Temperature. The mean annual temperature is approximately 60 degrees Fahrenheit. Average annual maximum and minimum temperatures are approximately 71 and 49 degrees Fahrenheit, respectively. Average maximum temperatures for the months of July and August are in excess of 90 degrees Fahrenheit. Average minimum temperatures for the months of December, January and February are below 32 degrees Fahrenheit.

b. Precipitation. Average monthly and annual rainfall and runoff data are shown in Table 4-1.

TABLE 4-1

AVERAGE MONTHLY AND ANNUAL RAINFALL
AND RUNOFF ABOVE FORT COBB DAM

Month	Avg. rainfall (1) (inches)	Percent of avg. annual rainfall	Avg. runoff (2) (3) (acre-feet)	(inches)	Percent of avg. annual runoff
January	0.98	4	2460	0.15	6
February	1.21	4	2610	0.16	6
March	1.78	6	3590	0.22	9
April	2.54	9	4120	0.25	10
May	4.81	17	7420	0.46	18
June	3.85	14	6510	0.40	16
July	2.19	8	2610	0.16	6
August	2.40	9	1790	0.11	4
September	3.18	11	2790	0.17	6
October	2.55	9	3490	0.22	9
November	1.43	5	1940	0.12	5
December	1.16	4	2070	0.13	5
TOTAL	28.08	100	41,400	2.55	100

(1) Period of record is January 1930 through December 1991.
(2) Drainage area above Fort Cobb Reservoir is 304 square miles.
(3) Period of record is January 1926 through December 1991.

c. Snowfall. Mean annual total snowfall is approximately nine inches. Sixty percent (60%) of this total occurs within the months of January and February.

d. Evaporation. Evaporation of water from Fort Cobb Reservoir is considered to be seventy percent (70%) of recorded pan evaporation. Estimated monthly pan evaporation is shown in Table 4-2.

TABLE 4-2

ESTIMATED MONTHLY PAN EVAPORATION

MONTH	EVAPORATION(1)
	(inches)
January	---- (2)
February	---- (2)
March	5.94
April	7.08
May	8.33
June	9.28
July	12.01
August	10.65
September	8.10
October	5.89
November	4.00
December	---- (2)
ANNUAL TOTAL: 71.28	
(1) Period of record 1979 to 1995.	
(2) Data not available.	

e. Wind. Mean annual wind speed is approximately 12 miles per hour. Maximum mean wind speeds occur in the months of March and April (approximately 15 miles per hour). Winds are generally from the southeasterly direction.

4-06. Storms and Floods. Two types of storms form over the Cobb Creek basin. First, frontal action results when cold, dry polar air masses from the north meet moist, warm air masses from the Gulf of Mexico to the south. Second, convective type thunderstorms frequently form and produce intense precipitation over relatively small areas. Winter precipitation generally results from air mass movement while summer rainfall comes from thunderstorm showers. Storms with an average precipitation of three inches or more and storms which have caused major floods over the watershed are shown in Table 4-3. These averages were computed from published rainfall records of stations surrounding the watershed which do not necessarily record the center of intense storms. Because of this, and since antecedent rainfall, season of the year, and many other factors influence storm runoff, floods have frequently followed periods of relatively small amounts of recorded rainfall. Likewise, larger storms of greater amounts of recorded rainfall have caused only minor flooding.

The Washita River basin is long and narrow. The river flows generally from a northwest to southeast direction which is perpendicular to the axis of major frontal storms. This

basin shape and orientation result in the generation of floods in relatively short reaches of the river. Floods resulting form runoff over the entire watershed are extremely infrequent. Table 4-4 shows the major floods at the Anadarko, Alex, and Pauls Valley gaging stations.

The major flood of record was in June, 1995. A pool elevation reading of 1352.
25 feet, NGVD, was recorded at the Fort Cobb dam on June 13, 1995.

TABLE 4-3

FORT COBB RESERVOIR

MAJOR STORMS

JANUARY 1923 THROUGH DECEMBER 1995

DATE OF STORM	AVERAGE RAINFALL (INCHES)	DATE OF STORM	AVERAGE RAINFALL (INCHES)
April 11-13, 1923	3.19	October 16-18, 1960	3.10
June 7-9, 1923	3.50	October 12-13, 1962	4.30
September 17-29, 1923	4.09	September 15-16, 1963	3.20
October 12-14, 1923	4.90	April 11-13, 1967	3.20
September 26-28, 1926	4.58	June 30-July 2, 1968	3.60
October 2-4, 1926	3.04	May 3-5, 1969	3.60
April 6-7, 1927	4.02	September 3-8, 1973	4.00
May 27-28, 1929	4.06	August 26-28, 1974	3.70
September 7-9, 1929	5.38	July 23-25, 1975	3.60
December 22-23, 1932	3.48	May 19-21, 1977	3.00
September 12-13, 1933	3.20	May 25-28, 1978	4.50
August 22-23, 1934	3.23	June 20-22, 1980	3.30
July 1-3, 1940	3.70	June 2-4, 1981	3.80
May 9-10, 1943	3.15	May 16-17, 1982	6.00
June 12-14, 1944	2.78	May 22-24, 1982	4.00
June 10-12, 1945	3.49	October 17-22, 1983	9.20
September 28-30, 1945	4.33	June 2-6, 1985	4.31
December 3-5, 1947	3.21	September 28-October 3, 1986	8.41
June 21-23, 1948	4.96	October 21-22, 1986	3.15
May 17-19, 1949	5.66	May 26-28, 1987	4.10
July 18-20, 1950	3.52	September 17-23, 1988	5.48
May 16-18, 1951	4.68	May 31-June 2, 1989	3.20
July 19-20, 1953	3.11	September 8-13, 1989	3.44
May 9-11, 1955	3.48	March 9-14, 1990	5.81
May 18-20, 1955	3.35	May 29-June 1, 1990	3.29
May 25-17, 1956	3.39	September 16-21, 1990	3.79
May 2-4, 1957	3.22	June 1-8, 1991	4.54
June 19-21, 1958	3.75	August 27-September 7, 1991	4.95
July 16-28, 1959	3.94	November 18-21, 1992	3.15
October 24, 1959	3.94	May 6-11, 1993	5.24
		June 3-6, 1995	7.33

TABLE 4-4

FLOODS FOR PERIOD OF DISCHARGE RECORD

Washita River at Anadarko Flood Stage=19.0 feet			Washita River at Alex Flood Stage=19.0 feet			Washita River NR Pauls Valley Flood Stage=24.0 feet		
Date	Stage(ft)	Flow(cfs)	Date	Stage(ft)	Flow(cfs)	Date	Stage(ft)	Flow(cfs)
06-08-36	23.57	10800	11-09-64	12.06	4300	05-23-38	24.92	8800
06-19-37	19.43	4660	08-28-65	11.03	3800	06-10-41	(1)	22,000
09-23-65	24.20	11000	09-27-65	14.03	5830	10-05-41	23.35	7070
10-22-65	21.80	7190	10-23-65	13.35	4980	04-09-42	25.34	9000
07-16-68	15.65	3840	04-12-67	15.52	7440	04-20-42	24.70	7840
05-10-69	18.61	5650	05-07-69	17.83	9350	04-25-42	24.50	7700
03-12-73	15.05	3180	06-14-69	13.25	6450	05-18-43	25.30	9890
04-02-73	18.02	4700	04-30-70	11.40	4130	03-15-45	23.56	8170
04-18-73	15.94	3810	05-29-70	13.15	5620	04-20-45	23.20	8100
11-05-74	15.06	3100	09-23-70	12.92	5490	06-17-45	24.21	8380
05-23-75	15.36	3300	10-03-71	16.82	8100	07-10-45	23.28	8600
07-30-75	18.52	4520	11-01-72	13.86	4660	05-23-46	22.06	7750
05-24-77	18.45	4560	04-04-73	12.98	4300	05-31-46	26.19	9860
05-31-77	21.55	6200	05-25-73	13.65	5240	06-30-46	23.10	8600
05-31-78	17.38	4390	06-02-73	18.34	8850	12-11-46	21.92	8590
06-11-79	15.84	3970	06-05-73	15.73	6580	04-15-47	23.80	10,400
06-02-80	18.24	5170	07-23-73	12.31	4490	05-25-47	27.52	14,500
05-26-82	19.71	6260	03-11-74	12.52	4790	06-02-47	26.25	12,500
10-21-83	25.20	44700	05-23-75	17.13	8090	06-24-47	25.41	12,100
05-30-87	24.73	25200	07-30-75	15.92	6700	05-01-49	28.42	21,700
03-06-88	19.92	5670	05-21-77	14.53	6240	05-11-50	29.88	30,000
06-16-89	21.78	11200	05-27-78	17.50	8770	05-18-57	27.34	35,800
03-13-90	19.89	8650	06-10-79	17.37	9090	05-26-57	24.64	29,300
05-11-93	25.07	29,000	05-30-80	15.63	6940	05-20-60	17.34	16,500
06-06-95	25.37	52,800	05-29-82	16.31	8000	06-09-62	16.10	11,700
			10-02-83	23.78	23,400	10-28-62	16.50	12,200
Period of Record:			06-13-89	19.01	14,500	05-10-64	15.37	10,300
10-01-35 to 02-01-38			06-08-95	17.28	25,000	06-01-68	19.48	14,500
10-01-63 to 09-30-95			Period of Record:			05-07-69	16.21	10,300
			10-01-64 to 09-30-86			09-23-70	18.19	12,200
			10-01-88 to 09-30-95			11-01-72	16.91	9090
						11-25-73	16.50	8580
						05-03-75	15.14	10,000
						05-24-75	17.57	14,100
						07-28-75	16.46	12,200
						05-20-77	17.54	14,100
						05-28-78	16.40	12,100
						06-09-79	19.50	12,200
						05-30-80	18.71	12,200
						06-01-82	17.34	11,100
						10-22-83	25.82	28,400
						05-29-87	28.72	43,600
						06-09-95	19.68	29,100
						Period of Record:		
						10-01-37 to 09-30-95		
						(1) Data not available		

4-07. Runoff Characteristics. Many of the western and central rivers and streams of Oklahoma are dry, or nearly dry, most of the year. They are subject to sudden rises and severe flash floods of short duration as a result of thunderstorm activity. It is not unusual for several consecutive crests to follow within comparatively short periods due to recurrent heavy rainfall. Floods of considerable magnitude are occasionally produced by a general heavy rain. As Cobb Creek is situated in a plains area, there is no dependable spring or summer stream flow resulting from snow melt. Almost one-half of the flow into Fort Cobb Reservoir has been recorded during April, May and June. The flat alluvial valleys of the Washita and its tributaries are sharply delineated by steeply rising land which rises to an elevation about 200 feet above the flood plains. The flood plain of Cobb Creek and the Washita tributaries below it are narrow (1/2 mile or less) while that of the main stem of the Washita between Anadarko and Chickasha is relatively wide (up to 6 miles). The alluvial soil is sandy and porous. As a result, high peak flows generated on the tributaries are rapidly attenuated and considerable flood volume is lost in the sandy soil. The time of concentration for the Cobb Creek basin is about 11 hours. Because of the predominance of sandy soil, and the underlying sandstones, there is a considerable base flow coming into Cobb Creek in the form of ground water discharge from the Rush Springs sandstone formation. It is estimated that during the period of record, this base flow amounted to about 49 percent of the average annual flow. Irrigation from wells has been practiced in the Cobb Creek basin since 1947. Presently, it is estimated that there are several hundred small irrigation wells drilled in the area. In addition to the depletion of the ground water discharge by these wells, Reclamation contemplates serious stream flow depletion resulting from land treatment measures initiated by the Natural Resources Conservation Service. Pertinent data from stream gaging stations used in the regulation of Fort Cobb Reservoir are given in Table 4-5. Monthly flows into Fort Cobb Reservoir were obtained from the Fort Cobb gage from March 1940 through February 1959 and from actual records at Fort Cobb Dam from March 1959 through December 1993. Estimated monthly and annual inflow tabulations are given in Table 4-6. The inflow volume frequency by months is shown in Table 4-7. Hydrographs of pool elevations at the damsite for the period July 1962 through September 1997 are shown on Plates 4-3 through 4-5.

TABLE 4-5

PERTINENT DATA FOR STREAM GAGING STATIONS

Station	Stream	Miles above mouth	Gage zero (NGVD)	Flood stage (feet)	Bankfull capacity (cfs)	Maximum flood of record		
						Date	Stage (feet)	Discharge (cfs)
Clinton, OK	Washita River	447.4	1467.60	18.0	1,800	5-16-51	31.09	66,800
Carnegie, OK	Washita River	353.9	1254.23	23.0	8,600	10-20-87	31.70	40,600
Eakly, OK	Cobb Creek	22.9	1369.70	---	---	9-29-86	24.38	10,000
Anadarko, OK	Washita River	305.2	1150.00	19.0	6,100	6-06-95	25.37	52,800
Alex, OK	Washita River	226.5	995.0	19.0	32,300	10-21-83	28.70	23,400
Pauls Valley, OK	Washita River	146.4	854.61	24.0	39,800	5-11-50	29.08	30,000

		2d largest flood of record			3d largest flood of record			Period of record	
Station	Stream	Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge (cfs)	From	To
Clinton, OK	Washita River	5-26-59	27.84	22,200	4-11-40	25.93	10,600	10-03-86	Date
Carnegie, OK	Washita River	10-01-37	31.70	40,600	6-05-95	31.50	40,200	10-01-37	Date
Eakly, OK	Cobb Creek	6-04-95	22.05	12,000	5-17-82	21.08	8,680	10-01-68	Date
Anadarko, OK	Washita River	10-21-83	25.20	44,700	5-11-93	25.20	29,000	10-01-02 10-01-35 10-01-63	9-30-08 2-28-38 Date
Alex, OK	Washita River	6-02-73	23.34	8,850	5-07-69	22.83	9,350	10-01-64 10-01-88	9-30-86 Date
Pauls Valley, OK	Washita River	5-11-87	28.72	43,600	5-18-57	27.34	35,800	10-01-37	Date

TABLE 4-6

ESTIMATED MONTHLY AND ANNUAL FLOWS IN ACRE-FEET

FORT COBB RESERVOIR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	ANNUAL
1940	-	-	1300.	2800.	1200.	930.	5300.	1100.	1300.	610.	1700.	1700.	17940.
1941	2500.	2200.	2000.	7800.	10100.	9700.	1300.	1200.	960.	11900.	3200.	3400.	56260.
1942	2700.	2800.	2700.	9300.	2300.	2100.	1600.	2700.	5300.	2500.	2400.	3200.	39600.
1943	2800.	2400.	2600.	2200.	7700.	1800.	1100.	430.	470.	1200.	1200.	1800.	25700.
1944	2500.	2100.	6100.	9600.	3000.	14100.	1900.	1300.	1100.	1700.	2300.	3300.	49000.
1945	3400.	2800.	4300.	14300.	2300.	18200.	10600.	2000.	4800.	2800.	2200.	2500.	70200.
1946	3400.	2900.	2600.	2600.	3600.	9300.	8700.	1500.	2000.	1400.	2800.	2300.	43100.
1947	2500.	1900.	2400.	7700.	12300.	2600.	3400.	580.	390.	570.	920.	3500.	38760.
1948	1900.	2600.	3900.	2100.	1400.	9800.	1800.	830.	610.	680.	1300.	1500.	28420.
1949	2500.	6200.	2600.	2400.	41600.	9500.	1300.	870.	910.	1400.	1500.	2200.	72980.
1950	2200.	2300.	2100.	1800.	6600.	4000.	9600.	5800.	2700.	1500.	1700.	2000.	42300.
1951	2300.	3000.	2600.	2000.	9900.	9000.	1100.	540.	870.	740.	1300.	1500.	34850.
1952	1900.	2000.	2300.	2900.	7000.	1400.	1300.	500.	290.	500.	820.	1200.	22110.
1953	1300.	1300.	2500.	3400.	1200.	480.	8400.	890.	580.	3300.	1400.	1800.	26550.
1954	1700.	1500.	2100.	1700.	6000.	1200.	340.	180.	140.	330.	560.	760.	16510.
1955	980.	1100.	1200.	1700.	15700.	6600.	1100.	4200.	1200.	1900.	1500.	1700.	38880.
1956	1700.	2400.	1900.	1500.	2300.	920.	390.	70.	30.	350.	550.	770.	12880.
1957	880.	1000.	1500.	6800.	6700.	5900.	890.	290.	650.	730.	930.	1200.	27470.
1958	1500.	1400.	2300.	2400.	930.	6300.	870.	240.	270.	360.	680.	960.	18210.
1959	1300.	1200.	1300.	120.	5000.	620.	5000.	310.	3000.	15900.	3200.	4200.	41150.
1960	2600.	4100.	2700.	1000.	2700.	1500.	1400.	760.	1000.	10300.	1700.	1900.	31660.
1961	1100.	2100.	3200.	1800.	2700.	5000.	3400.	2000.	6900.	2300.	4800.	2400.	37700.
1962	1500.	760.	780.	3800.	2700.	13500.	1600.	100.	2900.	1900.	810.	1500.	31850.
1963	1100.	2100.	3100.	6600.	8000.	17000.	18000.	18700.	3000.	900.	1100.	1200.	80800.
1964	1900.	3400.	2200.	2500.	5700.	2300.	420.	2600.	2200.	650.	5200.	1100.	30170.
1965	1900.	1800.	2300.	3100.	5300.	4100.	400.	720.	30800.	6000.	1400.	2900.	60720.
1966	1800.	3300.	3500.	2400.	1500.	2700.	1200.	5400.	1100.	650.	790.	1200.	25540.
1967	1400.	1200.	2300.	6900.	2100.	1700.	1300.	350.	3800.	570.	650.	1100.	23370.
1968	2100.	3200.	2400.	3800.	5400.	7000.	8800.	3200.	2400.	2600.	5800.	3100.	49000.
1969	8600.	2800.	3900.	3100.	12700.	4700.	630.	1100.	2100.	960.	1200.	960.	42750.
1970	1200.	1500.	2200.	4900.	3900.	2300.	380.	3200.	210.	620.	50.	820.	21280.
1971	990.	1400.	2300.	910.	1400.	6000.	1900.	2700.	2400.	3600.	970.	4200.	28770.
1972	1100.	1800.	1700.	2600.	2700.	1400.	1200.	90.	100.	1600.	1300.	1500.	17090.
1973	4200.	2000.	13900.	10400.	2800.	2800.	2100.	320.	5000.	2800.	1900.	2100.	50320.
1974	1300.	2200.	2500.	2400.	7400.	340.	330.	10000.	2300.	2000.	9200.	1400.	41370.
1975	3700.	4100.	4300.	3100.	16300.	10800.	14000.	5300.	290.	1600.	2400.	2500.	68390.
1976	1800.	1900.	2200.	3700.	5600.	1100.	640.	100.	3800.	1300.	660.	1100.	23900.
1977	1600.	2300.	1700.	2600.	23600.	3500.	770.	1700.	220.	810.	1700.	220.	40720.
1978	4800.	2400.	2700.	2800.	7800.	1900.	280.	620.	1500.	310.	420.	310.	25840.
1979	660.	1100.	4100.	3900.	5600.	3700.	570.	360.	360.	470.	1100.	910.	22830.
1980	1600.	1800.	1800.	2700.	13300.	12100.	160.	930.	180.	60.	120.	1200.	35950.
1981	600.	970.	2100.	1800.	2300.	4900.	1400.	850.	1300.	4800.	1600.	830.	23450.
1982	4000.	2400.	2800.	1500.	48600.	5900.	580.	310.	530.	20.	990.	1200.	68830.
1983	2200.	2100.	4300.	2800.	3500.	9200.	370.	70.	0.	17000.	780.	950.	43270.
1984	1700.	3700.	2000.	2600.	1100.	2400.	30.	60.	0.	610.	150.	2500.	16850.
1985	1400.	3700.	6000.	2900.	1100.	4800.	400.	270.	1300.	5400.	1500.	1500.	30270.
1986	1100.	2300.	2000.	2900.	1400.	6300.	790.	520.	24300.	27800.	4800.	3600.	77810.
1987	5600.	8000.	5400.	3100.	34600.	18000.	3000.	1900.	2900.	2300.	2500.	4100.	91400.
1988	6700.	3300.	10700.	14000.	2000.	3000.	1600.	1400.	6700.	1600.	3900.	2400.	57300.
1989	3100.	3200.	4100.	2700.	8300.	40800.	1900.	2100.	6000.	4700.	2400.	2300.	81600.
1990	4700.	7000.	22800.	6600.	18500.	3200.	18900.	4200.	2400.	1200.	3900.	2400.	95800.
1991	4400.	3300.	3900.	3300.	7100.	6000.	1500.	4000.	4800.	2700.	3000.	11500.	55500.
1992	5200.	4700.	3500.	3400.	5700.	6500.	5300.	6800.	1500.	1900.	8400.	10600.	63500.
1993	8800.	6900.	8700.	8100.	47100.	5600.	5100.	2200.	3400.	2100.	3100.	3800.	104900.
1994	3500	3900.	9400.	13200.	6700.	4700.	2200.	1700.	830.	810.	10900.	2400.	60240.
1995	3200.	2800.	6400.	4300.	14100.	47000.	3100.	11200.	7900.	3800.	2700.	4000.	110500.
1996	3500.	3900.	4100.	3600.	3600.	10400.	3300.	8900.	2600.	2700.	4000.	3800.	54400.
1997	3200.	8700.	5200.	19800.	16600.	7200.	3500.	5300.	3800.	3600.	3200.	7600.	87700.
1998	9000.	6300.	24600.	--	--	--	--	--	--	--	--	--	--
MEAN	2800.	2900.	4100.	4400.	8800.	7000.	3100.	2300.	3000.	3000.	2300.	2400.	45900.
MAXIMUM	9000.	8700.	24600.	19800.	48600.	47000.	18900.	18700.	30800.	27800.	10900.	11500.	110500.
MINIMUM	600.	760.	780.	120.	930.	340.	30.	60.	0.	20.	50.	220.	12880.

TABLE 4-7

FORT COBB RESERVOIR

INFLOW VOLUME FREQUENCY

(MARCH 1940 - DECEMBER 1993)

MONTHLY INFLOW VOLUME IN ACRE-FEET Frequency of Occurrence in Years					
MONTH	2	5	10	20	50
January	2,000	3,500	4,900	6,400	9,000
February	2,300	3,600	4,600	5,800	7,400
March	2,600	4,500	6,600	9,400	14,900
April	3,100	5,400	7,600	10,400	15,200
May	4,700	11,800	20,100	32,000	56,100
June	4,200	9,500	14,200	19,500	27,700
July	1,400	4,000	7,300	12,500	23,700
August	950	3,000	5,200	8,300	13,800
September	1,300	3,900	6,900	11,200	19,500
October	1,450	4,000	6,900	11,100	19,500
November	1,600	3,100	4,300	5,500	7,100
December	1,750	3,100	4,400	5,900	8,400

4-08. Water Quality. Hardness and PH in the water are slightly high, however, the overall quality of water stored is very good. Naturally occurring conditions may lead to water quality deterioration near the bottom of the lake for short periods in midsummer; however, surface water remains in good condition. Water supply releases are generally made from the upper level intake conduit. The municipal water supply released through the Anadarko Aqueduct is chlorinated at the station located adjacent to the aqueduct stilling well at the base of the dam.

4-09. Channel and Floodway Characteristics. Cobb Creek below Fort Cobb Dam is a well matured stream that is entrenched in the old plain surface. The banks are made of sandy soils which are easily eroded and result in the existing meandering stream alignment. Vegetation within the channel floodway itself consists of light grasses with some mature trees and understory brush. The overbanks of Cobb Creek consist of pasture and cultivated cropland. The channel capacity of Cobb Creek downstream of Fort Cobb Dam is approximately 1,000 cfs, which corresponds to a stage of

14.7 feet at the USGS gage 1.2 miles downstream of the dam.

Flows from Cobb Creek combine with the Washita River below the town of Fort Cobb. The channel capacity of the Washita downstream near Anadarko is about 6,100 cfs = 19′ stage, near Alex is about 32,300 cfs = 19′ stage, and near Pauls Valley is about 39,800 cfs = 24′ stage. Discharge rating curves (without shifts applied) for the Clinton, Carnegie, Anadarko, Alex, Pauls Valley, Eakly and Fort Cobb gages are shown on plates 4-6 through 4-12, and are valid for approximations only. Shifted discharge rating curves used by the Water Control Section are adjusted for changing conditions and are maintained in current status insofar as possible. Time of crest travel for Cobb Creek and the Washita River are shown on Plate 4-13.

It should be noted that the channel capacities shown above are defined by the regulating stage. The corresponding flow rates are subject to variations with naturally occurring changes in stream conveyance.

4-10. Upstream Structures. There are no major structures upstream of Fort Cobb Reservoir in the Cobb Creek Basin. However, Foss Reservoir lies upstream of Fort Cobb Reservoir in the Washita River Basin. Foss Reservoir is located on the Washita River at river mile 474.4 and has a drainage area of 1496 square miles Foss Reservoir is operated and regulated by Reclamation, except for flood control regulation which is the responsibility of the Corps of Engineers.

4-11. Downstream Structures. There are no major structures below Fort Cobb Reservoir on Cobb Creek. Arbuckle Reservoir lies downstream of Fort Cobb on Rock Creek, a small tributary of the Washita River. This reservoir is located at mile 4.0 about six miles southwest of Sulphur, Oklahoma and has a drainage area of 126 square miles. Arbuckle Reservoir is operated and regulated by Reclamation, and the District, except for flood control regulation which is the responsibility of the Corps of Engineers.

4-12. Economics.

a. Population. Table 4-8 shows the actual and projected population of counties and major cities in the Washita River region below Fort Cobb Reservoir to Lake Texoma. A majority of the population resides either in small communities or rural areas. The population of the region has declined slightly between 1980 and 1990, largely

due to the oil decline of that period and a restructuring of the agricultural industry. However, projections have indicated a slow recovery for this area over the next 20 to 50 years. Migration into the major communities will result in the majority of the population growth.

TABLE 4-8

Population of Counties and Major Cities in the Region

County/City	YEAR 1980	1990	2000
	POPULATION		
Caddo County	30,905	29,550	32,270
Anadarko	6,378	6,586	7,470
Grady County	39,490	41,747	45,195
Chickasha	15,826	14,988	15,235
Garvin County	27,856	26,605	27,710
Pauls Valley	5,997	6,150	6,635
Murray County	12,147	12,042	12,490
Sulphur	5,516	4,824	4,650
Carter County	43,610	42,919	46,120
Ardmore	23,689	23,079	24,665
Johnston County	10,356	10,032	10,450
Tishomingo	3,212	3,116	3,190

SOURCE: 1993 County and City Extra, and "Population Projections for Oklahoma 1990-2020."

b. Agriculture. Agriculture is still the predominant industry in the region with about 6,200 farms in 1987. About 2.6 million acres of land were in farms in 1987 in the six counties in the region. Livestock production is dominant over crops in total value of products sold. Along Cobb Creek in Caddo County about one-half of the 2250 acres of cropland is wheat, with the remainder in a variety of crops: cotton, corn, grain sorghum, peanuts, alfalfa, and hay pasture. In Grady County, about one-half of the total floodplain acres is alfalfa, followed by wheat (20 percent), corn and pasture (each 10 percent), with the remainder in cotton and grain sorghum. Likewise, Garvin County above Pauls Valley is mainly alfalfa (50 percent) and wheat (20 percent), corn (10 percent), and pasture (10 percent) with some cotton and grain sorghum (5 percent each). Most of the land in the floodplain in Murray County is bermuda grass (59 percent) and wheat and alfalfa (20 percent each). In Carter County, about 85

percent of the floodplain acres is wheat. Johnston County is similar to Murray County in distribution of crops in the flood plain. Estimated yearly annual value of the major crops produced in the flood plains below Fort Cobb reservoir are shown in Table 4-9, based on FY 1994 current normalized prices (CNP) and average yields for each county in 1993.

TABLE 4-9

Washita River Flood Plain
Annual Value of Crops

Stream and Reach	Total Acres	Total Value
Cobb Creek Fort Cobb Reservoir to Mouth of Cobb Creek	2,250	$520,576
Washita River Mouth of Cobb Creek to Garvin-Grady County Line	23,000	$6,307,854
Garvin-Grady County Line to Mouth of Rush Creek	21,000	$5,765,036
Rush Creek to Upper Limits of Lake Texoma	9,900	$1,896,884
TOTAL	56,150	$14,490,349

c. Industry. The private non-farm civilian labor force in 1989 totals about 65,000, led by manufacturing and retail trade (about 7,000 employees each), and followed by services (such as education and health care, with about 5,000 employees), finance, insurance, and real estate. This excludes government workers, self-employed persons, farm workers, domestic workers, and railroad workers. State and local government employment totals about 10,000 employees. Unemployment ranges from 7 to 8 percent.

d. Flood Damages. Cumulative flood damages prevented by Fort Cobb Reservoir from completion in 1959 through FY 1993 total $2,495,000 of which $1,471,000 occurred in FY 1993 alone. In FY 1992, benefits attributed to Fort Cobb were $9,000; in FY 1991, benefits were $54,000; and in FY 1990, $45,000. Stage area curves and structural-loss curves for the reaches below Fort Cobb Reservoir are shown on Plates 4-14 through 4-17.

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological Stations.

a. General. The water control data system must meet the specific needs of the water control manager. The data system must include facilities to perform the following functions:

(1) Observe and store data at field stations.
(2) Transmit data from field stations.
(3) Decode and validate transmitted data.
(4) Store and retrieve data from database.
(5) Provide graphical and tabular data displays.
(6) Exchange data with other users.

A majority of the data input into the water control data collection system are time-variable data. They represent observations of the water regulation at various projects, water levels in the river basins, and hydrometeorological elements that affect these river basins. Although non-variable data are used in the data processing (such as reservoir capacities, outflow capabilities, etc.), the principal requirement is to gather, process and transmit time-variable data.

Hydrometeorological elements collected are:

(1) Water levels in rivers, lakes, and reservoirs.
(2) Precipitation measured at ground stations or estimated by radar or other sensors.
(3) Air temperature.
(4) Pan evaporation.
(5) Humidity.
(6) Wind speed and direction.

b. Facilities. The Corps, National Weather Service (NWS), USGS, Reclamation and the District share in the cost and maintenance of the data collection and communication network required to regulate Fort Cobb Reservoir. Pertinent reporting stations are shown on Plate 5-1. The key stream gages for regulation of Fort Cobb Reservoir are: Clinton-upstream, Carnegie-upstream, Eakley-upstream, Anadarko-downstream, Alex-downstream and Pauls Valley-downstream.

c. Reporting. The reporting procedure for precipitation and stream gaging is on a cooperative basis with the NWS. The reporting criteria for the pertinent precipitation and stream gaging stations are shown in Table 5-1. Hydrometeorological data collected by project personnel at Fort Cobb Dam are transmitted to the Water Control Section, Hydrology and Hydraulics Branch, Tulsa District Office, by

telephone (see Emergency Personnel Roster, page ii). Detailed instructions on reporting criteria are presented in Exhibit D, Standing Instructions to Damtender.

TABLE 5-1

REPORTING CRITERIA FOR PERTINENT STATIONS

STATION	REPORT TO	TIMES OF REPORT
RAINFALL STATIONS		
Airport Stations	National Weather Service	6-hour rainfall as of 6 a.m., 12 Noon, 6 p.m., and 12 Midnight.
Fort Cobb Dam	Corps of Engineers	Reporting criteria identical to that listed in subparagraph 5-07d.
All Other Stations	National Weather Service	24-hour rainfall as of 7 a.m., 1 p.m., 7 pm., whenever 0.50 or more of rainfall has accumulated in the rainfall gage.
STREAM GAGE STATION		
Washita River		
Upstream of Fort Cobb		
Clinton	Corps of Engineers	Every 4 hours and on set demand requirement
Carnegie	Corps of Engineers	Every 4 hours and on set demand requirement
Eakley	Corps of Engineers	Every 4 hours and on set demand requirement
Downstream of Fort Cobb		
Anadarko	Corps of Engineers	Every 4 hours and on set demand requirement
Alex	Corps of Engineers	Every 4 hours and on set demand requirement
Pauls Valley	Corps of Engineers	Every 4 hours and on set demand requirement
RADAR STATIONS	National Weather Service	Hourly

d. Maintenance. Maintenance and repair of the weather stations instrumentation are responsibilities of the NWS. Maintenance, repair and historical recording of stream gages are responsibilities of the USGS. The Hydrology/Hydraulic Section, Hydrology and Hydraulics Branch, Tulsa District, is charged with the responsibility for the equipment owned by the Corps.

e. Automation. Presently, only a few stream gages in the Tulsa District are manually called by telephone. The remainder are dual reporting data collection platforms (DCPs) which record data hourly and transmit the data every four hours as well as random transmissions when threshold values are exceeded. The data is transmitted via GOES satellite to a downlink and computer facility owned and operated by the National Oceanic and Atmospheric Administration (NOAA) in Washington, D.C. The data is retransmitted to the DOMSAT satellite and received by a downlink directly into the computer network at the District Office. When received, the river stage is converted to flow, and lake elevation is converted to storage. All the data is then stored in a data base in the Corps' Water Control Data System (WCDS) for access when needed. DCPs also report rain data in the same way. In addition to DCP data, observer rainfall data is collected and stored in the data base for use in forecasting. Observers phone the NWS offices in this region, and the NWS then encodes that data into a Standard Hydrologic Exchange Format (SHEF). This data is then transferred to the WCDS computer using telephone modems and a dedicated phone line to the Tulsa River Forecast Center (RFC). Once the data is received, it is decoded and handled in a manner similar to the DCP data. Informative display of all this data is possible through the use of several computer programs.

5-02. Water Quality Stations. There are no water quality stations in the lake. Water quality of the stream is monitored by the Oklahoma Water Resources Board (OWRB).

5-03. Sedimentation Stations.

a. Facilities. There are no sediment stations on Cobb Creek near Fort Cobb Reservoir. There are, however, 23 sedimentation ranges upstream of Fort Cobb Dam and 13 degradation ranges downstream of the dam. These ranges can be surveyed periodically for the purpose of computing sediment deposition and new lake area and capacity data. The sedimentation and degradation ranges are shown on Plates 2-5 and 2-6.

5-04. Recording Hydrologic Data. Hydrologic information is recorded as it is received by the Water Control Section as follows:

a. Stages and Discharges. The stages received from stream gaging stations and the corresponding discharges are maintained in the WDCS data base.

b. Precipitation. The precipitation data received from the NWS and DCPs are maintained in the WCDS data base.

c. Water Quality Data. No water quality data is recorded pertaining to the lake. Water quality data at stream locations is recorded the by OWRB and received at the Tulsa District Office in the form of the Oklahoma Water Quality Standards.

d. Radar and Satellite Reports. Current computer-enhanced satellite images, weather charts, and national radar summaries are automatically received into the WCDS computer from a private vendor. Also, a computer-enhanced image of the real-time radar scope image depicting cloud coverage and relative intensity is available from the NWS and is routinely received from Oklahoma City. NWS locations in and near the Tulsa District with this capability, in addition to Oklahoma City, are Kansas City and Monett, Missouri; Garden City and Wichita, Kansas; Amarillo, Texas; and others. Hard copies of any of this data are available by use of several plotters located in the Water Control Section.

The current radar system provides information about the areal distribution of precipitation. The NEXRAD (NEXT Generation RADAR) system of data collection developed by the NWS in cooperation with other agencies, uses sophisticated reflectivity and Doppler radar technology. NEXRAD provides useful quantitative precipitation data with high areal resolution. The radars are connected to computers which process the information into visual and digital output. Access to the NEXRAD system is available to the Corps.

5-05. Communication Network. Wire facilities at Fort Cobb Reservoir are local and long distance telephone service. Maintenance of the telephone lines is the responsibility of the company leasing the line to the U.S. Government.

5-06. Communication With Project.

a. Regulating Office With Project Office. Instructions for the storage and release of water from the flood control pool at Fort Cobb Reservoir will be communicated by the Water Control Section to the damtender for the implementation of the provisions set forth in Chapter 9 of this manual. This communication will normally be made by long distance telephone. The reports by the project office, described in paragraph 5-07 and Exhibit D of this manual, will be communicated directly to the Water Control Section. Should communication between the project and the Water Control Section be disrupted, the damtender at the project will, on his own initiative, direct regulation of the lake in

accordance with the Loss of Communication regulations as required in Chapter 7 and Exhibit D of this manual. A chart, "Organization for Flood Control Regulation, Fort Cobb Reservoir," is shown on Plate 5-2.

b. Between Project Office and Others. Communication between project personnel and other Federal, State and local agencies will be sufficient to effect the coordination described in Chapter 9 of this manual.

5-07. Project Reporting Instructions. Daily lake data from Fort Cobb Reservoir (see Plate 5-3) will be submitted to the Water Control Section during normal working hours. The Water Control Section is normally manned from 7:45 a.m. to 4:30 p.m. daily and various hours during flood control operations and weekends and holidays. Data for nonworking days shall be read from the recorder chart and submitted the following workday. Should unusual conditions arise during nonworking hours, one of the persons listed in the Emergency Personnel Roster on page ii should be contacted. Reports should be transmitted by 9:00 a.m. via telephone. The following data should be included in the daily report.

a. As of 8:00 a.m. Pool elevations at 8:00 a.m. and for the previous day at 12 noon, 4:00 p.m., and 12 midnight (all values should be read from the recorder chart); number of river outlet gates open, with the height of the openings; municipal and industrial release volumes for the preceding 24 hours; precipitation and evaporation in inches for the preceding 24 hours (7:00 a.m. to 7:00 a.m.); wind velocity and direction (at 8:00 a.m.).

b. Each Gate Operation. Date and time of gate operation, number and height of gates open before and after gate operation, and lake elevation. Confirmation of gate changes shall be made immediately after completion of the change. Complaints about pool elevations or releases, operating machinery failure and out-of-service times for maintenance shall be reported to the Water Control Section as they occur.

c. During Flood Periods. In addition to subparagraphs a and b above, reports should also be made at 1:00 p.m. and 7:00 p.m. or as instructed by the Water Control Section.

d. Rainfall Reports. Rainfall reports shall be made as follows:

(1) At 8:00 a.m. all precipitation that has occurred during the preceding 24 hours, 7:00 a.m. to 7:00 a.m. as shown on Plate 5-3 (covered by routine report on working days).

(2) At 1:00 p.m. when 0.50 inch or more of precipitation has occurred since 7:00 a.m. or if it has continued to rain since reporting at 8:00 a.m.

(3) At 7:00 p.m. when 0.50 inch or more of precipitation has occurred since the 8:00 a.m. report and no 1:00 p.m. report was made, or if it has continued to rain since reporting at 1:00 p.m.

(4) Report at once the occurrence of 2.00 inches or more of precipitation that occurred during a period of 6 hours or less.

(5) During non-normal working hours, the report should be made to one of the persons listed on the Emergency Personnel Roster on page ii; however, if no contact can be made, rainfall reports should be made to the NWS (see Supplemental Telephone Listing, page iii).

5-08. Warning System. Fort Cobb Dam has no audible warning system. Dam operators have the responsibility to initiate a warning to the Oklahoma Department of Civil Emergency Management and local law enforcement agencies if emergency situations develop. They have the responsibility to properly recognize emergency situations and to seek assistance from supervisory offices, if time permits. They must be knowledgeable of conditions that constitute an emergency, such as dam failure possibility. The downstream population should be notified as early as possible of a potential problem. Minimum notification procedures are as follows: A "General Alert" should be issued by the dam operator to the Anadarko olice Department when life-threatening high releases from a dam failure or flooding are predicted to reach the downstream population at risk within 6 hours; an "Evacuation Warning" should be issued by the dam operator when analysis of the threatening event, and reservoir response indicate that life-threatening floodwaters will reach the downstream population in four hours or less.

Should emergency or unusual situations occur, the Dam Operator will inform, by radio or by telephone, the Fort Cobb Reservoir Master Conservancy District Manager, who will assist in notifying the Oklahoma Highway Patrol, Caddo County Sheriff's department, fire departments, and the Civil Defense. If telephones are inoperable, the Manager will drive to the Anadarko Police Department Office, and they will radio the above agencies for assistance.

5-09. Frequency of Gate Changes. During flood periods, gate changes may be directed by the Water Control Section at any time. The initial transition to flood releases or vice versa may require gate changes every hour. When the flood waters have significantly risen into the flood control pool, gate changes can be expected two or more times daily. Only under the most unusual circumstances will gate changes be ordered more frequently than once every hour.

VI - HYDROLOGIC FORECASTS

6-01. General. Hydrologic forecasts are necessary in predicting streamflow upstream and downstream of Fort Cobb Reservoir to determine if and when releases should be made.

a. Role of Corps of Engineers. Hydrologic forecasts are made by the Forecasting Section for the Water Control Section, Tulsa District, for use in the regulation of lakes for flood control and other authorized purposes and for the benefit of the Corps' construction projects and flood-fighting activities. The NWS furnishes weather and flood forecasts to the public. The District furnishes current information on lake levels, weather, streamflow, or any other available information on observed conditions, along with technical advice and general news releases, all made through the Public Affairs Office (see Supplemental Telephone Listing, page iii).

b. Role of Other Agencies. The NWS, River Forecast Center in Tulsa, Oklahoma, is the official agency making river flood forecasts. The forecasts are sent to the Water Control Section and other NWS offices via the NWS Automation of Field and Operation Services (AFOS) system. This information is disseminated by Oklahoma Weather Wire circuit (by commercial vendors) to subscribing Government agencies and various news media. The NWS issues routine scheduled reports containing the following forecasts:

(1) Weather forecasts (daily and 5-day extended).

(2) National weather summaries and additional details for the five south-central states (four times daily).

(3) Quantitative precipitation forecasts (four times daily - one 24-hour and one 48-hour quantitative precipitation forecast and two 6-hour quantitative precipitation forecasts).

(4) Three-day river stage forecasts, when required.

(5) Urgent priority messages such as severe weather warnings, watches, forecasts and statements and instructions from Civil Defense during emergency conditions are transmitted immediately, regardless of scheduled traffic. Unscheduled traffic, including the following, is sent any time the circuit is idle.

(a) Damage reports.

(b) Road information and winter weather conditions.

(c) River and flood warning bulletins, forecasts and statements.

(d) Thirty-day forecast.

(6) Percent chance of precipitation (twice daily).

6-02. Flood Condition Forecasts.

a. Requirements. Flood condition forecasts are necessary whenever substantial rainfall has occurred on the basin upstream or downstream of Fort Cobb Reservoir. The Forecasting Section makes forecasts for inflow into Fort Cobb Reservoir for the area shown on Plate 6-1. The time required to make forecasts will vary from 2 to 6 hours depending on the timely reception of rainfall reports and the amount of basin area covered by the storm.

b. Methods. The Forecasting Section makes individual lake inflow forecasts and forecasts of flow for the uncontrolled areas downstream of the dams. These forecasts are made using the Corps' Hydrologic Engineering Center (HEC) computer program 723-X6-L2010, HEC-1.

(1) Forecasting River Stages. The official forecasts of the NWS are utilized in predicting river stages. Forecasts are also made by the Forecasting Section by applying the peak flows determined by the forecasting procedures described below to stage discharge curves. Forecasts for the stream gages listed in Table 5-1 are pertinent to the regulation of Fort Cobb Reservoir.

(2) Forecasting Flows. A HEC-1 computer forecast model of the drainage area upstream of Fort Cobb Reservoir is used to forecast inflows. The area downstream of the dam is modeled in the Lake Texoma Forecast Model. These models are used separately to predict inflow to Fort Cobb Reservoir and flows at downstream control points.

(a) Runoff Estimate. Precipitation data is received from the NWS and the data collection platforms by the Water Control Data System (WCDS) computer. The average precipitation over the project basin is computed by a computer program called RAIN. The RAIN program plots isohyetal maps of 24-hour rainfall from the DCP data. It then computes the basin average total rainfall using a variation of the NWS

alternate method of rainfall calculation which uses a grid system. The program is able to break the rainfall down into sub-basin totals for input into HEC-1F forecasting models from which reservoir inflow volume estimates are made and pool elevations and time of peak are predicted.

(b) Computer Model. The HEC-1 inflow model for Fort Cobb Reservoir consists of one area as shown on Plate 6-1. Snyder's coefficients are used to describe the hydrologic characteristics of the area. Hydrograph routing is accomplished using the modified Puls method which requires input of the storage-discharge relationship within each routing reach for the downstream forecast model. Channel losses are also considered significant for the Washita River and are included in the forecast model for downstream control points. A sample of the input is shown on Table 6-1 (page T6-1).

(c) Inflow Computations. Computation of the forecasted inflow and pool elevation is accomplished by the HEC-1 computer model. Input requirements are runoff (or rainfall and loss rates), initial base flow, if any, starting pool elevation, and controlled releases. The model is run interactively on the WCDS computer located in the Hydrology-Hydraulics Branch of the Tulsa District office. The model can be run on the WCDS computer at the Southwestern Division (SWD) office in Dallas, and can also be loaded on other computers which are used as backups if the primary computer in Tulsa is down. HEC Data Storage System (DSS) files are periodically backed up on magnetic disk and tape. A sample of the output summary is shown on Table 6-2 (pages T6-2 and T6-3).

Stream gage stage data is received from the DCPs by the WCDS computer which aids in verifying the predicted hydrographs. The predicted inflow hydrograph is verified and adjusted as necessary by comparing it to the actual developing hydrograph. The developing inflow and lake stage hydrograph is computed from known pool elevations and releases. A sample discharge and inflow computation is shown on Plate 6-2.

(d) Flood Control Releases. Estimated hydrographs at control points downstream from the dam are made by procedures described in paragraph 6-02 of this manual. These hydrographs are adjusted to conform with the latest hydrologic information available. Trial releases within the limitations of Fort Cobb Reservoir flood control storage and outlet works are routed and combined with the adjusted hydrographs for determination of hydrographs at the downstream control points. The resulting hydrographs are examined for concurrence with flow limits at downstream control points and adjusted accordingly.

6-03. Conservation Purpose Forecasts.

a. Requirements. Conservation forecasts may be requested by Reclamation and/or the District to predict pool levels during fish spawning season, special recreation events, water supply and irrigation supply. Forecasts may also be requested for water quality.

b. Methods. Forecasts for conservation purposes during the non-flood periods would rely largely on statistical interpretation of historical data. Estimated flows at the dam site, see Table 4-6, may be used for conservation forecasts.

6-04. Long-range Forecasts.

a. Requirements. The regulatory decision involved in evacuating stored floodwater, sustaining yield during low-flow periods, and maintaining constant or slowly changing pool levels for conservation purposes is dependent on accurate estimates of the water volume that will pass through the reservoir.

b. Methods. Reliable methods for long-range runoff forecasts are not presently available. The NWS publishes an "Average Monthly Weather Outlook" semi-monthly which may be used as an estimate of the trend of the weather but should not be given too much weight for one forecast, especially for a specific point. The NWS forecasts described in paragraph 6-01b are more useful in a shorter range.

VII - WATER CONTROL PLAN

7-01. General Objectives. The primary objectives of Fort Cobb Reservoir are to store, regulate and convey water for irrigation and municipal use; provide fish and wildlife resources; provide outdoor recreation opportunities; downstream flow regulation; and to control floods. The flood control storage provided by Fort Cobb Reservoir can contain 3.83 inches of runoff from the drainage area upstream of the dam.

7-02. Major Constraints. The major constraint is the limited channel capacity downstream of the dam. The current channel capacity is 1,000 cfs while the river outlet works are capable of releasing 2,070 cfs at the top of the conservation pool.

7-03. Overall Plan for Flood Control.

a. General. Fort Cobb Reservoir is operated by the District under contract with Reclamation. Under the provisions of Section 7 of the Flood Control Act of 1944, the Secretary of the Army prescribes regulations for the use of storage allocated for flood control at all lakes constructed wholly or in part with Federal funds provided on the basis of such purposes. Fort Cobb Reservoir will be regulated for control of floods on the Washita River in a manner to maximize downstream benefits and to meet authorized purposes from the conservation pool. The resource development to be accomplished by the Red River system is discussed in the Reservoir Regulation Master Manual Red River Basin, while the specific purposes of the various projects are detailed in the appropriate appendices. The specific objectives and regulation procedures for the various project purposes at Fort Cobb Reservoir are discussed in the following paragraphs.

b. System Regulation. Fort Cobb Reservoir will be regulated in conjunction with Foss and Arbuckle Reservoirs for benefits on the Washita River and will obtain incidental benefits on the Red River. Flood control releases from Fort Cobb, Foss, and Arbuckle Reservoirs will share the downstream channel capacity. The reservoir with the highest percent of flood control storage utilized will be given priority to use of available channel capacity.

7-04. Standing Instructions to the Dam Operator. During flood periods, the reservoir will be regulated in accordance with the normal regulations for flood control as directed in subparagraph 7-05a. and Exhibit D of this manual. Instructions for the storage and discharge of floodwater from the flood control pool will be issued by the Water Control Section, Tulsa District. In the event that communications with the Tulsa District Office are disrupted, the reservoir will be regulated in accordance with the

schedule of loss of communication (emergency) regulations for flood control instructions in subparagraph 7-05b and Exhibit D. In addition, the Dam Operator will immediately make every effort to re-establish communications with the Tulsa District Office. The Dam Operator will make daily records of the weather station and pool level data and report those data, as directed in paragraph 5-07 and repeated in Exhibit D. Should an emergency exist, such as inoperable gates, drowning accident, excessive trash in the gates, embankment boils, or power outage, the Water Control Section will be notified immediately.

7-05. Flood Control.

a. Normal Flood Control Regulations. Fort Cobb Reservoir is regulated to provide flood reductions on Cobb Creek from Fort Cobb Dam to the confluence with the Washita River and in conjunction with Foss and Arbuckle Reservoirs cn the Washita River. The following regulations will govern releases from Fort Cobb Reservoir (see Table 7-1).

TABLE 7-1

NORMAL FLOOD CONTROL REGULATION SCHEDULE

FORT COBB RESERVOIR

RESERVOIR ELEVATION (Feet NGVD)	POOL CONDITIONS	REGULATIONS
Below 1342.0	Rising or Falling	Releases are scheduled by the Fort Cobb Reservoir Master Conservancy District. Releases are not to exceed the channel capacity of Cobb Creek downstream of the dam (currently estimated to be 1,000 cfs). When combined with local flows, releases are not to exceed a stage of 19.0 feet (currently estimated to pass approximately 6,100 cfs) at the Anadarka, Oklahoma gage, a stage of 19.0 feet (currently estimated to pass approximately 32,300 cfs) at the Alex, Oklahoma gage, or a stage of 24.0 feet (currently estimated to pass approximately 39,800 cfs) at the Pauls Valley, Oklahoma gage.

TABLE 7-1 (Cont'd)

NORMAL FLOOD CONTROL REGULATION SCHEDULE

FORT COBB RESERVOIR

1342.0 - 1354.8	Rising	Releases shall be made under the direction of the Corps of Engineers. *Releases will be limited to amounts, which when combined with local flows downstream of the dam, will not produce flows in excess of bankfull On Cobb Creek (estimated to be 1,000 cfs). In addition, flood control releases, when combined with uncontrolled runoff downstream of the dam, will not exceed a stage of 19.0 feet (estimated to pass a flow of approximately 6,100 cfs) at the USGS gage on the Washita River near Anadarka, Oklahoma, a stage of 19.0 feet (estimated to pass approximately 32,300 cfs) at the USGS gage on the Washita River near Alex, Oklahoma, or a stage of 24.0 feet at the Pauls Valley, Oklahoma gage (currently estimated to pass approximately 39,800 cfs). When the reservoir elevation forecast indicates that this operation will result in a reservoir level exceeding elevation 1354.8 feet, NGVD, releases may be modified in order to prevent the reservoir from exceeding elevation 1354.8 feet insofar as possible. When the pool elevation reaches 1354.8ft, NGVD, the release rate shall be equal to inflow or Maximum rate possible, whichever is less. Close coordination is required among the Tulsa District, the Corps

TABLE 7-1 (Cont'd)

NORMAL FLOOD CONTROL REGULATION SCHEDULE

FORT COBB RESERVOIR

RESERVOIR ELEVATION (Feet NGVD	POOL CONDITIONS	REGULATIONS
1342.0-1354.8 (cont'd)	Rising	of Engineers, and the Bureau of Reclamation to ensure that the maximum releases through the river outlet gates are attained prior to significant uncontrolled spillway discharge.
Above 1354.8	Rising	The Bureau of Reclamation is responsible for directing release of water when the pool is above elevation 1354.8 feet, NGVD. Discharge shall be made at the maximum release possible through the river outlet gates and the uncontrolled spillway.
Above 1354.8	Falling	Continue the maximum release rate reached under rising pool conditions, until the pool recedes to elevation 1354.8 feet, NGVD.
1354.8 - 1342.0	**Falling	*Release rates shall not exceed the maximum rate permissible under rising conditions within this pool elevation range.

* For release rates less than that equal to 2 conduit gates opened 10 percent each, use only one gate.

** After making near channel capacity releases (1000 cfs) for several days or longer, make one gate change to about 800 cfs and hold for 2 or 3 days to allow the saturated banks to stabilize. The release rate may then be decreased by one or two gate changes per day.

b. Loss of Communications. When communication with the Tulsa District Office is disrupted, the Dam Operator will, on his own initiative, direct regulation of the reservoir in accordance with the following schedule (see Table 7-2) until communication is restored. In addition, the Dam Operator will immediately make every effort to re-establish communication with the Tulsa District Office. The river outlet gates shall be operated at uniform openings except when gates are open less than 10 percent.

TABLE 7-2
EMERGENCY FLOOD CONTROL REGULATION SCHEDULE
LOSS OF COMMUNICATION WITH WATER CONTROL SECTION
FORT COBB RESERVOIR

RESERVOIR ELEVATION (Feet NGVD)	POOL CONDITIONS	REGULATION
Below 1342.0	Rising or Falling	Release to be scheduled by the Fort Cobb Reservoir Master Conservancy District and are not to exceed the channel capacity of Cobb Creek down stream of the dam (currently estimated to be approximately 1,000 cfs.)
1342.0 - 1354.6	Rising	Release being made prior to loss of communication shall be maintained until communications are restored or the pool rises to elevation 1354.6 feet NGVD.
1354.6 - 1354.8	Rising	Releases shall be increased by 170 cfs every two hours until the pool becomes static or the pool rises to elevation 1354.8 feet, NGVD, at which time the river outlet will be staged to fully open.

TABLE 7-2 (Cont'd)
EMERGENCY FLOOD CONTROL REGULATION SCHEDULED
LOSS OF COMMUNICATION WITH WATER CONTROL SECTION
FORT COBB RESERVOIR

RESERVOIR ELEVATION (Feet NGVD)	POOL CONDITIONS	REGULATION
Above 1354.8	Rising or Falling	Releases shall be made at at the maximum rate possible and continued until the pool recedes to elevation 1354.8 feet, NGVD. At no time while pool is rising shall releases be decreased.
1354.8 - 1343.5	Fallng	Maintain release in effect when communication was lost or maintain release attained under rising pool conditions if the release is less than or equal to 1000 cfs. If the release is greater than 1000 cfs, reduce the release by 250 cfs every 2 hours until the release is 1000 cfs. Do not reduce release if the reduction would cause the pool to rise.
1343.5 - 1342.0	Falling	Begin a gradual reduction of the release (at a rate not to exceed 170 cfs per 3-hour period) making sure the pool continues to fall. Stabilize the pool at elevation 1342.0 feet, NGVD.

c. Constraints. The regulation schedules provide that the currently estimated channel capacity of 1,000 cfs in the reach from the dam to the Washita River is not to be exceeded insofar as practicable. Floodwaters will be released as rapidly as practicable with consideration given to minimizing flooding of low-water crossings and low-lying farmland.

7-06. Recreation. Recreation is an authorized project purpose at Fort Cobb Reservoir although no storage or releases are specifically provided or to be used for this purpose.

7-07. Water Quality.

a. General. Water quality control is not an authorized project purpose at Fort Cobb Reservoir, and there is no storage or release specifically provided for it.

b. Regulation Procedure for Water Quality. Responsibility for releases to be made to alleviate or respond to emergency conditions such as fish kills and flow augmentation for pollution abatement or aesthetics will be with Reclamation through the District.

7-08. Fish and Wildlife. Fish and wildlife conservation is an authorized project purpose at Fort Cobb Reservoir although no storage is specifically provided for this purpose.

7-09. Water Supply.

a. General. All water supply-related activities are the responsibility of the District. Municipal and industrial water supply facilities at Fort Cobb Reservoir consist of a control house and a 21- mile water supply pipeline to down stream customers (See Exhibit A).

b. Regulation Procedure for Water Supply.

The withdrawal of water from Fort Cobb Reservoir can be made from two withdrawal levels in the reservoir (See Exhibit A). The withdrawal is made to a stilling well in the control house where it is metered into a closed conduit for municipal water supply. The municipal water outlet is designed so that a minimum discharge of 5 cfs and a maximum discharge of 35 cfs can be made.

7-10. Downstream Water Rights. Downstream water rights are the responsibility of the Oklahoma Water Resources Board. Any release for downstream water rights is the responsibility of the District and Reclamation.

7-11. Hydroelectric Power. Hydroelectric power production is not a project purpose of Fort Cobb Reservoir and is not being pursued at this time.

7-12. Navigation. Navigation is not considered in the regulation of Fort Cobb Reservoir at the present time.

7-13. Drought Contingency Plans. Section 7 of the Flood Control Act of 1944 limits control of projects not owned or operated by

the Corps of Engineers to regulation for the use of storage allocated for flood control or navigation. There is no authority for the Corps to develop or implement a drought contingency plan for this project.

7-14. Flood Emergency Action Plans. The Standing Operating Procedures prepared by the Bureau for Fort Cobb Dam contains an Emergency Preparedness Plan which describes procedures to be followed during flooding and other emergencies. Controlled distribution of this document is determined by the Bureau.

7-15. Deviation From Normal Flood Control Regulation. Deviation from normal flood control regulation of the reservoir is occasionally necessary. Prior approval for a deviation is obtained from the SWD except as noted in subparagraph 7-15a. below. Deviation requests fall into the following categories:

a. Emergencies. The water control plan is subject to temporary modification by the Corps if found necessary in time of emergency. Request for and actions on such modifications may be made by the fastest means of communication available. The action shall be confirmed in writing the same day to Reclamation (the project owner) and to the District (the operator) and shall include justification for the action. Also, the project owner or operator may temporarily deviate from the water control plan in the event an immediate short term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other serious hazards. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing as soon as possible to the Corps by Reclamation or the District and shall include justification for the action. Continuation of the deviation will require the express approval of the Corps.

b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulations of the reservoir, although they are not considered emergencies. Construction accounts for the major portion of the incidents and include utility stream crossings, bridge work, and major construction contracts. Changes in releases are sometimes necessary for maintenance and inspection. Requests for changes of release rates are generally from a few hours to a few days. Each request is analyzed on its own merits. Consideration is given to upstream watershed conditions, potential flood threat, conditions of the lakes, and possible alternative measures. In the interest of maintaining good public relations, the requests are complied with providing there are no adverse effects on the overall operation of the project (or projects) for the authorized purposes. Approval for these minor deviations will normally be obtained from the Corps by telephone.

A written confirmation showing the deviation and condition will be furnished to the Corps by Reclamation.

c. Planned Deviations. Advance approval of the Corps is required prior to any deviation from the plan of regulation prescribed or approved by the Corps in the interest of flood control, except in emergency situations provided for in subparagraph 7-15a. above. Each condition will be analyzed on its own merits. When conditions appear to warrant a prolonged deviation from the approved plan, Reclamation and the Corps will jointly investigate and evaluate the proposed deviation to insure that the overall integrity of the plan would not be unduly compromised. Approval of prolonged deviations will not be granted unless such investigation and evaluations have been conducted to the extent deemed necessary by the Corps.

7-16. Operational Curves. The evaporation curves, the uncontrolled spillway rating curve, the river outlet works conduit rating curve (1 - gate, partial gate openings), and the river outlet works (2 - gates, partial gate openings) are shown on Plates 7-1 through 7-4. The Clinton, Carnegie, Anadarko, Alex, Pauls Valley, Eakley, and Fort Cobb rating curves are shown on Plates 4-6 through 4-12. Rating curves provided by the USGS and used by the Water Control Section are adjusted for changing conditions and are maintained in current status to the extent practical. Table 7-3 located on pages T7-1 through T7-5, shows elevation versus area and capacity for Fort Cobb Reservoir.

7-17. Rate of Release Change. The increase and decrease in releases from the reservoir shall be accomplished in a manner which minimizes damage to the reservoir area and downstream channel as shown in Table 7-4. Every reasonable precaution will be made to minimize bank sloughing, undercutting, erosion, and eliminate, if possible, danger to human and animal lives. Situations will arise which will not allow an orderly increase and/or decrease in releases. Examples of these situations are large releases as described in paragraph 7-05(a), and drownings which occur downstream of the dam.

TABLE 7-4

RELEASE RATE CHANGES

FORT COBB RESERVOIR

INCREASING RELEASES TO CHANNEL CAPACITY (1)

Current Release Range (cfs)	Maximum Increase (cfs)	Minimum Time Between Changes (Hours)
0 - 1,000	170	2

DECREASING RELEASES BELOW CHANNEL CAPACITY (1)

Current Release Range (cfs)	Maximum Decrease (cfs)	Minimum Time Between Changes (Hours)
1,000 - 0	170	3

(1) See paragraph 7-05(a) for releases that will exceed channel capacity and decrease of releases in excess of channel capacity.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. In addition to the general benefits from the project, the effects of flood control regulations on the inflow design flood and an example of the normal and loss-of-communication regulations applied to a major flood are discussed in the following paragraphs.

8-02. Flood Control.

a. General. The flood control storage incorporated in Fort Cobb Reservoir was based on the design storm for the project. Several storms were considered in determining the design storm. It was found that the storm of September 2-6, 1940, centered at Hallet, Oklahoma, as transposed, fitted and adjusted for maximum moisture, gave critical results.

b. Inflow Design Flood. The inflow design flood (a percentage of the probable maximum flood series) can be routed through the reservoir and not overtop the dam. The American Meteorological Society (AMS) defines the probable maximum precipitation (PMP) as "the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage basin at a certain time of year" (AMS, 1959). The probable maximum storm was developed using procedures and criteria from NWS Hydrometerological Reports No. 51 and 52 (HMR51 and HMR52) (Schreiner and Riedel, 1978; Hansen, Schreiner and Miller, 1982).

The probable maximum flood is identified as a hypothetical flood that combines the most critical meteorologic and hydrologic conditions reasonably possible at a specific location. Reclamation adopted a flood series as the critical event in determining the safety of Fort Cobb Dam. The critical event (PMF series) contains a 100-year antecedent flood followed by the PMF.

Fort Cobb Dam was originally designed for an inflow design flood (IDF) having a peak inflow of 181,000 cfs and a 42-hour volume of 190,000 acre-feet. The IDF was routed, beginning with the flood pool half full, resulting in a maximum design pool of elevation 1374.4 feet, NGVD. Reclamation's updated hydrologic studies approved in December 1984 for Fort Cobb Reservoir resulted in a PMF with a peak inflow of 370,700 cfs and a 72-hour volume of 235,000 acre-feet.

A dam failure study does not exist using the 1984 PMF. The 1984 PMF results in a higher maximum water surface elevation being reached in Fort Cobb Reservoir than resulting from the 1956 IDF. The 1984 PMF would overtop the dam by 1.8 feet, but it is not likely that the failure of Fort Cobb Dam at the higher maximum water surface elevation associated with the 1984 PMF would result in any significant increase in flow depths or flood

boundaries when compared to the existing inundation study. The dam failure flood boundaries depicted on the 1983 Area Inundation Maps have been determined to be a reasonably accurate representation of the flooding caused by the failure of Fort Cobb Dam during the 1984 PMF.

Based on the 1983 Inundation Study, failure of Fort Cobb Dam commenced when the reservoir was at elevation 1374.8 feet, 5.2 feet below the dam crest. The breach was assumed to have a base width of 510 feet, and takes 3 hours to reach full size. The peak outflow through the assumed breach was 1,287,000 $feet^3/s$. Area Inundation Maps are based on the 1983 Inundation Study and are dated May 1983. The maps cover the area between the dam and Chickasha, Oklahoma, a distance of slightly more than 50 miles. Plate 8-1 shows the operational hydrograph for the IDF.

c. Standard Project Flood. One-half of the inflow design flood was considered equivalent to the standard project flood (SPF). Plate 8-2 shows the operational hydrograph for the SPF.

d. Other Floods. The flood of May 1993 is the maximum flood of record on Cobb Creek. This flood had an estimated peak discharge of 17,250 cfs and an estimated volume of 41,700 acre-feet. Plate 8-3 shows the May 1993 flood operational hydrograph.

The flood of May-June 1995 had a 33 day inflow volume of 55,800 acre-feet and resulted in the maximum pool of record of 1352.25 on 13 June 1995. This flood hydrograph is not shown on a plate.

8-03. Recreation. Fort Cobb Reservoir provides over 2,000 acres of land and some 2,300 acres of water surface areas for recreation. There are also about 1,800 acres of land and 1,800 acres of water surface for wildlife management. The reservoir provides some 45 miles of shoreline at the top of the conservation pool. The recreation areas are administered by the Oklahoma Tourism and Recreation Department, while the wildlife area is administered by the Oklahoma Department of Wildlife Conservation. Since reservoir releases are primarily for municipal and industrial (M&I) demands and flood control, the reservoir is maintained at a near full conservation pool elevation and does not normally experience drastic drawdowns. Recreation includes sightseeing, picnicking, camping, swimming, boating, fishing, hunting, golfing, and water skiing.

8-04. Water Quality. No specific storage is provided for water quality control; however, the occasional flood control releases will aid in maintaining flow on Cobb Creek and the Washita River. Most of the flow on Cobb Creek immediately downstream from Fort Cobb Dam is from the water released from the reservoir and the flow collected by the seepage control system.

8-05. Fish and Wildlife.

a. Wildlife. The Game Division of the Oklahoma Department of Wildlife is in charge of managing the wildlife area at Fort Cobb Reservoir. The wildlife conservation portion of the reservoir is located north of Township 9. The Game Division has identified deer and fur-bearing animals as species to maintain and improve. Work has also been initiated with the objective of improving the population of migratory birds, especially Canadian geese.

b. Fisheries. The reservoir fishery consists of large mouth bass, white bass, walleye, crappie (black and white), and catfish. These species are compatible with the environment.

c. Fishing and Hunting Access Areas. All motor vehicles must remain on designated roads and parking areas for hunting and fishing. There are paved roads, gravel roads, and unimproved roads leading to the wildlife area.

8-06. Water Supply. Fort Cobb Reservoir contains 72,570 acre-feet of storage in the conservation pool between elevation 1300.0 feet NGVD (top of inactive pool) and elevation 1342.0 feet NGVD (top of active conservation pool). This storage will provide municipal and industrial water to the city of Anadarko and to the Western Farmers Electric Cooperative.

8-07. Hydroelectric Power. Hydroelectric power is not a project purpose of Fort Cobb Reservoir.

8-08. Navigation. Navigation is not a project purpose of Fort Cobb Reservoir.

8-09. Drought Contingency Plans. Section 7 of the Flood Control Act of 1944 limits control of projects not owned or operated by the Corps of Engineers to regulation for the use of storage allocated for flood control or navigation. There is no authority for the Corps to develop or implement a drought contingency plan for this project.

8-10. Emergency Action Plans. The Standing Operating Procedures prepared by the Bureau for Fort Cobb Dam contains an Emergency Preparedness Plan (EPP) which describes procedures to be followed during flooding and other emergencies. Controlled distribution of this document is determined by the Bureau. A newly revised Emergency Action Plan, which will replace the EPP, is scheduled for completion in 1998.

8-11. Frequencies.

a. Peak Inflow Probability. Peak inflows taken from the monthly inflow computation records for the period 1959 through

1993 were used to compute the maximum annual peak inflow probability. The inflow probability was derived in accordance with Bulletin 17B "Guidelines for Determining Flood Flow Frequency" (USGS, 1981). The peak inflow probability curve is shown on Plate 8-4.

b. Pool elevation duration and frequency. The maximum and minimum annual pool elevations were taken from the Fort Cobb Reservoir records for the period 1963 through 1993. This record was chosen to reflect actual regulation of the project after the conservation pool of elevation 1342.0 feet NGVD was reached. The frequency computations were made using the procedures presented in ER 1110-2-1450 dated October 1962. Plate 8-5 shows the pool elevation probability curve.

The pool elevation-duration curve was also taken from the Fort Cobb Reservoir records for the period 1963 through 1993, as stated above. The pool elevation-duration curve is shown on Plate 8-6.

c. Key Control Points. Discharge rating curves used in the regulation of Fort Cobb Reservoir are shown on Plates 4-6 through 4-12 for the USGS stream gages near Clinton, Carnegie, Anadarko, Alex, Pauls Valley, Eakley, and Fort Cobb, respectively.

8-12. Other Studies.

a. Examples of Regulation. Computer programs have been developed to forecast inflows to the lake, the resulting pool elevations, and the effects of releases at downstream gages. Use of these programs during real-time flood regulation greatly enhances the Corps' ability to achieve significant flood reductions.

b. Channel and Floodway Improvements. The limiting non-damaging flow used in regulation is currently estimated to be 1,000 cfs based on observations of several floods in the 1980's and 1990's.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organizations.

a. Corps of Engineers. Fort Cobb Reservoir is a Reclamation project, with the Tulsa District Corps prescribing and directing the flood control releases. Operation and maintenance, as well as regulation of the conservation storage, will be the responsibility of the District acting through a dam operator. Regulation of flood waters in excess of the flood control storage is the responsibility of Reclamation. Project reporting instructions are presented in Chapter 5, and project regulating instructions are presented in Chapter 7 of this manual.

(1) Responsibilities and Duties During Normal Operations. The Water Control Section, Hydrology-Hydraulics Branch, Tulsa District Office, is charged with the following responsibilities and duties under general supervision of the Engineering and Construction Division.

(a) Normal flood control of reservoirs and dissemination of routine data.

(b) Investigations and refinement of flood control regulation procedures.

1. Analysis of past floods.

2. Reconnaissance to determine downstream damages and recommend channel capacities (maximum controlled release rates).

3. Improvement of hydrologic forecasting techniques.

4. Planning and coordinating the hydrometeorologic reporting network with Reclamation, NWS, and the USGS.

(c) Training personnel in flood control duties.

1. Periodic visits to projects by personnel of the Water Control Section to familiarize themselves with water control facilities, become acquainted with the operating personnel, discuss emergency regulation procedures, and provide the onsite information for improving facilities and operational methods.

2. Instruction of personnel of the Hydrology-Hydraulics Branch in flood control procedures to supplement the Water Control Section during flood emergencies.

(d) Preparation of reports on lake regulations.

1. Recurring reports.
2. Water control manuals.
3. Providing information for post flood reports.

(2) Responsibilities and Duties During Flood Emergencies. During flood emergencies, the Water Control Section is responsible for the following:

(a) Evaluation of current hydrologic, hydraulic and meteorologic data and determination of appropriate release schedules.

(b) Presentation of storm and flood analysis to the District Engineer and other District personnel as required.

(c) When necessary, furnishing personnel to assist project operating personnel in flood regulations.

(d) Regulation of lakes in accordance with flood control regulation schedules.

(e) Furnishing information to higher authority.

1. Initial reports to the SWD and Office of the Chief of Engineers by means of the fastest communication channels available.

2. Situation data provided to EOC.

(f) Furnishing information to the Reservoir Information Control Center (RICC).

(g) Furnishing information to Reclamation.

The duties of the dam operator under flood conditions are set forth in Chapter 7 of this manual. The details of the overall procedures of the Tulsa District under emergency conditions are set forth in Tulsa District Supplement A, Natural Disaster Activities, to ER 500-1-1.

(3) Assignment of Personnel. During non-flood periods, routine regulation of the reservoir are accomplished by the Fort Cobb Reservoir Master Conservancy District. However, during flood periods, the Water Control Section with the assistance of other Corps personnel are responsible for providing flood control regulation of the reservoir. Plate 5-2 shows the organization chain of command for the Water Control Section during a flood. The area, magnitude and duration of the flood will determine the staffing requirements for each event.

(4) Provision for 24-hour Alert. The NWS and project personnel are provided with a list of names, addresses, and telephone numbers of key personnel of the Engineering and Construction Division, Hydrology and Hydraulics Branch, with instructions to provide warning if unusual conditions occur. Responsible personnel are on duty at the Tulsa District Office 24 hours a day whenever basin and/or project conditions warrant and during flood emergencies. Responsible personnel will be on duty or on call at the project at all times.

(5) Role of Dam operator. The dam operator will operate the reservoir during flood periods according to instructions issued by personnel of the Water Control Section. The instructions follow the "Normal Regulations for Flood Control", included in Chapter 7 and paragraph II of Exhibit D. If the dam operator loses communication with the District Office, he will immediately make every effort to reestablish communication with the District Office while initiating "Emergency Regulations for Flood Control", as included in Chapter 7 and Exhibit C of this manual. The dam operator will make observations at the weather station and report those observations as directed in paragraph 5-07.

b. Other Federal Agencies.

(1) The District is responsible for regulation of the conservation storage for irrigation and municipal water supply. Reclamation is responsible for the reservoir's regulation once the flood control storage has been exceeded. However, at the request of Reclamation, during these surcharge operations, the Corps will provide assistance by continuing to make hydrologic forecasts and suggesting release rates and producing other pertinent information requested by Reclamation. The information provided by the Corps will be used at the discretion of Reclamation as the safety of the structure remains the responsibility of Reclamation.

(2) The NWS and the USGS cooperate with the Water Control Section to accumulate rainfall and streamflow data.

c. State Agencies. The Tulsa District Office exchanges information with State government officials, the State Department of Transportation, Oklahoma Highway Patrol, and other agencies during time of flood emergencies. The Oklahoma Water Resources Board has the responsibility to protect the waters from pollution and to coordinate procedures.

9-02. Interagency Coordination. Cooperative arrangements with other Federal agencies, State agencies, and local interests are discussed in the following subparagraphs.

a. Local Press and Corps Bulletins. The Corps and the NWS cooperate in forecasting flood stages and making

streamflow measurements. Local press will be provided with flood forecasts by the Tulsa River Forecast Center and the NWS (officially responsible for issuing flood warnings). This information will be supplemented by the Corps bulletins on observed conditions and with technical advice to enable local interests, within the limits of their capabilities, to obtain optimum flood protection and to perform rescue and relief functions. The Corps further assists in flood fighting through the office of the Emergency Management/Security Division, which furnishes sandbags and other necessary equipment based on need and on the equipment on hand. To facilitate the distribution of these data, a Reservoir Information Control Center (RICC) is in operation when conditions warrant.

b. National Weather Service. The Tulsa District Office, the Tulsa River Forecast Center and the NWS exchange hydrometeorologic information to prevent duplication of effort in obtaining and disseminating data. This exchange of information is discussed in detail in Chapter 6 of this manual.

c. U.S. Geological Survey. The Corps and the USGS cooperate in a program for the construction, maintenance, and operation of stream gaging stations throughout the Tulsa District. During floods, the Corps and the USGS coordinate field activities to maximize the number of stream discharge measurements.

d. Power Marketing Agency. Power is not a project purpose at Fort Cobb Reservoir.

e. Bureau of Reclamation. The Corps keeps Reclamation advised of the situation during the flood control operations as the conditions warrant.

9-03. Interagency Agreements. A Letter of Understanding (see Exhibit B) and a Water Control Agreement (see Exhibit C) have been agreed upon and signed by the District, Reclamation, and the Corps.

9-04. Commissions, River Authority, Compacts and Committees. A Red River Compact Commission was established, and a compact was ratified by all the states on 12 May 1978 and passed Congress as PL 96-564 on 22 December 1980.

9-05. Reports.

a. General. Much of the project and watershed data collected in real-time are stored in an automated data system. The data are used to regulate projects, provide public information and prepare reports. The following reports are prepared to summarize real-time water management activities.

b. Project Operators' Reports. Project operators are required to monitor climatological data of reservoir conditions and any changes in project status and report to the Water Control Section, Tulsa District. Specific details are outlined in Chapter 5 of this manual.

c. Morning Report. This management type report is used to evaluate watershed and project conditions. This report is the principal means of informing all personnel having a need to know the prevailing conditions. The report is formulated from several sources of information on project and hydrometeorological conditions that have been entered into a data base management system each day.

This report is prepared by the Water Control Section daily, except Saturday, Sunday, and holidays, to cover a period of 24 hours. The report provides information for use by personnel whose work requires knowledge pertaining to the regulation of reservoirs, field investigations, stream gaging, construction of flood control projects affected by releases from reservoirs, answering public inquiries, and preparing public releases. The report includes a summary of hydrologic conditions as of 8 a.m. of that date and lake data for the previous and present day. The report is completed and distributed by 10 a.m. daily, insofar as possible.

d. Flood Situation Reports. The Water Control Section provides daily information to the Corps' Emergency Management Division for situation reports during floods in accordance with ER 500-1-1. The information contains various types of information relative to the floods. Pertinent data specifically required for reservoirs are as follows: name of reservoir, reservoir stage, forecasted maximum stage and date, rates of inflow and outflow in cfs, percent of flood control storage utilized to date, the forecast of maximum stage, and any special information pertinent to the flood situation.

e. Post Flood Reports. This report is prepared in accordance with ER 500-1-1 as soon as practicable after a flood causing major damage. The report describes flood emergency operation by the Corps and others. Included in summary form are: available hydrologic information, damage estimates, and other engineering data considered to be essential for flood control and flood plain studies or in the review of possible claims against the United States. The report is prepared by the Tulsa District Office Planning Division personnel, using information compiled and prepared by the Water Control Section. The report should be completed within approximately three months of the time of flooding, including statement of final cost.

f. Monthly Water Control Charts. A monthly record of reservoir regulation data is prepared and maintained by the

Water Control Section. These data are a tabular record of hydrometeorological conditions, inflows, storages and releases each day of the month. Summary data are also available. The data is maintained in a form readily available for transmittal to the Chief of Engineers, or others, upon request.

g. Annual Reports. This report is prepared by the Water Control Section and includes project accomplishments, annual report on water quality activities and a status report of water control documents, with a schedule for their initial preparation and revision. (The report also presents the activities and accomplishments of the Water Control Section for the past year). The report is forwarded to the SWD Reservoir Control Center for inclusion of the SWD's annual report.

h. Summary of Reports. Table 9-1 is a summary of the reports required in the regulation of lakes in the Tulsa District.

TABLE 9-1

TABULATION OF REPORTS

Name of Report	When Required	Regulation Requiring Reports
Morning Report (CESWT-EC-H)	Daily, except Saturday, Sunday, and holidays	OM 1130-2-12 EM 1110-2-3600
Flood Situation Report (Special Advisories)	During floods	EM 500-1-1 EM 1110-2-3600
Post Flood Report	Following a flood	EM 500-1-1 EM 1110-2-3600
Annual Report	Annually	ER-1110-2-240
Monthly Water Control Charts	Monthly	ER-1110-2-240

TABLE 6-1

SAMPLE INPUT
HEC-1 MODEL

```
ID   FORT COBB RESERVOIR FORECAST
ID   2-HR UNIT HYDROGRAPH INPUT FROM FORECAST MANUAL  6 APR 81
ID   MODIFIED FOR NETWORK FORECASTING APRIL 1991
ID   DRAG N DROP ADDED 16 APR '92
ID
ID    MESONET STATIONS: FORT COBB  "FCSO2"  ADDED 2/13/95
ID                HINTON   "HTSO2"  "
ID                WEATHERFORD "WXSO2"  "
ID
*DIAGRAM
*FREE
IT  120 01APR95  0000   100
IO  5
VSFTCOBB FTCOBB  COBB COBOUT
VV 5.11  2.11  7.11  2.11
*************************************************
KKFTCOBB   SUBAREA 1  COMXDPUTED HYDROGXDRAPH AT FORT COBB RESERVOIR
BA  285
*B      BASE FLOW CARD FOR ENTIRE MODEL
BF   0                        -.25   1.03
*L      LOSS RATE CARD FOR ENTIRE MODEL
LU   0    0
PB   0
ZR=PI  A=FT COBB B=FTCOBB C=PRECIP-INC F=ADJUST
UI 1080  3900  6700  10000  13600  14800  14000  10800   7400   4600
UI 2700  1800  1300   820   460   270   180
ZW    A=WASHITA B=FCOB C=FLOW-RES IN F=CALC
*************************************************
KKCOBOUT   RELEASES FROM FT COBB RESERVOIR
BA   1
ZR=-QI  A=POSITIVE B=FCOB C=FLOW-RES OUT F=OBS
*************************************************
KK  COMB   COMBINE TO GET NET INFLOW
HC   2
*************************************************
KK  COBB   INFLOW HYDROGRAPH AT FORT COBB ROUTED THROUGH THE LAKE
*:PLOT-MACRO: FCOB
*R       FORT COBB RESERVOIR
RS   1   ELEV   1342
SV 1664   4458   9332  16490  26500  40030  57730  80010  92900 107000
SV122300 139020 157220 175500 189300 203000 219011 251616 290500 347651
SE 1300   1306   1312   1318   1324   1330   1336   1342   1345   1380
SE 1351   1354   1357   1360   1362   1364   1366   1370 1374.2   1357
SQ   0     0    800   1200   1600   2250   2350   2600   2800   3050
SE 1300 1354.8   1357 1357.5   1358   1359   1360   1365   1369 1374.2
ZW    A=WASHITA B=FCOB C=ELEV F=CALC
*************************************************
KKCOBRLS   RELEASES FROM FT COBB RESERVOIR
BA   1
ZR=QI  A=POSITIVE B=FCOB C=FLOW-RES OUT F=OBS
*************************************************
KKCOBSPL   CONTROLLED + UNCONTROLLED
HC   2
ZW    A=WASHITA B=FCOB C=FLOW-RES OUT F=CALC
*************************************************
ZZ
```

TABLE 6-2

SAMPLE OUTPUT SUMMARY
FROM HEC-1 MODEL

TABLE 1	STATION		FTCOBB EXCESS	FTCOBB FLOW	FTCOBB STAGE	COBB FLOW	COBOUT
PER	DAY	MON HRMN					
1	1	APR 0000	.00	.00	1342.00	.00	
2	1	APR 0200	1.00	1080.00	1342.02	.00	
3	1	APR 0400	.00	3900.00	1342.12	.00	
4	1	APR 0600	.00	6700.00	1342.32	.00	
5	1	APR 0800	.00	10000.00	1342.64	.00	
6	1	APR 1000	.00	13600.00	1343.10	.00	
7	1	APR 1200	.00	14800.00	1343.64	.00	
8	1	APR 1400	.00	14000.00	1344.20	.00	
9	1	APR 1600	.00	10800.00	1344.67	.00	
10	1	APR 1800	.00	7400.00	1345.02	.00	
11	1	APR 2000	.00	4600.00	1345.21	.00	
12	1	APR 2200	.00	3586.65	1345.34	.00	
13	2	APR 0000	.00	3380.76	1345.45	.00	
14	2	APR 0200	.00	3186.69	1345.55	.00	
15	2	APR 0400	.00	3003.76	1345.65	.00	
16	2	APR 0600	.00	2831.33	1345.75	.00	
17	2	APR 0800	.00	2668.80	1345.83	.00	
18	2	APR 1000	.00	2515.60	1345.92	.00	
19	2	APR 1200	.00	2371.20	1345.99	.00	
20	2	APR 1400	.00	2235.08	1346.07	.00	
21	2	APR 1600	.00	2106.78	1346.14	.00	
22	2	APR 1800	.00	1985.84	1346.20	.00	
23	2	APR 2000	.00	1871.85	1346.26	.00	
24	2	APR 2200	.00	1764.39	1346.32	.00	
25	3	APR 0000	.00	1663.11	1346.37	.00	
26	3	APR 0200	.00	1567.64	1346.43	.00	
27	3	APR 0400	.00	1477.65	1346.47	.00	
28	3	APR 0600	.00	1392.83	1346.52	.00	
29	3	APR 0800	.00	1312.88	1346.56	.00	
30	3	APR 1000	.00	1237.51	1346.60	.00	
31	3	APR 1200	.00	1166.47	1346.64	.00	
32	3	APR 1400	.00	1099.51	1346.68	.00	
33	3	APR 1600	.00	1036.40	1346.71	.00	
34	3	APR 1800	.00	976.90	1346.74	.00	
35	3	APR 2000	.00	920.82	1346.77	.00	
36	3	APR 2200	.00	867.97	1346.80	.00	
37	4	APR 0000	.00	818.14	1346.83	.00	
38	4	APR 0200	.00	771.18	1346.85	.00	
39	4	APR 0400	.00	726.91	1346.88	.00	
40	4	APR 0600	.00	685.18	1346.90	.00	
41	4	APR 0800	.00	645.85	1346.92	.00	
42	4	APR 1000	.00	608.77	1346.94	.00	
43	4	APR 1200	.00	573.83	1346.96	.00	
44	4	APR 1400	.00	540.89	1346.98	.00	
45	4	APR 1600	.00	509.84	1346.99	.00	
46	4	APR 1800	.00	480.57	1347.01	.00	
47	4	APR 2000	.00	452.99	1347.02	.00	
48	4	APR 2200	.00	426.98	1347.04	.00	
49	5	APR 0000	.00	402.47	1347.05	.00	
50	5	APR 0200	.00	379.37	1347.06	.00	
51	5	APR 0400	.00	357.59	1347.08	.00	
52	5	APR 0600	.00	337.06	1347.09	.00	
53	5	APR 0800	.00	317.71	1347.10	.00	

TABLE 6-2 (Continued)

SAMPLE OUTPUT SUMMARY
FROM HEC-1 MODEL

TABLE 1	STATION	FTCOBB EXCESS	FTCOBB FLOW	FTCOBB STAGE	COBB FLOW	COBOUT
PER	DAY MON HRMN					
54	5 APR 1000	.00	299.48	1347.11	.00	
55	5 APR 1200	.00	282.29	1347.12	.00	
56	5 APR 1400	.00	266.08	1347.13	.00	
57	5 APR 1600	.00	250.81	1347.13	.00	
58	5 APR 1800	.00	236.41	1347.14	.00	
59	5 APR 2000	.00	222.84	1347.15	.00	
60	5 APR 2200	.00	210.05	1347.16	.00	
61	6 APR 0000	.00	197.99	1347.16	.00	
62	6 APR 0200	.00	186.62	1347.17	.00	
63	6 APR 0400	.00	175.91	1347.17	.00	
64	6 APR 0600	.00	165.81	1347.18	.00	
65	6 APR 0800	.00	156.29	1347.18	.00	
66	6 APR 1000	.00	147.32	1347.19	.00	
67	6 APR 1200	.00	138.87	1347.19	.00	
68	6 APR 1400	.00	130.89	1347.20	.00	
69	6 APR 1600	.00	123.38	1347.20	.00	
70	6 APR 1800	.00	116.30	1347.21	.00	
71	6 APR 2000	.00	109.62	1347.21	.00	
72	6 APR 2200	.00	103.33	1347.21	.00	
73	7 APR 0000	.00	97.40	1347.22	.00	
74	7 APR 0200	.00	91.81	1347.22	.00	
75	7 APR 0400	.00	86.54	1347.22	.00	
76	7 APR 0600	.00	81.57	1347.22	.00	
77	7 APR 0800	.00	76.89	1347.23	.00	
78	7 APR 1000	.00	72.47	1347.23	.00	
79	7 APR 1200	.00	68.31	1347.23	.00	
80	7 APR 1400	.00	64.39	1347.23	.00	
81	7 APR 1600	.00	60.70	1347.24	.00	
82	7 APR 1800	.00	57.21	1347.24	.00	
83	7 APR 2000	.00	53.93	1347.24	.00	
84	7 APR 2200	.00	50.83	1347.24	.00	
85	8 APR 0000	.00	47.91	1347.24	.00	
86	8 APR 0200	.00	45.16	1347.24	.00	
87	8 APR 0400	.00	42.57	1347.25	.00	
88	8 APR 0600	.00	40.13	1347.25	.00	
89	8 APR 0800	.00	37.82	1347.25	.00	
90	8 APR 1000	.00	35.65	1347.25	.00	
91	8 APR 1200	.00	33.61	1347.25	.00	
92	8 APR 1400	.00	31.68	1347.25	.00	
93	8 APR 1600	.00	29.86	1347.25	.00	
94	8 APR 1800	.00	28.14	1347.25	.00	
95	8 APR 2000	.00	26.53	1347.25	.00	
96	8 APR 2200	.00	25.01	1347.25	.00	
97	9 APR 0000	.00	23.57	1347.26	.00	
98	9 APR 0200	.00	22.22	1347.26	.00	
99	9 APR 0400	.00	20.94	1347.26	.00	
100	9 APR 0600	.00	19.74	1347.26	.00	
	MAX	1.00	14800.00	1347.26	.00	
	MIN	.00	.00	1342.00	.00	
	AVE	.01	1490.37	1346.50	.00	

*** NORMAL END OF HEC-1 ***

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Pointer Utilization: .27
Number of Records: 17
File Size: 40.4 Kbytes
Percent Inactive: .0

TABLE 7-3

FORT COBB RESERVOIR
ELEVATION-AREA-CAPACITY TABLE

BASED ON
MAY 1993 RESURVEY
POOL ELEV (FT. NGVD)

CAPACITY (1000'S OF ACRE-FEET)
AREA (1000'S OF ACRES)

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1290.0	0.000	0.000	0.000	0.001	0.002	0.002	0.003	0.005	0.006	0.007
	0.000	0.002	0.004	0.005	0.007	0.009	0.011	0.013	0.014	0.016
1291.0	0.009	0.011	0.013	0.015	0.018	0.020	0.023	0.026	0.029	0.033
	0.018	0.020	0.022	0.023	0.025	0.027	0.029	0.031	0.032	0.034
1292.0	0.036	0.040	0.044	0.048	0.052	0.056	0.061	0.066	0.071	0.076
	0.036	0.038	0.040	0.041	0.043	0.045	0.047	0.049	0.050	0.052
1293.0	0.081	0.087	0.092	0.098	0.104	0.110	0.117	0.123	0.130	0.137
	0.054	0.056	0.058	0.060	0.061	0.063	0.065	0.067	0.068	0.070
1294.0	0.144	0.151	0.159	0.167	0.174	0.182	0.191	0.199	0.207	0.216
	0.072	0.074	0.076	0.077	0.079	0.081	0.083	0.085	0.086	0.088
1295.0	0.225	0.234	0.244	0.254	0.265	0.276	0.288	0.300	0.312	0.325
	0.090	0.095	0.099	0.104	0.109	0.114	0.118	0.123	0.128	0.132
1296.0	0.339	0.353	0.367	0.382	0.397	0.413	0.429	0.446	0.463	0.481
	0.137	0.142	0.146	0.151	0.155	0.160	0.165	0.169	0.174	0.178
1297.0	0.499	0.517	0.536	0.556	0.576	0.596	0.617	0.638	0.660	0.682
	0.183	0.188	0.192	0.197	0.202	0.207	0.211	0.216	0.221	0.225
1298.0	0.705	0.728	0.752	0.776	0.801	0.826	0.852	0.878	0.904	0.931
	0.230	0.235	0.239	0.244	0.249	0.254	0.258	0.263	0.268	0.272
1299.0	0.959	0.987	1.015	1.044	1.073	1.103	1.133	1.164	1.195	1.227
	0.277	0.282	0.286	0.291	0.295	0.300	0.305	0.309	0.314	0.318
1300.0	1.259	1.291	1.324	1.357	1.391	1.425	1.460	1.494	1.530	1.565
	0.323	0.327	0.331	0.335	0.339	0.343	0.347	0.351	0.355	0.359
1301.0	1.602	1.638	1.675	1.712	1.750	1.788	1.827	1.866	1.905	1.945
	0.363	0.367	0.371	0.375	0.379	0.384	0.388	0.392	0.396	0.400
1302.0	1.985	2.026	2.067	2.108	2.150	2.192	2.235	2.278	2.321	2.365
	0.404	0.408	0.412	0.416	0.420	0.424	0.428	0.432	0.436	0.440
1303.0	2.409	2.454	2.499	2.544	2.590	2.636	2.683	2.730	2.777	2.825
	0.444	0.448	0.452	0.456	0.460	0.464	0.468	0.472	0.476	0.480
1304.0	2.873	2.922	2.971	3.020	3.070	3.120	3.171	3.222	3.273	3.325
	0.484	0.488	0.492	0.496	0.500	0.504	0.508	0.512	0.516	0.520
1305.0	3.377	3.430	3.483	3.537	3.592	3.647	3.703	3.760	3.817	3.875
	0.524	0.531	0.537	0.544	0.550	0.557	0.563	0.570	0.576	0.583
1306.0	3.934	3.993	4.053	4.113	4.174	4.236	4.299	4.362	4.426	4.490
	0.589	0.596	0.602	0.609	0.615	0.622	0.628	0.635	0.641	0.648
1307.0	4.555	4.621	4.687	4.754	4.822	4.890	4.959	5.029	5.099	5.170
	0.654	0.661	0.667	0.674	0.680	0.687	0.693	0.700	0.706	0.713
1308.0	5.242	5.314	5.387	5.460	5.534	5.609	5.685	5.761	5.838	5.915
	0.719	0.726	0.732	0.739	0.745	0.752	0.758	0.765	0.771	0.778
1309.0	5.993	6.072	6.151	6.231	6.312	6.393	6.475	6.558	6.641	6.725
	0.784	0.790	0.797	0.803	0.810	0.816	0.822	0.829	0.835	0.842

TABLE 7-3 (continued)

FORT COBB RESERVOIR
ELEVATION-AREA-CAPACITY TABLE

BASED ON
MAY 1993 RESURVEY
POOL ELEV (FT. NGVD)

CAPACITY (1000'S OF ACRE-FEET)
AREA (1000'S OF ACRES)

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1310.0	6.809	6.894	6.980	7.066	7.153	7.240	7.328	7.417	7.506	7.595
	0.848	0.854	0.859	0.865	0.871	0.877	0.882	0.888	0.894	0.899
1311.0	7.686	7.776	7.868	7.960	8.052	8.145	8.239	8.333	8.428	8.523
	0.905	0.911	0.916	0.922	0.928	0.934	0.939	0.945	0.951	0.956
1312.0	8.619	8.716	8.813	8.910	9.008	9.107	9.207	9.306	9.407	9.508
	0.962	0.968	0.973	0.979	0.985	0.991	0.996	1.002	1.008	1.013
1313.0	9.610	9.712	9.815	9.918	10.022	10.126	10.231	10.337	10.443	10.549
	1.019	1.025	1.030	1.036	1.041	1.047	1.053	1.058	1.064	1.069
1314.0	10.657	10.764	10.873	10.982	11.091	11.201	11.312	11.423	11.535	11.647
	1.075	1.081	1.086	1.092	1.098	1.104	1.109	1.115	1.121	1.126
1315.0	11.760	11.874	11.988	12.103	12.219	12.336	12.453	12.571	12.690	12.810
	1.132	1.140	1.147	1.155	1.162	1.170	1.178	1.185	1.193	1.200
1316.0	12.930	13.051	13.173	13.296	13.419	13.544	13.669	13.795	13.921	14.048
	1.208	1.216	1.223	1.231	1.239	1.247	1.254	1.262	1.270	1.277
1317.0	14.177	14.305	14.435	14.566	14.697	14.829	14.961	15.095	15.229	15.364
	1.285	1.293	1.300	1.308	1.315	1.323	1.331	1.338	1.346	1.353
1318.0	15.500	15.636	15.773	15.911	16.050	16.190	16.330	16.471	16.613	16.756
	1.361	1.369	1.376	1.384	1.392	1.400	1.407	1.415	1.423	1.430
1319.0	16.899	17.043	17.188	17.334	17.480	17.628	17.776	17.924	18.074	18.224
	1.438	1.446	1.453	1.461	1.468	1.476	1.484	1.491	1.499	1.506
1320.0	18.375	18.527	18.679	18.833	18.987	19.141	19.297	19.453	19.610	19.768
	1.514	1.522	1.529	1.537	1.544	1.552	1.559	1.567	1.574	1.582
1321.0	19.927	20.086	20.246	20.407	20.568	20.731	20.894	21.058	21.222	21.387
	1.589	1.597	1.604	1.612	1.619	1.627	1.635	1.642	1.650	1.657
1322.0	21.554	21.720	21.888	22.056	22.226	22.395	22.566	22.737	22.910	23.082
	1.665	1.673	1.680	1.688	1.695	1.703	1.710	1.718	1.725	1.733
1323.0	23.256	23.430	23.606	23.781	23.958	24.135	24.314	24.492	24.672	24.852
	1.740	1.748	1.755	1.763	1.770	1.778	1.785	1.793	1.800	1.808
1324.0	25.034	25.215	25.398	25.582	25.766	25.951	26.136	26.323	26.510	26.698
	1.815	1.823	1.830	1.838	1.845	1.853	1.861	1.868	1.876	1.883
1325.0	26.887	27.076	27.267	27.458	27.650	27.843	28.037	28.232	28.428	28.625
	1.891	1.900	1.909	1.918	1.927	1.936	1.944	1.953	1.962	1.971
1326.0	28.822	29.021	29.220	29.420	29.621	29.823	30.026	30.230	30.434	30.640
	1.980	1.989	1.998	2.006	2.015	2.024	2.033	2.042	2.050	2.059
1327.0	30.846	31.053	31.261	31.471	31.680	31.891	32.103	32.316	32.529	32.743
	2.068	2.077	2.086	2.095	2.104	2.113	2.121	2.130	2.139	2.148
1328.0	32.959	33.175	33.392	33.610	33.829	34.048	34.269	34.490	34.713	34.936
	2.157	2.166	2.175	2.184	2.193	2.202	2.210	2.219	2.228	2.237
1329.0	35.160	35.385	35.611	35.838	36.066	36.294	36.524	36.754	36.985	37.218
	2.246	2.255	2.264	2.273	2.282	2.291	2.299	2.308	2.317	2.326

TABLE 7-3 (continued)

FORT COBB RESERVOIR
ELEVATION-AREA-CAPACITY TABLE

BASED ON
MAY 1993 RESURVEY
POOL ELEV (FT. NGVD)

CAPACITY (1000'S OF ACRE-FEET)
AREA (1000'S OF ACRES)

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1330.0	37.451	37.685	37.920	38.156	38.394	38.633	38.873	39.114	39.356	39.600
	2.335	2.347	2.359	2.370	2.382	2.394	2.406	2.418	2.429	2.441
1331.0	39.845	40.090	40.338	40.586	40.835	41.086	41.338	41.591	41.845	42.100
	2.453	2.465	2.477	2.488	2.500	2.512	2.524	2.536	2.547	2.559
1332.0	42.357	42.614	42.873	43.133	43.395	43.657	43.921	44.185	44.451	44.719
	2.571	2.583	2.595	2.607	2.619	2.631	2.642	2.654	2.666	2.678
1333.0	44.987	45.257	45.527	45.799	46.073	46.347	46.622	46.899	47.177	47.456
	2.690	2.702	2.714	2.725	2.737	2.749	2.761	2.773	2.784	2.796
1334.0	47.736	48.017	48.300	48.584	48.869	49.155	49.442	49.731	50.021	50.311
	2.808	2.820	2.832	2.844	2.856	2.868	2.879	2.891	2.903	2.915
1335.0	50.604	50.897	51.191	51.486	51.783	52.080	52.379	52.678	52.979	53.281
	2.927	2.938	2.948	2.959	2.969	2.980	2.991	3.001	3.012	3.022
1336.0	53.584	53.887	54.192	54.498	54.805	55.113	55.422	55.733	56.044	56.356
	3.033	3.044	3.054	3.065	3.075	3.086	3.097	3.107	3.118	3.128
1337.0	56.670	56.984	57.300	57.616	57.934	58.252	58.572	58.893	59.215	59.538
	3.139	3.150	3.160	3.171	3.182	3.193	3.203	3.214	3.225	3.235
1338.0	59.862	60.187	60.513	60.841	61.169	61.498	61.829	62.161	62.493	62.827
	3.246	3.257	3.267	3.278	3.289	3.300	3.310	3.321	3.332	3.342
1339.0	63.162	63.497	63.834	64.172	64.511	64.851	65.192	65.535	65.878	66.222
	3.353	3.364	3.374	3.385	3.395	3.406	3.417	3.427	3.438	3.448
1340.0	66.568	66.914	67.263	67.613	67.965	68.319	68.674	69.032	69.390	69.751
	3.459	3.476	3.494	3.511	3.529	3.546	3.563	3.581	3.598	3.616
1341.0	70.114	70.478	70.844	71.211	71.581	71.952	72.325	72.699	73.075	73.453
	3.633	3.650	3.668	3.685	3.702	3.720	3.737	3.754	3.771	3.789
1342.0	73.833	74.215	74.598	74.983	75.369	75.758	76.148	76.540	76.934	77.329
	3.806	3.823	3.841	3.858	3.876	3.893	3.910	3.928	3.945	3.963
1343.0	77.726	78.125	78.526	78.928	79.332	79.738	80.145	80.555	80.966	81.379
	3.980	3.997	4.015	4.032	4.050	4.067	4.084	4.102	4.119	4.137
1344.0	81.793	82.209	82.627	83.047	83.469	83.892	84.317	84.744	85.172	85.602
	4.154	4.171	4.189	4.206	4.224	4.241	4.258	4.276	4.293	4.311
1345.0	86.034	86.468	86.903	87.339	87.777	88.217	88.658	89.101	89.545	89.991
	4.328	4.343	4.358	4.374	4.389	4.404	4.419	4.434	4.450	4.465
1346.0	90.438	90.887	91.337	91.789	92.242	92.697	93.153	93.611	94.071	94.532
	4.480	4.495	4.510	4.526	4.541	4.556	4.571	4.586	4.602	4.617
1347.0	94.994	95.458	95.924	96.391	96.859	97.329	97.801	98.274	98.748	99.224
	4.632	4.647	4.662	4.678	4.693	4.708	4.723	4.738	4.754	4.769
1348.0	99.702	100.181	100.662	101.144	101.628	102.113	102.600	103.088	103.578	104.069
	4.784	4.799	4.814	4.830	4.845	4.860	4.875	4.890	4.906	4.921
1349.0	104.562	105.056	105.552	106.050	106.549	107.049	107.551	108.055	108.560	109.066
	4.936	4.951	4.966	4.982	4.997	5.012	5.027	5.042	5.058	5.073

TABLE 7-3 (continued)

FORT COBB RESERVOIR
ELEVATION-AREA-CAPACITY TABLE

BASED ON
MAY 1993 RESURVEY
POOL ELEV (FT. NGVD)

CAPACITY (1000'S OF ACRE-FEET)
AREA (1000'S OF ACRES)

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1350.0	109.574	110.084	110.595	111.108	111.622	112.139	112.657	113.176	113.697	114.220
	5.088	5.105	5.121	5.138	5.154	5.171	5.187	5.204	5.220	5.237
1351.0	114.745	115.271	115.799	116.328	116.859	117.392	117.926	118.462	119.000	119.540
	5.253	5.270	5.286	5.303	5.319	5.336	5.353	5.369	5.386	5.402
1352.0	120.081	120.623	121.168	121.714	122.261	122.811	123.362	123.914	124.469	125.025
	5.419	5.436	5.452	5.469	5.485	5.502	5.518	5.535	5.551	5.568
1353.0	125.582	126.141	126.702	127.265	127.829	128.395	128.962	129.532	130.102	130.675
	5.584	5.601	5.617	5.634	5.650	5.667	5.684	5.700	5.717	5.733
1354.0	131.249	131.825	132.402	132.982	133.562	134.145	134.729	135.315	135.902	136.491
	5.750	5.767	5.783	5.800	5.816	5.833	5.849	5.866	5.882	5.899
1355.0	137.082	137.674	138.268	138.863	139.460	140.059	140.659	141.261	141.864	142.469
	5.915	5.931	5.947	5.962	5.978	5.994	6.010	6.026	6.041	6.057
1356.0	143.076	143.684	144.293	144.905	145.517	146.132	146.748	147.365	147.985	148.605
	6.073	6.089	6.105	6.120	6.136	6.152	6.168	6.184	6.199	6.215
1357.0	149.228	149.851	150.477	151.104	151.733	152.363	152.994	153.628	154.263	154.899
	6.231	6.247	6.262	6.278	6.294	6.310	6.325	6.341	6.357	6.372
1358.0	155.537	156.177	156.818	157.461	158.105	158.751	159.398	160.047	160.698	161.350
	6.388	6.404	6.420	6.435	6.451	6.467	6.483	6.499	6.514	6.530
1359.0	162.004	162.659	163.316	163.975	164.635	165.297	165.960	166.625	167.291	167.959
	6.546	6.562	6.578	6.593	6.609	6.625	6.641	6.657	6.672	6.688
1360.0	168.629	169.300	169.973	170.648	171.325	172.004	172.684	173.366	174.050	174.736
	6.704	6.722	6.740	6.758	6.776	6.794	6.812	6.830	6.848	6.866
1361.0	175.423	176.112	176.803	177.496	178.191	178.887	179.586	180.286	180.988	181.691
	6.884	6.902	6.920	6.938	6.956	6.974	6.991	7.009	7.027	7.045
1362.0	182.397	183.104	183.813	184.524	185.236	185.951	186.667	187.385	188.105	188.826
	7.063	7.081	7.099	7.117	7.135	7.153	7.171	7.189	7.207	7.225
1363.0	189.550	190.275	191.002	191.731	192.461	193.194	193.928	194.664	195.402	196.141
	7.243	7.261	7.279	7.297	7.315	7.333	7.351	7.369	7.387	7.405
1364.0	196.883	197.626	198.371	199.118	199.866	200.616	201.369	202.123	202.878	203.636
	7.423	7.441	7.459	7.477	7.495	7.513	7.530	7.548	7.566	7.584
1365.0	204.395	205.156	205.919	206.684	207.450	208.219	208.989	209.761	210.534	211.310
	7.602	7.620	7.638	7.656	7.674	7.692	7.710	7.728	7.746	7.764
1366.0	212.087	212.866	213.647	214.430	215.214	216.001	216.789	217.579	218.370	219.164
	7.782	7.800	7.818	7.836	7.854	7.872	7.890	7.908	7.926	7.944
1367.0	219.959	220.756	221.555	222.356	223.158	223.963	224.769	225.577	226.386	227.198
	7.962	7.980	7.998	8.016	8.034	8.052	8.070	8.088	8.106	8.124
1368.0	228.011	228.826	229.643	230.462	231.282	232.105	232.929	233.755	234.582	235.412
	8.142	8.160	8.178	8.196	8.214	8.232	8.250	8.268	8.286	8.304
1369.0	236.243	237.076	237.911	238.748	239.586	240.426	241.269	242.112	242.958	243.805
	8.322	8.340	8.358	8.376	8.394	8.412	8.429	8.447	8.465	8.483

TABLE 7-3 (continued)

FORT COBB RESERVOIR
ELEVATION-AREA-CAPACITY TABLE

BASED ON
MAY 1993 RESURVEY
POOL ELEV (FT. NGVD)

CAPACITY (1000'S OF ACRE-FEET)
AREA (1000'S OF ACRES)

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1370.0	244.655	245.506	246.359	247.214	248.072	248.931	249.793	250.657	251.522	252.390
	8.501	8.522	8.543	8.564	8.585	8.606	8.626	8.647	8.668	8.689
1371.0	253.260	254.132	255.006	255.883	256.761	257.641	258.524	259.408	260.295	261.184
	8.710	8.731	8.752	8.773	8.794	8.815	8.835	8.856	8.877	8.898
1372.0	262.075	262.968	263.863	264.760	265.659	266.560	267.464	268.369	269.277	270.186
	8.919	8.940	8.961	8.982	9.003	9.024	9.044	9.065	9.086	9.107
1373.0	271.098	272.012	272.928	273.846	274.766	275.688	276.613	277.539	278.467	279.398
	9.128	9.149	9.170	9.191	9.212	9.233	9.253	9.274	9.295	9.316
1374.0	280.331	281.265	282.202	283.141	284.082	285.025	285.970	286.918	287.867	288.819
	9.337	9.358	9.379	9.400	9.421	9.442	9.462	9.483	9.504	9.525

E X H I B I T A

SUPPLEMENTARY PERTINENT DATA

FORT COBB DAM AND RESERVOIR

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

FORT COBB DAM AND RESERVOIR

TABLE OF CONTENTS

SUPPLEMENTARY PERTINENT DATA

FORT COBB DAM AND RESERVOIR

1 - GENERAL INFORMATION

OTHER NAMES FOR PROJECT:	Fort Cobb Lake
LOCATION:	Red River Basin, Cobb Creek Mile 7.4, about 5 miles northwest of Fort Cobb, Oklahoma, State of Oklahoma
TYPE OF PROJECT:	Dam and reservoir
OBJECTIVES OF REGULATION:	Multipurpose - flood control, water supply, fish and wildlife, recreational benefits, and flow regulation
PROJECT OWNER:	U.S. Department of Interior, Bureau of Reclamation
OPERATING AGENCY:	Fort Cobb Reservoir Master Conservancy District under direction of the Bureau of Reclamation, Great Plains Region. Dam Operator lives at dam and is on call 24 hours a day.
REGULATING AGENCY:	U.S. Army Corps of Engineers, Tulsa District, for flood control purposes. Fort Cobb Reservoir Master Conservancy District under direction of the Bureau of Reclamation, Great Plains Region, for conservation and dam safety purposes and Bureau of Reclamation for dam safety purposes.
CODE OF FEDERAL REGULATION, TITLE 33	Part 208.11, Code of Federal Regulations, ChapterII, July 1, 1989, Edition (included as Exhibit E of this manual.
WATER SUPPLY CONTRACTS:	Fort Cobb Reservoir Master Conservancy District with the City of Anadarko and the Western Farmers Electrical Cooperative for 13,264 acre-feet annually from storage and with the City of Chickasha for 6,250 acre-feet annually of excess water.
OTHER INTERAGENCY AGREEMENTS:	Letter of Understanding and Water Control Agreement between the Corps of Engineers, Bureau of Reclamation, and Fort Cobb Reservoir Master Conservancy District.
WATER RIGHTS:	Appropriated by the Oklahoma Resources Board.
PROJECT COST:	$14,720,004.00
CLOSURE DATE:	30 March 1959
SPECIAL PROJECT FEATURES:	Dam Operator residence provided at dam.

2 - RESERVOIR INFORMATION
ELEVATIONS, AREAS AND STORAGES

Feature	Elevation (ft. NGVD)	Area (Acres)	Storage (1) Accumulative (Acre-feet)	Runoff (2) Inches	Storage (1) Incremental (Acre-feet)
Top of Dam	1380.0	--	--	--	--
Maximum Design Pool	1374.4	9,421	284,100	17.52	148,300
Top of Flood Control Pool and Spillway Crest	1354.8	5,882	135,900	8.38	62,070
Top of Conservation Pool	1342.0	3,806	73,830	4.55	72,570
Top of Inactive Pool	1300.0 (3)	323	1,260	0.08	1,260
Streambed	1279.0	--	0	0	0
Flood Control Storage	1342.0-1354.8	--	62,070	3.71	--
Water Supply Storage	1300.0-1342.0	--	72,570	4.33	--

(1) Using capacity table from Bureau of Reclamation.

(2) Contributing drainage area 304 square miles.

(3) Crest elevation of river outlet works intake structure.

MAJOR FLOODS PAST DAMSITE (1)

DATE	PEAK FLOW (cfs)	VOLUME (Acre-Feet)	RUNOFF (Inches (2))
20 May-21 June 1995	-	55,800	3.44
6-19 May 1993	17,250	41,700	2.57
17-21 May 1949	35,000	34,700	2.14
20-21 September 1965	25,000	27,900	1.72

(1) Flood data on Cobb Creek near Fort Cobb, Oklahoma, river mile 7.5 with a drainage area of 304 square miles.

(2) At Fort Cobb, Oklahoma, one inch of runoff = 16,213 acre-feet.

REAL ESTATE TAKING LINE FOR FEE TITLE:	Reservoir land was purchased in fee to a blocked perimeter encompassing elevation 1344.0 feet NGVD (5-year flood frequency pool). Land was also purchased in fee for recreational purposes (550 acres), and fish and wildlife mitigation purposes (435 acres). There are 8,648 total acres in fee.
REAL ESTATE TAKING LINE FOR EASEMENT:	Flowage easements were acquired for the 1,832-acre area between the lands purchased in fee simple and (as a general rule) the contour of the top of the 500-year pool (between elevations 1344.0 and 1364.5 feet NGVD).
RANGE OF CLEARING:	The reservoir area was cleared to top of design conservation pool (elevation 1342.0 feet NGVD).
POOL ELEVATION CORRESPONDING TO DISCHARGE CAPABILITY OF MAXIMUM NONDAMAGING FLOW RATE DOWNSTREAM:	Nondamaging channel capacity down stream of Fort Cobb Dam is currently estimated to be approximately 1,000 cfs. This flow can be discharged through the river outlet works when the reservoir level is at or above elevation 1306.0 feet NGVD.
RESERVOIR LENGTH AT TOP CONSERVATION POOL:	7.5 miles
SHORELINE LENGTH AT TOP CONSERVATION POOL:	45 miles
SAFETY ASPECTS POSSIBLY REQUIRING WARNING:	Seepage control and safety of dam with respect to PMF. An emergency action plan has been developed and will be implemented upon being given an evacuation notice.

EMERGENCY DRAWDOWN:

The lowest crest usable for reservoir drawdown is elevation 1300.0 feet at the river outlet works. The storage remaining at this elevation is 1,660 acre-feet. Making releases through the river outlet works would require 32 days at 1,000 cfs to evacuate the flood control storage with no inflow during the period.

3 - HYDROLOGY

DRAINAGE AREA:	304 square miles
INFLOW DESIGN FLOOD:	
MAXIMUM WATER SURFACE ELEVATION:	1374.4 feet NGVD
PEAK INFLOW:	181,000 cfs
TOTAL STORM RUNOFF:	11.47 inches
VOLUME:	192,000 acre-feet
MAXIMUM OUTFLOW:	5,620 cfs
FLOOD DURATION:	2 days
STANDARD PROJECT FLOOD (1/2 INFLOW DESIGN FLOOD):	
MAXIMUM WATER SURFACE ELEVATION:	1363.05 feet NGVD
PEAK INFLOW:	90,500 cfs
TOTAL STORM RUNOFF:	5.73 inches
VOLUME:	96,000 acre-feet
MAXIMUM OUTFLOW:	4,910 cfs
FLOOD DURATION:	2 days
CLIMATE:	Subhumid, bordering on semi-arid
ONE-INCH RUNOFF:	16,213 acre-feet
STORM TYPES:	Frontal action between cold polar air masses and warm, moist gulf air masses, thunderstorms, and occasional storms from residual hurricanes.
FLOOD SEASONS:	Spring and fall
LOW FLOW SEASON:	July through mid-September, although low flows can occur at any time during the year.
MINIMUM DAILY FLOW:	0 (often)
MINIMUM MONTHLY FLOW:	0 (September 1983 and September 1984)
MINIMUM ANNUAL FLOW:	12,880 acre-feet (1956)

AVERAGE ANNUAL FLOW:	43,000 acre-feet
MAXIMUM ANNUAL FLOW:	104,900 acre-feet (1993)
MAXIMUM MONTHLY FLOW:	48,600 acre-feet (May 1982)
MAXIMUM DAILY FLOW:	9,840 cfs (May 1949) (estimated)
MAXIMUM INSTANTANEOUS FLOW:	35,000 cfs (May 1949)
MAXIMUM FLOOD VOLUME:	34,700 acre-feet (May 1949)
NAME AND LOCATION OF KEY STREAM-FLOW STATIONS:	Washita River near Anadarko, OK at RM 305.2, near Alex, OK at RM 226.5, and near Pauls Valley, OK at RM 146.5.
TYPE OF HYDROMETEOROLOGIC DATA RECORDED AT DAMSITE:	Pool elevation, air temperature, rainfall, evaporation, wind direction and velocity
NUMBER OF PRECIPITATION STATIONS USED IN HYDROLOGIC FORECASTING:	6
NUMBER OF SEDIMENT RANGES:	23

4 - EMBANKMENT

LOCATION:	Cobb Creek at river mile 7.5
PURPOSE:	Municipal and industrial water supply, flood control, fish and wildlife, and recreation
TYPE:	Rolled earthfill
SLOPE PROTECTION:	Riprap upstream and sod downstream
HEIGHT (Above Streambed):	101 feet
LENGTH:	9,900 feet
TOP WIDTH:	30 feet
TOP ELEVATION:	1380.0 feet NGVD
DESIGN FLOOD:	Inflow design flood
FREEBOARD:	5.8 feet
USED FOR ROADWAY:	Yes
ELEVATION OF STREAMBED:	1279.0 feet NGVD

5 - SPILLWAY

LOCATION:	Near left abutment
TYPE:	Uncontrolled, circular drop inlet
CREST ELEVATION:	1354.8 feet NGVD
SIZE OF OUTLET:	9-foot 6-inch, circular conduit.
INDUCED SURCHARGE:	None
MAXIMUM HEAD ABOVE SPILLWAY CREST:	19.4 feet
DISCHARGE CAPACITY AT MAXIMUM POOL ELEVATION 1374.4 FEET NGVD:	3,050 cfs
TYPE ENERGY DISSIPATOR:	Stilling basin with baffle blocks, separate from river outlet works stilling basin.
RECURRENCE INTERVAL OF POOL ATTAINING CREST ELEVATION:	With a limited period of record available, the recurrence interval can not be determined accurately, however, it is estimated to be greater than 100 years.
SPILLWAY ACTIVATION:	No occurrence to date.

6 - OUTLET FACILITIES

A - RIVER OUTLET WORKS

LOCATION:	Near right abutment
PURPOSE:	Flood control
TYPE OF OUTLET AND SIZE:	9-foot diameter pressure concrete conduit upstream and a modified 13-foot diameter conduit downstream with a 10-inch bypass.
INTAKE INVERT ELEVATION:	1300.0 feet NGVD
TYPE OF SERVICE GATES:	Two 5'H x 5'W high-pressure gates

	Discharge	Elevation
AT MAXIMUM POOL	2,570 cfs	1374.4 feet NGVD
AT TOP OF FLOOD CONTROL POOL	2,270 cfs	1354.8 feet NGVD
AT TOP OF CONSERVATION POOL	2,070 cfs	1342.0 feet NGVD

MINIMUM TIME TO OPEN/CLOSE GATES:	25-30 minutes
TYPE EMERGENCY CLOSURE AND TIME REQUIRED:	Two 5'H x 5'W high-pressure emergency gates in tandem with service gates; closure time not available.
TYPE ENERGY DISSIPATOR:	Stilling basin with baffle blocks separate from uncontrolled spillway outlet stilling basin.

B - MUNICIPAL WATER SUPPLY OUTLET WORKS

LOCATION:	Near right abutment
PURPOSE:	Municipal and industrial water supply
TYPE OF OUTLET AND SIZE:	Two trashracked intake structures with 2 concrete-encased 26-inch steel conduits, wyed to a 26-inch steel outlet conduit
INTAKE INVERT ELEVATIONS:	1324.50 feet NGVD 1300.00 feet NGVD
TYPE OF GATES:	Two 24-inch wedge gate valves
TYPE OF EMERGENCY CLOSURE AND TIME REQUIRED:	Stop-log slot provided in each intake structure; closure time not available.
DISCHARGE CAPACITY:	Minimum 5 cfs Maximum 35 cfs

7 - CONTROL POINTS

A - ANADARKO GAGE

LOCATION:	Washita River near Anadarko, OK, at river mile 305.2, 35 feet upstream from U.S. Highway 281 bridge
PURPOSE OF GAGE:	Used by U.S. Geological Survey as source of public record, by Corps of Engineers for regulation of Fort Cobb and Foss Reservoirs.
CHANNEL AND FLOOD PLAIN:	Natural channel controlled at all stages by permanent rock riffle streambed. Channel is straight 400 feet upstream and 1,000 feet downstream. Banks lightly wooded, patchy underbrush with cultivation on left upstream and right downstream. Stream strikes bridge at slight angle.
UNCONTROLLED DRAINAGE AREA:	1,846 square miles
TREATMENT OF UNCONTROLLED RUNOFF:	Contributes to flood control target flow
TARGET FLOW RATE:	Operational stage 19 feet, 6,100 cfs, (see Plate 4-8.)
TIME OF CREST TRAVEL:	24 hours from Fort Cobb Dam to the Anadarko gage
MONITORING PROVISIONS:	Water surface elevation is recorded by water-stage recorder with satellite data collection platform. Discharge measurements are made on schedule and as needed.
CHANNEL USAGE:	Fishing

B - ALEX GAGE

LOCATION:	Washita River near Alex, OK, at river mile 226.5, on County road 19-C.
PURPOSE OF GAGE:	Used by U.S. Geological Survey as source of public record, by Corps of Engineers for regulation of Fort Cobb and Foss Reservoirs.
CHANNEL AND FLOOD PLAIN:	Banks are irregular, and sand dunes are common in the flood plain near the channel. The tops of the banks in the vicinity of the gage appear to be about 19 feet above the gage datum. The channel of the river is rather unstable; what appears to have been an old channel was noted in the flood plain south of the gaging station. Overflow of the river over low bank areas into the old channels is likely when bankfull stage is approached.
UNCONTROLLED DRAINAGE AREA:	2977 square miles
TREATMENT OF UNCONTROLLED RUNOFF:	Contributes to flood control target stages
TARGET FLOW RATE:	Operational stage 19.0 feet, 32,300 cfs (see Plate 4-9.)
TIME OF CREST TRAVEL:	70 hours from Fort Cobb Dam to the Alex gage
MONITORING PROVISIONS:	Water surface elevation is recorded by water-stage recorder with satellite data collection platform. Discharge measurements are made on schedule and as needed.
CHANNEL USAGE:	Fishing

C - PAULS VALLEY

LOCATION:	Washita River near Pauls Valley, OK, at river mile 146.5, upstream of U.S. Highway 77 bridge.
PURPOSE OF GAGE:	Used by U.S. Geological Survey as source of public record, by Corps of Engineers for regulation of Fort Cobb and Foss Reservoirs.
CHANNEL AND FLOOD PLAIN:	Channel is controlled at all stages. Banks are sand and clay and are subject to sloughing. Right bank is overtopped into a wide flood plain at 31.5 feet, gage height. Left bank is overtopped at 27.5 feet, gage height, but overflow is relatively narrow. The channel is straight for 0.5 miles above and below the gage, with a 30 degree bend to left at the gage. Overflow begins at about 25 feet.
UNCONTROLLED DRAINAGE AREA:	3,520 square miles
TREATMENT OF UNCONTROLLED RUNOFF:	Contributes to flood control target flows
TARGET FLOW RATE:	Operational stage 24 feet, 39,800 cfs (see Plate 4-10.)
TIME OF CREST TRAVEL:	120 hours from the Fort Cobb Dam to the Pauls Valley gage
MONITORING PROVISIONS:	Water surface elevation is recorded by water-stage recorder with satellite data collection platform. Discharge measurements are made on schedule and as needed.
CHANNEL USAGE:	Fishing

E X H I B I T B

LETTER OF UNDERSTANDING

FORT COBB DAM AND RESERVOIR

POND (COBB) CREEK, OKLAHOMA

LETTER OF UNDERSTANDING

FORT COBB DAM AND RESERVOIR

POND (COBB) CREEK, OKLAHOMA

The Corps of Engineers, the Bureau of Reclamation, and the Fort Cobb Master Conservancy District hereby set forth this agreement to carry out the provisions of Section 7 of the 1944 Flood Control Act for the operation of the Fort Cobb Dam and Reservoir.

WHEREAS, Fort Cobb Reservoir on Pond (Cobb) Creek, Oklahoma, was authorized by Public Law 84-419, 84th Congress, 2nd Session. The project was constructed by the Bureau of Reclamation with 63,740 acre-feet of flood control storage, which will be regulated in accordance with Section 7 of the 1944 Flood Control Act.

WHEREAS, Section 7 of the Flood Control Act of 1944, Public Law 78-534, 58 Stat. 890, 33 U.S.C. § 709, directs the Secretary of the Army to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds.

WHEREAS, 33 CFR § 208.11, Part 208, further prescribes the policy and procedures for regulating the use of storage allocated for flood control or navigation purposes at all reservoirs capable of such regulation and constructed wholly or in part with Federal funds provided on the basis of such purposes.

THEREFORE, this Letter of Understanding shall consummate the provisions of Section 7 of the 1944 Flood Control Act for Fort Cobb Dam and Reservoir. In addition to the responsibilities of the Bureau of Reclamation (project owner) and the Corps of Engineers, in accordance with 33 CFR § 208.11, it is agreed or understood that:

a. The Bureau of Reclamation (hereinafter called Reclamation) has a contract with the Fort Cobb Master Conservancy District (hereinafter called the District) which, among other things, delegates to the District the responsibility of the physical operation of the flood control facilities at the direction of the Corps of Engineers (hereinafter called the Corps) for the purpose of releasing flood waters between elevations 1,342.0 and 1,354.8 feet National Geodetic Vertical Datum (NGVD).

b. The Corps is responsible for directing real-time implementation of the flood control plan and until further notice shall direct the regulation of the project for storage and release of flood waters in the exclusive flood control pool (1,342.0 to 1,354.8 feet NGVD) in accordance with the approved "Water Control Agreement."

c. The Corps will continue to operate and maintain data collection platforms (DCPs) for the stream stage gaging stations on the Washita River near Anadarko, Oklahoma, and near Alex, Oklahoma, which are used to monitor downstream conditions during flood control releases from Fort Cobb Reservoir.

d. Reclamation shall be responsible for directing storage and release of all waters when the reservoir stage is above the top of the flood control pool, elevation 1,354.8 feet NGVD. Corps assistance in evaluating the real time flood runoff situation will be available to Reclamation.

e. Reclamation shall oversee the operation and maintenance of the hydrometeorological instrumentation and weather equipment at the project. This automated equipment and the reporting transmissions will be maintained compatible with the Corps' Southwestern Division automated data collection system by the District.

f. The District shall be responsible for directing storage and release of all waters below elevation 1,342.0 feet NGVD.

g. The District shall be responsible for the operation and maintenance of the flood control facilities. The District shall maintain capabilities of the flood control outlet works and uncontrolled spillway in accordance with the construction specifications and the "as built" drawings.

h. The District will record and transmit daily hydrometeorological and lake data to the Corps office in Tulsa, Oklahoma, in the format provided by the Corps. These reports will be made as requested by the Corps and shall be made by 9:00 a.m. on normal working days, and on weekends and holidays at Corps' request during flood situations. The format used will show the lake elevations, precipitation, evaporation, wind velocity, daily municipal pumpage, gate settings at 8 a.m., and gate changes. The lake elevations will be at noon, 4 p.m. and midnight of the previous date, and 8 a.m. of the report date. Precipitation in inches shall be reported for the periods ending at 1 p.m. and 7 p.m. of the previous date, and at 7 a.m. of the report date. The total 24-hour precipitation ending at 7 a.m. of the report date shall also be given. Wind velocity data shall consist of direction, as a compass heading from which the wind is proceeding, and speed using the Beaufort scale. Daily municipal pumpage shall be reported at 8 a.m. on the report date. Gate changes will be given chronologically for the report date since 8 a.m. of the previous date. The information provided for each gate change shall consist of the date and time, rounded to the nearest 5 minutes, lake elevation, settings of all gates prior to change, and settings at all gates after change was made. All changes in the gate settings affecting channel discharge shall also be reported immediately via telephone to the Corps by the District.

i. The flood control regulations under the water control plan, insofar as they govern use of the exclusive flood control storage capacity between elevations 1,342.0 and 1,354.8 feet NGVD, are subject to temporary deviations by the Corps in times of floods. Such deviations would be consistent with emergency requirements for protecting the dam and reservoir from major damage. The modification shall be communicated by the Corps to the representative of the District in immediate charge of operation at Fort Cobb Dam and to Reclamation, by the fastest available means of communication. The modification shall be confirmed in writing the same day by the Corps to Reclamation and a copy sent to the District and shall include justification for the action.

j. Reclamation or the District may temporarily deviate from the flood control regulations for emergency reasons to protect the safety of the dam or to avoid other serious hazards. In the event an immediate short-term departure is deemed necessary, such action shall be immediately reported to the Corps by the fastest means of communication available. Actions shall be confirmed in writing the same day by the District to the Corps and shall include justification for the action. Continuation of the deviation will require the express approval of the Corps. Advance approval of the Corps will be acquired prior to any deviation from the plan of regulation prescribed or approved by the Corps in the interest of flood control and/or navigation except in the emergency situations mentioned above. When conditions appear to warrant a prolonged deviation from the approved plan, Reclamation and the Corps will jointly investigate and evaluate the proposed deviation from the approved plan to insure that the overall integrity of the plan would not be unduly compromised. Approval of prolonged deviations will not be granted unless such investigations and evaluations have been conducted to the extent deemed necessary by the Corps to fully substantiate the deviation.

k. Flood control regulation shall not restrict municipal and industrial uses and downstream releases for authorized users as determined by Reclamation or others.

l. The Corps, Reclamation, and the District shall provide warnings that will start immediately when a water condition is expected that could produce severe damage to property and be potentially dangerous to life. The following paragraphs identify the action to be taken by each agency:

(1) Corps. The Corps shall furnish Reclamation and the District with the projected reservoir levels and flood control releases, when requested. The Corps shall furnish available pertinent hydrologic facts concerning Fort Cobb Reservoir and known conditions downstream of Fort Cobb Dam, as requested for use in warning the public around and downstream of Fort Cobb Reservoir. The Corps will dispatch personnel to the Fort Cobb Dam and Reservoir area to assist Reclamation and the District as required, insofar as possible.

(2) Reclamation. Reclamation will dispatch personnel to the Fort Cobb Dam and Reservoir area to assist the Corps and the District as required.

(3) District. The District shall maintain a list of key contacts and shall release information furnished by the Corps to the public in the reservoir area. The District shall alert the following public officials concerning projected reservoir levels and flood control releases: the Civil Defense and Sheriff Departments for Anadarko County; the Oklahoma State Highway Patrol; and the public immediately downstream of the dam. The District shall alert and assist Reclamation by providing the current status of seepage flows and foundation pressures of Fort Cobb Dam.

m. The water control manual for Fort Cobb Reservoir will contain this Letter of Understanding and the approved Water Control Agreement. In addition, the manual will contain instructions for reporting data necessary for flood control regulations of Fort Cobb Reservoir, communication procedures between the District, Reclamation, and the Corps, and instructions to be followed for flood control regulation. The manual will serve as a detailed guide to personnel involved in the flood control regulation of Fort Cobb Reservoir during the life of the project. Portions of the manual will be updated as conditions warrant.

Revisions to the Water Control Manual and all associated documents will be in accordance with the provisions of 208.11(d)(10), 33 CFR.

WITNESS OUR HAND in the capacities on the dates shown below and effective on the last signature date.

(Signature)

James P. King
Colonel, US Army
Commanding Officer
Southwestern Division
Corps of Engineers
Authorized Representative of the
Chief of Engineers

6 June 1994
Date

(Signature)

Neil Stessman
Regional Director
Great Plains Region
Bureau of Reclamation
Authorized Representative
of the Bureau of Reclamation

9 Nov, 1994
Date

(Signature)

Quinton O. Opitz
Superintendent
Fort Cobb Reservoir, Master
Conservancy District

1 Nov. 1994
Date

E X H I B I T C

WATER CONTROL AGREEMENT

FORT COBB DAM AND RESERVOIR

COBB CREEK, OKLAHOMA

WATER CONTROL AGREEMENT

FORT COBB DAM AND RESERVOIR

POND (COBB) CREEK, OKLAHOMA

Pursuant to Section 7 of the Flood Control Act of 1944 (58 Stat. 890, 33 U.S.C. § 709), and further prescribed in 33 CFR § 208.11(d)(5)(i), the following water control release schedules will govern the use of the water storage at Fort Cobb Dam and Reservoir on Pond (Cobb) Creek, Oklahoma.

The discharge characteristics of the controlled river outlet works and the uncontrolled spillway (capable of discharging approximately 2,570 cfs and 3,050 cfs, respectively, with the reservoir level at elevation 1374.2 feet NGVD) shall be maintained in accordance with the construction plans, to wit: Bureau of Reclamation Specification No. DC-4988 as modified by the "as built" drawings.

Flood control regulation shall not restrict releases necessary for municipal and industrial uses and downstream releases for authorized users as determined by Reclamation or others.

Releases made in accordance with these regulations are subject to the condition that releases shall be made at rates and in a manner that would be consistent with the emergency requirements for protecting the dam and reservoir from major damage.

The regulation of this section, insofar as it governs use of the flood control storage capacity above elevation 1342.0 feet NGVD, are subject to temporary modification by the Corps of Engineers (Corps) in time of flood, if found desirable on the basis of conditions at the time. Actions on modifications along with justification shall be communicated immediately to the Bureau of Reclamation.

The Bureau of Reclamation may temporarily deviate from this water control plan if it determines that short-term departure is necessary for emergency reasons to protect the safety of Fort Cobb Dam. In such an event, it will so advise the Corps immediately, with justification, and furnish written confirmation thereof. When conditions appear to warrant a prolonged deviation from the approved plan, Reclamation and the Corps will jointly investigate and evaluate the proposed deviation to insure that the overall integrity of the plan would not be unduly compromised.

All elevations stated in this section are at Fort Cobb Dam and are referred to the datum in use at that location.

Schedules are shown in tabular form for both the "Normal" and "Emergency" Flood Control Regulations, specifically, Tables C-1, C-2 and C-3, and are attached hereto and incorporated herein in compliance with the regulations.

WITNESS OUR HANDS in the capacities and on the dates shown below and effective on the last signature date.

(Signature)

James P. King
Colonel, US Army
Commanding Officer
Southwestern Division
Corps of Engineers
Authorized Representative of the
Chief of Engineers

6 June 1994
Date

(Signature)

Neil Stessman
Regional Director
Great Plains Region
Bureau of Reclamation
Authorized Representative
of the Bureau of Reclamation

9 Nov 1994
Date

Signature

Quinton O. Opitz
Superintendent
Fort Cobb Reservoir Master
Conservancy District

1 Nov. 1994
Date

TABLE C-1

FORT COBB DAM AND RESERVOIR

RESERVOIR ALLOCATIONS

Feature	Elevation (ft. NGVD)	Area (Acres)	Storage[1] Total (Acre-Feet)	Storage[1] Allocation (Acre-Feet)
Top of Flood Control Pool and Spillway Crest	1354.8	5,930	143,750	63,740
Top of Conservation Pool	1342.0	4,070	80,010	78,350
Top of Inactive Pool	1300.0	335	1,660	1,660
Streambed	1279.0	0	0	0
Flood Control Storage	1342.0-1354.8	--	63,740	
Water Supply Storage	1300.0-1342.0	--	78,350	

[1] Using capacity table from Bureau of Reclamation.

a. Flood Control Storage. Flood control storage capacity allocation shall include the storage capacity between elevation 1342.0 and 1354.8 feet (presently amounting to 63,740 acre-feet).

b. Active Conservation Storage. The active conservation storage capacity allocation shall include the storage capacity between elevation 1300.0 and 1342.0 feet (presently amounting to 78,350 acre-feet).

c. Inactive and Dead Storage. The inactive and dead storage capacity allocation shall include the storage capacity between the streambed and elevation 1300.0 feet (presently amounting to 1,660 acre-feet).

TABLE C-2

NORMAL FLOOD CONTROL REGULATION SCHEDULE

FORT COBB DAM AND RESERVOIR

RESERVOIR ELEVATION (Feet NGVD)	POOL CONDITIONS	REGULATION
Below 1342.0	Rising or Falling	Releases are scheduled by the Fort Cobb Reservoir Master Conservancy District. Releases are not to exceed the channel capacity of Cobb Creek downstream of the dam (currently estimated to be 1,000 cfs). When combined with local flows, releases are not to exceed a stage of 19.0 feet (currently estimated to pass approximately 6,100 cfs) at the Anadarko, Oklahoma gage or a stage of 19.0 feet (currently estimated to pass approximately 32,300 cfs) at the Alex, Oklahoma gage, or a stage of 24.0 feet (currently estimated to pass 39,800 cfs) at the Pauls Valley, OK gage
1342.0 - 1354.8	Rising	Releases shall be made under the direction of the Corps of Engineers. * Releases will be limited to amounts, which when combined with local flows downstream of the dam, will not produce flows in excess of bankfull on Cobb Creek (estimated to be 1,000 cfs). In addition, flood control releases, when combined with uncontrolled runoff downstream of the dam, will not exceed a stage of 19.0 feet (estimated to pass a flow of approximately 6,100 cfs) at the USGS gage on the Washita River near Anadarko, Oklahoma or a stage of 19.0 feet (estimated to pass approximately 32,300 cfs) at the USGS gage on the Washita River near Alex, Oklahoma, or a stage of 24,0 feet at the Pauls Valley, OK guage (currently estimated to pass 39,800 cfs). When the reservoir elevation forecast indicates that this operation will result in a reservoir level exceeding elevation 1354.8 feet, NGVD, releases may be modified in order to prevent the reservoir from exceeding elevation 1354.8 feet insofar as possible. When the pool elevation reaches

TABLE C-2 (cont'd)

NORMAL FLOOD CONTROL REGULATION SCHEDULE

FORT COBB DAM AND RESERVOIR

RESERVOIR ELEVATION (Feet NGVD)	POOL CONDITIONS	REGULATION
1342.0-1354.8 (contd)	Rising	1354.8 feet, NGVD, the release rate shall be equal to inflow or the maximum rate possible, whichever is less. Close coordination is required among the District, the Corps of Engineers, and the Bureau of Reclamation to ensure that the maximum releases through the river outlet gates are attained prior to significant uncontrolled spillway discharge.
Above 1354.8	Rising	The Bureau of Reclamation is responsible for directing release of water when the pool is above elevation 1354.8 feet, NGVD. Discharge shall be made at the maximum release possible through the river outlet gates and the uncontrolled spillway.
Above 1354.8	Falling	Continue the maximum release rate reached under rising pool conditions, until the pool recedes to elevation 1354.8 feet, NGVD.
1354.8 - 1342.0	**Falling	*Release rates shall not exceed the maximum rate permissible under rising conditions within this pool elevation range.

* For release rates less than that equal to 2 conduit gates opened 10 percent each, use only one gate.

** After making near channel capacity releases (1,000 cfs) for several days or longer, make one gate change to about 800 cfs and hold for 2 or 3 days to allow the saturated banks to stabilize. The release rate may then be decreased by one or two gate changes per day.

TABLE C-3

EMERGENCY FLOOD CONTROL REGULATION SCHEDULE

LOSS OF COMMUNICATION WITH ARKANSAS RIVER CONTROL SECTION

FORT COBB DAM AND RESERVOIR

RESERVOIR ELEVATION (Feet NGVD)	POOL CONDITIONS	REGULATION
Below 1342.0	Rising or Falling	Release to be scheduled by the Fort Cobb Reservoir Master Conservancy District and are not to exceed the channel capacity of Cobb Creek downstream of the dam (currently estimated to be approximately 1,000 cfs.)
1342.0 - 1354.6	Rising	Release being made prior to loss of communication shall be maintained until communications are restored or the pool rises to elevation 1354.6 feet, NGVD.
1354.6 - 1354.8	Rising	Releases shall be increased by 170 cfs every two hours until the pool becomes static or the pool rises to elevation 1354.8 feet, NGVD, at which time the river outlet will be staged to fully open.
Above 1354.8	Rising or Falling	Releases shall be made at the maximum rate possible and continued until the pool recedes to elevation 1354.8 feet, NGVD. At no time while pool is rising shall releases be decreased.
1354.8 - 1343.5	Falling	Maintain release in effect when communication was lost or maintain release attained under rising pool conditions if the release is less than or equal to 1000 cfs. If the release is greater than 1000 cfs, reduce the release by 250 cfs every 2 hours until the release is 1000 cfs. Do not reduce release if the reduction would cause the pool to rise.
1343.5 - 1342.0	Falling	Begin a gradual reduction of the release (at a rate not to exceed 170 cfs per 3-hour period) making sure the pool continues to fall. Stabilize the pool at elevation 1342.0 feet, NGVD.

E X H I B I T D

STANDING INSTRUCTIONS TO DAM OPERATOR

FORT COBB DAM AND RESERVOIR

EXHIBIT D
STANDING INSTRUCTIONS TO DAM OPERATOR
FORT COBB DAM AND RESERVOIR

TABLE OF CONTENTS

EXHIBIT D

STANDING INSTRUCTIONS TO DAM OPERATOR
FORT COBB DAM AND RESERVOIR

I - GENERAL

1. Instructions. Detailed instructions to the Conservancy District and/or Reclamation project personnel at Fort Cobb Reservoir are presented below.

a. Standing instructions to the Dam Operator. During flood periods, the reservoir will be regulated in accordance with the normal regulations for flood control as directed in subparagraph 7-05a. and Exhibit E of this manual. Instructions for the storage and discharge of floodwater from the flood control pool will be issued by the Water Control Section, Tulsa District. In the event that communications with the Tulsa District Office are disrupted, the reservoir will be regulated in accordance with the schedule of loss of communication (emergency) regulations for flood control instructions in subparagraph 7-05b and Exhibit E. In addition, the Dam Operator will immediately make every effort to reestablish communications with the Tulsa District Office. The Dam Operator will make daily records of the weather station and pool level data and report those data, as directed in paragraph 5-06 and repeated in Exhibit E. Should an emergency exist, such as inoperable gates, drowning accident, excessive trash in the gates, broken buoy line, embankment boils, or power outage, the Water Control Section will be notified immediately.

b. Project reporting instructions. Daily lake data from Fort Cobb Reservoir (see Plate 5-3) will be submitted to the Water Control Section by telephone (see the Emergency Personnel Roster, page ii of the Corps Water Control Manual) during normal working hours. The Water Control Section is normally manned from 7:45 a.m. to 4:30 p.m. daily and various hours during flood control operations and weekends and holidays. Data for nonworking days shall be read from the recorder chart and submitted the following workday. Should unusual conditions arise during nonworking hours, one of the persons

listed in the Emergency Personnel Roster on page ii should be contacted. Reports should be transmitted by 9:00 a.m. via telephone. The following data should be included in the daily report.

(1) As of 8:00 a.m. Pool elevations at 8:00 a.m. and for the previous day at 12 noon, 4:00 p.m., and 12 midnight (all values should be read from the recorder chart); number of river outlet gates open, with the height of the openings; municipal and industrial release volumes for the preceding 24 hours ending at midnight; precipitation and evaporation in inches for the preceding 24 hours (7:00 a.m. to 7:00 a.m.); wind velocity and direction (at 8:00 a.m.).

(2) Each gate operation. Date and time of gate operation, number and height of gates open before and after gate operation, and lake elevation. Confirmation of gate changes shall be made immediately after completion of the change. Complaints about pool elevations or releases, operating machinery failure and out-of-service times for maintenance shall be reported to the Water Control Section as they occur.

(3) During flood periods. In addition to subparagraphs a and b above, reports should also be made at 1:00 p.m. and 7:00 p.m. or as instructed by Water Control Section.

(4) Rainfall reports. Rainfall reports shall be made as follows:

a. At 8:00 a.m. all precipitation that has occurred during the preceding 24 hours, 7:00 a.m. to 7:00 a.m. as shown on Plate 5-3 (covered by routine report on working days).

b. At 1:00 p.m. when 0.50 inch or more of precipitation has occurred since 7:00 a.m. or if it has continued to rain since reporting at 8:00 a.m.

c. At 7:00 p.m. when 0.50 inch or more of precipitation has occurred since the 8:00 a.m. report and no 1:00 p.m. report was made, or if it has continued to rain since reporting at 1:00 p.m.

d. Report at once the occurrence of 2.00 inches or more of precipitation that occurs during a period of 6 hours or less.

e. During non-normal working hours, the report should be made to one of the persons listed on the Emergency Personnel Roster, page ii; however, if no contact can be made, rainfall reports should be made to

the NWS, Tulsa, Oklahoma (see Supplemental Telephone Listing, page ii of Corps Water Control Manual).

c. Reporting unusual events. Events or conditions not normally encountered in the routine operation of the dam and lake which might endanger the dam or necessitate temporary or permanent revision of the operating procedures shall be reported immediately to the Water and Land Operations Division, Regional Office, Bureau of Reclamation, Billings, Montana, by telephone. The following unusual occurrences require a report:

(1) Rainfall of 2.0 inches or more in a 6-hour period or inflow which results in reservoir storage approaching elevation 1342.0 feet NGVD and conditions (current rate of inflow, probable duration, continuing or predicted precipitation) which will probably require initiation of flood control operations.

(2) Settlement, movement, or cracking of the dam embankment, earth dikes, abutments, or concrete in the outlet works or spillway.

(3) Any unusual change in seepage rates or development of new seepage areas.

(4) Failure or mechanical malfunction of hoists, gates,or any related appurtenances required to operate the outlet works.

(5) Landslides, rockslides, or indication of any impending movement.

(6) Occurrences which would indicate any degree of jeopardy to safety of the dam or adjacent structures or that would affect safety of the public.

(7) The construction, failure, or malfunction of any upstream facility in the Fort Cobb Dam watershed which would adversely affect the quality of water in storage in the reservoir.

d. Warnings. It is the responsibility of Reclamation, the Conservancy District, the Corps, and other Federal and State agencies, depending on the urgency of the situation, to provide warnings when release conditions are expected that could produce severe property damage and/or be potentially dangerous to life. This will be performed in accordance with the Letter of Understanding (see Exhibit B). The Dam Operator and the District or Reclamation project personnel authorized to

make gate changes will maintain a list of current residents and/or property which could be endangered or inconvenienced by releases and give them adequate warning of impending releases.

II - REGULATION PROCEDURES

a. Normal flood control regulations. Fort Cobb Reservoir is regulated to provide flood reductions on the Cobb Creek from Fort Cobb Dam to the confluence of Washita River and, in conjunction with Foss and Arbuckle Reservoirs, to Lake Texoma. The normal flood control schedule as shown in table C-2, Exhibit C, will govern releases from Fort Cobb Reservoir.

b. Loss of communications. When communication with the Tulsa District Office is disrupted, the Dam Operator will, on his own initiative, direct regulation of the reservoir in accordance with the emergency flood control regulation schedule shown in Table C-3, Exhibit C, until communication is restored. In addition, the Dam Operator will immediately make every effort to reestablish communication with the Tulsa District Office. The river outlet gates shall be operated at uniform openings, except when opened less than 10 percent only one gate will be used.

c. During emergency events. The Dam Operator may temporarily deviate from the current release rates in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam, or by the fastest means of communication available. Actions shall be confirmed in writing the same day to Reclamation and the Conservancy and shall include justification for the action. Continuation of the deviation will require the express approval of the Water Control Section.

d. Constraints. The regulation schedules provide that the channel capacity (currently estimated to pass approximately 1,000 cfs) in the reach from the dam to the confluence of Washita River is not to be exceeded insofar as practicable. Floodwaters will be released as rapidly as practicable with consideration given to minimizing flooding of low-water crossings (which have an estimated capacity of about 300 cfs) and low-lying farmland.

E X H I B I T E

SECTION 7 FLOOD CONTROL REGULATION

EXTRACTED FROM CODE OF FEDERAL REGULATIONS,

TITLE 33, CH. II (7-1-89 EDITION)

§ 208.11 Regulations for use of storage allocated for flood control or navigation and/or project operation at reservoirs subject to prescription of rules and regulations by the Secretary of the Army in the interest of flood control and navigation.

(a) *Purpose.* This regulation prescribes the responsibilities and general procedures for regulating reservoir projects capable of regulation for flood control or navigation and the use of storage allocated for such purposes and provided on the basis of flood control and navigation, except projects owned and operated by the Corps of Engineers; the International Boundary and Water Commission, United States and Mexico; and those under the jurisdiction of the International Joint Commission, United States, and Canada, and the Columbia River Treaty. The intent of this regulation is to establish an understanding between project owners, operating agencies, and the Corps of Engineers.

(b) *Responsibilities.* The basic responsibilities of the Corps of Engineers regarding project operation are set out in the cited authority and described in the following paragraphs:

(1) Section 7 of the Flood Control Act of 1944 (58 Stat. 890, 33 U.S.C. 709) directs the Secretary of the Army to prescribe regulations for flood control and navigation in the following manner:

Hereafter, it shall be the duty of the Secretary of War to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations: *Provided*, That this section shall not apply to the Tennessee Valley Authority, except that in case of danger from floods on the lower Ohio and Mississippi Rivers the Tennessee Valley Authority is directed to regulate the release of water from the Tennessee River into the Ohio River in accordance with such instructions as may be issued by the War Department.

(2) Federal Energy Regulatory Commission (formerly Federal Power Commission (FPC)) licenses.

(i) Responsibilities of the Secretary of the Army and/or the Chief of Engineers in Federal Energy Regulatory Commission (FERC) licensing actions are set out in the Federal Power Act. Pertinent sections of that Act are cited herein. The Commission may also stipulate, as part of license conditions, that the licensee enter into an agreement with the Department of the Army providing for operation of the project during flood times, in accordance with rules and regulations prescribed by the Secretary of the Army.

(A) Section 4(e) of the Federal Power Act requires approval by the Chief of Engineers and the Secretary of the Army of plans of dams or other structures affecting the navigable capacity of any navigable waters of the United States, prior to issuance of a license by the Commission as follows:

The Commission is hereby authorized and empowered to issue licenses to citizens * * * for the purpose of constructing, operating, and maintaining dams, water conduits, reservoirs, powerhouses, transmission lines, or other project works necessary or convenient for the development and improvement of navigation and for the development, transmission, and utilization of power across, along, from or in any of the streams or other bodies of water over which Congress has jurisdiction * * * *Provided further*, That no license affecting the navigable capacity of any navigable waters of the United States shall be issued until the plans of the dam or other structures affecting navigation have been approved by the Chief of Engineers and the Secretary of the Army.

(B) Sections 10(a) and 10(c) of the Federal Power Act specify conditions of project licenses including the following:

(1) Section 10(a). That the project adopted * * * shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use of benefit of interstate or foreign commerce, for the improvement and utilization of waterpower development, and for other beneficial public use * * *.

(2) Section 10(c). That the licensee shall * * * so maintain and operate said works as not to impair navigation, and shall conform to such rules and regulations as the Commission may from time to time prescribe for the protection of life, health, and property.* * *

(C) Section 18 of the Federal Power Act directs the operation of any navigation facilities built under the provision of that act, be controlled by rules and regulations prescribed by the Secretary of the Army as follows:

The operation of any navigation facilities which may be constructed as part of or in connection with any dam or diversion structure built under the provisions of this Act, whether at the expense of a licensee hereunder or of the United States, shall at all times be controlled by such reasonable rules and regulations in the interest of navigation; including the control of the pool caused by such dam or diversion structure as may be made from time to time by the Secretary of the Army, * * *

(ii) Federal Power Commission order No. 540 issued October 31, 1975, and published November 7,1975 (40 FR 51998), amending section 2.9 of the Commission's general policy and interpretations prescribed standardized conditions (forms) for inclusion in preliminary permits and licenses issued under Part I of the Federal Power Act. As an example, Article 12 of Standard Form L-3, titled: "Terms and Conditions of License for Constructed Major Projects Affecting Navigable Waters of the United States," sets out the Commission's interpretation of appropriate sections of the Act, which deal with navigation aspects, and attendant responsibilities of the Secretary of the Army in licensing actions as follows:

The United States specifically retains and safeguards the right to use water in such

amount, to be determined by the Secretary of the Army, as may be necessary for the purposes of navigation on the navigable waterway affected; and the operation of the Licensee, so far as they affect the use, storage and discharge from storage of waters affected by the license, shall at all times be controlled by such reasonable rules and regulations as the Secretary of the Army may prescribe in the interest of navigation, and as the Commission may prescribe for the protection of life, health, and property, * * *, and the Licensee shall release water from the project reservoir at such rate * * *, as the Secretary of the Army may prescribe in the interest of navigation, or as the Commission may prescribe for the other purposes hereinbefore mentioned.

(3) Section 9 of Pub. L. 436, 83d Congress (68 Stat. 303) provides for the development of the Coosa River, Ala. and Ga., and directs the Secretary of the Army to prescribe rules and regulations for project operation in the interest of flood control and navigation as follows:

The operation and maintenance of the dams shall be subject to reasonable rules and regulations of the Secretary of the Army in the interest of flood control and navigation.

NOTE: This Regulation will also be applicable to dam and reservoir projects operated under provisions of future legislative acts wherein the Secretary of the Army is directed to prescribe rules and regulations in the interest of flood control and navigation. The Chief of Engineers, U.S. Army Corps of Engineers, is designated the duly authorized representative of the Secretary of the Army to exercise the authority set out in the congressional acts. This regulation will normally be implemented by letters of understanding between the Corps of Engineers and project owner and will incorporate the provisions of such letters of understanding prior to the time construction renders the project capable of significant impoundment of water. A water control agreement signed by both parties will follow when deliberate impoundment first begins or at such time as the responsibilities of any corps-owned projects may be transferred to another entity. Promulgation of this regulation for a given project will occur at such time as the name of the project appears in the FEDERAL REGISTER in accordance with the requirements of § 208.11(d)(11). When agreement on a water control plan cannot be reached between the corps and the project owner after coordination with all interested parties, the project name will be entered in the FEDERAL REGISTER and the Corps of Engineers plan will be the officials water control plan until such time as differences can be resolved.

(c) *Scope and terminology.* This regulation applies to Federal authorized flood control and/or navigation storage projects, and to non-Federal projects which require the Secretary of the Army to prescribe regulations as a condition of the license, permit or legislation, during the planning, design and construction phases, and throughout the life of the project. In compliance with the authority cited above, this regulation defines certain activities and responsibilities concerning water control management throughout the Nation in the interest of flood control and navigation. In carrying out the conditions of this regulation, the owner and/or operating agency will comply with applicable provisions of Pub. L. 85-624, the Fish and Wildlife Coordination Act of 1958, and Pub. L. 92-500, the Federal Water Pollution Control Act Amendments of 1972. This regulation does not apply to local flood protection works governed by § 208.10, or to navigation facilities and associated structures which are otherwise covered by Part 207 (Navigation Regulations) of Title 33 of the code. Small reservoirs, containing less than 12,500 acre-feet of flood control or navigation storage, may be excluded from this regulation and covered under § 208.10, unless specifically required by law or conditions of the license or permit.

(1) The terms "reservoir" and "project" as used herein include all water resource impoundment projects constructed or modified, including natural lakes, that are subject to this regulation.

(2) The term "project owner" refers to the entity responsible for maintenance, physical operation, and safety of the project, and for carrying out the water control plan in the interest of flood control and/or navigation as prescribed by the Corps of Engineers. Special arrangements may be made by the project owner for "operating agencies" to perform these tasks.

(3) The term "letter of understanding" as used herein includes statements which consummate this regulation for any given project and define

the general provisions or conditions of the local sponsor, or owner, cooperation agreed to in the authorizing legislative document, and the requirements for compliance with section 7 of the 1944 Flood Control Act, the Federal Power Act or other special congressional act. This information will be specified in the water control plan and manual. The letter of understanding will be signed by a duly authorized representative of the Chief of Engineers and the project owner. A "field working agreement" may be substituted for a letter of understanding, provided that the specified minimum requirements of the latter, as stated above, are met.

(4) The term "water control agreement" refers to a compliation of water control criteria, guidelines, diagrams, release schedules, rule curves and specifications that basically govern the use of reservoir storage space allocated for flood control or navigation and/or release functions of a water control project for these purposes. In general, they indicate controlling or limiting rates of discharge and storage space required for flood control and/or navigation, based on the runoff potential during various seasons of the year.

(5) For the purpose of this regulation, the term "water control plan" is limited to the plan of regulation for a water resources project in the interest of flood control and/or navigation. The water control plan must conform with proposed allocations of storage capacity and downstream conditions or other requirements to meet all functional objectives of the particular project, acting separately or in combination with other projects in a system.

(6) The term "real-time" denotes the processing of current information or data in a sufficiently timely manner to influence a physicial response in the system being monitored and controlled. As used herein the term connotes * * * the analyses for and execution of water control decisions for both minor and major flood events and for navigation, based on prevailing hydrometeorological and other conditions and constraints, to achieve efficient management of water resource systems.

(d) *Procedures*—(1) *Conditions during project formulation.* During the planning and design phases, the project owner should consult with the Corps of Engineers regarding the quantity and value of space to reserve in the reservoir for flood control and/or navigation purposes, and for utilization of the space, and other requirements of the license, permit or conditions of the law. Relevant matters that bear upon flood control and navigation accomplishment include: Runoff potential, reservoir discharge capability, downstream channel characteristics, hydrometeorological data collection, flood hazard, flood damage charateristics, real estate acquisition for flowage requirements (fee and easement), and resources required to carry out the water control plan. Advice may also be sought on determination of and regulation for the probable maximum or other design flood under consideration by the project owner to establish the quantity of surcharge storage space, and freeboard elevation of top of dam or embankment for safety of the project.

(2) *Corps of Engineers involvement.* If the project owner is responsible for real-time implemenetation of the water control plan, consultation and assistance will be provided by the Corps of Engineers when appropriate and to the extent possible. During any emergency that affects flood control and/or navigation, the Corps of Engineers may temporarily prescribe regulation of flood control or navigation storage space on a day-to-day (real-time) basis without request of the project owner. Appropriate consideration will be given for other authorized project functions. Upon refusal of the project owner to comply with regulations prescribed by the Corps of Engineers, a letter will be sent to the project owner by the Chief of Engineers or his duly authorized representative describing the reason for the regulations prescribed, events that have transpired, and notification that the project owner is in violation of the Code of Federal Regulations. Should an impasse arise, in that the project owner or the designated operating entity persists in noncompliance with regulations prescribed by the Corps of

Engineers, measures may be taken to assure compliance.

(3) *Corps of Engineers implementation of real-time water control decisions.* The Corps of Engineers may prescribe the continuing regulation of flood control storage space for any project subject to this regulation on a day-to-day (real-time) basis. When this is the case, consultation and assistance from the project owner to the extent possible will be expected. Special requests by the project owner, or appropriate operating entity, are preferred before the Corps of Engineers offers advice on real-time regulation during surcharge storage utilization.

(4) *Water control plan and manual.* Prior to project completion, water control managers from the Corps of Engineers will visit the project and the area served by the project to become familiar with the water control facilities, and to insure sound formulation of the water control plan. The formal plan of regulation for flood control and/or navigation, referred to herein as the water control plan, will be developed and documented in a water control manual prepared by the Corps of Engineers. Development of the manual will be coordinated with the project owner to obtain the necessary pertinent information, and to insure compatibility with other project purposes and with surcharge regulation. Major topics in the manual will include: Authorization and description of the project, hydrometeorology, data collection and communication networks, hydrologic forecasting, the water control plan, and water resource management functions, including responsibilities and coordination for water control decisionmaking. Special instructions to the dam tender or reservoir manager on data collection, reporting to higher Federal authority, and on procedures to be followed in the event of a communication outage under emergency conditions, will be prepared as an exhibit in the manual. Other exhibits will include copies of this regulation, letters of understanding consummating this regulation, and the water control agreements. After approval by the Chief of Engineers or his duly authorized representative, the manual will be furnished the project owner.

(5) *Water control agreement.* (i) A water control diagram (graphical) will be prepared by the Corps of Engineers for each project having variable space reservation for flood control and/or navigation during the year; e.g., variable seasonal storage, joint-use space, or other rule curve designation. Reservoir inflow parameters will be included on the diagrams when appropriate. Concise notes will be included on the diagrams prescribing the use of storage space in terms of release schedules, runoff, nondamaging or other controlling flow rates downstream of the damsite, and other major factors as appropriate. A water control release schedule will be prepared in tabular form for projects that do not have variable space reservation for flood control and/or navigation. The water control diagram or release schedule will be signed by a duly authorized representative of the Chief of Engineers, the project owner, and the designated operating agency, and will be used as the basis for carrying out this regulation. Each diagram or schedule will contain a reference to this regulation.

(ii) When deemed necessary by the Corps of Engineers, information given on the water control diagram or release schedule will be supplemented by appropriate text to assure mutual understanding on certain details or other important aspects of the water control plan not covered in this regulation, on the water control diagram or in the release schedule. This material will include clarification of any aspects that might otherwise result in unsatisfactory project performance in the interest of flood contol and/or navigation. Supplementation of the agreement will be necessary for each project where the Corps of Engineers exercises the discretionary authority to prescribe the flood control regulation on a day-to-day (real-time) basis. The agreement will include delegation of the responsibility. The document should also cite, as appropriate, section 7 of the 1944 Flood Control Act, the Federal Power Act and/or other congressional legislation authorizing

construction an/or directing operation of the project.

(iii) All flood control regulations published in the FEDERAL REGISTER under this section (Part 208) of the code prior to the date of this publication which are listed in § 208.11(e) are hereby superseded.

(iv) Nothing in this regulation prohibits the promulgation of specific regulations for a project in compliance with the authorizing acts, when agreement on acceptable regulations cannot be reached between the Corps of Engineers and the owner.

(6) *Hydrometeorological instrumentation.* The project owner will provide instrumentation in the vicinity of the damsite and will provide communication equipment necessary to record and transmit hydrometeorological and reservoir data to all appropriate Federal authorities on a real-time basis unless there are extenuating circumstances or are otherwise provided for as a condition of the license or permit. For those projects where the owner retains responsibility for real-time implementation of the water control plan, the owner will also provide or arrange for the measurement and reporting of hydrometeorological parameters required within and adjacent to the watershed and downstream of the damsite, sufficient to regulate the project for flood control and/or navigation in an efficient manner. When data collection stations outside the immediate vicinity of the damsite are required, and funds for installation, observation, and maintenance are not available from other sources, the Corps of Engineers may agree to share the costs for such stations with the project owner. Availability of funds and urgency of data needs are factors which will be considered in reaching decisions on cost sharing.

(7) *Project safety.* The project owner is responsible for the safety of the dam and appurtenant facilities and for regulation of the project during surcharge storage utilization. Emphasis upon the safety of the dam is especially important in the event surcharge storage is utilized, which results when the total storage space reserved for flood control is exceeded. Any assistance provided by the Corps of Engineers concerning surcharge regulation is to be utilized at the discretion of the project owner, and does not relieve the owner of the responsibility for safety of the project.

(8) *Notification of the general public.* The Corps of Engineers and other interested Federal and State agencies, and the project owner will jointly sponsor public involvement activities, as appropriate, to fully apprise the general public of the water control plan. Public meetings or other effective means of notification and involvement will be held, with the initial meeting being conducted as early as practicable but not later than the time the project first becomes operational. Notice of the initial public meeting shall be published once a week for 3 consecutive weeks in one or more newspapers of general circulation published in each county covered by the water control plan. Such notice shall also be used when appropriate to inform the public of modifications in the water control plan. If no newspaper is published in a county, the notice shall be published in one or more newspapers of general circulation within that county. For the purposes of this section a newspaper is one qualified to publish public notices under applicable State law. Notice shall be given in the event significant problems are anticipated or experienced that will prevent carrying out the approved water control plan or in the event that an extreme water condition is expected that could produce severe damage to property or loss of life. The means for conveying this information shall be commensurate with the urgency of the situation. The water control manual will be made available for examination by the general public upon request at the appropriate office of the Corps of Engineers, project owner or designated operating agency.

(9) *Other generalized requirements for flood control and navigation.* (i) Storage space in the reservoirs allocated for flood control and navigation purposes shall be kept available for those purposes in accordance with the water control agreement, and the plan of regulation in the water control manual.

(ii) Any water impounded in the flood control space defined by the water control agreement shall be evacuated as rapidly as can be safely accomplished without causing downstream flows to exceed the controlling rates; i.e., releases from reservoirs shall be restricted insofar as practicable to quantities which, in conjunction with uncontrolled runoff downstream of the dam, will not cause water levels to exceed the controlling stages currently in force. Although conflicts may arise with other purposes, such as hydropower, the plan or regulation may require releases to be completely curtailed in the interest of flood control or safety of the project.

(iii) Nothing in the plan of regulation for flood control shall be construed to require or allow dangerously rapid changes in magnitudes of releases. Releases will be made in a manner consistent with requirements for protecting the dam and reservoir from major damage during passage of the maximum design flood for the project.

(iv) The project owner shall monitor current reservoir and hydro- meteorological conditions in and adjacent to the watershed and downstream of the damsite, as necessary. This and any other pertinent information shall be reported to the Corps of Engineers on a timely basis, in accordance with standing instructions to the damtender or other means requested by the Corps of Engineers.

(v) In all cases where the project owner retains responsibility for real-time implementation of the water control plan, he shall make current determinations of: Reservoir inflow, flood control storage utilized, and scheduled releases. He shall also determine storage space and releases required to comply with the water control plan prescribed by the Corps of Engineers. The owner shall report this information on a timely basis as requested by the Corps of Engineers.

(vi) The water control plan is subject to temporary modification by the Corps of Engineers if found necessary in time of emergency. Requests for and action on such modifications may be made by the fastest means of communication available. The action taken shall be confirmed in writing the same day to the project owner and shall include justification for the action.

(vii) The project owner may temporarily deviate from the water control plan in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other serious hazards. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing the same day to the Corps of Engineers and shall include justification for the action. Continuation of the deviation will require the express approval of the Chief of Engineers, or his duly authorized representative.

(viii) Advance approval of the Chief of Engineers, or his duly authorized representative, is required prior to any deviation from the plan of regulation prescribed or approved by the Corps of Engineers in the interest of flood control and/or navigation, except in emergency situations provided for in paragraph (d)(9)(vii) of this section. When conditions appear to warrant a prolonged deviation from the approved plan, the project owner and the Corps of Engineers will jointly investigate and evaluate the proposed deviation to insure that the overall integrity of the plan would not be unduly compromised. Approval of prolonged deviations will not be granted unless such investigations and evaluations have been conducted to the extent deemed necessary by the Chief of Engineers, or his designated representatives, to fully substantiate the deviation.

(10) *Revisions.* The water control plan and all associated documents will be revised by the Corps of Engineers, as necessary, to reflect changed conditions that come to bear upon flood control and navigation, e.g., reallocation of reservoir storage space due to sedimentation or transfer of storage space to a neighboring project. Revision of the water control plan, water control agreement, water control diagram, or release schedule requires approval of the Chief of Engineers or his duly authorized representative. Each such revision shall be effective upon

the date specified in the approval. The original (signed document) water control agreement shall be kept on file in the Office, Chief of Engineers, Department of the Army, Washington, D.C. Copies of the agreement shall be kept on file and may be obtained from the office of the project owner, or from the office of the appropriate Division Engineer, Corps of Engineers.

(11) *Federal Register.* The following information for each project subject to section 7 of the 1944 Flood Control Act and other applicable congressional acts shall be published in the FEDERAL REGISTER prior to the time the projects becomes operational and prior to any significant impoundment before project completion or * * * at such time as the responsibility for physical operation and maintenance of the Corps of Engineers owned projects is transferred to another entity:

(i) Reservoir, dam, and lake names,

(ii) Stream, county, and State corresponding to the damsite location,

(iii) The maximum current storage space in acre-feet to be reserved exclusively for flood control and/or navigation purposes, or any multiple-use space (intermingled) when flood control or navigation is one of the purposes, with corresponding elevations in feet above mean sea level, and area in acres, at the upper and lower limits of said space,

(iv) The name of the project owner, and

(v) Congressional legislation authorizing the project for Federal participation.

(e) *List of projects.* The following tables, "Pertinent Project Data—Section 208.11 Regulation," show the pertinent data for projects which are subject to this regulation.

LIST OF PROJECTS

[Pertinent project data]

[Footnotes at end of table]

Project name [1]	State, county and stream [1]	Exclusive-use					Multiple-use					Project owner [2]	Authorizing legislation [3]
		Flood control/navigation					Flood control/navigation						
		Storage (1,000 AF)	Elevation limits (feet, m.s.l.)		Area (acres)		Storage (1,000 AF)	Elevation limits (feet, m.s.l.)		Area (acres)			
			Upper	Lower	Upper	Lower		Upper	Lower	Upper	Lower		
Alpine Dam	IL, Winnebago, Keith Cr	0.6	796.0	764.0	52	0						City of Rockford, IL	PWA Proj.
Agency Valley Dam & Res.	OR, Malheur, N. Fork Malheur R.						60.0	3,340.0	3,263.2	1,900	0	USBR	PL 68-292.
American Fall Dam & Res.	ID, Power, Snake River						1,700.0	4,343.2	4,295.6	56,100	0	USBR	FERC 2259.
Anderson Ranch Dam & Res.	ID, Elmore, S. Fk. Boise River						423.2	4,196.0	4,043.0	4,740	1,150	USBR	Act of 1939, 53 Stat 1187.
Arrowrock Dam & Res.	ID, Elmore, Boise River						286.6	3,216.0	2,967.0	3,100	200	USBR	Act of 1902, 32 Stat 388.
Bear Cr Dam	MO, Marion Ralls, Bear Cr	8.7	546.5	520.0	540	0						City of Hannibal, MO.	PL 83-780.
Bear Swamp Pumped Storage.	MA, Franklin, Deerfield R Trib											New England Pwr Co.	Fed Pwr Act.
Big Dry Creek and Div.	CA, Fresno, Big Dry Cr & Dog Cr.	16.2	425.0	393.0	1,530	0						Reclamation Board of CA.	PL 77-228.
Bocu Dam & Res	CA, Nevada, Little Truckee R					41	5,605.0	5,596.4	980	873		USBR	PL 81-299, PL 68-292.
Bonny Dam & Res	CO, Yuma, S. Fork Republican R.	128.8	3,710.0	3,672.0	5,036	2,042						USBR	PL 78-534.
Boysen Dam & Res	WY, Fremont, Wild River	146.0	4,732.0	4,725.0	22,100	19,560	146.1	4,725.0	4,717.0	19,560	16,955	USBR	PL 78-534.
Brownlee Dam & Res	OR, Baker, ID, Washington, Snake River.						960.3	2,077.0	1,976.0	13,840	6,650	Idaho Pwr Co	FERC No 1971-C.
Bully Cr Dam & Res	OR, Malheur, Bully Creek						31.6	2,523.0	2,456.8	1,062	140	USBR	PL 86-248.
Camanche Dam & Res.	CA, San Joaquin, Mokelumne R.						200.0	235.5	205.1	7,600	5,507	East Bay Mun Util Dist.	PL 86-645.
Canyon Ferry Dam & Lk.	MT, Lewis, Clark, Missouri R						799.1	3,797.0	3,770.0	34,435	24,126	USBR	PL 78-534.
Cedar Bluff Dam & Res.	KS, Trego, Smoky Hill River	191.9	2,166.0	2,144.0	10,790	6,669						USBR	PL 78-534.
Clark Canyon Dam & Res.	MT, Beaverhead, Beaverhead River.	79.1	5,560.4	5,546.1	5,903	5,160	50.4	5,546.1 [4]	5,535.7	5,160	4,496	USBR	PL 78-534.

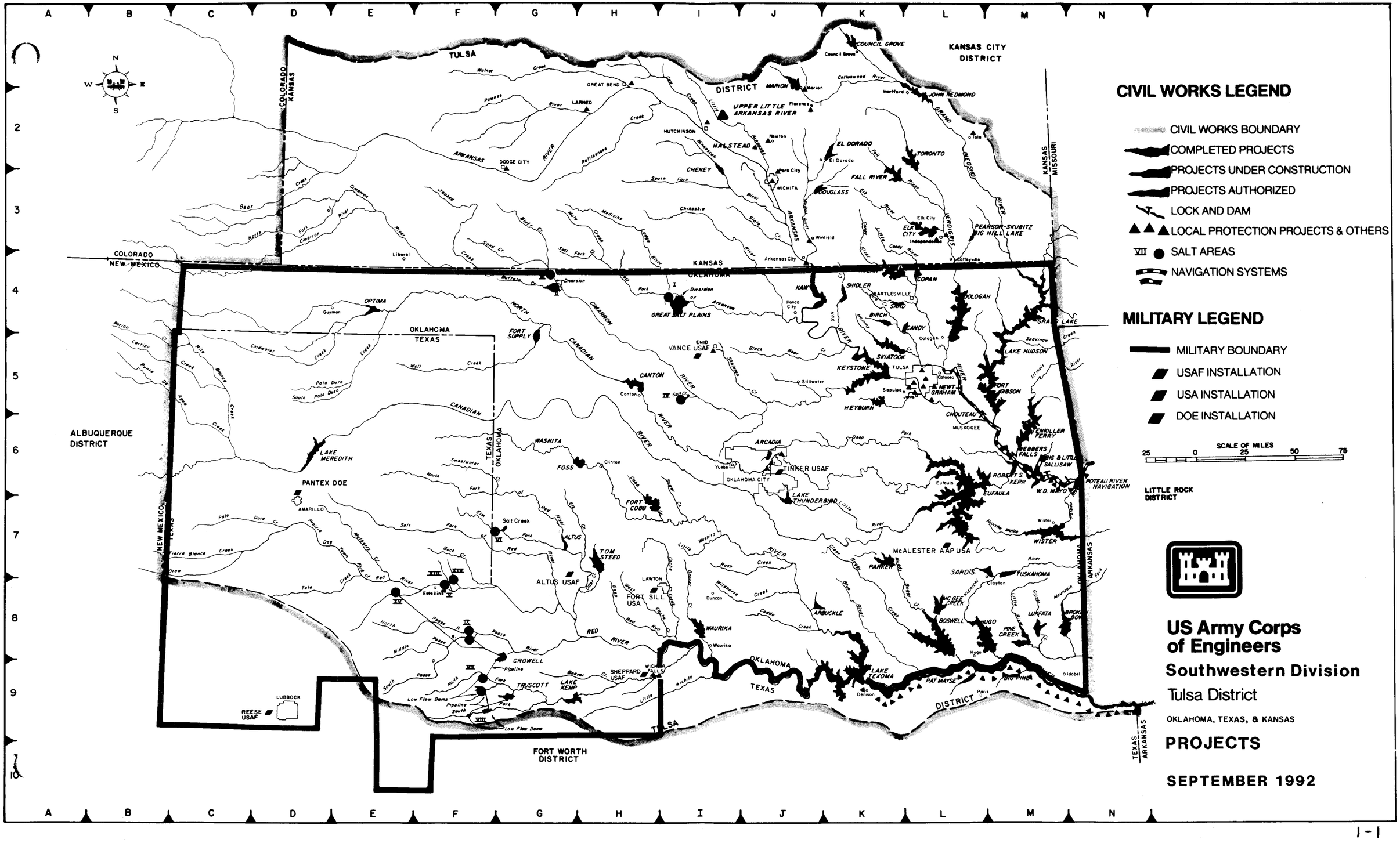
Del Valle Dam & Res	CA, Alameda, Alameda Cr	37.0	745.0	703.1	1,060	710	1.0	03.1	702.2	710	700	CA Dept of Wtr Rsc.	PL 87-874.
Don Pedro Dam & Lk	CA, Tuolumne, Tuolumne R						340.0	830.0	802.0	12,900	11,260	Modesto & Turlock Irr.	PL 78-534.
East Canyon Dam & Res.	UT, Morgan, East Canyon Creek.						48.0	5,705.5	5,577.0	664	127	USBR	PL 81-273.
Echo Dam & Res	UT, Summit, Weber River						74.0	5,560.0	5,450.0	1,455	0	USBR	PL 81-273.
Emigrant Dam & Res	OR, Jackson, Emigrant Cr	39.0	2,241.0	2,131.5	601	80						USBR	PL 83-606.
Enders Dam & Res	NB, Chase, Frenchman Cr	30.0	3,127.0	3,112.3	2,405	1,707						USBR	PL 78-534.
Folsom Dam & Lk	CA, Sacramento, American R						400.0	466.0	427.0	11,450	9,040	USBR	PL 81-356.
Friant Dam & Millerton LK.	CA, Fresno, San Joaquin River						390.0	578.0	466.3	4,850	2,101	USBR	PL 75-392, PL 78-868.
Gaston-Roanoke Rapids Dam Res.	NC, Northhampton, Halifax, Roanoke R.	63.0	203.0	200.0	22,500	20,300						VA Elec & Pwr Co.	Fed Pwr Act.
Glen Elder Dam & Waconda Lk.	KS, Mitchel, Solomon R	722.3	1,488.0	1,455.6	33,682	12,602						USBR	PL 78-534, PL 79-526.
Glendo Dam & Res	WY, Platte, N. Platte R	271.9	4,653.0	4,653.0,	17,966	12,365						USBR	PL 78-534.
Grand Coulee Dam, FDR Lk.	WA, Okanogan, Grant, Columbia R.						5,185.5	1,290.0	1,208.0	82,290	45,592	USBR	PL 89-561.
H. Neely Henry	AL, Calhoun, St. Clair, Coosa River.						49.7	508.0	502.5	11,235	7,632	Alabama, Pwr Co.	PL 83-436.
Heart Butte Dam & Lk Techida.	ND, Grant, Heart River	150.0	2,094.5	2,064.5	6,625	3,400						USBR	PL 78-534.
Hells Canyon Dam & Res.	OR, Wallowa, ID, Adams, Snake River.						11.7	1,888.0	1,883.0	2,380	2,280	Idaho Pwr Co	FERC No 1971-A.
Hoover Dam & Lake Mead.	NV, Clark, AZ, Mohave, Colorado R.	1,500	1,229.0	1,219.6	162,700	156,500	15.8	1,219.6	1,083.0	158,500	83,500	USBR	PL 70-642.
Hungry Horse Dam & Res.	MT, Flathead, S. Fork Flathead R.	2,982.0	3,560.0	3,336.0	23,800	5,400						USBR	PL 78-329.
Indian Valley Dam & Res.	CA, Lake, N. Fork Cache Creek.						40.0	1,485.0	1,474.7	3,975	3,749	Yolo Cty Fl Cont & Wtr.	PL 84-964 Cons Dist.
Jamestown Dam & Res.	ND, Stutsman, James River	185.4	1,454.0	1,432.7	13,208	2,555	6.6	1,432.7	1,429.8	2,555	2,085	USBR	PL 78-534.
Kerr Dam, Flathead Lk.	MT, Lake, Flathead R						1,219.0	2,893.0	2,883.0	125,560	120,000	Montana Pwr Co.	FERC No 5.
Keyhole Dam & Res	WY, Crook, Belle Fourche River.	140.2	4,111.5	4,099.3	13,666	9,394						USBR	PL 78-534.
Kirwin Dam & Res	KS, Phillips, N. Fork Solomon R.	215.1	1,767.3	1,729.3	10,640	5,073						USBR	PL 78-534.
Lemon Dam & Res	CO, La Plata, Florida R						39.0	8,148	8,023	622	82	USBR	PL 84-485
Lewis M. Smith Dam & Res.	AL, Walker, Culman, Sipsey Fork Black Warrior River.	260.0	522.0	510.0	25,700	21,200						Alabama Pwr Co.	Fed Pwr Act.
Little Wood	ID, Blain, Little Wood River	30.0	5,237.3	5,127.8	574	0						USBR	PL 84-993.
Logan Martin Dam & Res.	AL, Talladega, Coosa River	245.3	477.0	465.0	26,310	15,260						Alabama Pwr Co.	PL 83-436.
Los Banos Dam & Detention.	CA, Merced, Los Banos Cr						14.0	353.5	327.8	619	467	USBR	PL 86-488.

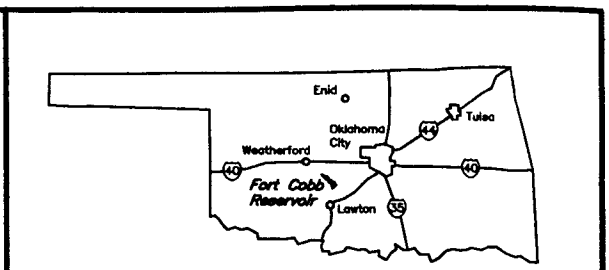
LIST OF PROJECTS—Continued

[Pertinent project data]

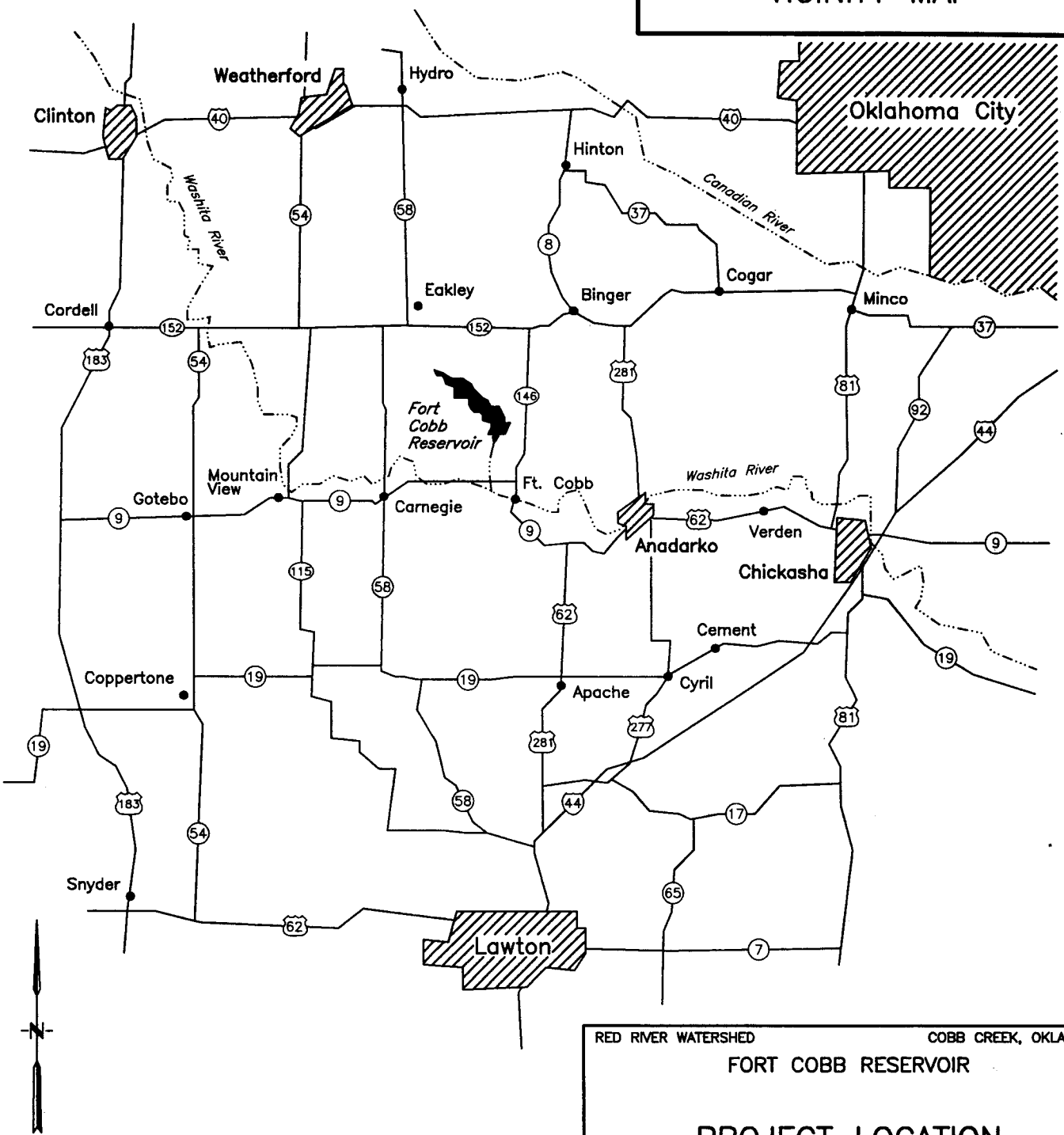
[Footnotes at end of table]

Project name [1]	State, county and stream [1]	Exclusive-use					Multiple-use					Project owner [2]	Authorizing legislation [3]
		Flood control/navigation					Flood control/navigation						
		Storage (1,000 AF)	Elevation limits (feet, m.s.l.)		Area (acres)		Storage (1,000 AF)	Elevation limits (feet, m.s.l.)		Area (acres)			
			Upper	Lower	Upper	Lower		Upper	Lower	Upper	Lowe		
Lost Creek Dam & Res.	UT, Morgan, Lost Creek						20.0	6,005.0	5,912.0	365	93	USBR	PL 81-273.
Lovewell Dam & Res	KS, Jewell, White Rock Cr	50.5	1,595.3	1,582.6	5,025	2,966						USBR	PL 78-534.
Markham Ferry Dam, Lake Wash E. Hudson.	OK, Mayes, Grand Neosho River.	244.2	636.0	619.0	18,000	10,900						Grand R Dam Authority.	PL 76-476.
Mayfield Dam & Res	WA, Lewis, Cowlitz River						21.4	425.0	415.0	2,070	1,825	City of Tacoma.	FPC No 2016-A.
Medicine Cr Dam Harry Strunk Lk.	NB, Frontier, Medicine Cr	52.2	2,366.2	2,366.1	3,465	1,650						USBR	PL 78-534.
Mossyrock Dam Davisson Lk.	WA, Lewis, Cowlitz River						1,397.0	778.5	621.5	11,800	5,000	City of Tacoma.	FERC No 2016-B.
Navajo Dam & Res	NM, San Juan, Arriba, Rio, San Juan R.						1,036.1	6,085.0	5,990.0	15,610	7,400	USBR	PL 84-485.
New Exchequer Dam & Lake.	CA, Tuolumne, Merced River						400.0	867.0	799.7	7,110	4,849	Merced Irr	PL 86-645.
New Melones Dam & Lk.	CA, Tuolumne, Calaveras, Stanislaus R.						450.0	1,088.0	1,049.5	12,500	10,900	USBR	PL 87-874.
Norton Dam Res	KS, Norton, Prairie Dog Cr	98.8	2,331.4	2,304.3	5,316	5,316						USBR	PL 78-534.
Ochoco Dam & Res	OR, Crook, Ochoco Creek	51.4	3,136.2	3,048.1	1,150	120						USBR	PL 84-992.
Oroville Dam & Lake	CA, Butte, Feather River						750.0	900.0	848.5	15,800	13,346	CA Dept of Wtr Rsc.	PL 85-500.
Oxbow Dam & Res	OR, Baker, ID, Adams, Snake River.						5.0	1,805.0	1,800.0	1,165	1,115	Idaho Pwr Co	FERC No 1971-B.
Pactola Dam & Res	SD, Pennington, Rapid Creek	34.0	4,621.5	4,580.2	1,232	860						USBR	PL 78-534.
Palisades Dam & Res	ID, Bonneville, Snake River	1,202.0	5,620.0	5,452.4	16,100	2,170						USBR	PL 81-864.
Paonia Dam & Res	CO, Gunnison, Muddy Creek						17.0	6,447.5	6,373.0	334	120	USBR	PL 80-177, PL 84-485.
Pineview Dam & Res	UT, Weber, Odgen River						110.0	4,900.0	4,818.0	2,874	0	USBR	PL 81-273.
Platoro Dam & Res	CO, Conejos, Conejos R	6.0	10,034.0	10,027.5	947	920	54.0	10,027.5	9,911.0	920	0	USBR	PL 78-640.
Priest Rapid Dam & Res.	WA, Grant, Columbia R						44.0	488.0	481.0	7,100	6,500	Grant County PUD No 2.	FERC No 2114-A.
Pineville Dam & Res	OR, Crook, Crooked Cr	153.0	3,234.8	3,112.0	2,990	120						USBR	PL 84-992.
Prosser Cr & Res	CA, Nevada, Prosser Cr						20.0	5,741.2	5,703.7	745	334	USBR	PL 84-858.


TULSA
COLORADO
KANSAS
GREAT BEND
LARNED
DODGE CITY
ARKANSAS
RIVER
HUTCHINSON
HALSTEAD
CHENEY
WICHITA
DISTRICT
MARION
UPPER LITTLE ARKANSAS RIVER
COUNCIL GROVE
KANSAS CITY DISTRICT
JOHN REDMOND
EL DORADO
TORONTO
FALL RIVER
DOUGLASS
ELK CITY
VERDIGRIS
PEARSON-SKUBITZ BIG HILL LAKE
KANSAS
MISSOURI
COLORADO
NEW MEXICO
KANSAS
OKLAHOMA
Liberal
Arkansas City
Winfield
Coffeyville
Independence
Diversion
GREAT SALT PLAINS
OPTIMA
Guymon
OKLAHOMA
TEXAS
FORT SUPPLY
CANADIAN
RIVER
ENID
VANCE USAF
CANTON
Canton
Stillwater
KAW
SHIDLER
BARTLESVILLE
COPAN
OOLOGAH
SAND
BIRCH
CANDY
SKIATOOK
KEYSTONE
TULSA
Sapulpa
NEWT GRAHAM
HEYBURN
CHOUTEAU
MUSKOGEE
LAKE HUDSON
FORT GIBSON
GRAND LAKE
Spavinaw
Creek
River
Illinois
TENKILLER FERRY
WEBBERS FALLS
BIG & LITTLE SALLISAW
ROBERTS KERR
W.D. MAYO
POTEAU RIVER NAVIGATION
EUFAULA
Eufaula
Wister
WISTER
McALESTER AAP USA
PARKER
SARDIS
TUSKAHOMA
Clayton
McGEE CREEK
BOSWELL
HUGO
PINE CREEK
LUKFATA
Hugo
Idabel
ARKANSAS
ALBUQUERQUE DISTRICT
LAKE MEREDITH
PANTEX DOE
AMARILLO
NEW MEXICO
TEXAS
TEXAS
OKLAHOMA
WASHITA
FOSS
Clinton
Yukon
ARCADIA
TINKER USAF
OKLAHOMA CITY
LAKE THUNDERBIRD
FORT COBB
Salt Creek
ALTUS
ALTUS USAF
TOM STEED
LAWTON
FORT SILL USA
Duncan
WAURIKA
Waurika
ARBUCKLE
RED RIVER
OKLAHOMA
TEXAS
LAKE TEXOMA
Denison
PAT MAYSE
BIG PINE
Paris
DISTRICT
TULSA
FORT WORTH DISTRICT
LUBBOCK
REESE USAF
CROWELL
TRUSCOTT
LAKE KEMP
SHEPPARD USAF
WICHITA FALLS
Low Flow Dams
Pipeline
TEXAS
ARKANSAS
LITTLE ROCK DISTRICT
CIVIL WORKS LEGEND
CIVIL WORKS BOUNDARY
COMPLETED PROJECTS
PROJECTS UNDER CONSTRUCTION
PROJECTS AUTHORIZED
LOCK AND DAM
LOCAL PROTECTION PROJECTS & OTHERS
SALT AREAS
NAVIGATION SYSTEMS
MILITARY LEGEND
MILITARY BOUNDARY
USAF INSTALLATION
USA INSTALLATION
DOE INSTALLATION
SCALE OF MILES
25 0 25 50 75
US Army Corps of Engineers
Southwestern Division
Tulsa District
OKLAHOMA, TEXAS, & KANSAS
PROJECTS
SEPTEMBER 1992



VICINITY MAP



RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

PROJECT LOCATION AND VICINITY

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

2–1

(b) (7)(F)

RED RIVER WATERSHED COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

GENERAL PLAN AND SECTION

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

2-2

(b) (7)(F)

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

PLAN AND SECTIONS

UNCONTROLLED SPILLWAY
OUTLET CONDUIT

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 19??
DRAWN BY: K.S.R.
CHECKED BY: R.M.B.

2-3

(b) (7)(F)

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

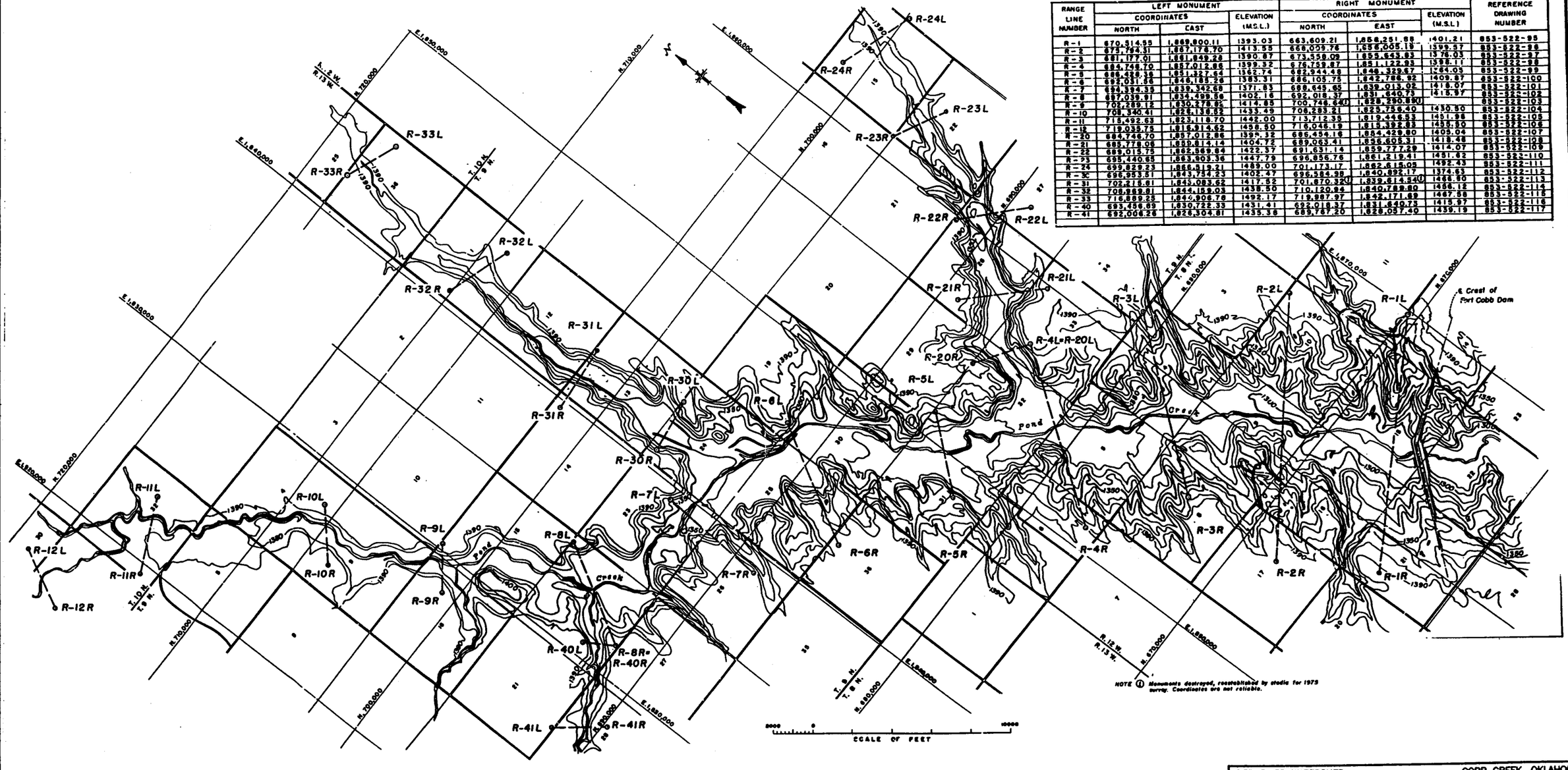
PLAN AND SECTIONS

OUTLET FACILITIES
RIVER AND MUNICIPAL WATER SUPPLY
OUTLET WORKS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1957
DRAWN BY: K.S.P.
CHECKED BY: R.W.B.

2-4

RANGE LINE NUMBER	LEFT MONUMENT COORDINATES NORTH	LEFT MONUMENT COORDINATES EAST	LEFT MONUMENT ELEVATION (M.S.L.)	RIGHT MONUMENT COORDINATES NORTH	RIGHT MONUMENT COORDINATES EAST	RIGHT MONUMENT ELEVATION (M.S.L.)	REFERENCE DRAWING NUMBER
R-1	670,514.55	1,868,800.11	1393.03	663,609.21	1,858,251.88	1401.21	853-522-95
R-2	675,794.31	1,867,176.70	1413.55	668,059.76	1,856,005.19	1399.57	853-522-96
R-3	681,177.01	1,861,849.26	1390.87	673,558.09	1,855,643.83	1376.03	853-522-97
R-4	684,746.70	1,857,012.86	1399.32	676,759.87	1,851,122.95	1398.11	853-522-98
R-5	686,428.36	1,851,327.64	1362.74	682,944.48	1,846,329.67	1384.05	853-522-99
R-6	692,031.56	1,846,185.26	1385.31	686,105.75	1,842,786.92	1409.87	853-522-100
R-7	694,394.33	1,839,342.68	1371.83	688,648.65	1,838,013.02	1418.07	853-522-101
R-8	697,039.91	1,834,499.56	1402.16	692,018.37	1,831,640.73	1415.97	853-522-102
R-9	702,269.12	1,830,278.95	1414.85	700,748.640	1,828,290.880		853-522-103
R-10	708,340.41	1,826,136.52	1433.49	708,283.21	1,825,756.40	1430.30	853-522-104
R-11	715,492.63	1,823,118.70	1442.00	713,712.35	1,819,444.83	1401.98	853-522-105
R-12	719,035.75	1,818,914.62	1458.80	716,046.19	1,815,322.83	1438.10	853-522-106
R-20	684,746.70	1,857,012.86	1395.32	686,454.16	1,854,429.80	1409.04	853-522-107
R-21	685,778.05	1,850,814.14	1404.72	689,063.41	1,856,605.31	1418.46	853-522-108
R-22	689,015.75	1,865,889.84	1422.57	691,631.14	1,859,777.29	1414.07	853-522-109
R-23	695,440.65	1,863,903.36	1447.79	696,856.76	1,861,219.41	1451.82	853-522-110
R-24	699,829.23	1,866,519.21	1489.00	701,173.17	1,862,615.05	1492.43	853-522-111
R-3C	696,953.81	1,843,754.23	1402.47	696,584.98	1,840,892.17	1374.53	853-522-112
R-31	702,215.81	1,843,083.62	1417.52	701,870.320	1,839,614.540	1468.50	853-522-113
R-32	708,989.81	1,844,159.03	1438.50	710,120.84	1,840,718.80	1456.12	853-522-114
R-33	716,889.25	1,840,906.78	1492.17	715,887.97	1,842,171.89	1467.58	853-522-115
R-40	693,456.89	1,830,722.33	1431.41	692,018.37	1,831,640.73	1415.97	853-522-116
R-41	692,006.26	1,826,304.81	1435.38	689,767.20	1,828,057.40	1439.19	853-522-117



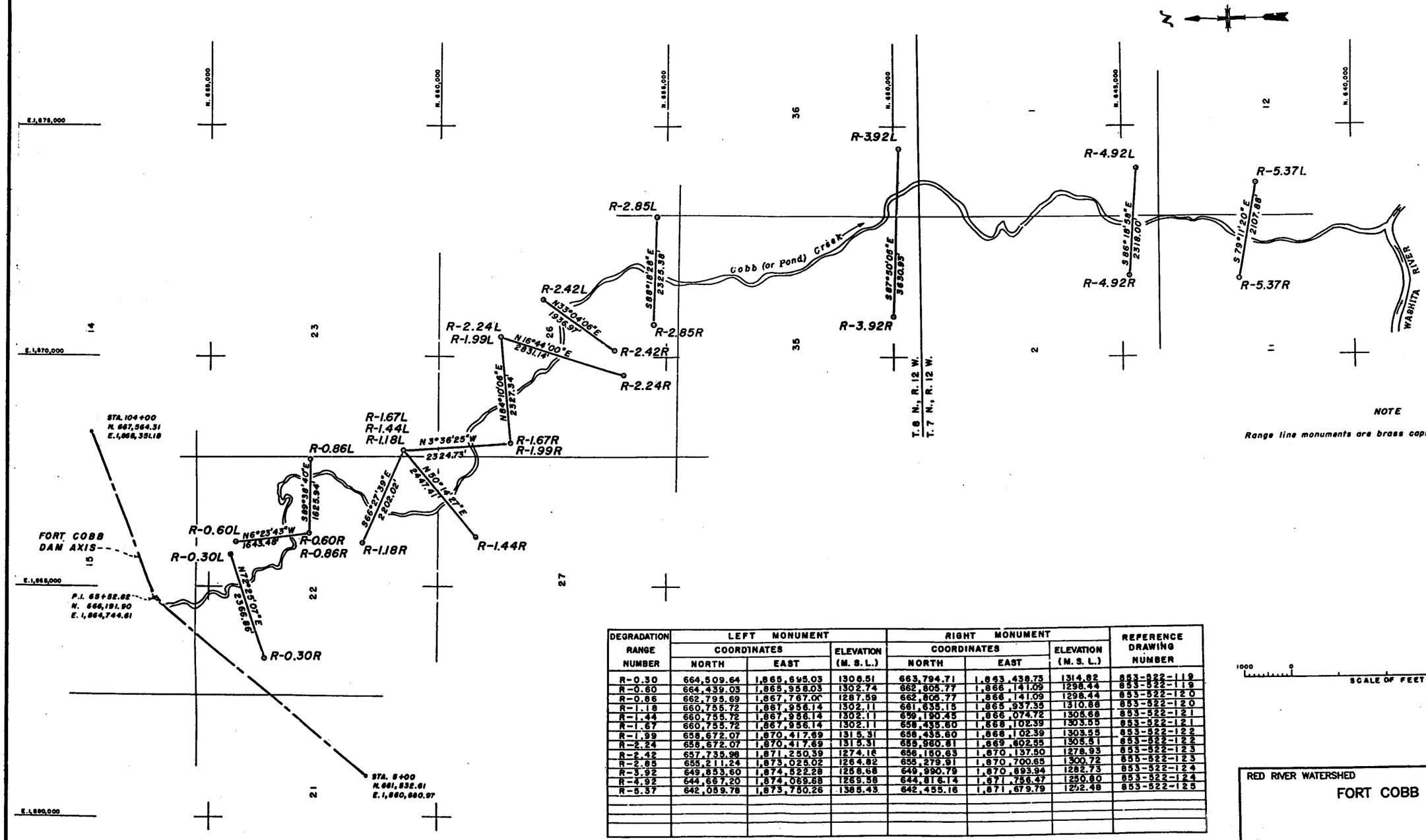
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

SEDIMENTATION RANGES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

2-5



DEGRADATION RANGE NUMBER	LEFT MONUMENT COORDINATES NORTH	LEFT MONUMENT COORDINATES EAST	LEFT MONUMENT ELEVATION (M. S. L.)	RIGHT MONUMENT COORDINATES NORTH	RIGHT MONUMENT COORDINATES EAST	RIGHT MONUMENT ELEVATION (M. S. L.)	REFERENCE DRAWING NUMBER
R-0.30	664,509.64	1,865,695.03	1308.51	663,794.71	1,863,438.73	1314.82	853-522-119
R-0.60	664,439.03	1,865,958.03	1302.74	662,805.77	1,866,141.09	1298.44	853-522-119
R-0.86	662,795.69	1,867,767.00	1287.59	662,805.77	1,866,141.09	1298.44	853-522-120
R-1.18	660,755.72	1,867,956.14	1302.11	661,635.15	1,865,937.35	1310.88	853-522-120
R-1.44	660,755.72	1,867,956.14	1302.11	659,190.45	1,866,074.72	1305.68	853-522-121
R-1.67	660,755.72	1,867,956.14	1302.11	658,435.60	1,866,102.39	1303.55	853-522-121
R-1.99	658,672.07	1,870,417.69	1315.31	658,435.60	1,866,102.39	1303.55	853-522-122
R-2.24	658,672.07	1,870,417.69	1315.31	658,960.81	1,869,602.55	1305.51	853-522-122
R-2.42	657,735.98	1,871,250.39	1274.16	656,150.63	1,870,137.50	1278.93	853-522-123
R-2.85	655,211.24	1,873,025.02	1264.82	655,279.91	1,870,700.65	1300.72	853-522-123
R-3.92	649,853.60	1,874,522.28	1258.68	649,990.79	1,870,893.94	1282.73	853-522-124
R-4.92	644,667.20	1,874,069.68	1269.58	644,816.14	1,871,756.47	1250.80	853-522-124
R-5.37	642,059.78	1,873,750.26	1385.43	642,455.16	1,871,679.79	1252.48	853-522-125

NOTE

Range line monuments are brass caps set in concrete piers

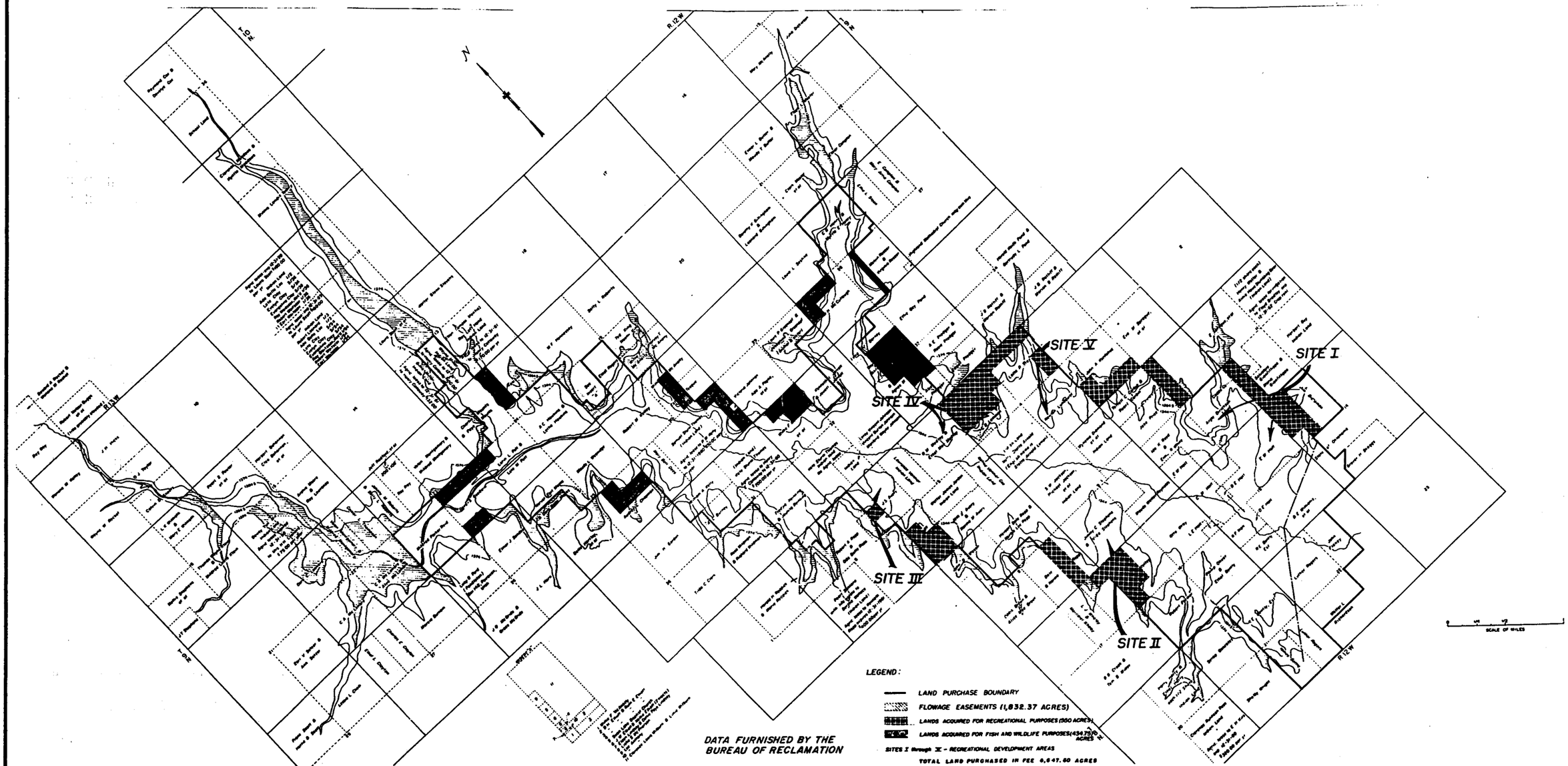
1000 0 5000
SCALE OF FEET

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

DEGRADATION RANGES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.



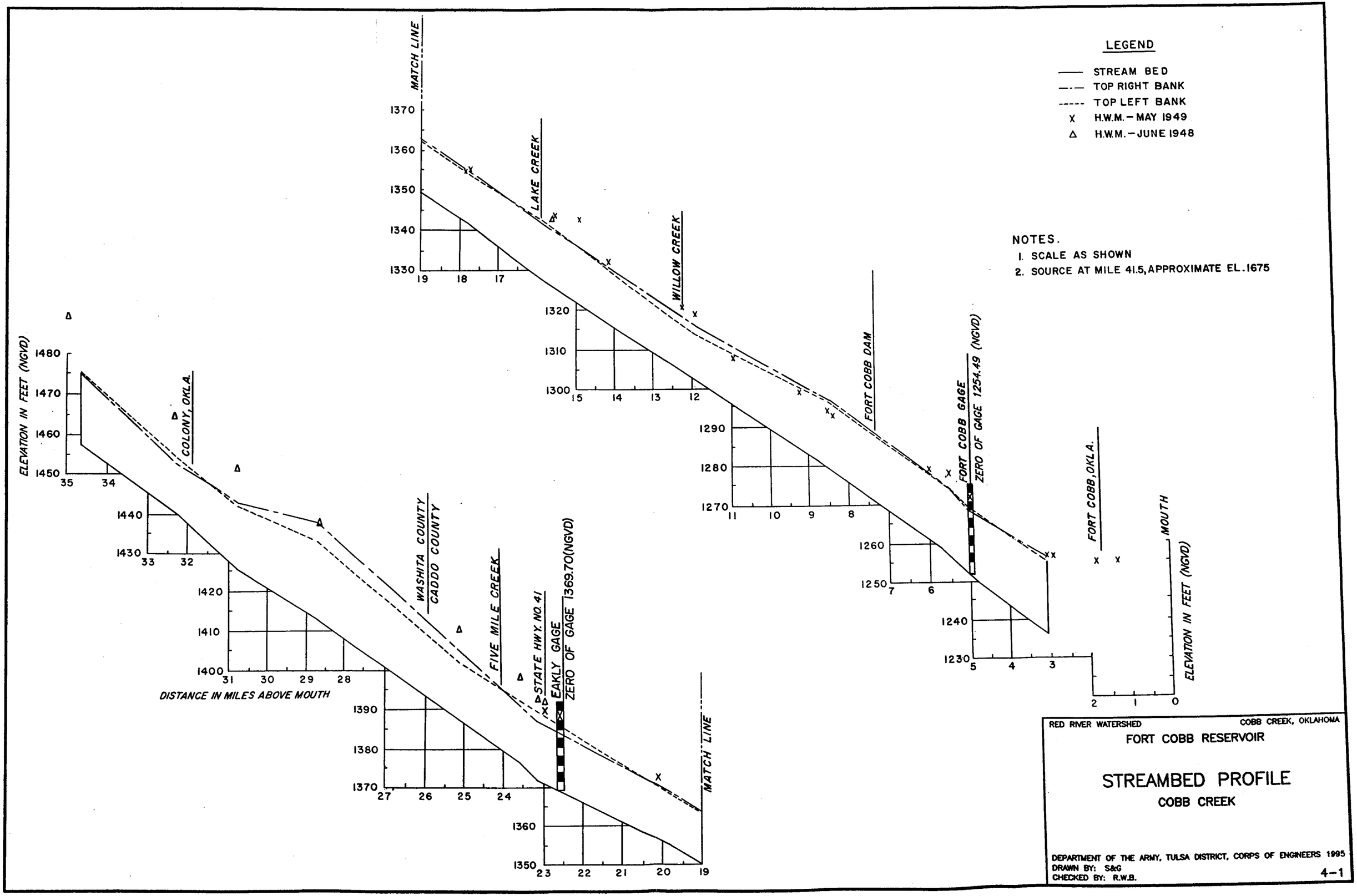
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

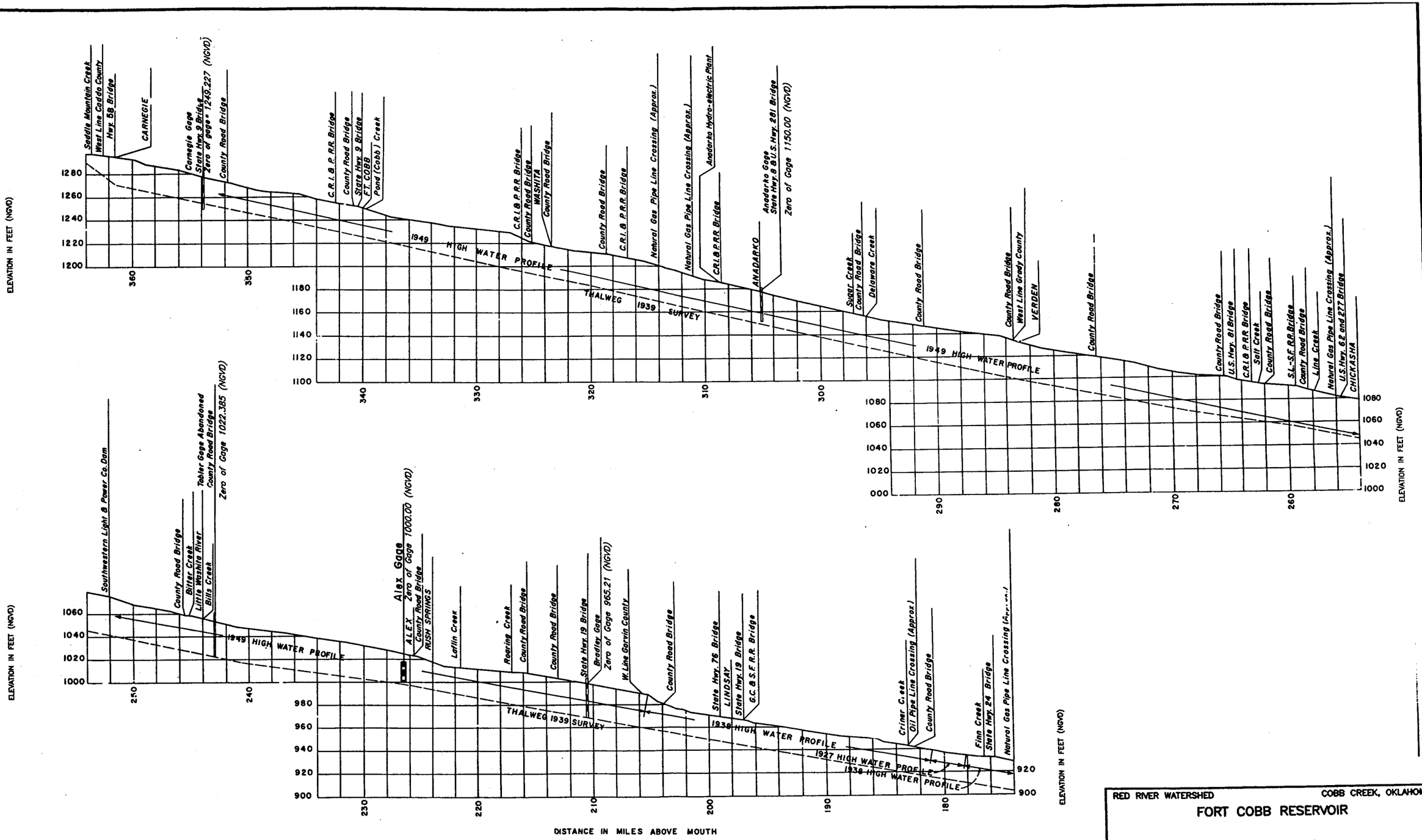
FORT COBB RESERVOIR

TAKING LINE AND EASEMENT AREAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

2-7


LEGEND
STREAM BED
TOP RIGHT BANK
TOP LEFT BANK
H.W.M. – MAY 1949
H.W.M. – JUNE 1948
NOTES.
1. SCALE AS SHOWN
2. SOURCE AT MILE 41.5, APPROXIMATE EL. 1675
MATCH LINE
LAKE CREEK
WILLOW CREEK
FORT COBB DAM
COLONY, OKLA.
WASHITA COUNTY
CADDO COUNTY
FIVE MILE CREEK
STATE HWY. NO. 41
EAKLY GAGE
ZERO OF GAGE 1369.70(NGVD)
FORT COBB GAGE
ZERO OF GAGE 1254.49 (NGVD)
FORT COBB, OKLA.
MOUTH
ELEVATION IN FEET (NGVD)
DISTANCE IN MILES ABOVE MOUTH
RED RIVER WATERSHED
COBB CREEK, OKLAHOMA
FORT COBB RESERVOIR
STREAMBED PROFILE
COBB CREEK
DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.
4-1



NOTE: DISTANCES IN MILES SHOWN ON THIS SHEET ARE FROM A.W.R. DRAINAGE AREA DATA NOVEMBER 1954

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

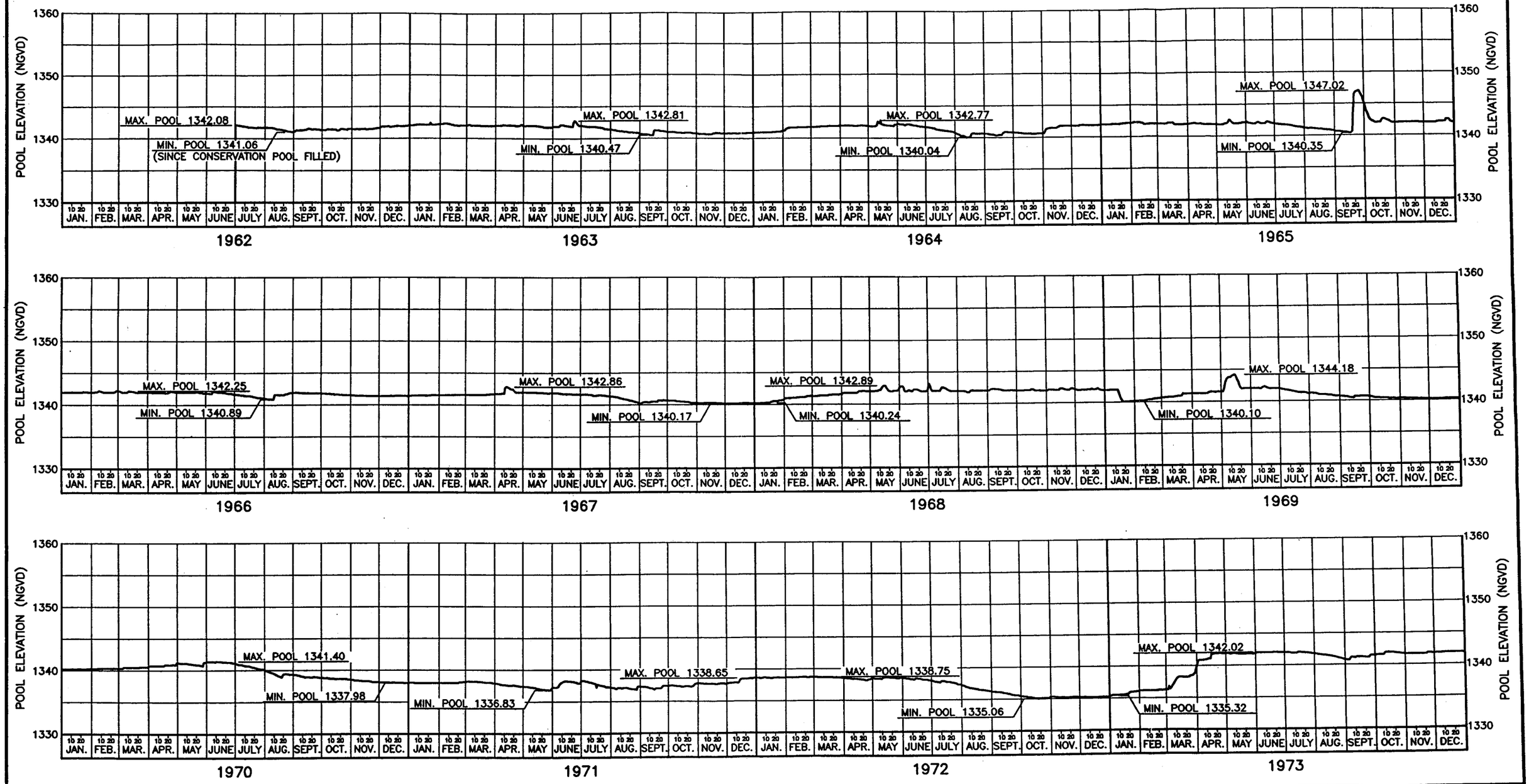
FORT COBB RESERVOIR

STREAMBED PROFILE

WASHITA RIVER

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

4-2



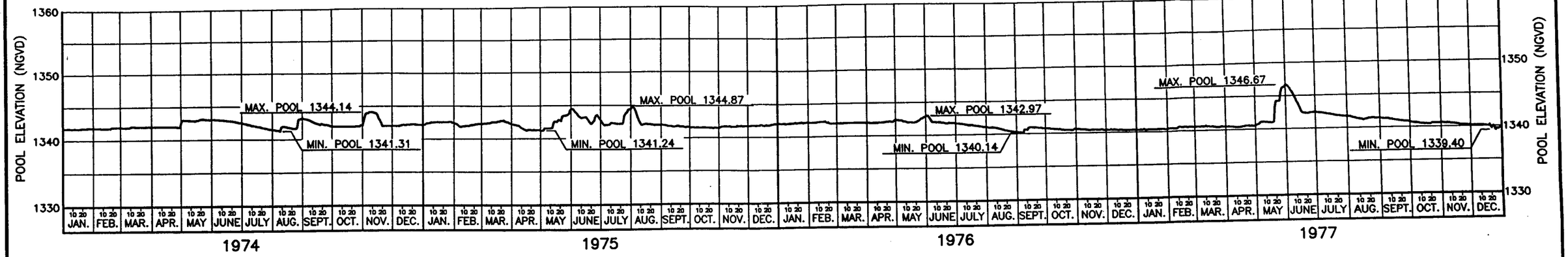
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

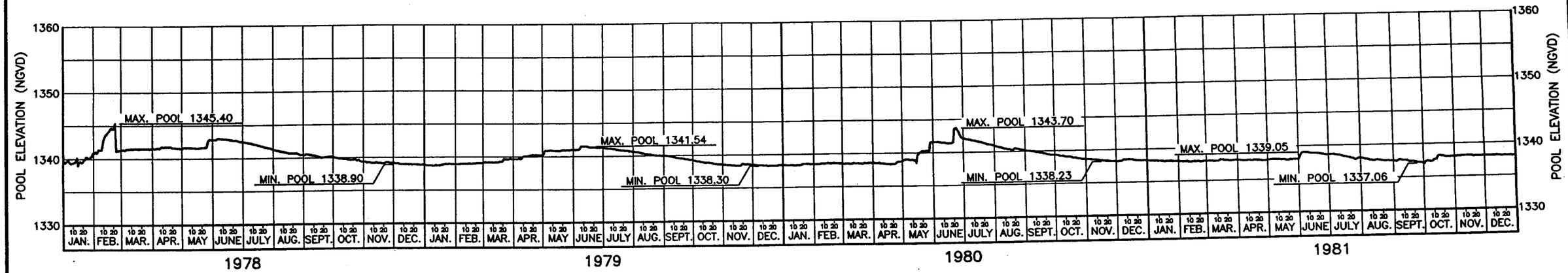
FORT COBB RESERVOIR

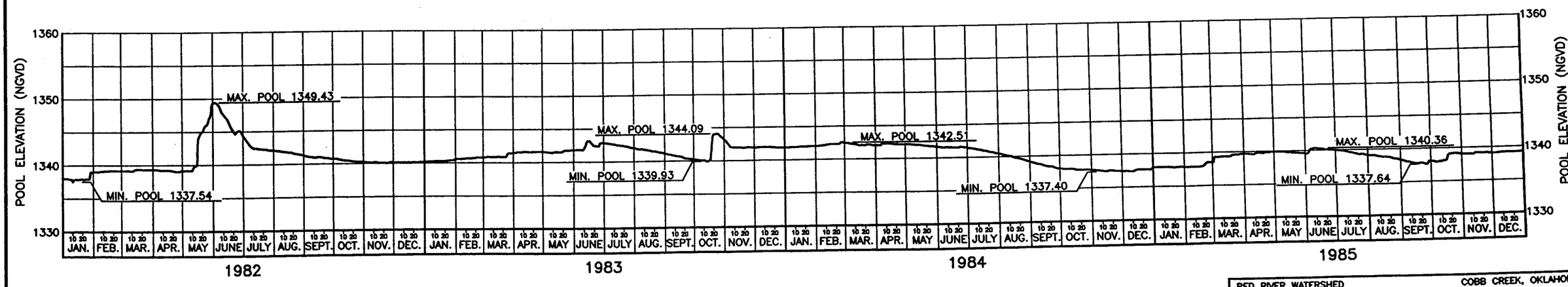
POOL ELEVATION HYDROGRAPHS 1962–1973

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

4–3







RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

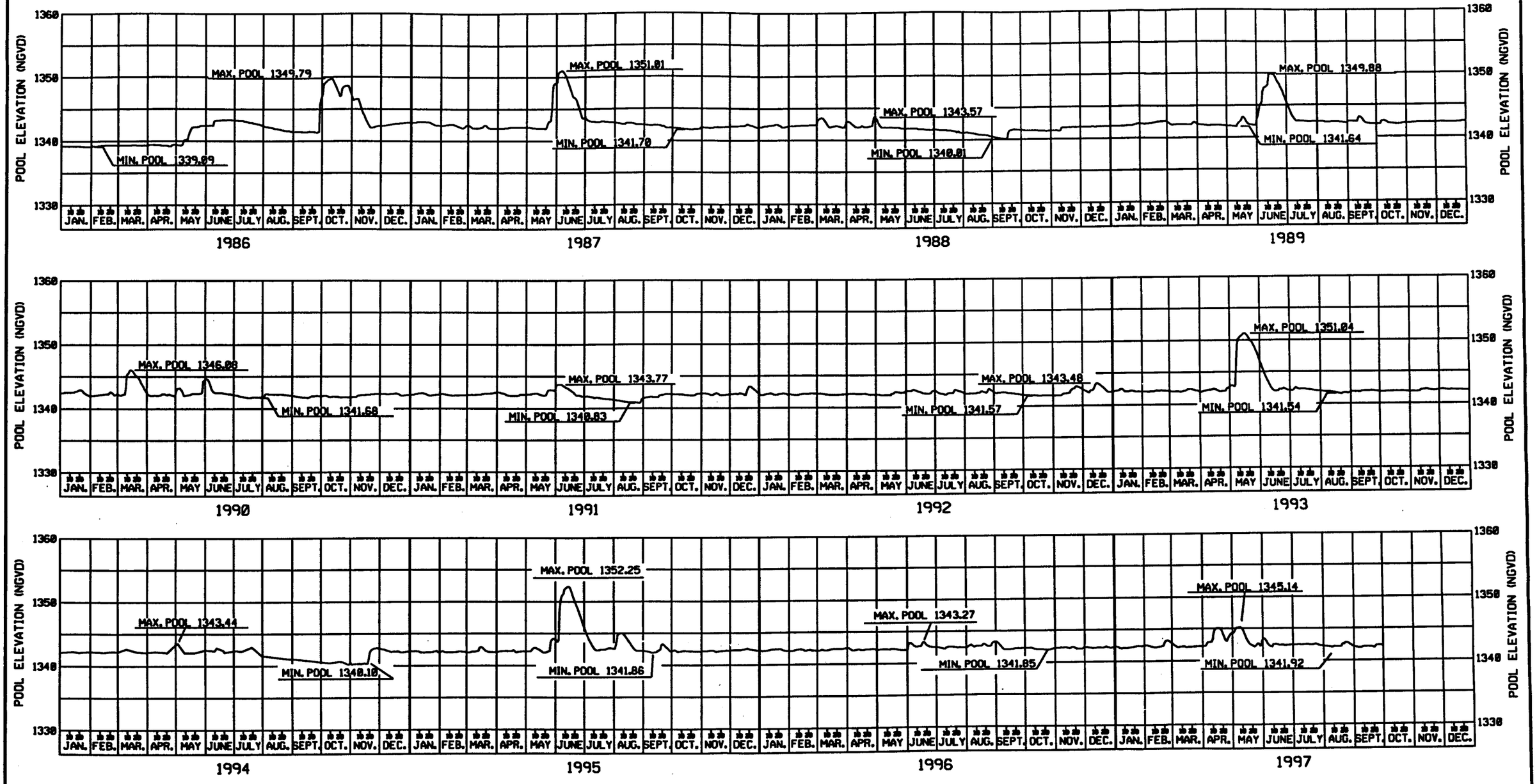
FORT COBB RESERVOIR

POOL ELEVATION HYDROGRAPHS 1974–1985

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995

DRAWN BY: S&G

CHECKED BY: R.W.B.



RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

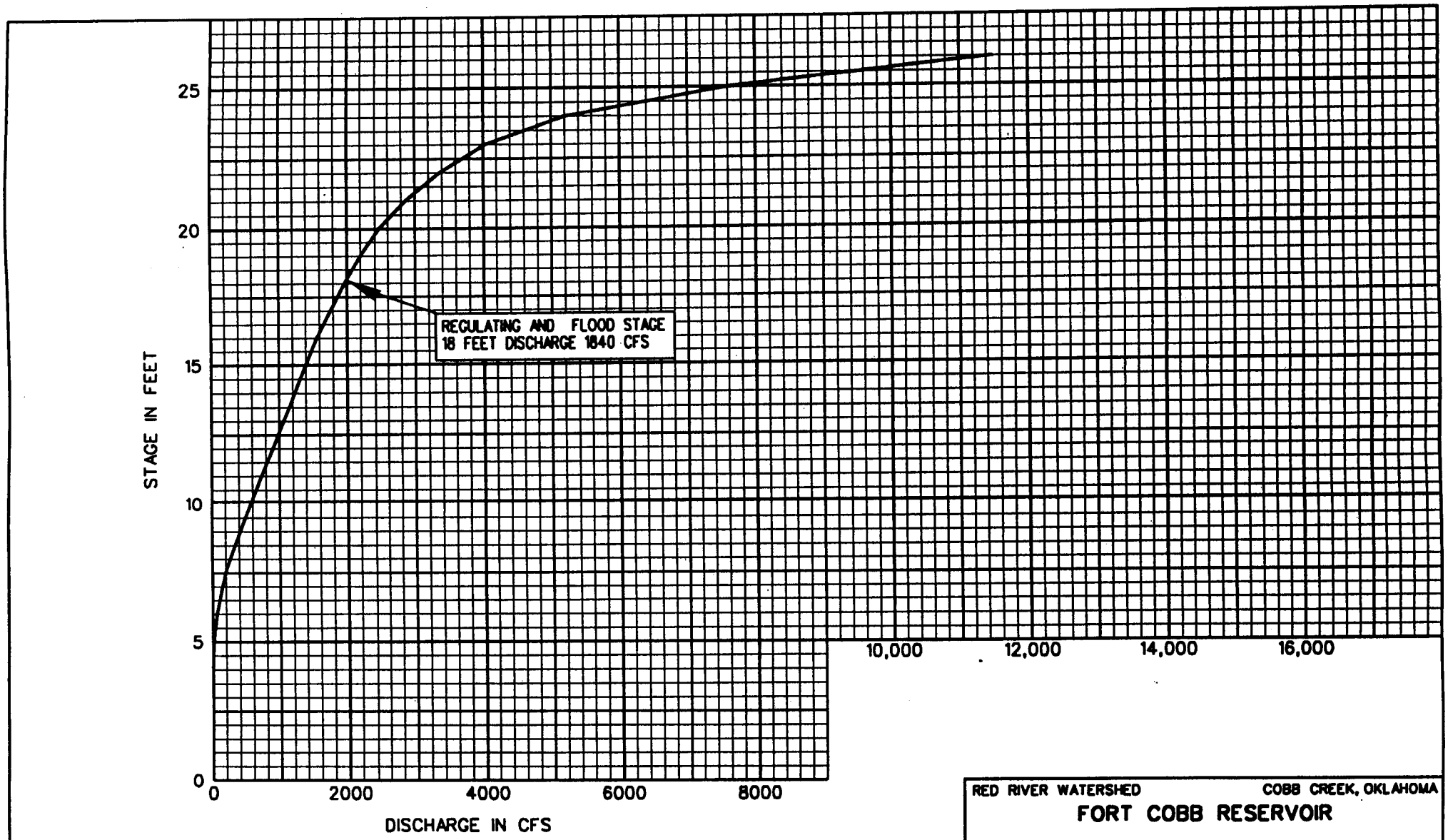
POOL ELEVATION HYDROGRAPHS 1986-1997

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998

DRAWN BY: K.S.R.

CHECKED BY: R.M.B.

4-5



NOTE: ZERO OF GAGE IS 1467.44 FEET NGVD
CURVE IS BASED UPON RATING CURVE
NUMBER 16, DATED OCT 1, 1994
SHIFT CURVE DATE SEP 25, 1996 (SEE SEC. 4-09)

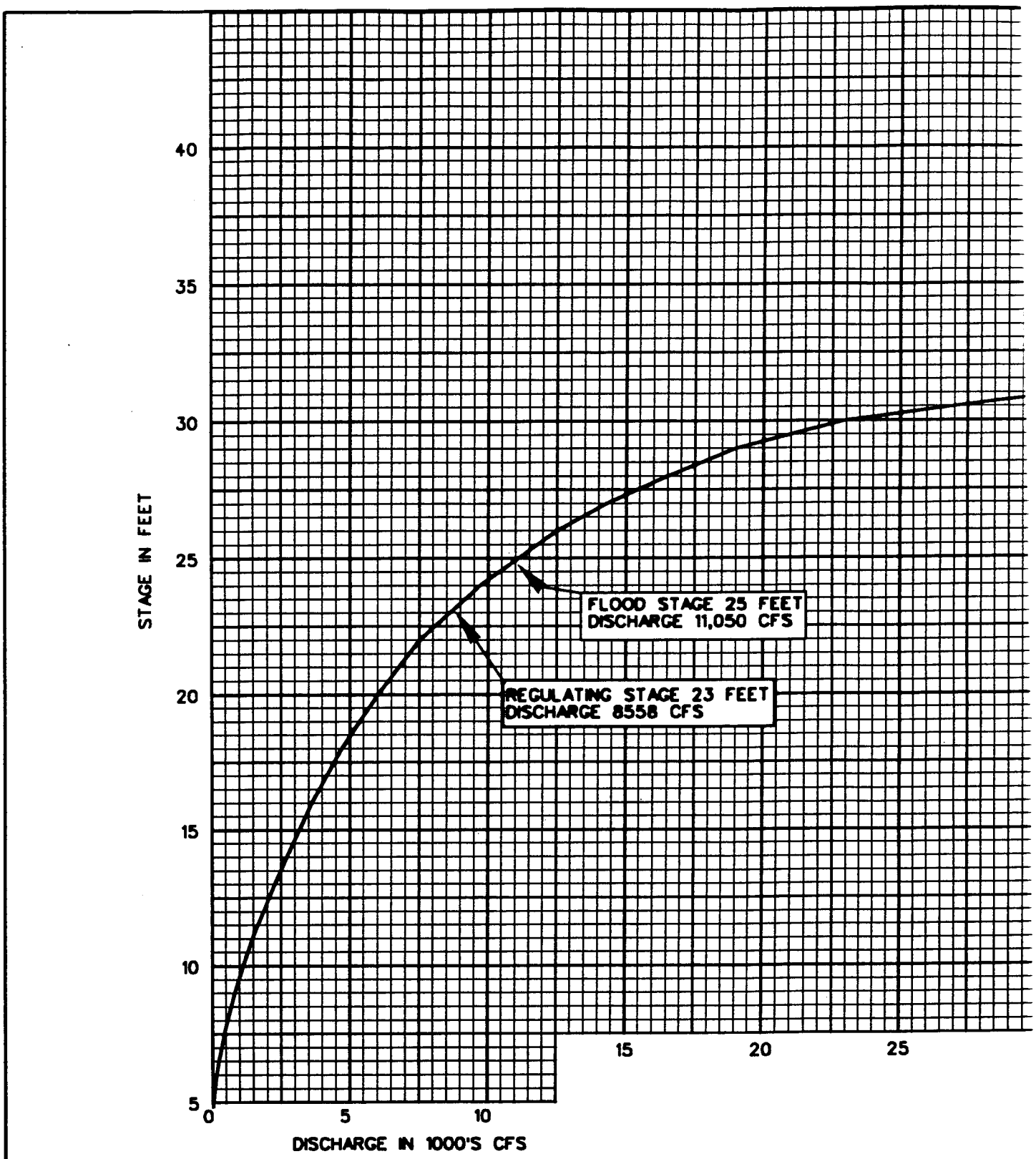
RED RIVER WATERSHED COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

DISCHARGE RATING CURVE

WASHITA RIVER AT
CLINTON, OKLAHOMA

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1997
DRAWN: K.S.R.
CHECKED: R.W.B.



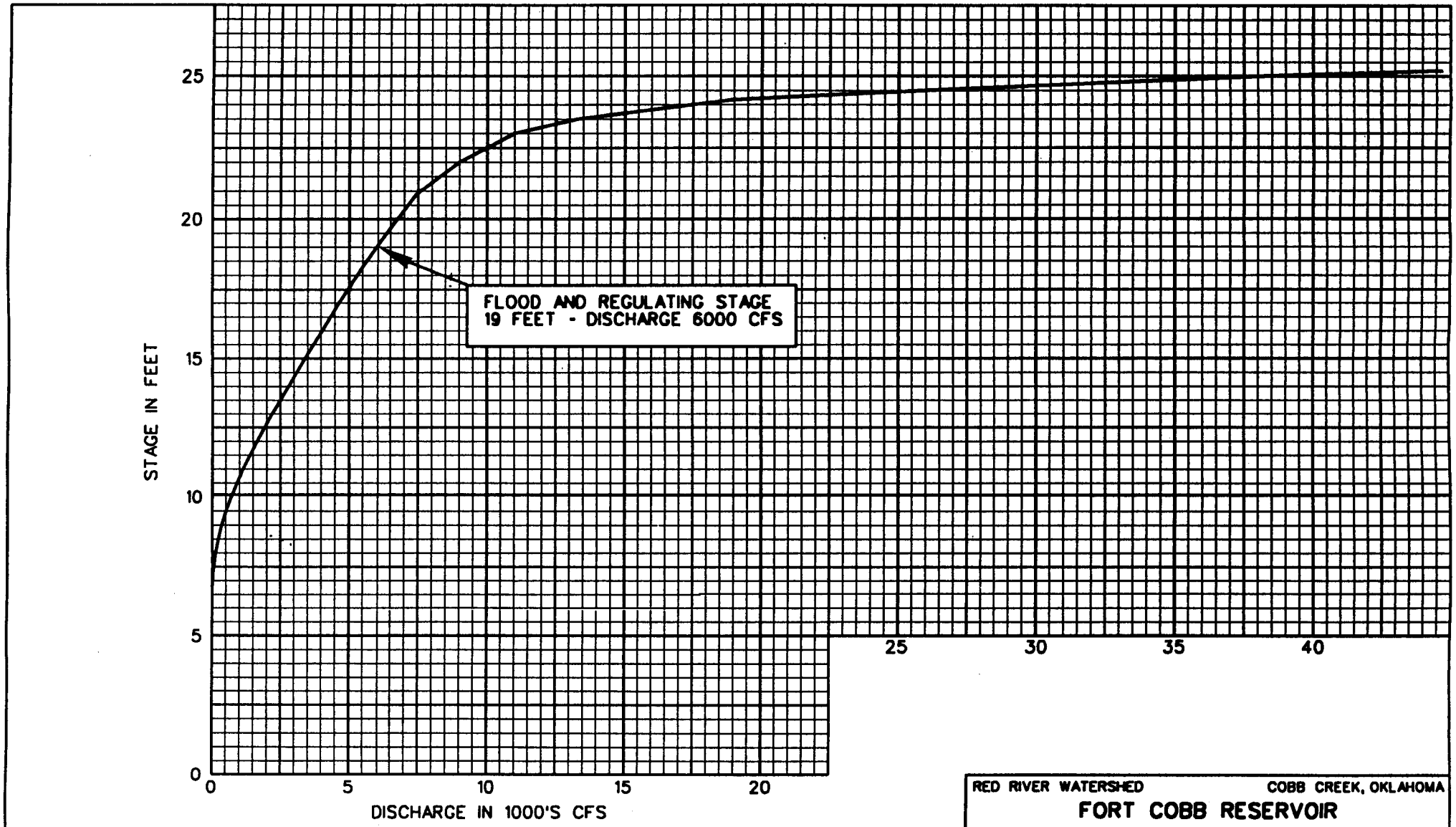
RED RIVER WATERSHED — FORT COBB, OKLAHOMA

FORT COBB RESERVOIR

DISCHARGE RATING CURVE

WASHITA RIVER AT
CARNEGIE, OKLAHOMA

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1997
DRAWN: K.S.R.
CHECKED: R.W.B.



NOTE: ZERO OF GAGE IS 1150.00 FEET NGVD
CURVE IS BASED UPON RATING CURVE
NUMBER 3, DATED SEP 30, 1989
SHIFT CURVE DATE FEB 21, 1997 (SEE SEC. 4-09)

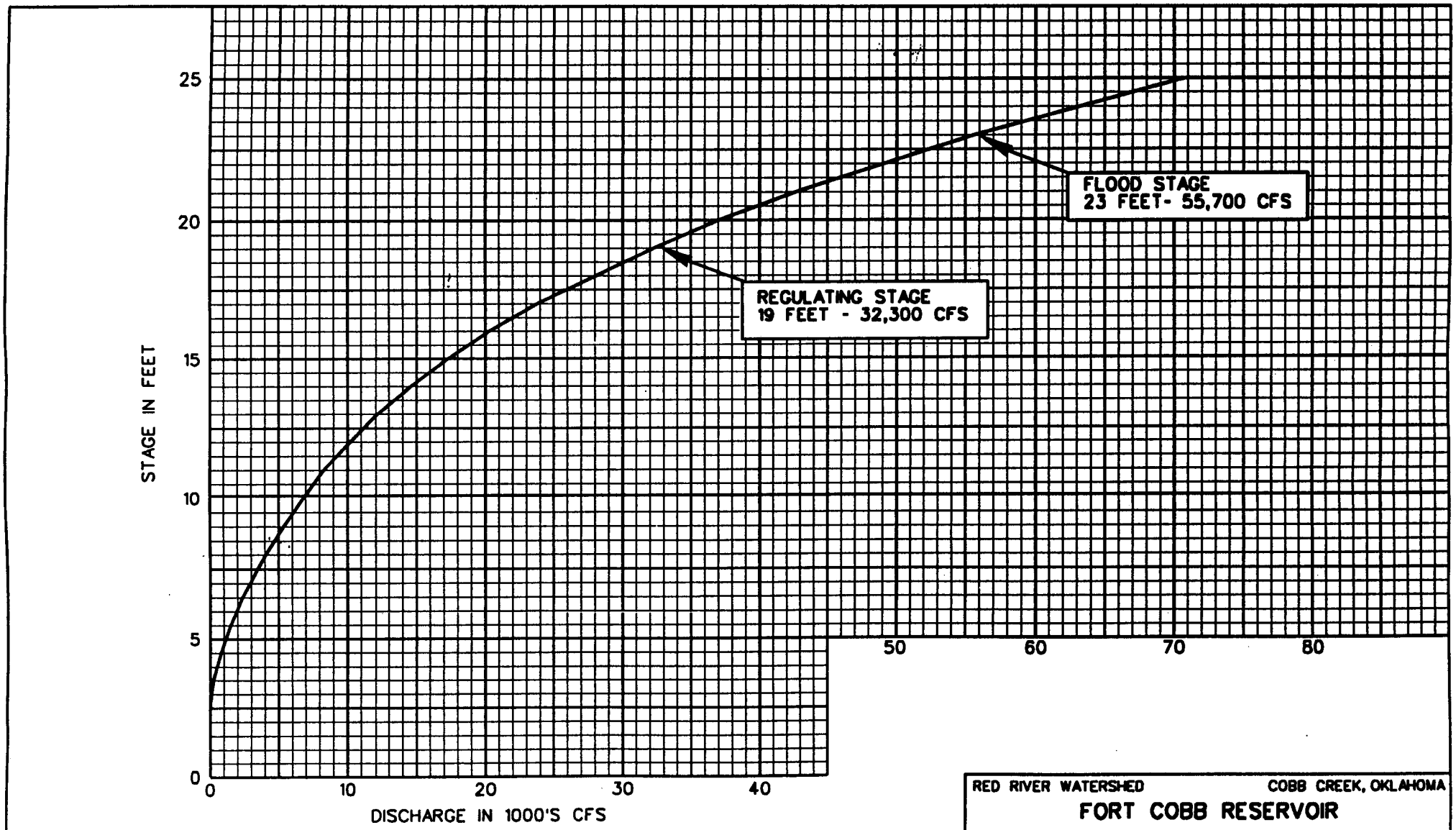
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

DISCHARGE RATING CURVE

WASHITA RIVER AT
ANADARKO GAGE

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1997
DRAWN: K.S.R.
CHECKED: R.W.B.



NOTE: ZERO OF GAGE IS 995.00 FEET NGVD
CURVE IS BASED UPON RATING CURVE
NUMBER 7, DATED SEP 30, 1994
CURVE EXTRAPOLATED ABOVE 21.0 FEET

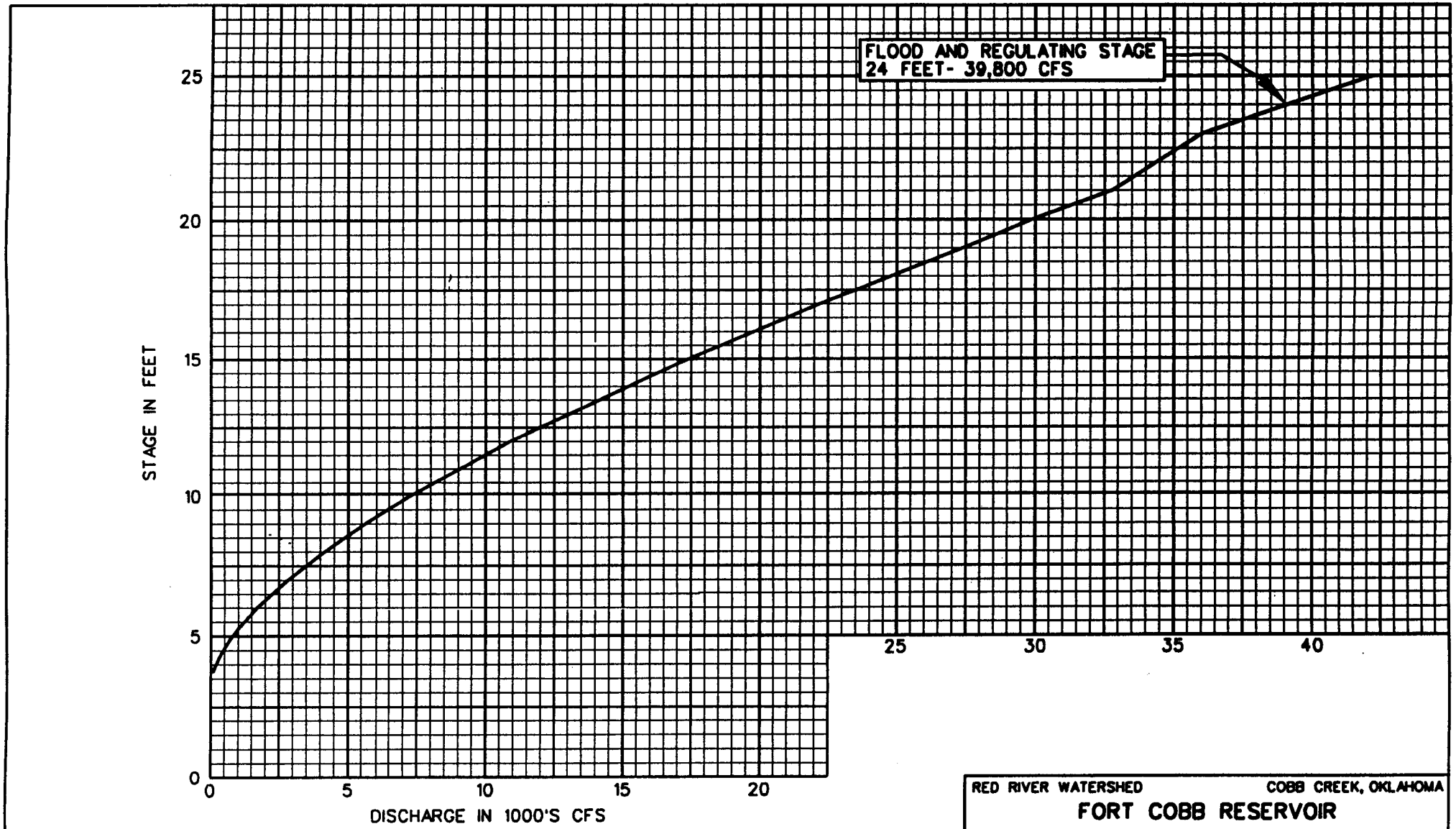
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

DISCHARGE RATING CURVE

WASHITA RIVER AT
ALEX GAGE

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1997
DRAWN: K.S.R.
CHECKED: R.W.B.



NOTE: ZERO OF GAGE IS 854.61 FEET NGVD
CURVE IS BASED UPON RATING CURVE
NUMBER 19, DATED SEP 30, 1994
SHIFT CURVE DATE APR 26, 1996 (SEE SEC 4-09)

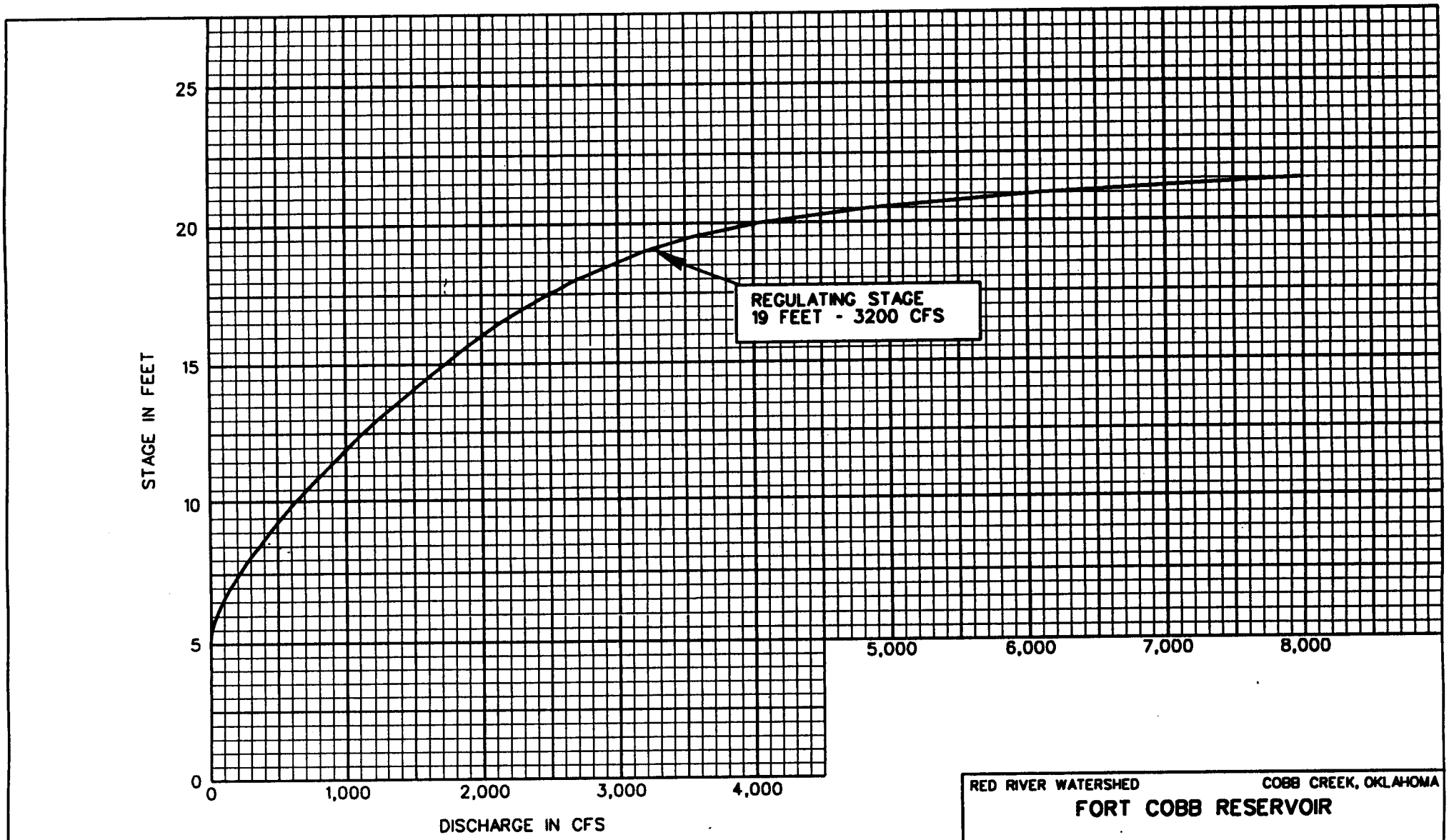
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

DISCHARGE RATING CURVE

WASHITA RIVER AT
PAULS VALLEY GAGE

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1997
DRAWN: K.S.R.
CHECKED: R.W.B.



NOTE: ZERO OF GAGE IS 1369.70 FEET NGVD
CURVE IS BASED UPON RATING CURVE
NUMBER 8, DATED SEP 30, 1992
SHIFT CURVE DATE OCT 1, 1996 (SEE SEC. 4-09)

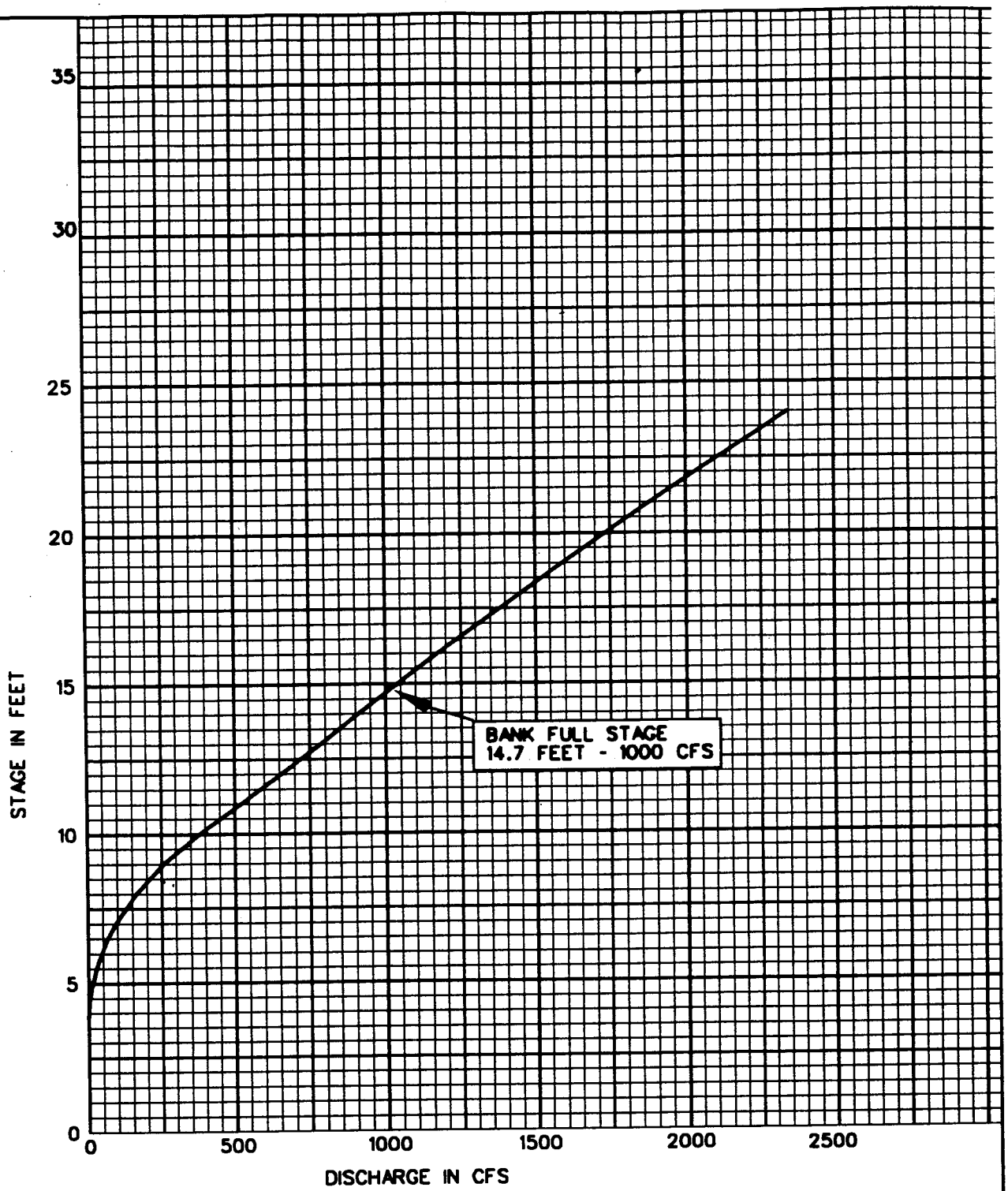
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

DISCHARGE RATING CURVE

COBB CREEK AT
EAKLY GAGE

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1997
DRAWN: K.S.R.
CHECKED: R.W.B.



NOTE: ZERO OF GAGE IS 1254.49 FEET NGVD
CURVE IS BASED UPON RATING CURVE
NUMBER 12, DATED OCT 1, 1993
SHIFT CURVE DATE FEB 17, 1995 (SEE SEC. 4-09)

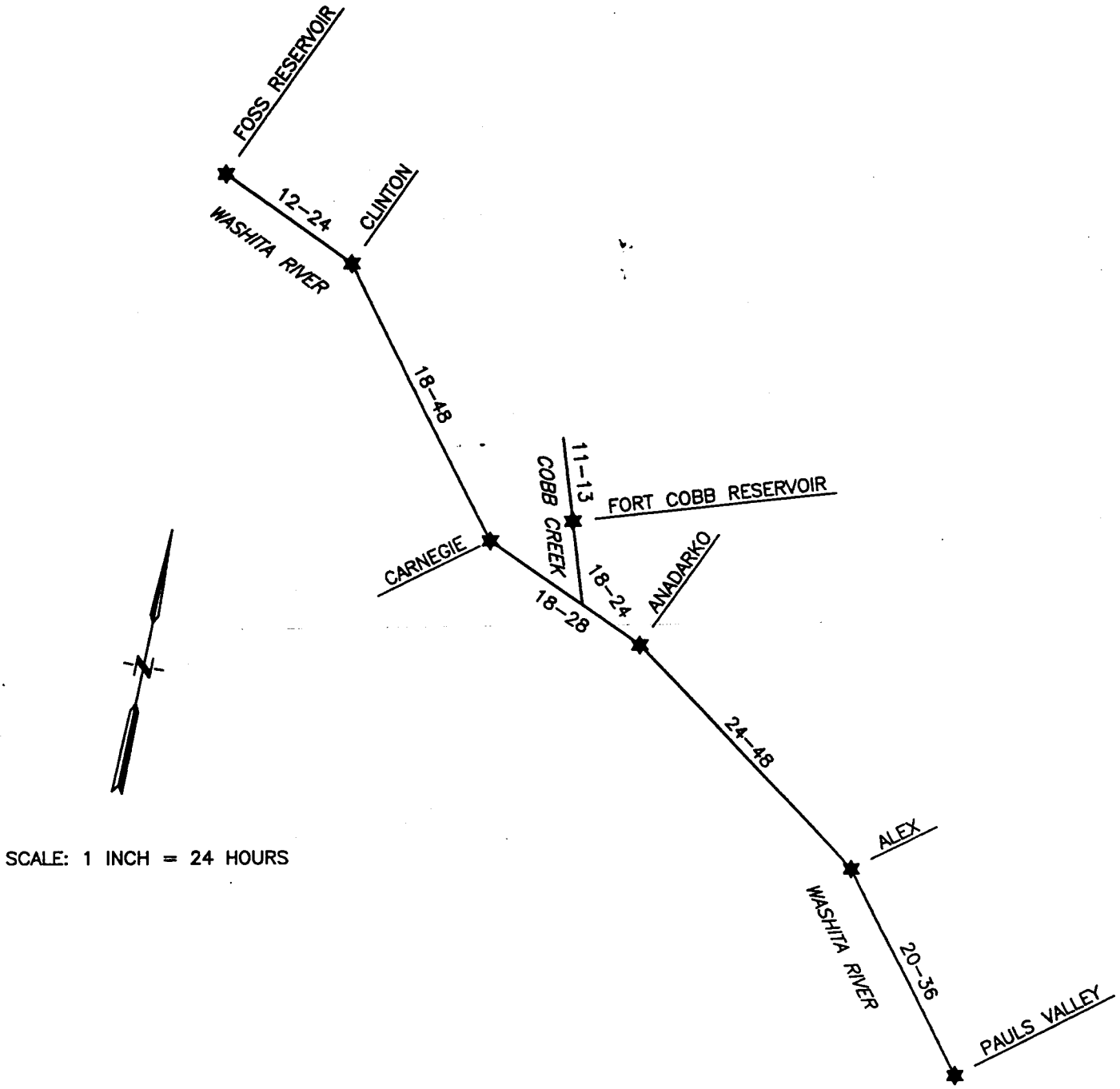
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR LAKE

DISCHARGE RATING CURVE

COBB CREEK AT
FORT COBB, OKLAHOMA

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1997
DRAWN: K.S.R.
CHECKED: R.W.B.



SCALE: 1 INCH = 24 HOURS

NOTE:

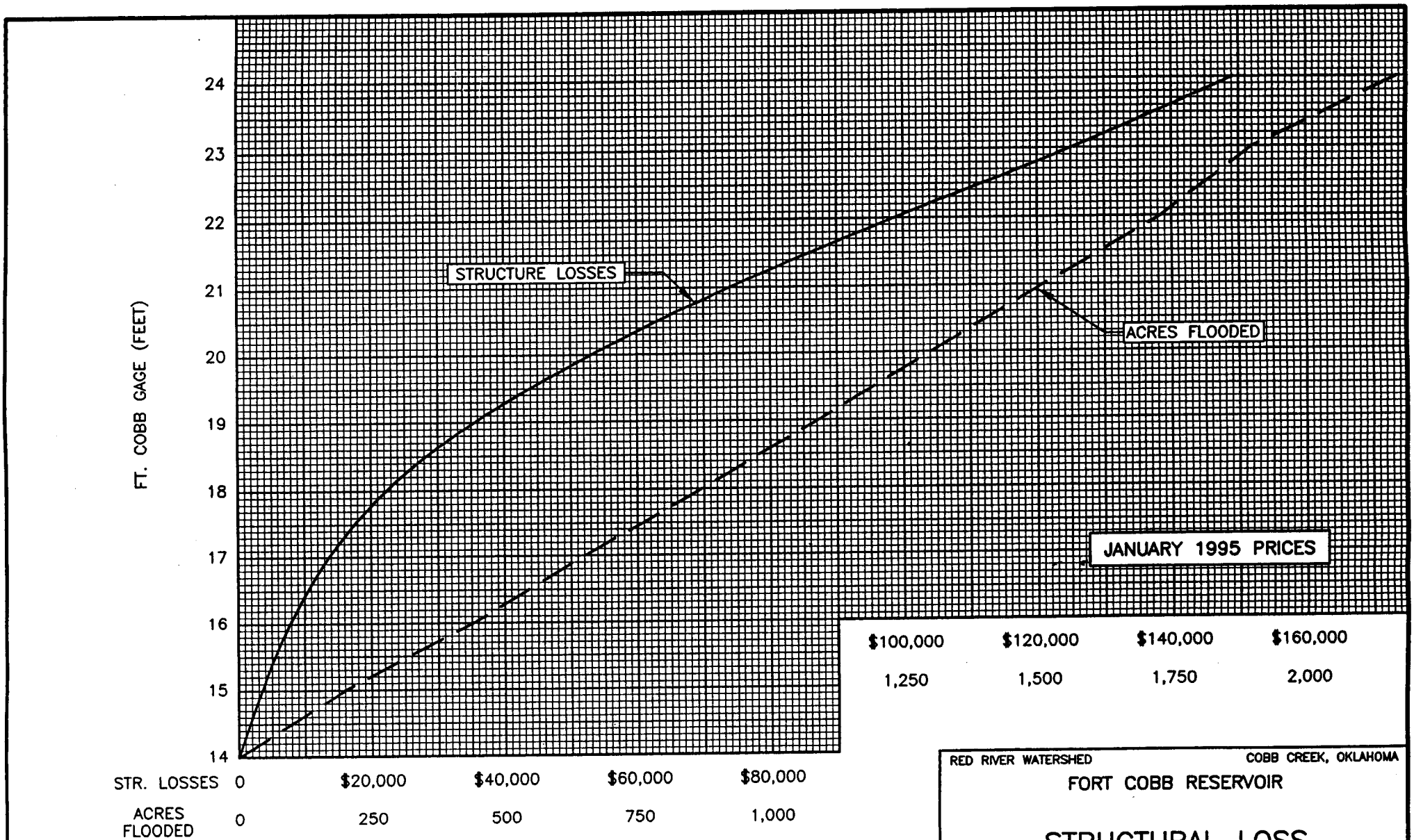
1. TIME OF TRAVEL IN HOURS FOR LARGE RISES IS SHOWN BETWEEN STARS (✱ 24 ✱)
2. TIME SHOWN ABOVE UPSTREAM STATION IS AVERAGE TIME IN HOURS TO CREST AFTER BEGINNING OF RUNOFF.

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

TIME OF CREST TRAVEL

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.



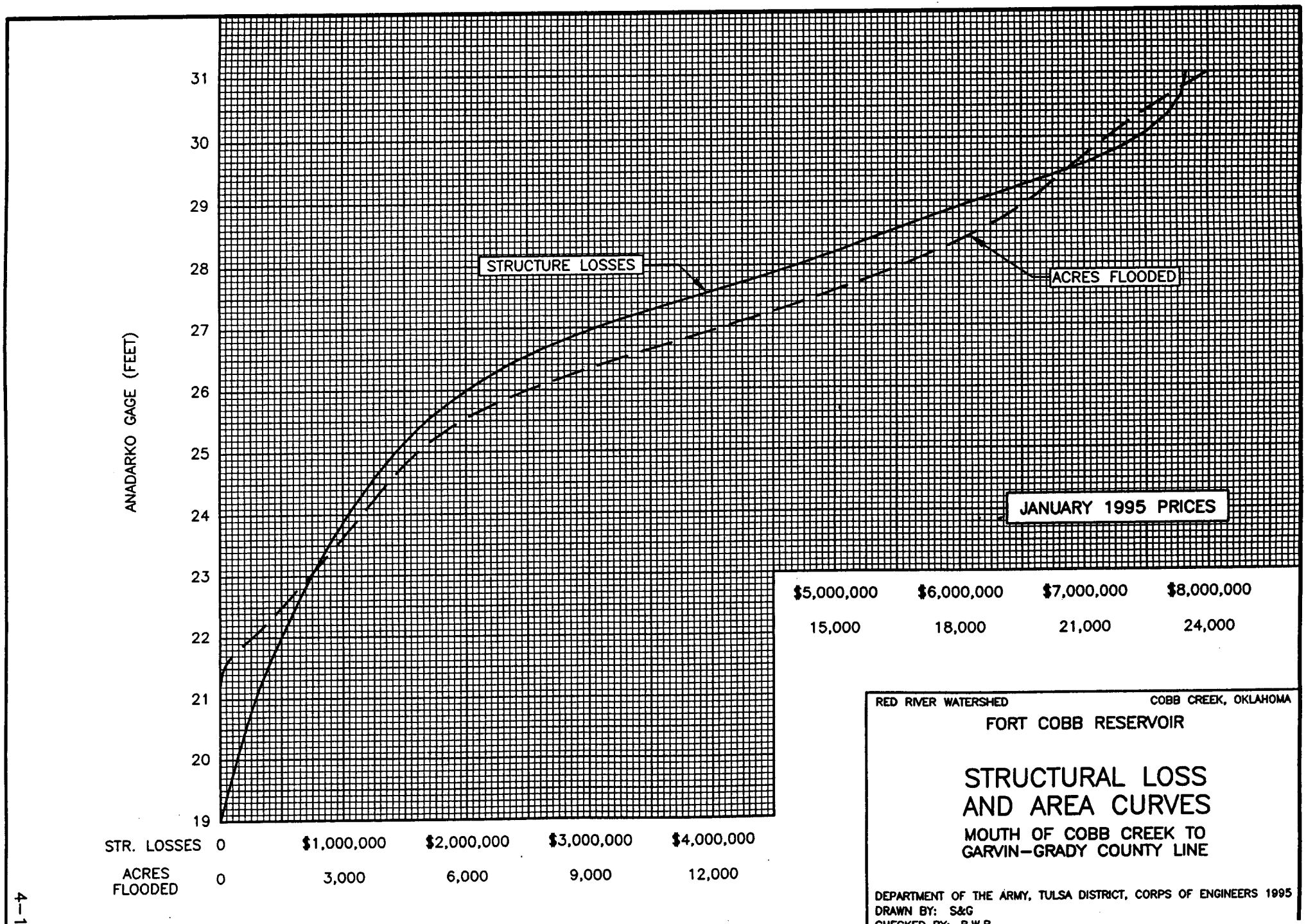
RED RIVER WATERSHED COBB CREEK, OKLAHOMA

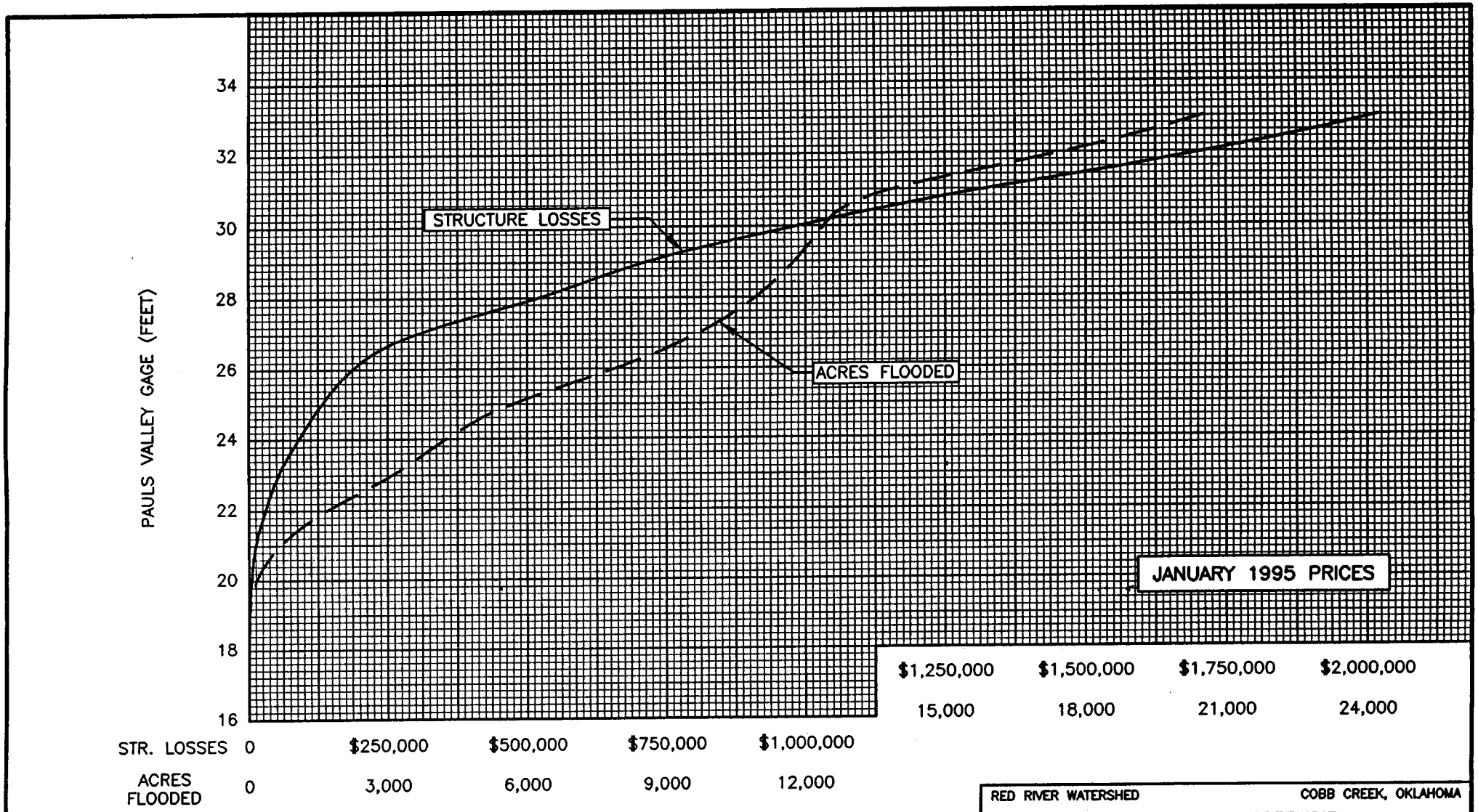
FORT COBB RESERVOIR

STRUCTURAL LOSS AND AREA CURVES

FORT COBB RESERVOIR TO MOUTH OF COBB CREEK

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.


ANADARKO GAGE (FEET)
31
30
29
28
27
26
25
24
23
22
21
20
19
STRUCTURE LOSSES
ACRES FLOODED
JANUARY 1995 PRICES
STR. LOSSES 0 $1,000,000 $2,000,000 $3,000,000 $4,000,000
ACRES FLOODED 0 3,000 6,000 9,000 12,000
$5,000,000 $6,000,000 $7,000,000 $8,000,000
15,000 18,000 21,000 24,000
RED RIVER WATERSHED
COBB CREEK, OKLAHOMA
FORT COBB RESERVOIR
STRUCTURAL LOSS AND AREA CURVES
MOUTH OF COBB CREEK TO GARVIN–GRADY COUNTY LINE
DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G



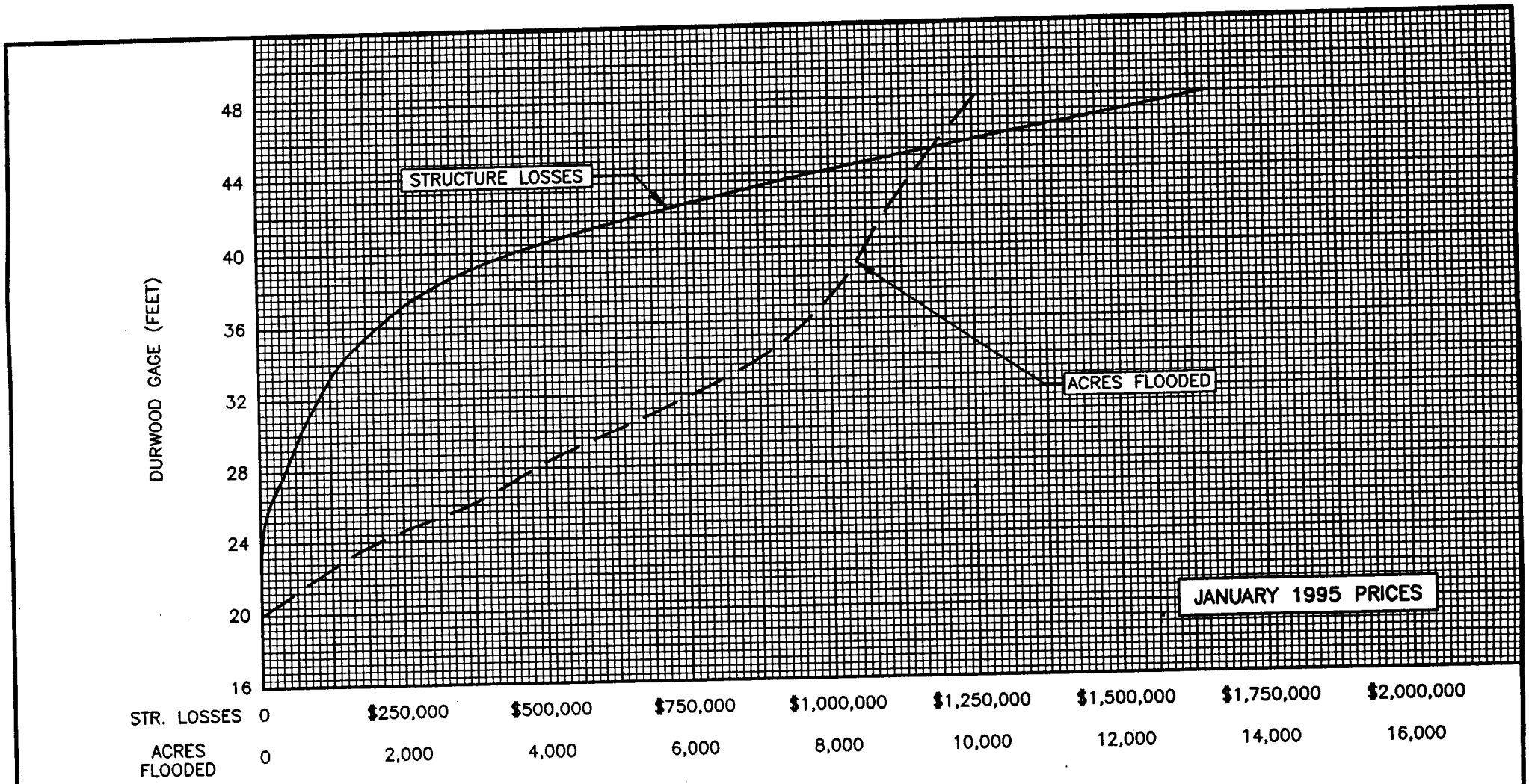
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

STRUCTURAL LOSS AND AREA CURVES

GARVIN–GRADY COUNTY LINE TO MOUTH OF RUSH CREEK ON WASHITA RIVER

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.



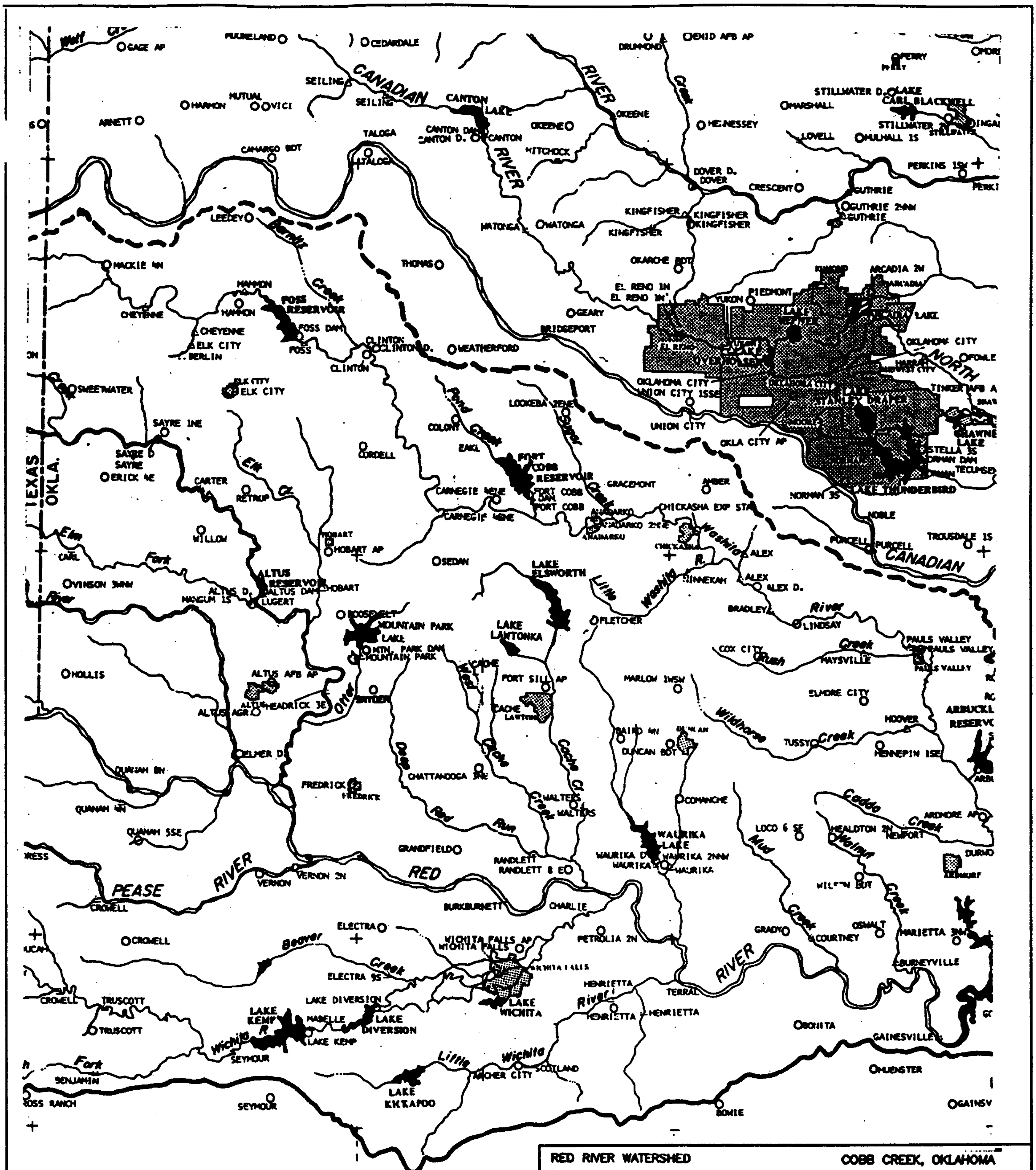
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

STRUCTURAL LOSS AND AREA CURVES

RUSH CREEK TO
UPPER LIMITS OF LAKE TEXOMA

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.



LEGEND:

SCALE OF MILES

10 0 10 20 30 40

○ Stream Gage

△ Rainfall Station

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

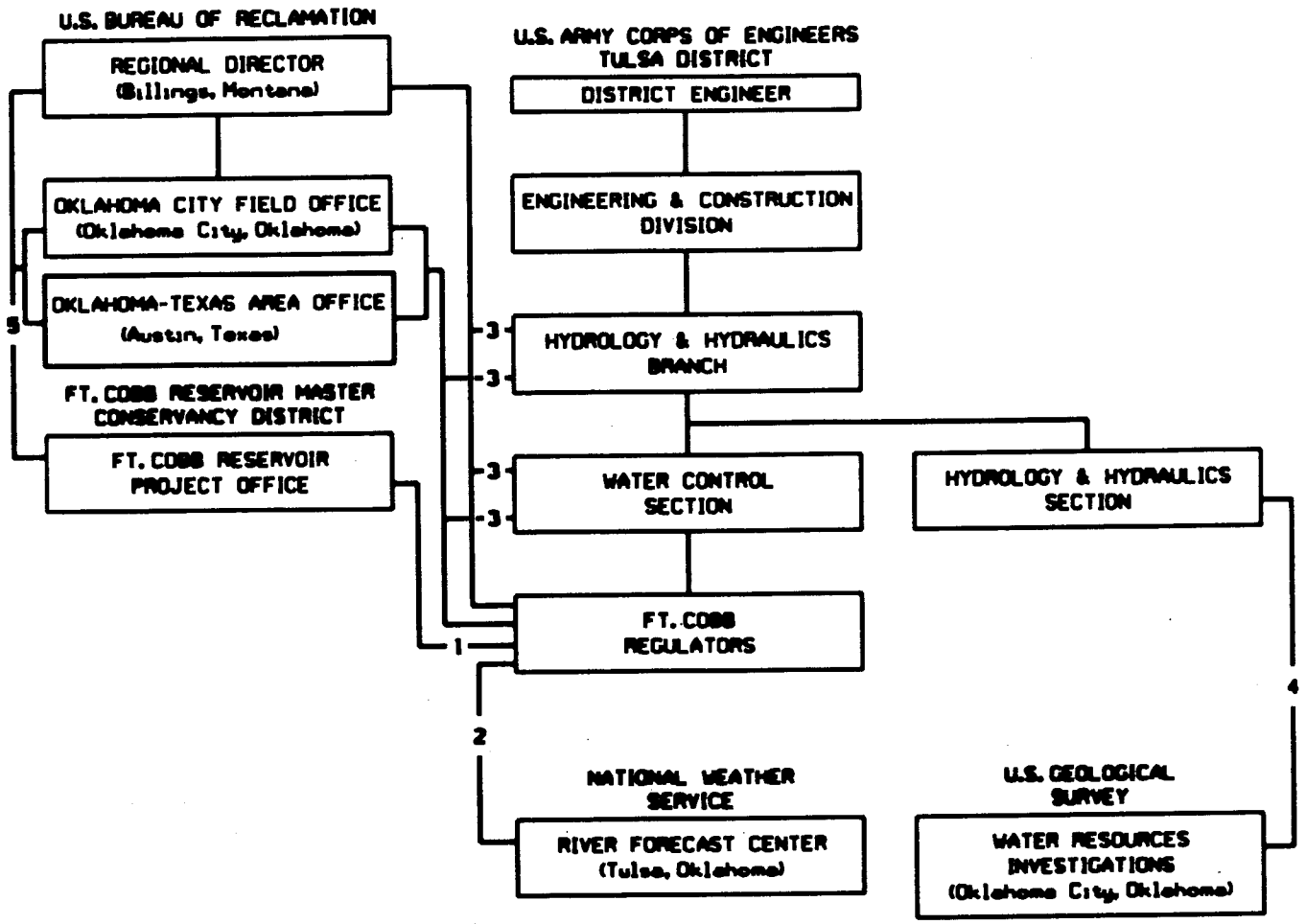
STREAM GAGE AND RAINFALL STATIONS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995

DRAWN BY: S&G

CHECKED BY: R.W.B.

5–1



1. DIRECT COMMUNICATIONS ARE MAINTAINED BETWEEN THE PROJECTS AND THE WATER CONTROL SECTION FOR TRANSMISSION OF RESERVOIR DATA, REGULATIONS, AND INSTRUCTIONS.
2. PRECIPITATION AND STREAM GAGE DATA ARE SHARED BY THE NATIONAL WEATHER SERVICE, RIVER FORECAST CENTER AND THE CORPS OF ENGINEERS.
3. DURING CRITICAL FLOOD CONTROL OPERATIONS, COMMUNICATION IS MAINTAINED WITH HIGHER ECHELONS BETWEEN AGENCIES.
4. MEASUREMENT AND MAINTENANCE OF GAGES IS PERFORMED BY U.S.G.S.
5. OPERATIONS DIRECTED BY U.S.B.R. WHEN POOL LEVEL EXCEEDS OR IS FORECASTED TO EXCEED TOP OF FLOOD POOL, OR WHEN SAFETY OF DAM IS IN JEOPARDY.

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

ORGANIZATION FOR FLOOD CONTROL REGULATION

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: SBG
CHECKED BY: R.M.B.

5-2

LAKE DATA

1-12- 19 95

LINE #	ITEM	TIME	FCOB							
1	Pool Elevation	12N	1342.05							
2	Pool Elevation	4PM	.05							
3	Pool Elevation	12M	.05							
4	Pool Elevation	8AM	.06							
5	Tailwater Elevation	8AM								
6	24 HR Ave Power Discharge	12M								
7	24 HR Ave Total Discharge	12M	93							
8	Net Power Generation	12M								
9	Gen # 1 Hrs of use	12M								
	Gen # 2 Hrs of use	12M								
	Gen # 3 Hrs of use	12M								
	Gen # 4 Hrs of use	12M								
10	Instantaneous Power Discharge	8AM								
11	Instantaneous Total Discharge	8AM	128							
12	Lake Conditions	8AM								
13	Weather Conditions	8AM								
14	Total Preceding 6 Hour Precipitation Ending At:	1PM								
		7PM								
		1AM								
		7AM								
15	Total 24 Hour Precipitation	7AM								
16	Comments on Precip. Dist.									
17	Evaporation 24 Hours	8AM	.201							
18	Wind Direction	8AM	C							
19	Wind Velocity	8AM	B-0							
20	Water Supply		12							
21	Gate Settings No, Type, Opening	8AM	2CG5%							
22	Gate Changes — Date Time		1-11 0900							
23	Pool Elevation		1342.05							
24	From: Gate Setting		2CG10%							
25	To: Gate Setting		2CG5%							
26	Gate Changes — Date Time									
27	Pool Elevation									
28	From: Gate Setting									
29	To: Gate Setting									
30	River Stage - Low Flow Weir									

SWT FORM 0813
Rev. 1/94

ALL PREVIOUS EDITIONS ARE OBSOLETE

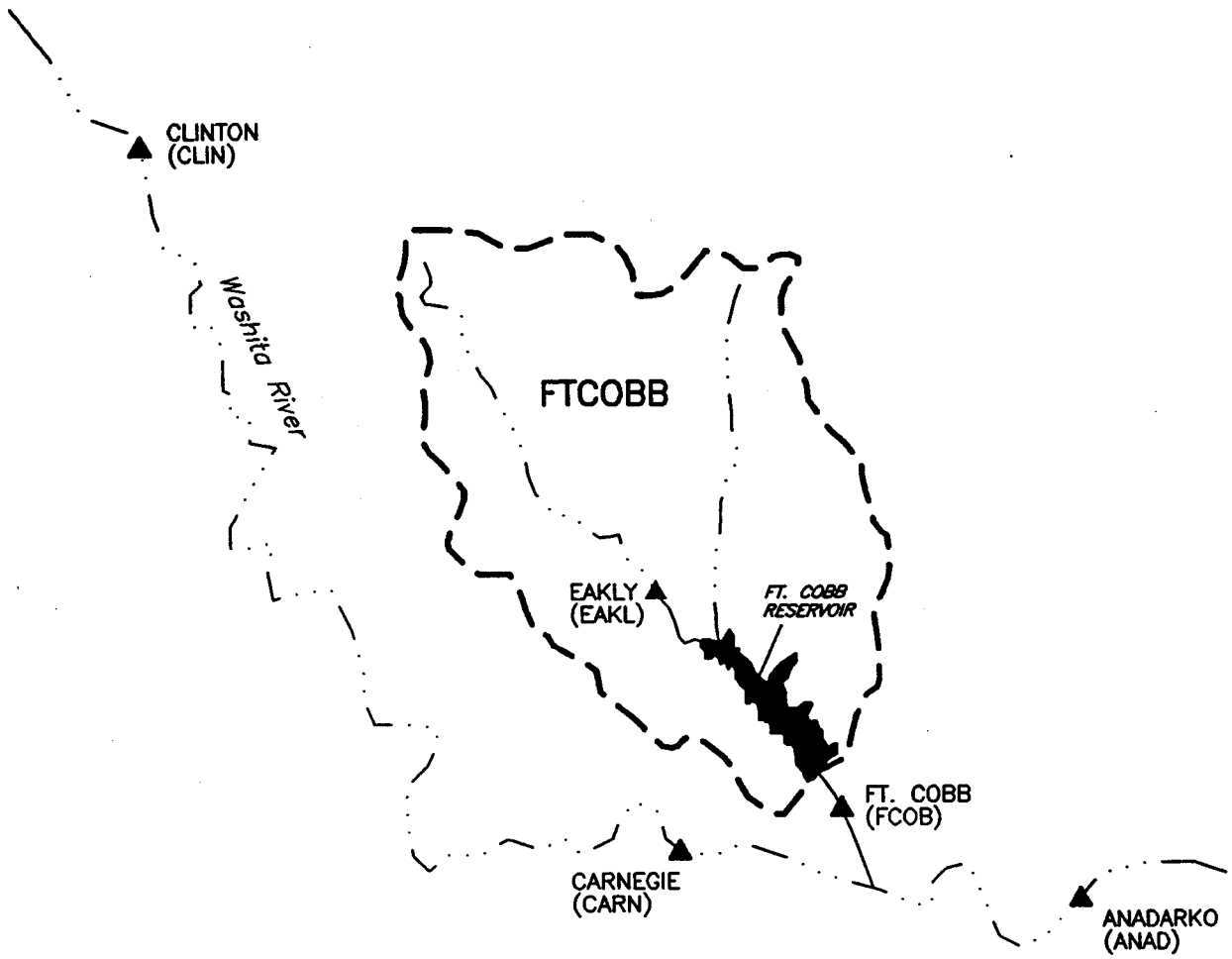
PROPONENT: SWTEC-HR

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

LAKE DATA
REPORT FORM

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.



RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

FORECASTING REACHES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

SWD Form 156
25 Nov 52
1/94 by SWT

FORT COBB RESERVOIR
DISCHARGE AND INFLOW COMPUTATION

Computed By _____ Date February 1995 Checked By _____ Date _____ Book No _____

Date	Time	Pool Elevation	Storage (1000's A.F.)	Δ Storage (1000's A.F.)	Δ Storage c.f.s	Gates Operating No. & Type	Gates Operating Opening	Discharge in c.f.s Instantaneous Flood Control	Instantaneous Power	Instantaneous Total	Average Flood Control	Average Power	Average Evap.	Average Total	Inflow
	2400	1342.26	74828												
2/13	0800	1342.34	75137	8/.309	8/464								11	11	8/475
	1200	1342.38	75292	4/.155	4/465								11	11	4/476
	1600	1342.45	75563	4/.271	4/813								11	11	4/824
	2400	1342.55	75953	8/.390	8/585	CLOSED		0	—	0	0	—	11	11	8/596
				24/1.125	24/563								0.10" 11	11	24/574
2/14	0800	1342.64	76305	8/.352	8/528								14	14	8/542
	1200	1342.65	76344	4/.039	4/117								14	14	4/131
	1600	1342.67	76422	4/.078	4/234								14	14	4/248
	2400	1342.69	76501	8/.079	8/119	CLOSED		0	—	0	0	—	14	14	8/133
				24/.548	24/274								0.12" 14	14	24/288
2/15	0800	1342.71	76579	8/.078	8/117	2CG	10%	180	—	180	8/0		28	28	8/145
	1200	1342.69	76501	4/-.078	4/-234						4/180		28	208	4/-26
	1600	1342.66	76383	4/-.118	4/-354						4/180		28	208	4/-146
	2400	1342.63	76265	8/-.118	8/-177						8/180	—	28	208	8/31
				24/-.236	24/-118						24/120		0.24" 28	148	24/30
2/16	0800	1342.61	76187	8/-.078	8/-117	2CG	10%	180	—	180	8/180		28	208	8/91
			(1)	(2)	(3)			(4)			(5)		(6)		(7)

(1) Reservoir capacity table.
(2) Subtract storage at beginning of period from storage at end of period. If pool is rising, change in storage is positive (+), if falling negative (-).
(3) Change in storage (a.f.) x 12 / No. of hours in period. = change in storage in c.f.s.
(4) From discharge rating curves.
(5) Average discharge during period.
(6) Pan evaporation applied to evaporation curves.
(7) Inflow = change in storage (c.f.s.) + average discharge + evaporation.

NOTE: During flood periods evaporation is usually neglected in preliminary inflow calculations. Number of hours for the inflow period is indicated by

4/

RED RIVER WATERSHED COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

SAMPLE DISCHARGE AND INFLOW COMPUTATION

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

DAILY CLASS "A" PAN EVAPORATION

0.1" 0.2" 0.3" 0.4" 0.5" 0.6" 0.7" 0.8" 0.9" 1.0"

POOL ELEVATION IN FEET (NGVD)

1380
1370
1360
1350
1340
1330
1320
1310

0 20 40 60 80 100 120 140 160 180 200 220 240 260 280

EVAPORATION IN CFS

NOTES:

CURVES COMPUTED FOR 70% OF DAILY U.S.W.B. CLASS "A" PAN EVAPORATION. CURVES BASED ON 1993 LAKE AREA DATA.

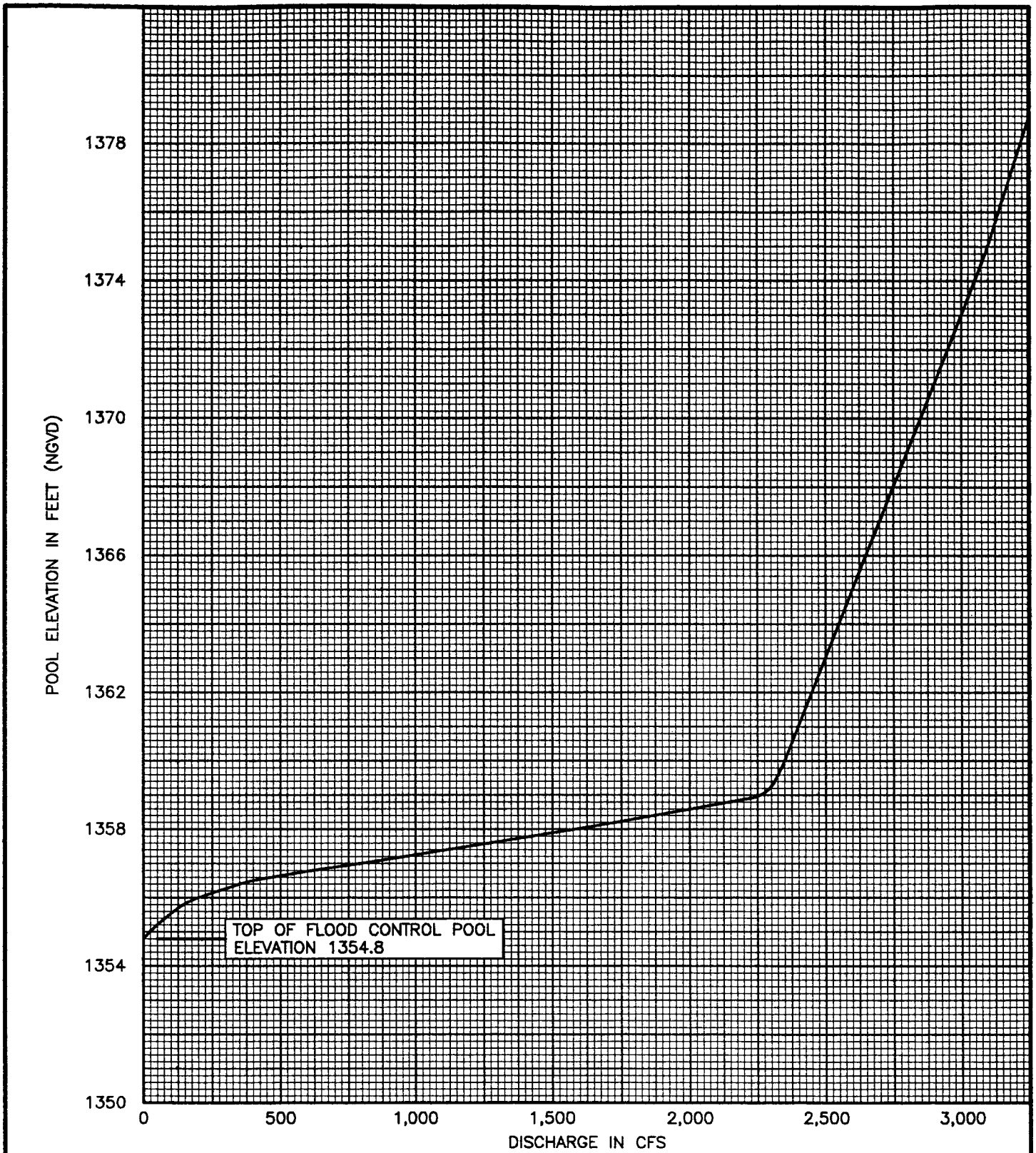
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

EVAPORATION CURVES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

7-1

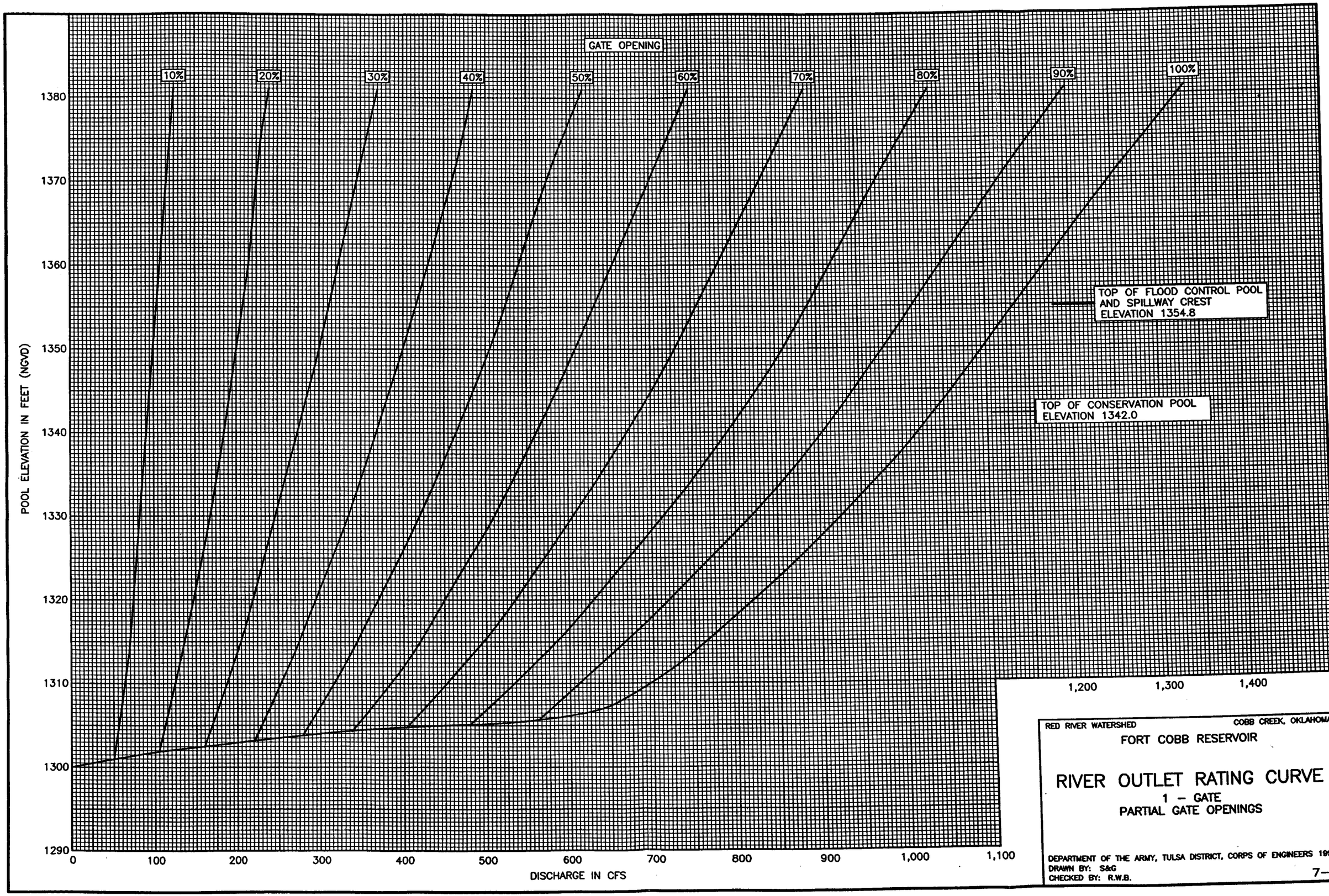


RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

UNCONTROLLED SPILLWAY RATING CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.



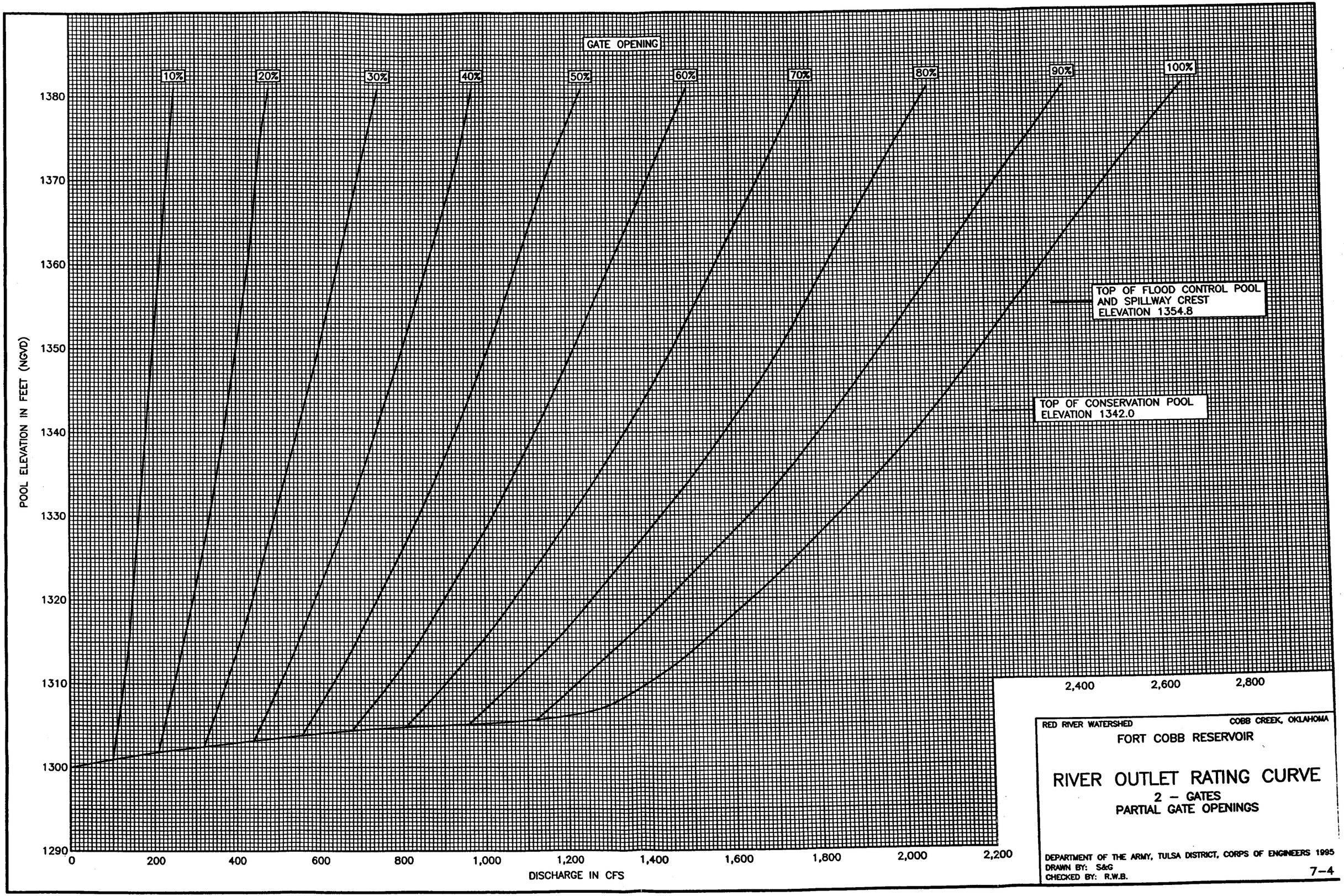
RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

RIVER OUTLET RATING CURVE

1 – GATE
PARTIAL GATE OPENINGS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.



RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

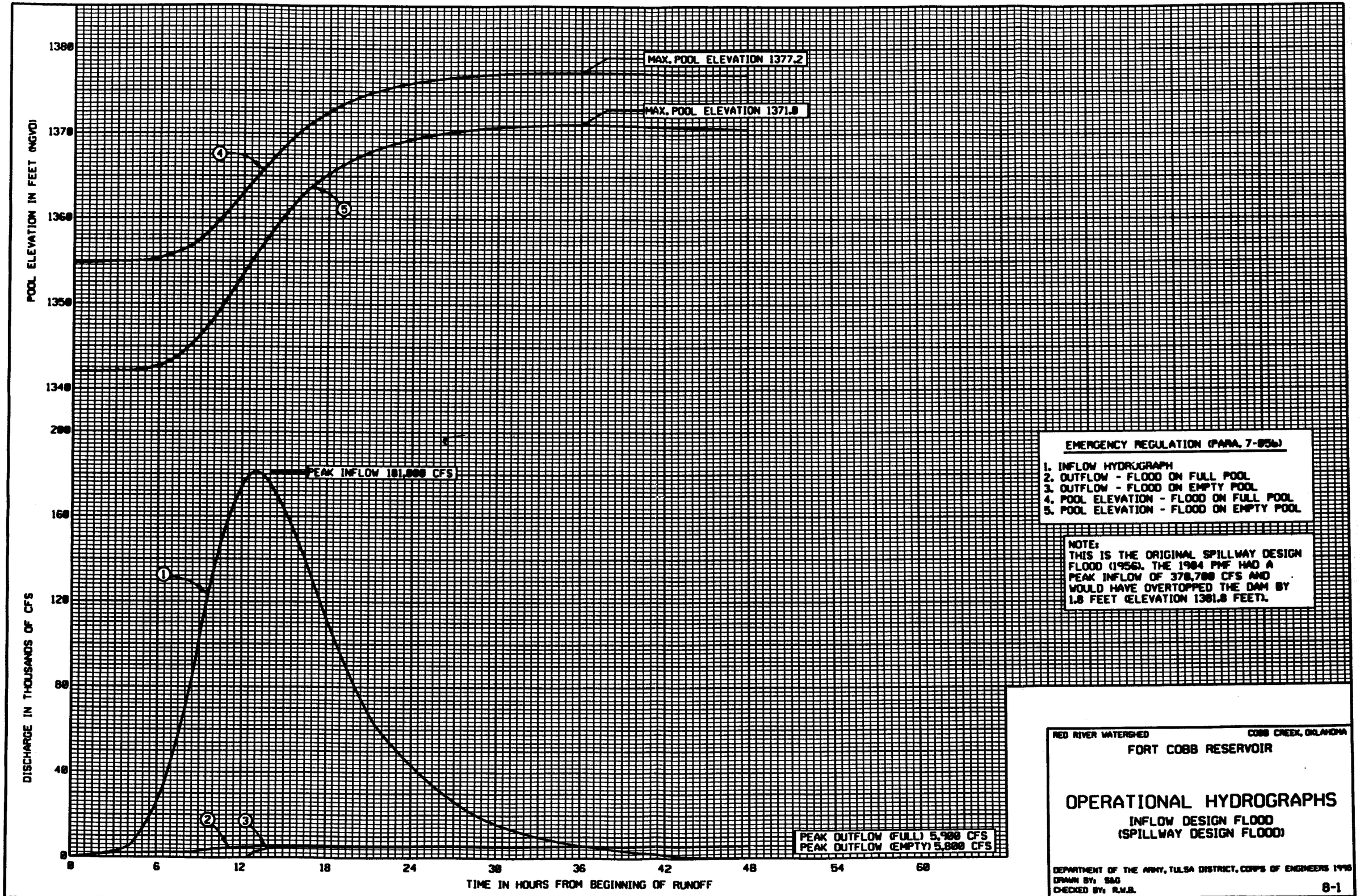
FORT COBB RESERVOIR

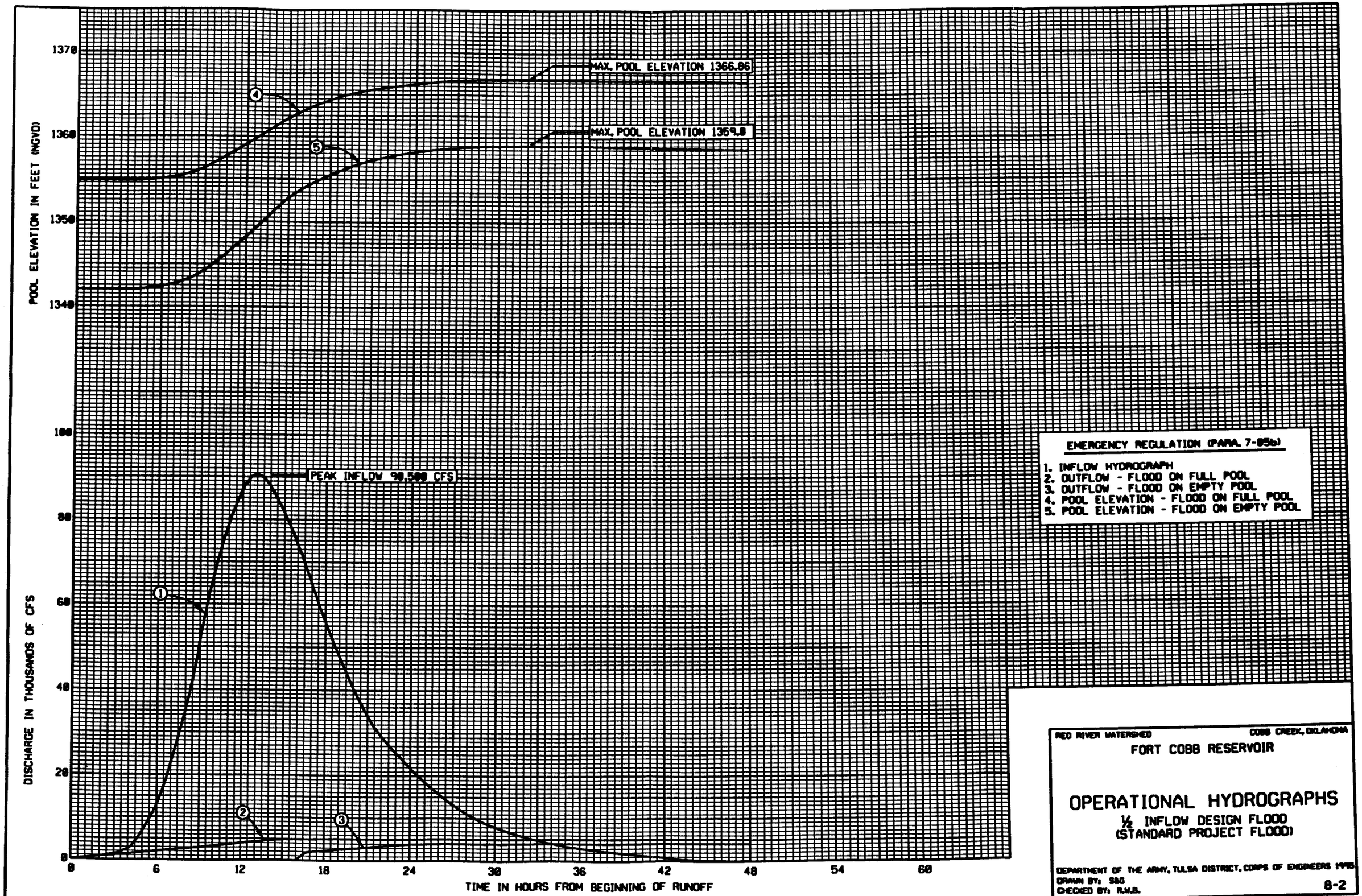
RIVER OUTLET RATING CURVE

2 – GATES
PARTIAL GATE OPENINGS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.

7–4


MAX. POOL ELEVATION 1377.2
MAX. POOL ELEVATION 1371.8
PEAK INFLOW 181,000 CFS
PEAK OUTFLOW (FULL) 5,900 CFS
PEAK OUTFLOW (EMPTY) 5,800 CFS
POOL ELEVATION IN FEET (NGVD)
1380
1370
1360
1350
1340
200
DISCHARGE IN THOUSANDS OF CFS
160
120
80
40
0
0
6
12
18
24
30
36
42
48
54
60
TIME IN HOURS FROM BEGINNING OF RUNOFF
EMERGENCY REGULATION (PARA. 7-95b)
1. INFLOW HYDROGRAPH
2. OUTFLOW - FLOOD ON FULL POOL
3. OUTFLOW - FLOOD ON EMPTY POOL
4. POOL ELEVATION - FLOOD ON FULL POOL
5. POOL ELEVATION - FLOOD ON EMPTY POOL
NOTE:
THIS IS THE ORIGINAL SPILLWAY DESIGN FLOOD (1956). THE 1984 PMF HAD A PEAK INFLOW OF 378,700 CFS AND WOULD HAVE OVERTOPPED THE DAM BY 1.8 FEET (ELEVATION 1381.8 FEET).
RED RIVER WATERSHED
COBB CREEK, OKLAHOMA
FORT COBB RESERVOIR
OPERATIONAL HYDROGRAPHS
INFLOW DESIGN FLOOD
(SPILLWAY DESIGN FLOOD)
DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1986
DRAWN BY: S&G
CHECKED BY: R.W.B.
8-1



RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

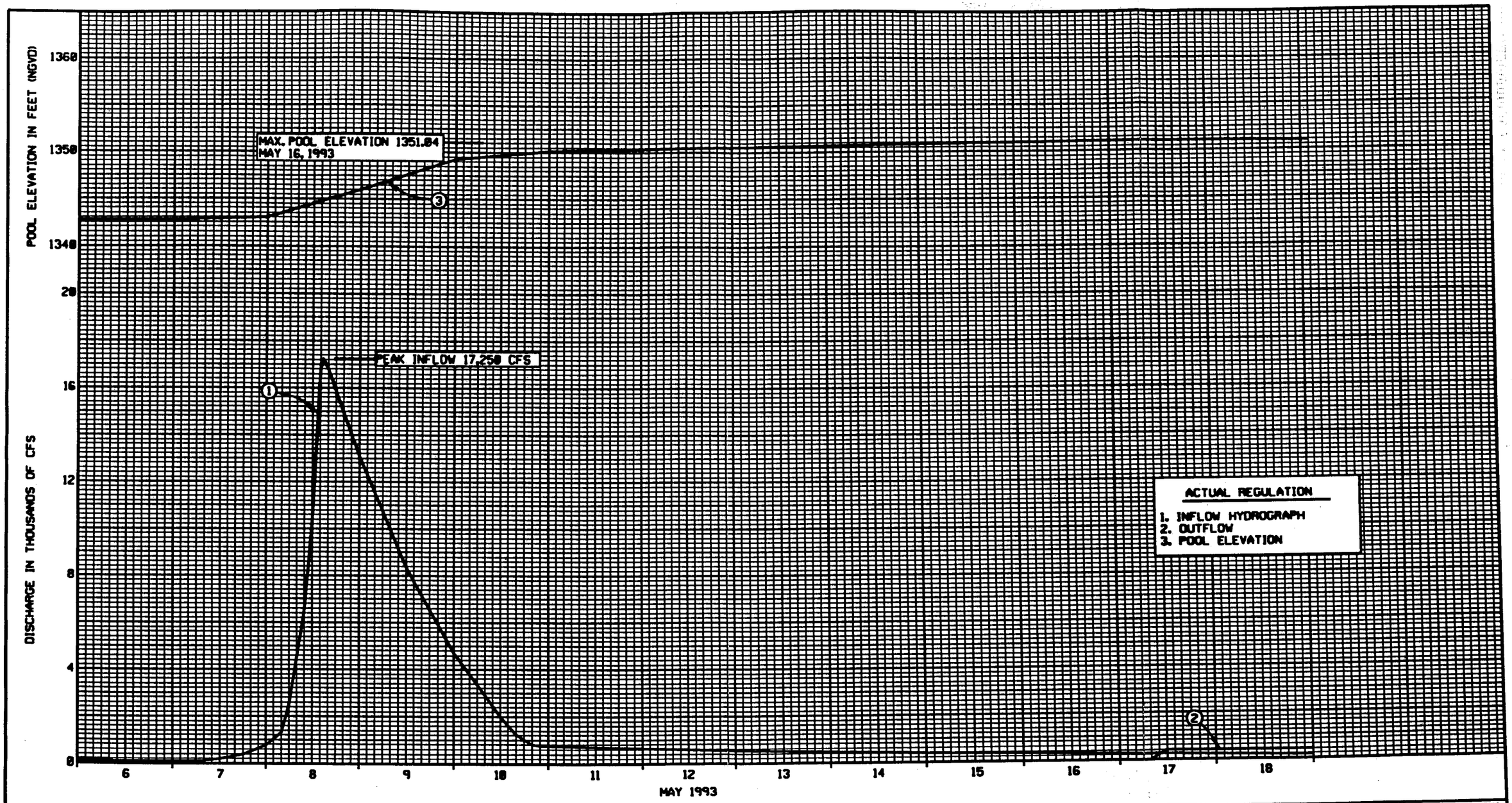
FORT COBB RESERVOIR

OPERATIONAL HYDROGRAPHS

½ INFLOW DESIGN FLOOD
(STANDARD PROJECT FLOOD)

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1965
DRAWN BY: SBG
CHECKED BY: R.V.B.

8-2



NOTES:
RELEASES OF 400 CFS BEGAN AT NOON ON MAY 17, 1993.
MAX. POOL = 1351.84 ON MAY 16, 1993.

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

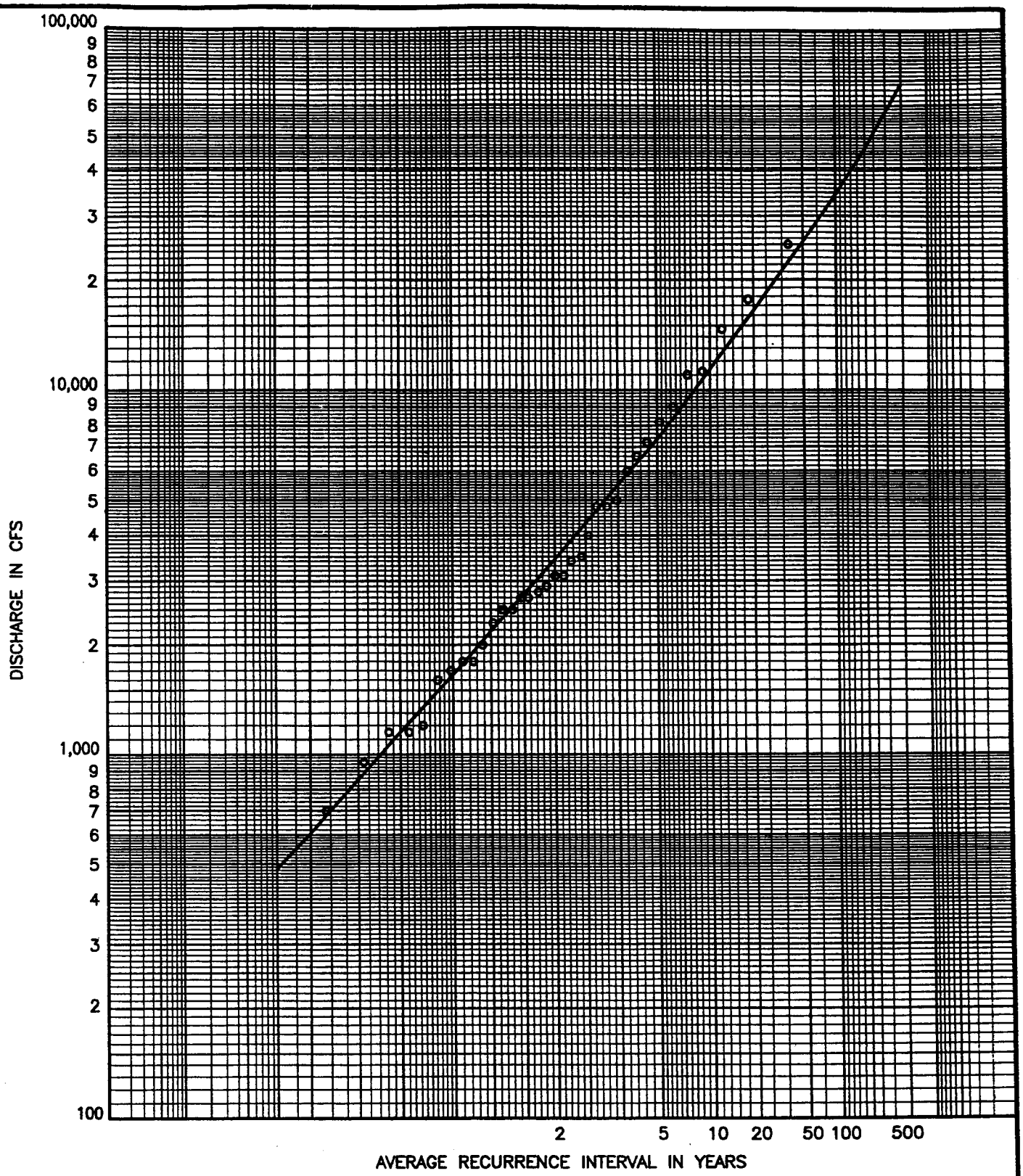
FORT COBB RESERVOIR

OPERATIONAL HYDROGRAPHS

FLOOD OF MAY 1993

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SAG
CHECKED BY: R.M.B.

8-3



NOTES

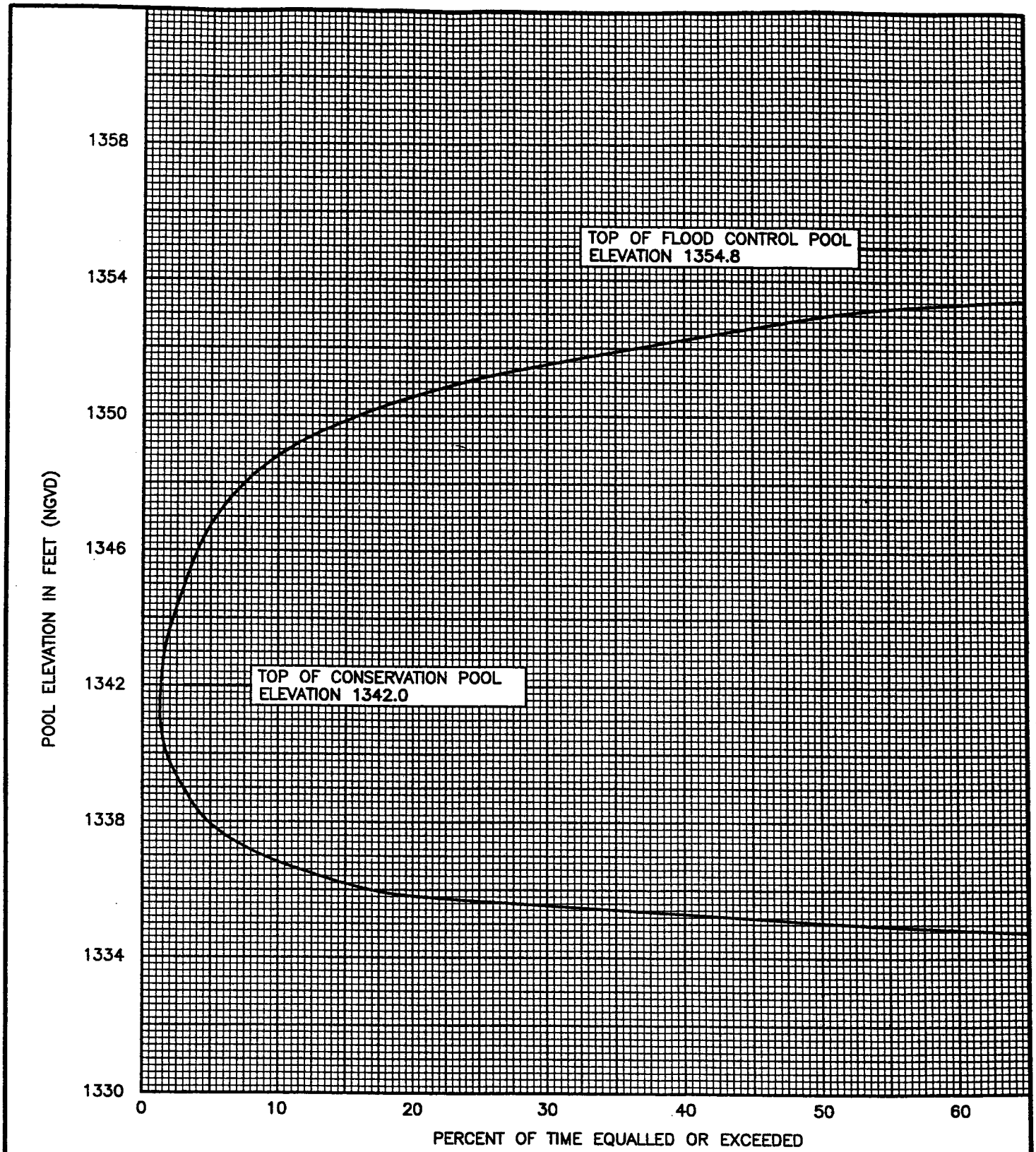
1. BASED ON ANNUAL PEAK INFLOWS FOR PERIOD OF RECORD 1959 THROUGH 1993.
2. BULLETIN NO. 17B "GUIDELINES FOR DETERMINING FLOOD FLOW FREQUENCY" WAS USED.
3. THE ADOPTED SKEW COEFFICIENT OF 0.2 WAS USED.

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

PEAK INFLOW PROBABILITY CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.



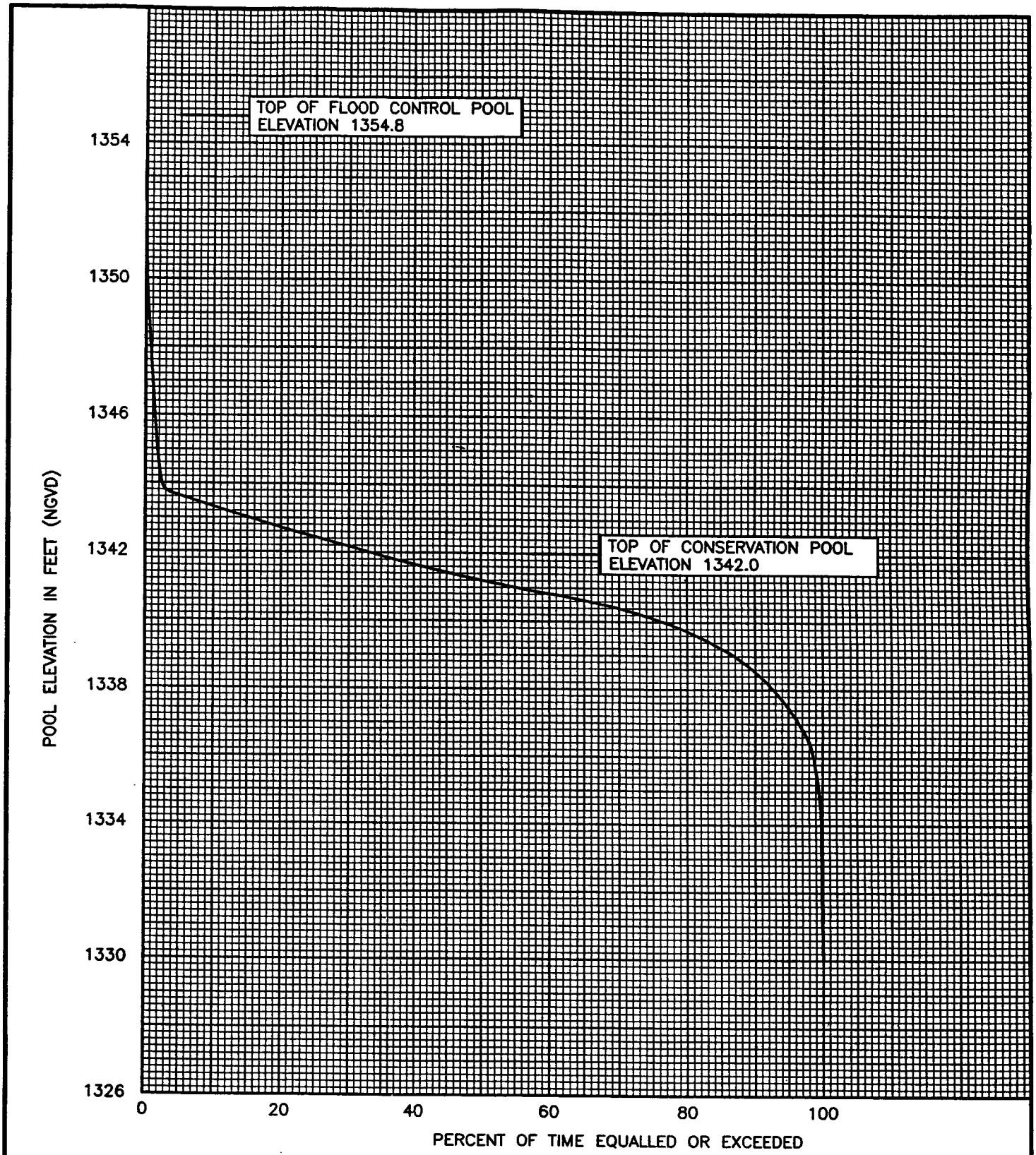
NOTE: BASED ON PERIOD OF RECORD JAN. 1963 THRU DEC. 1993.

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

POOL ELEVATION PROBABILITY CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.



NOTE: BASED ON PERIOD OF RECORD JULY 1962 THRU DECEMBER 1993.

RED RIVER WATERSHED — COBB CREEK, OKLAHOMA

FORT COBB RESERVOIR

POOL ELEVATION DURATION CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1995
DRAWN BY: S&G
CHECKED BY: R.W.B.