



DEPARTMENT OF ARMY
U.S. Army CORPS OF ENGINEERS, TULSA DISTRICT
1645 SOUTH 101ST EAST AVENUE
TULSA, OKLAHOMA 74128-4609

CESWT-EC-HM (1110-2-240b)

18 APR 2016

MEMORANDUM FOR Commander, Southwestern Division, ATTN: CESWD-RBT

SUBJECT: Water Control Manual Revision for Kaw Lake, Arkansas River, Oklahoma

1. Enclosed for your review are revised Page 7-9 and Plate 7-3 of the water control manual for Kaw Lake.
2. Section 7-08 Fish and Wildlife of the old manual stated in the last sentence "Plate 7-3 shows the current manipulation plan, which is approved for use until a reevaluation is deemed necessary." Since Tulsa District has operated Kaw Lake under deviations for at least the past 10 years it is deemed a reevaluation is necessary and the pool plan should revert to a top of conservation pool level elevation of 1010.00 which was valid in the authorizing documents and the original Kaw Lake water control manual.
3. If you have any questions concerning this revision, please call Mr. Scott Henderson at 918-669-7509.

Encl


RICHARD A. PRATT
Colonel, EN
Commanding

**KAW LAKE
ARKANSAS RIVER, OKLAHOMA**

**WATER CONTROL MANUAL
APPENDIX T
TO
WATER CONTROL MASTER MANUAL
ARKANSAS RIVER BASIN**

**DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
OKLAHOMA**

FEBRUARY 1995

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 Arkansas River Control Section, Tulsa District Office (918) 669-7095, 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 persons shown below. Section VII 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 section. A separate copy of this section has been provided the project office and must be displayed on the bulletin board at all times.

EMERGENCY

PERSONNEL ROSTER

<u>Title and Name</u>	<u>Residence Telephone</u>
Project Coordinator, Office (b) (6), Residence	(b) (6) (b) (6)
Backup Coordinator, Office (b) (6), Residence	(b) (6) (b) (6)
Backup Coordinator, Office (b) (6), Residence	(b) (6) (b) (6)
Backup Coordinator, Office (b) (6), Residence	(b) (6) (b) (6)
Chief, Ark River Ctrl Sec, Office (b) (6), Residence	(b) (6) (b) (6)



KAW LAKE

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KAW DAM AND LAKE PERTINENT DATA

LOCATION:

In Kay and Osage Counties,
R.M. 653.7 on the Arkansas River,
about 8 miles east of Ponca City

DRAINAGE AREA:

46,531 square miles above the dam
6,652 contributing

DAM:

Type: Rolled earthfill
Length (including spillway): 9,466 feet
Max. height: 125 feet
Top width Embankment: 32 feet

OUTLET WORKS:

Type and Size: 2 - 5'8" x 10'0" sluices
Location: Through spillway piers
Control: 2 - 5'8" X 10'0" hydraulic slide gates
Invert Elevation: 940.0 feet, NGVD

WATER SUPPLY OUTLET:

Type: 48 inch diameter pipe
Location: Right non-overflow section

Invert Elevation: 970.0 feet, NGVD

POWER FEATURES:

Capacity: 37,000 KW (approximately
5,500 c.f.s.) at conservation pool
No. of units: 1
Penstock invert elevation: 953.5 feet, NGVD

SPILLWAY:

Crest Elevation: 997.5 feet, NGVD
Length: 470 feet gross and 400 feet Net
Type: Gate controlled, concrete,
gravity ogee weir
Control: 8-50 feet wide X 47 feet high
Tainter Gates

LAND ACQUISITION

[Guide Contour] Area (Acres)

Fee Simple	1050 ft, NGVD	49,000
Easement	(1)	2,600
Permit	None	0
Total		51,600

(1) Flowage easements were required
in some extreme upper reaches
affected by backwater.

Feature	Elev feet NGVD	Lake Capacity				Spillway capacity (c.f.s.) 8 gates	Outlet works capacity c.f.s. 2 sluices (c.f.s.)
		Lake area (acres)	Accumulative (ac-ft)	Runoff (inches)(1)	Incremental (ac-ft)		
Top of dam	1056.5						
Maximum pool	1053.9						
Top of induced surcharge	1047.5	39,800	1,466,500	4.13	118,500	653,000	7,900
Top of flood control pool	1044.5	38,000	1,348,000	3.80	919,400	525,000	7,800
Top of conservation pool	1010.0	17,000	428,600	1.21	177,900	490,000	7,600
Spillway crest	997.5	11,760	250,700	0.71	165,700	57,000	6,100
Top of inactive pool	978.0	5,590	85,000	0.24	-	0	5,480
Invert at lowest intake	940.0	95	243	-	-	0	4,480
Flood control storage	1010.0-1044.5	-	919,400	2.59	-	-	0
Conservation storage	978.0-1010.0	-	343,600(2)	0.97	-	-	-
Streambed at Dam	931.5	-	-	-	-	-	-

- (1) Runoff from normal contributing basin area of 6,652 sq. miles. The spillway design drainage area is 8,975 square miles. The total drainage area is 46,530 square miles.
- (2) This includes 171,200 acre-feet for water supply (167 mgd yield), 31,800 acre-feet for water quality control (39 mgd), and 140,500 acre-feet for sediment storage.

KAW LAKE
ARKANSAS RIVER, OKLAHOMA

WATER CONTROL MANUAL
APPENDIX T
TO
WATER CONTROL MASTER MANUAL
ARKANSAS RIVER BASIN

I - INTRODUCTION

1-01. Authorization. This manual is submitted in accordance with ER 1110-2-240 and prepared in accordance with EM 1110-2-3600, ETL 1110-2-251, 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 higher authority; and to give guidance to personnel who will become concerned with, or responsible for, regulation of the lake during the life of the project. These regulations supercede those contained in the Water Control Manual for Kaw Lake dated December 1977.

1-03. Related manuals and reports. This manual is Appendix T to the Arkansas River Basin Water Control Master Manual. Other related manuals in this District are:

Appendix A - Great Salt Plains	November 1966
Appendix B - Heyburn	October 1984
Appendix D - Hulah	October 1968
Appendix E, Part I - Pensacola	December 1992
Appendix E, Part II - Markham Ferry (Lake Hudson)	December 1992
Appendix E, Part III - Fort Gibson	October 1992
Appendix F - Birch	August 1981
Appendix G - Tenkiller	July 1976
Appendix J - Wister	March 1974
Appendix L - Oologah	December 1975
Appendix M - Keystone	November 1989
Appendix N - Eufaula	September 1962
Appendix R - Cheney	October 1965
Appendix U - El Dorado	December 1981
Appendix W - Copan	February 1983
Appendix Y - Skiatook	October 1984

The locations of existing, under construction, and authorized projects in the Tulsa District are shown on Plate 1/1.

Design memoranda pertinent to Kaw Lake are:

<u>MEMORANDUM NO.</u>	<u>TITLE</u>	<u>DATE</u>
1	Hydrology	February 1965
3	General Design	September 1965
7	Embankment, Diversion Channel and Spillway Excavation	December 1966
8	Spillway	July 1968

1-04. Project owner. Kaw Lake is owned by the U.S. Government. The hydropower facilities are owned by the Oklahoma Municipal Power Authority (OMPA).

1-05. Operating agency. The Corps of Engineers is the operating agency for Kaw Lake. The Project Manager, Kaw Lake, operating through the Keystone Resident Office, and the Operations Division, Tulsa District, has the responsibility for project operations. The project is placed under 24-hour surveillance when the lake level is above elevation 1027.0. Below elevation 1027.0, the project will be manned during normal work hours each day through the recreational season. When the recreation season is over, the project will be manned for the normal 5-day week. However, when the project is in flood control operation, project personnel will closely monitor the dam and the downstream river reaches. The project office is furnished a list of the Reservoir Control Section personnel to contact when necessary. The Project Manager will furnish the Reservoir Control Section a list of project personnel with their office and home telephone numbers and addresses. The Project Manager resides as close to the project as is considered prudent to carry out his official duties. The hydropower facilities are remotely operated by OMPA from their dispatching center in Edmond, Oklahoma. A powerhouse superintendent is on site Monday through Friday during normal working hours.

1-06. Regulating agencies. The Corps of Engineers is the regulatory agency for Kaw Lake and the Arkansas River Control Section, Hydrology-Hydraulics Branch, Tulsa District is responsible for the regulation. Regulation of the lake is coordinated with the OMPA.

II - DESCRIPTION OF PROJECT

2-01. Location. Kaw Lake is located at river mile 653.7 on the Arkansas River, approximately 8 miles east of Ponca City, in Kay and Osage Counties, Oklahoma. The project area is shown on plate 2-1.

2-02. Purpose. Kaw Lake is a multi-purpose project for flood control, hydropower, navigation, water supply, water quality, recreation, and fish and wildlife conservation. Furthermore, it is a unit of the multi-purpose system which regulates for flood control, generation of hydropower, navigation, and other beneficial water uses on the Arkansas River and its tributaries.

2-03. Physical components.

a. Embankment. The embankment is a rolled, earth-filled structure with a maximum height of approximately 125 feet above the streambed and a total length of 9,466 feet including the spillway. The top of dam, elevation 1056.5, is 32 feet wide, with a 24-foot double bituminous surface roadway. Along the portion of the embankment covering the main channel exclusive of the spillway area, a cutoff trench is excavated to the top of rock. A partial cutoff trench extending 5 feet into an existing layer of lean clay is excavated under the remainder of the embankment. The upstream slopes of the embankment are protected by dumped riprap on backing material while the downstream slopes are seeded to grass. A general plan and elevation of the embankment are shown on plate 2-2.

b. Spillway. The spillway is a gated, concrete, gravity, ogee weir type structure with a gross length of 470 feet, net overflow length of 400 feet, and crest elevation of 997.5. The structure is located adjacent to the right abutment. Flows over the spillway are controlled by eight 50-foot wide by 47-foot high tainter gates operated by individual electric powered hoists. The concrete slab stilling basin has 2 rows of baffles and a 10-foot high end sill. The spillway plan and elevation is shown on Plate 2-3.

c. Outlet works. The outlet works consist of two 5'8" wide x 10'0" high rectangular sluices at invert elevation 940.0 located in the first two intermediate piers on the right side of the spillway. Regulation of flow for each sluice is by two hydraulic slide gates. One gate is for service operation and the second gate, upstream of the service gate, is for emergency operation. Bulkheads are also provided for emergency use.

d. Sedimentation and degradation ranges. Sixty-four sediment ranges have been established in and above the lake. The end of each range is marked by permanent monuments with known vertical and horizontal positions. Twenty-six

degradation ranges across the flood plain below the reservoir have also been established. The locations of the sedimentation and degradation ranges are shown on Plates 2-4 and 2-5, respectively.

e. Powerhouse. Hydroelectric power is generated at the dam and marketed by the Oklahoma Municipal Power Authority. The powerhouse is located between the spillway and the right abutment and contains one 37,000 kilowatt generator. One 20-foot penstock with intake invert elevation 953.5 allows flows from 800 to 5700 cfs to provide the water for the power units. The emergency shut off is a 20 foot butterfly valve located in the penstock. The plant is a run-of-river operation, with provisions for daily storage. The design power head is 76 feet.

f. Water supply pipe. The water supply facility consists of a 48-inch diameter pipe located in the right non-overflow section of the spillway. The city of Stillwater receives a portion of its water supply from this pipe and has a water line downstream to its pumping plant. The invert elevation of the water supply pipe is 970.0.

2-04. Related control facilities. A levee project surrounds three-quarters of Arkansas City, Kansas, to protect the city from flood waters on the Arkansas and Walnut Rivers. The levee is designed to withstand the hundred year flood which is approximately 100,000 c.f.s. Arkansas City, Kansas, is located on the northeast bank of the Arkansas River about 50 miles upstream of Kaw Dam.

2-05. Real estate acquisition. The envelope curves of backwater effects of the 50-yr flood (modified by Cheney Reservoir) under initial conditions and the 50-yr flood (modified by El Dorado Lake and Cheney Reservoir) after 100 years of sedimentation are shown on plates 2-6 and 2-7. Relocations were based on the 50-yr flood (modified by El Dorado Lake and Cheney Reservoir) after 100 years of sediment plus freeboard or the top of the flood control pool plus freeboard, whichever is higher. Freeboard requirements were determined by the physical characteristics and limitations, frequency and duration of inundation, exposure to damaging wave action, unique engineering features, and economics. The acquisition guideline is elevation 1050.0 or the limits of the backwater effects of the 50-yr flood (modified by El Dorado Lake and Cheney Reservoir) after 100 years of sediment, whichever is greater. Reservoir land (surface) was generally purchased in fee to a blocked perimeter that encompasses the acquisition guide contour with a minimum distance of 300 feet measured horizontally from the top of the flood control pool (elevation 1044.5). Fee simple title has been acquired to land required for construction of the dam and for operation and

maintenance purposes in the area designated as the damsite and public-use areas. There are 49,000 acres in fee simple title and 2,600 acres in easement.

2-06. Public facilities. There are 10 recreation areas at Kaw Lake: Traders Bend, Bear Creek Cove, Coon Creek Cove, Washunga Bay, Sarge Creek Cove, Pioneer Park, Osage Cove, McFadden Cove, and Fishermans Bend and Sandy Park. The locations of these recreation areas are shown on Plate 2-8.

III - HISTORY OF PROJECT

3-01. Authorization. Kaw Lake was authorized for construction by the Flood Control Act of 1962, Public Law 87-874, 87th Congress, 2d session. Non-federal hydropower was authorized by the Federal Energy Regulation Commission under Section I of the Federal Power Act.

3-02. Planning and design. The survey report, published in 1962, as Senate Document No. 143, 87th Congress, 2d session, contained recommendations of the Kaw Lake Survey Report as revised February 1962. The report indicated that the project is economically justified in the interest of flood control, conservation, recreation, and fish and wildlife. The original design survey report described a spillway which had 10 tainter gates, 40 feet wide by 35 feet high. This was changed to 8 tainter gates, 50 feet wide by 47 feet high. Storages were also changed from a flood control storage of 824,000 acre feet to 919,400 acre feet and from 232,000 acre feet of conservation storage to 343,600 acre feet. The rolled earth-filled dam was increased in length from 8,650 feet long to 9,466 feet long including the concrete spillway. Plans were amended to install a penstock for a future hydropower plant. A series of design memoranda have been prepared in connection with planning and construction of Kaw Lake. These reports cover the site selection, hydrology, structural features of the plan, sedimentation and degradation ranges, reservoir clearing, relocation of roads and utilities, and real estate.

3-03. Construction. A summary of construction activities for Kaw Lake is presented in Table 3-1.

TABLE 3-1

KAW DAM AND LAKE SUMMARY OF CONSTRUCTION ACTIVITIES

Activity	:	Date
Construction began	:	June 1966
Date of diversion	:	November 1974
Final storage began	:	April 1976
Conservation pool permanently filled	:	May 1977

3-04. Related projects. Kaw Lake is a component of the multi-purpose Arkansas River Basin flood control and navigation system. Included in this system are completed projects in the Verdigris, Walnut, Canadian, North Canadian, Grand, Caney, Illinois, and Poteau River Basins. The Arkansas River system is operated for the control of floods, navigation, and other beneficial uses.

3-05. Modification to regulations. The regulation of Kaw Lake has been modified to coincide with the present Arkansas River System Operating Plan as discussed in the Arkansas River Basin Water Control Master Manual.

3-06. Principal regulation problems. There have been no significant structural problems at the Kaw project related to the regulation of Kaw Lake. Twenty-four hour flood surveillance at the dam begins at elevation 1027.0. During the October 1986 flood operation, difficulties arose while operating the surcharge pool above elevation 1045.5. At this elevation, access to the catwalk (elevation 1046.5) becomes hazardous. Remote controls can be used to operate the tainter gates, although water can enter the control room if the door to the catwalk is not sealed before elevation 1046.5 is reached.

IV - WATERSHED CHARACTERISTICS

4-01. General characteristics. The Arkansas River rises in the Rocky Mountains near Leadville, Colorado (river mile 1440) and flows southeasterly through the states of Colorado, Kansas, Oklahoma, and Arkansas and joins the Mississippi River at a point near river mile 581.5. The total length of the Arkansas River is approximately 1,460 miles. The elevation at the source of the stream is about 11,500 feet and the elevation at the mouth is approximately 106 feet. The fall of the river ranges from 110 feet per mile near the source to about 2.8 feet per mile at Kaw Dam and 0.4 foot per mile near the mouth. The watershed upstream from Great Bend, Kansas is essentially noncontributing to floods at Kaw Dam. The channel from Hutchinson to the Kansas-Oklahoma state line averages about 400 feet in width with banks about five feet high. Major tributaries above Kaw Lake are: Rattlesnake Creek with a contributing drainage area of 623 square miles, Cow Creek with a contributing drainage area of 705 square miles, Little Arkansas River with a contributing drainage area of 1,266 square miles, Ninnescah River with a contributing drainage area of 1,951 square miles, Slate Creek with a drainage area of 290 square miles, Walnut River with a drainage area of 1,955 square miles, and Grouse Creek with a drainage area of 397 square miles. Between the Kansas-Oklahoma state line and Keystone Dam, the width of the channel ranges from 600 to 2,500 feet and the banks are from 10 to 12 feet high. During periods of low flow, the river meanders over a wide sandy bed between banks that are easily eroded, while during periods of high flow, bank caving occurs at many localities. Below Keystone Dam, the width of the channel ranges from 600 to 3,000 feet. The banks are from 10 to 20 feet high upstream from the Grand (Neosho) River and 20 to 40 feet high from there to the mouth. The Salt Fork of the Arkansas and Cimarron Rivers are the major tributaries to the Arkansas River below Kaw Dam and above Keystone Dam. Stream profiles of the Arkansas River are shown on Plate 4-1.

4-02. Topography. The terrain of the Arkansas River drainage basin varies from rolling to hilly and is characterized by sandstone hills, streams, and valleys with broad alluvial plains. Throughout Kansas and part of Oklahoma the course of the river is crooked and meandering and is subject to frequent changes. From its confluence with the Verdigris River near Muskogee, Oklahoma, to the Mississippi River, the Arkansas River's course has been stabilized and controlled to facilitate commercial navigation. Land use consists of crop production, ranching, and oil and gas production.

4-03. Geology and soils. Kaw Lake is located in the Northern Limestone Cuesta Plains subdivision of the Interior Lowlands physiographic province. Surface and subsurface rocks are lower Permian in age and belong to the Chase and Council Grove

groups. The rocks consist mainly of shales and limestone with occasional limestone beds. The tertiary alluvial deposits consist of terrace deposits, dune sand, and loess.

4-04. Sediment. Studies indicate that approximately 310,000 acre-feet of sediment, including bedload, will accumulate in the lake during a 100-yr period. Periodic resurveys will be made to compute the volume and distribution in the lake. The initial survey was by dry land methods and the sonic sounder method will be used where adaptable in the resurveys. The sedimentation ranges are described in paragraph 5-03 and are shown on plate 2-4.

4-05. Climate. The climate in the general project area is characterized by moderate winters and long summers with high temperatures. Rainfall usually occurs in the form of high intensity, local thunderstorms which occur primarily during the late spring and early fall months. These storms are frequently accompanied by high winds, hail, and occasional tornadoes. Climatic characteristics for the basin are shown in the following paragraphs.

a. Temperature

(from recorded data at Wichita, Kansas)

Mean annual	56.4 degrees F
Maximum recorded (August 12, 1936)	114 degrees F
Minimum recorded (February 12, 1899)	-22 degrees F

b. Precipitation

(average for drainage basin above Kaw Dam)

Mean annual (Oct. 1921 thru Sep. 1990)	30.80 inches
Maximum annual (1951)	44.40 inches
Minimum annual (1956)	15.70 inches
Percent during growing season (April through September)	72.0 percent

The average monthly and annual rainfall and runoff data are shown in Table 4-1.

c. Snow

(Period of record - 1960-1990 at Wichita, Kansas)

Mean annual	15.0 inches
Maximum month (January 1987)	19.7 inches
Minimum annual (1980-1981)	3.1 inches

d. Evaporation. The estimated monthly evaporation at Kaw Lake is shown in Table 4-2.

TABLE 4-1

AVERAGE MONTHLY AND ANNUAL RAINFALL AND RUNOFF
ABOVE KAW DAM

Month	: Average : rainfall : (1) : (inches)	: Percent of : average annual: : rainfall	: : (2) : (acre-feet)	: Average runoff : (inches)	: Percent of : average : annual : runoff
January	: .87	: 2.8	: 86,400	: .24	: 3.9
February	: 1.03	: 3.3	: 103,900	: .29	: 4.7
March	: 1.88	: 6.1	: 199,800	: .56	: 9.1
April	: 2.86	: 9.3	: 259,700	: .73	: 11.9
May	: 4.29	: 13.9	: 306,500	: .86	: 14.0
June	: 4.44	: 14.4	: 341,000	: .96	: 15.6
July	: 3.50	: 11.4	: 232,600	: .66	: 10.6
August	: 3.17	: 10.3	: 134,600	: .38	: 6.1
September	: 3.58	: 11.6	: 144,300	: .41	: 6.6
October	: 2.39	: 7.8	: 173,900	: .49	: 7.9
November	: 1.66	: 5.4	: 121,800	: .34	: 5.6
December	: 1.13	: 3.7	: 86,800	: .24	: 4.0
Total	: 30.80	: 100.0	: 2,191,300	: 6.18	: 100.0

(1) Period of Record - October 1921 through September 1990.

(2) Contributing drainage area above Kaw Lake = 6,652 square miles.

TABLE 4-2

ESTIMATED MONTHLY PAN EVAPORATION
KAW LAKE

EVAPORATION (inches) (1) (2)	
JANUARY	1.77
FEBRUARY	2.19
MARCH	4.74
APRIL	7.17
MAY	7.62
JUNE	9.35
JULY	11.31
AUGUST	10.44
SEPTEMBER	7.88
OCTOBER	5.55
NOVEMBER	3.61
DECEMBER	<u>2.18</u>
TOTAL INCHES PER YEAR	73.81

- (1) National Weather Service Class "A" Pan.
(2) Period of record - July 1974 to September 1990.

e. Wind. The prevailing wind is from the south with the greatest wind movement occurring in the spring months. Wind velocity data indicate the highest wind speed that can reasonably be expected at the dam site is 79 miles per hour and the highest wind speed for a 1-hour duration is 57 miles per hour.

4-06. Storms and floods. Most major storms in the Kaw Lake drainage basin have occurred in April through July and September through November. Thunderstorms and the remnants of hurricanes are the type of storms that produce most high runoff events in the basin. The largest flood in the 69 years of records was produced by the 29 September to 4 October 1986 storm which produced an average of 6.7 inches of rainfall over the basin. This storm was the combination of a stalled cold front and the remnant of a hurricane. The resulting runoff produced a peak inflow of 190,000 c.f.s. and had a volume of 1,298,000 acre-feet from 29 September to 21 October. Time of year and antecedent soil moisture conditions are major factors that determine the amount of runoff from a given storm. Thus, some lesser rainfall storms have resulted in runoff as great as or greater than storms of higher rainfall. Major storms in the basin are listed in Table 4-3. Major floods recorded at the Arkansas City, Winfield, and Ralston gages are listed in Table 4-4 on pages T4-1 through T4-2.

4-07. Runoff characteristics. The Arkansas River Basin above Kaw Lake produces moderately high runoff. During design studies, it was found that 1.0 to 2.5 inches of rainfall generally was needed to satisfy initial losses before significant runoff begins. The total contributing drainage area is 6,652 square miles. The largest tributary is the Walnut River which has a drainage area of 1,955 square miles, and it enters the Arkansas River at river mile 696.0 at about the head of Kaw Lake. The time of concentration from the period of most intense rainfall for major floods is about 24 to 30 hours and the flood travel time to Kaw Dam is about 14 hours. The second largest tributary is the Ninnescah River which has a contributing drainage basin area of 1,951 square miles, and enters the Arkansas River at river mile 727.7. The time of concentration for major floods is about 30 to 36 hours and the flood travel time to Kaw Dam is about 36 hours. The third largest tributary is the Little Arkansas River. The stream is now diverted into the Wichita and Valley Center Floodway. The contributing area above the basin is about 1,250 square miles. The time of concentration for major floods is about 24 hours and the travel time to Kaw Dam is about 48 hours. Pertinent data for stream gaging stations in the system are shown in Table 4-5. Estimated monthly and annual flows at Kaw Dam are shown in Table 4-6 on pages T4-3 through T4-4. The inflow volume frequency (volume by months) is shown in Table 4-7. The flow duration curve is shown on plate 4-2.

TABLE 4-3

MAJOR STORMS
(JANUARY 1923 THROUGH JUNE 1990)
Kaw Basin

<u>Inclusive Dates</u>	<u>Average Basin Rainfall (inches)</u>	<u>Inclusive Dates</u>	<u>Average Basin Rainfall (inches)</u>
21-24 May 1923	3.10	2-5 Oct 1955	3.20
6-11 June 1923	5.79	15-18 May 1957	3.48
12-20 Sept 1923	3.43	26 Jun - 1 July 1957	3.66
10-16 Oct 1923	3.02	3-7 July 1958	4.46
1-4 Oct 1926	4.59	15-17 Sept 1958	3.17
7-19 April 1927	5.50	12-18 July 1958	4.46
12-21 June 1927	4.06	30 Sep - 5 Oct 1959	5.30
28 July - 4 Aug 1927	4.64	30 Apr - 6 May 1961	5.00
12-18 Aug 1927	4.17	20-23 July 1961	4.26
31 May - 6 June 1928	3.10	12-14 Sept 1961	3.10
16-20 June 1928	3.02	30 Oct - 3 Nov 1961	3.09
14-19 Nov 1928	5.09	27 May - 5 Jun 1964	3.94
29 May - 8 June 1929	4.18	15-19 Nov 1964	4.66
18-24 June 1929	3.48	4-13 June 1965	5.39
7-11 July 1939	3.23	17-22 Sept 1965	3.78
2-11 May 1930	4.16	5-12 Jun 1967	3.29
5-11 Sept 1930	3.26	21-28 June 1969	3.03
10-15 June 1931	3.29	13-17 Sept 1969	3.10
20-23 Sept 1931	3.25	15-21 April 1970	3.11
10-17 Nov 1931	3.76	22-24 Sept 1970	3.12
20-24 Aug 1933	4.12	26 Oct - 2 Nov 1971	3.10
8-22 May 1935	7.68	2-11 March 1973	4.97
27 May - 4 June 1935	3.37	23 Mar - 1 Apr 1973	3.41
6-10 Oct 1936	3.30	22-30 Sept 1973	7.07
14-19 July 1937	4.26	10-12 Oct 1973	4.15
18-23 May 1938	4.65	7-12 March 1974	2.44
15-17 Aug 1938	4.17	19-22 April 1974	2.39
19-26 Nov 1940	3.24	19-26 May 1974	3.09
6-11 June 1941	3.78	3-10 June 1974	3.41
15-25 June 1942	5.22	23 Oct - 5 Nov 1974	5.13
2-8 Sept 1942	4.20	15-30 April 1976	4.10
13-18 July 1943	3.46	1-4 July 1976	3.20
14-22 Mar 1944	3.52	14-23 May 1977	3.80
8-11 April 1944	3.08	18-26 June 1977	3.50
19-23 April 1944	4.20	27 Aug - 5 Sep 1977	2.00
20-26 Aug 1944	3.60	4-10 June 1979	2.10
2-5 Dec 1944	3.00	30-31 Oct 1979	2.43
10-16 April 1945	4.86	31 Oct - 2 Nov 1981	2.21
21-30 Sept 1945	8.89	12-17 May 1982	4.40
9-16 April 1947	5.04	19 May - 4 Jun 1982	4.63
20-28 Jun 1948	6.21	26 Mar - 5 Apr 1983	3.69
14-22 July 1948	5.48	16-24 March 1984	3.83
6-16 Aug 1948	3.17	20-25 Sept 1985	2.08
14-25 May 1951	4.32	8-18 Oct 1985	3.92
16-19 July 1950	4.30	29 Sep - 4 Oct 1986	6.70
28 July - 2 Aug 1950	4.26	17-25 March 1987	2.58
15-24 May 1951	5.77	23 May - 6 Jun 1987	4.34
20-25 June 1951	3.39	1-3 April 1988	2.16
28 Jun - 3 July 1951	3.58	15-23 May 1989	3.95
9-14 July 1951	3.15	1-14 June 1989	5.14
3-13 Sept 1951	5.06	28 Aug - 10 Sep 1989	5.93

TABLE 4-5

PERTINENT DATA FOR STREAM GAGING STATIONS

Station	Stream	Miles	Gage	Flood	Bank Full	Maximum Flood of Record		
		Above	Zero Elev	Stage	Capacity	Date	Stage	Discharge
		Mouth	(ft. NGVD)	(ft.)	(c.f.s) (1)		(ft.)	(c.f.s.)
Ralston, OK	Arkansas River	594.0	776.70	16.0	83,600	10-13-73	22.98	211,000
Winfield, KS	Walnut River	24.8	1,082.86	30.0	30,500	04-23-44	38.38	105,000
Arkansas City, KS	Arkansas River	701.4	1,050.04	17.0	18,500	05-11-93	27.62(3)	75,600
Hutchinson, KS	Arkansas River	800.3	1,454.10	10.0	7,000	09-28-73	12.95	24,700
Derby, KS	Arkansas River	749.5	1,229.95	12.0	25,500	04-00-23	18.00(2)	--
Murdock, KS	SF Ninnescah Riv	68.0	1,357.81	8.0	4,100	10-13-79	12.84	28,700
Peck, KS	Ninnescah River	31.6	1,222.38	12.0	5,800	06-29-23	26.40	70,000
Augusta, KS	Walnut River	77.8	1,193.86	23.0	11,700	06-08-79	37.23(2)	--

Station	Stream	2nd Largest Flood of Record		3rd Largest Flood of Record		Period of Record		
		Date	Stage (ft.)	Discharge (c.f.s.)	Date	Stage (ft.)	Discharge (c.f.s.)	(Flow and/or Stage)
Ralston, OK	Arkansas River	06-11-23	23.80	200,000	04-25-44	22.80	179,000	Oct 1925-Sept 90
Winfield, KS	Walnut River	11-18-28	41.00	94,400	07-01-51	37.80	83,000	Oct 1921-Sept 90
Ark. City, KS	Arkansas River	10-12-85	26.10	85,200	06-10-23	25.46	103,000	Sep 1921-Sept 90
Hutchinson, KS	Arkansas River	05-00-45	12.10(2)	--	04-02-73	12.02	21,200	Sep 1959-Sept 93
Derby, KS	Arkansas River	07-16-93	16.26	61,800	05-09-93	16.10	56,200	Oct 1969-Sept 93
Murdock, KS	SF Ninnescah Riv	10-11-73	11.93	22,400	06-26-57	11.87	25,900	Aug 1950-Sept 93
Peck, KS	Ninnescah River	05-17-57	21.85	38,200	10-11-85	21.33	34,800	Oct 1937-Sept 93
Augusta, KS	Walnut River	06-05-65	36.30(2)	--	04-23-44	32.40(2)	--	Aug 1933-Sept 93

(1) Figures shown are approximate and subject to change.

(2) Flood mark.

(3) Preliminary value.

TABLE 4-7

INFLOW VOLUME FREQUENCY

(1940 - 1986)

Flow Modified by Cheney and El Dorado Lakes

Exceedance of Frequency (Percent)	Monthly Inflow in Thousands of Acre-Feet											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50	71	73	107	131	183	173	113	69	62	81	82	77
20	126	148	279	323	452	503	321	168	219	199	193	141
10	184	236	523	661	794	925	617	302	386	389	297	199
4	322	471	1,081	1,552	1,335	1,552	1,330	617	759	1,036	510	324
2	497	781	1,531	2,297	1,883	1,994	2,191	867	1,139	1,871	878	487

4-08. Water Quality. Kaw Lake contains 171,200 acre-feet of storage for water supply and 31,800 acre-feet of storage for water quality control. Water in Kaw Lake is of marginal quality for municipal and industrial uses. The water is highly mineralized and has a high degree of hardness. Treatment is required for its use.

4-09. Channel and floodway characteristics. The regulating channel capacity on the Arkansas River below Kaw Dam is estimated to be 40,000 c.f.s. below the dam and 79,000 cfs at the Ralston, Oklahoma gage. Rating curves for Wichita, Derby, Arkansas City, Ralston, and Hutchison on the Arkansas River are shown on Plates 4-3, 4-4, 4-5, 4-6, and 4-7. Rating curves for the Peck gage on the Ninnescah River watershed and the Winfield gage on the Walnut River watershed are shown on Plates 4-8 and 4-9. Rating curves used by the Reservoir Control Section are adjusted to changing conditions and are maintained in current status. Crest time of travel from the dam to the headwaters of Keystone Lake is about 48 hours. Crest time of travel from Keystone Dam to Van Buren, Arkansas is about 45 hours. A simplified diagram showing crest travel time is presented on Plate 4-10. Travel time varies with the magnitude of the flood, therefore this diagram should be used as a guide only.

In the vicinity of the dam, the Arkansas River has cut a relatively wide meandering valley and flows over bedrock and gravel. In the lower reach, the Arkansas River loses much of its velocity, becomes wider, and slightly turbid.

4-10. Upstream structures. Operational structures upstream of Kaw Dam are John Martin Reservoir in Colorado on the Arkansas River; El Dorado Lake in Kansas on the Walnut River; and Cheney Reservoir in Kansas on the North Fork of the Ninnescah River.

4-11. Downstream structures. Structures downstream of Kaw Lake on the Arkansas River include the following: Keystone Lake, Webbers Falls Lock and Dam, Robert S. Kerr Lock and Dam, and W. D. Mayo Lock and Dam. The city of Tulsa has constructed a low water recreation dam near river mile 522.

4-12. Economic data.

a. Population. The populations of Kansas and Oklahoma counties and cities in which Kaw Lake is located and their county seats are shown in Table 4-8. Although varying portions of the counties listed lie within the watershed boundary, the entire population of each county listed is included.

TABLE 4-8

POPULATION OF COUNTIES AND CITIES IN THE BASIN
(1970 - 1986)

County/City	Population (1)		Percent Change	
	1970	1980	1986	1970 - 1986
Cowley County	35,012	36,824	37,000	5.6
Winfield	11,405	11,860	11,650	2.1
Osage County	29,750	39,327	41,300	38.8
Pawhuska	4,238	4,771	4,760	12.3
Kay County	48,791	49,852	52,800	8.2
Newkirk	2,173	2,413	2,600	19.6
TOTAL COUNTIES	131,369	145,047	150,110	14.3

(1) U.S. Department of Commerce, Bureau of the Census.

TABLE 4-9

ANNUAL VALUE OF CROPS
(1989 Normalized Prices)

Kaw Dam to Salt Fork of Arkansas River			Salt Fork of Arkansas River to Upper Limit of Keystone Lake		Total	
Crops	Acres	Value	Acres	Value	Acres	Value
Corn	-	-	4050	620,900	4050	620,900
Alfalfa	1090	588,700	6080	3,284,000	7170	3,872,000
Wheat	2180	268,900	6080	749,600	8260	1,018,500
Barley	1090	106,000	4050	450,600	5140	556,600
Oats	930	94,700	-	-	930	94,700
Improved Pasture	460	62,600	2020	281,700	2480	344,300
Open Pasture	920	31,400	4050	207,500	4970	238,900
Wooded Pasture	1390	14,400	6070	82,900	7460	97,300
Total	8060	1,166,700	32,400	5,677,200	40,460	6,843,200

b. Agriculture. The principle agricultural crops grown in the Kaw flood plain region of the Arkansas River Basin are wheat, alfalfa, corn, oats, and barley. Livestock is also raised in this area. A large part of the crops produced are used locally as feed for cattle. Table 4-9 shows the acres of production and annual value of crops.

c. Industry. Farming is the leading industry in the Kaw flood plain region, with crop and cattle production and their related activities being the basic enterprises. In addition to the normal wholesale and retail commerce, the area has industries which include civilian and military aircraft manufacturing, petroleum and natural gas extraction, oil refining, construction-related firms, sand and gravel operations, salt mining, agricultural equipment manufacturing, and mobile home manufacturing.

d. Flood damages. Estimated average annual damages, estimated annual damages prevented by Kaw Lake, and estimated annual residual damages are shown in Table 4-10. Area and structural loss curves are shown on Plates 4-11 through 4-12.

TABLE 4-10

AVERAGE ANNUAL DAMAGES, DAMAGES PREVENTED
AND RESIDUAL DAMAGES ON ARKANSAS RIVER
BELOW KAW DAM

(Based on October 1989 Structural Prices
and 1989 Normalized Prices for Crops)

Reach and Item	Estimated Avg. Annual Damages*	Estimated Avg. Annual Damages Prevented	Estimated Avg. Annual Residual Damages
	\$	\$	\$
Arkansas River			
Kaw Dam to Upper Limits to Keystone Lake			
Structures	1,292,000	1,045,000	247,000
Crops	820,000	792,000	28,000
TOTAL	2,112,000	1,837,000	275,000

* Without Kaw, El Dorado, and Cheney

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological stations.

a. Facilities. The Arkansas River Control Section, Hydrology-Hydraulics Branch, Tulsa District Office; the National Weather Service (NWS); and the US Geological Survey (USGS) cooperate to collect data and maintain a reliable communication network. All pertinent reporting observation stations are shown on plate 5-1. Pool elevation data is provided by a Stevens AP graphic recorder located in a gage shelter 1,700 feet to the left (east) of the center line of the spillway. The gage is connected to the lake by two 1/8- inch orifices at elevation 1000.0 and 960.0. The graphic recorder drives a counter indicator which is connected to a digital recorder. A shaft encoder, wired to a data collection platform, is also driven by the graphic recorder. Twenty staff gages are located on the upstream slope of the dam as a backup for the graphic recorder. There is also a wire weight gage on the upstream handrail of the spillway. Tailwater records are provided by a graphic recorder located on the right bank 3,000 feet downstream of the dam. Key stream gaging stations used in forecasting inflows to Kaw Lake are Hutchison, Derby, and Arkansas City on the Arkansas River; Murdock and Peck on the Ninnescah River; and Augusta and Winfield on the Walnut River. Key stations for flood control regulation are the Kaw Lake tailwater and Ralston gages on the Arkansas River. Pertinent data for these stations are shown in Table 5-1. Automated stream gaging stations are equipped with automated rain gages that provide precipitation data which is transmitted along with stage data. The NWS also maintains a network of local observer stations throughout the district (see plate 5-1). A weather station located at the project office has equipment for monitoring precipitation, evaporation, wind speed and direction, and temperature.

b. Reporting. The reporting procedure for precipitation and stream gaging stations 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 Kaw Lake will be submitted to the Arkansas River Control Section, Hydrology-Hydraulics Branch, Tulsa District Office (telephone 918-669-7096 or VHF-FM radio, call signal WUI-3). Detailed instructions on reporting criteria are presented in paragraph 1b of Exhibit C, Standing Instructions to Project Manager.

TABLE 5-1

REPORTING CRITERIA FOR PERTINENT STATIONS

<u>Station</u>	<u>Report to</u>	<u>Times of report</u>
<u>Rainfall Stations</u>		
Airport stations	National Weather Service	6-hour rainfall as of 6 a.m., 12 noon, 6 p.m., and 12 midnight.
Corps of Engineers dams	Corps of Engineers	Reporting criteria identical to that listed in subparagraph 5-07e (1-5)
All other stations	National Weather Service	See Plate 5-2
<u>Stream Gaging Stations</u>		
Arkansas River		
Ralston	Data Collection Platform	Every 4 hours or
Arkansas City	Data Collection Platform	every 15 minutes
Derby	Data Collection Platform	if threshold
Hutchison	Data Collection Platform	exceeded
Kaw Lake	Data Collection Platform	
Ninnescah River		
Murdock	Data Collection Platform	"
Peck	Data Collection Platform	"
Walnut River	Data Collection Platform	"
Augusta	Data Collection Platform	"
Winfield	Data Collection Platform	"
<u>Radar Stations</u>	National Weather Service	Hourly

c. Maintenance. The NWS is responsible for the maintenance and repair of weather station instrumentation. The administering agency is responsible for the maintenance and repair of stream gages. Both the Corps of Engineers and the USGS have stream gaging equipment in the Arkansas River Basin. The Hydraulic Engineering Section, Hydrology-Hydraulics Branch, Tulsa District, is charged with the responsibility for the equipment owned by the Corps of Engineers.

d. Automation. The reporting of data from pool elevation and stream gaging stations has been automated through the use of data collection platforms (DCP). DCP's transmit data via GOES satellite and downlink to a NOAA-NESS nationwide central computer. The data is then rebroadcasted to the DOMSAT satellite and received at the District Office using a receiver dish. The Arkansas River Control Section, Tulsa District, maintains a water control computer which retrieves the data for stations within the Tulsa District. This data is then available to all computer terminals in the Arkansas River Control Section. The water control computer is also connected to the NWS AFOS network, which allows access to NWS rainfall data, weather warnings, forecasts, etc.

5-02. Water quality stations.

a. Hydropower Discharges. The Oklahoma Municipal Power Authority (OMPA) is constrained by their licensing agreement to ensure that hydropower releases meet appropriate water quality standards. Monitoring devices have been installed in the penstock, draft tube, stilling basin, and downstream areas to measure dissolved oxygen. Supplemental releases will be made through the sluice gates, if necessary, to ensure that OMPA releases are within the limits imposed by water quality standards.

b. Facilities. Additional reporting water quality stations below Kaw Lake are shown in Table 5-2.

c. Reporting. The reporting procedures for water quality stations are made in cooperation with the USGS. Water quality samples are taken by the USGS at periodic intervals to determine the chemical and biological quality of the stream water. The Corps of Engineers is sent copies of the published data entitled "Water Resources Data for Oklahoma, Volume 1, Arkansas River Basin." Water quality samples taken by Corps of Engineers personnel will be reported directly to the Tulsa District Office.

d. Maintenance. Maintenance and repair of the water quality stations are the responsibilities of the operating agency shown in Table 5-2.

TABLE 5-2

PERTINENT REPORTING WATER QUALITY STATIONS

Name & Location	Station	Type	Recording or Nonrecording	Period of Record	Frequency of Sample Analysis	Operating Agency
Arkansas River at Ralston, Oklahoma	11060006	1. Chemical analysis	Nonrecording	1-1950 to 9-1963, 7-1968 to present	Bimonthly	USGS
Arkansas River at Ralston, Oklahoma	11060006	2. Water temperature	Nonrecording	1-1950 to 9-1963, 7-1968 to present	Bimonthly	USGS
Arkansas River at Ralston, Oklahoma	11060006	3. Sediment analysis	Nonrecording	1939 to 1975, 1977 to present	As needed	C of E

5-03. Sediment stations.

a. Facilities. The 64 sedimentation ranges above Kaw Dam and 26 degradation ranges below Kaw Dam are used for sedimentation measurements (paragraph 2-03d). These ranges are surveyed periodically for the purpose of computing sediment deposition and new lake area/capacity data. Samples are also taken at the Ralston, OK gage to determine the suspended sediment load there.

b. Reporting. As necessary.

c. Maintenance. Maintenance on the sediment ranges will be done by the Corps of Engineers.

5-04. Recording hydrologic data. Hydrologic information is recorded as it is received by the Arkansas River Control Section as follows:

a. Elevation, flows, and storage. The raw data is stored by station and by time as it is received by the water control computer. Several computer programs convert the raw data into stage/pool elevation data and the corresponding flow/storage values as determined from rating curves. This processed data is then stored in two data bases. As the data bases fill they are occasionally archived on tape for permanent storage. Stream flow measurements made by the USGS are called in and entered into a computer program for storage.

b. Precipitation. Precipitation data from the DCP stations and the project are combined with NWS observer precipitation data and stored in the data base with the stage/discharge data. This data can then be accessed by computer programs for plotting distribution, determining basin rainfall, and forecasting runoff (see Chapter VI).

c. Water quality data. Water quality data are recorded by the USGS and received at the Tulsa District Office in the form of an annual report entitled "Water Resource Data, Part 2, Water Quality Records." Water quality data collected by OMPA is stored at the regulating office in Edmond, OK. The data is collected for purposes of licensing and maintaining acceptable releases.

d. Weather, radar and satellite reports. Current computer-enhanced satellite images, weather charts and national radar summaries are automatically received into the water control computer from a private vendor. A computer-enhanced image of the real-time radar scope image depicting cloud coverage and relative intensity is available from the National Weather Service and is routinely received from Oklahoma City. NWS locations in and near the Tulsa District with this capabil-

ity, in addition to Oklahoma City, are Kansas City and Monett, Missouri; Garden City and Wichita, Kansas; and Amarillo, Texas. Hard copies of any of this data are available by use of several plotters located in the Arkansas River Control Section.

5-05. Communication network. Wire facilities at Kaw Lake are local and long distance telephone service. Radio communication is by a VHF-FM fixed station (call signal WUI-353) capable of reaching local mobile stations, the Tulsa District Office, and other stations on the local loop of the District and other stations on the north and south loop of the District via repeater relay. Maintenance of the telephone lines is the responsibility of the company leasing the lines to the Government. To alert the public of impending gate changes, a warning horn is located on top of the powerhouse and a warning light is located on top of the elevator tower. Control buttons for these devices are located on the gate control panels for the gates.

5-06. Communication with project.

a. Regulating office with project office. Instructions for the storage and release of water from the lake will be communicated by the Arkansas River Control Section to the responsible project operating personnel at Kaw Lake. This communication will normally be made by long distance telephone but could on occasion be made by VHF-FM radio. The reports by the project office, described in paragraph 5-07 and exhibit C of this manual, will be communicated directly to the Arkansas River Control Section. Should communication between the project and the District Office be disrupted, the Project Manager will, on his own initiative, direct regulation of the lake in accordance with the emergency regulations as required in Chapter VII and Exhibit C of this manual. The Organizational Chart for flood control regulation of Kaw Lake is shown on plate 5-2.

b. Regulating office and OMPA. Communication with OMPA is necessary each working day for coordination of hydropower releases. Records of previous day(s) releases are furnished to the Arkansas River Control Section by OMPA. Hourly power releases (midnight to midnight), 8 a.m. instantaneous power discharge, 8 a.m. total discharge, and 24-hour average (midnight to midnight) power release will be reported daily. The releases for the following day(s) are agreed upon between the two agencies. Occasionally, the release request will require modification, and appropriate coordination is performed as necessary.

c. Between project office and others. Communication between project personnel and other Federal, State, and local agencies will be sufficient to effect the coordination de-

scribed in Chapter IX of this manual.

5-07. Project reporting instructions. Daily lake data from Kaw Lake will be submitted to the Arkansas River Control Section, Hydrology-Hydraulics Branch, Tulsa District Office (telephone 918-669-7096 or VHF-FM radio, call signal WUI-3). The Arkansas River Control Section office is manned from 7:00 a.m. to 4:30 p.m. daily and various hours on weekends and holidays. Data for nonworking days shall be read from the recorder chart and submitted on the following workday. Data shall be submitted according to the form shown on plate 5-3, "Daily Lake Data Report." Should unusual conditions arise during nonworking hours, one of the persons listed on page i should be contacted. The following data should be included in the daily report.

a. As of 8 a.m. - Pool elevations at 12 noon, 4 p.m., and 12 midnight of the previous day and the current (8 a.m.) pool elevation (read from the recorder chart); number, type, and height of gate openings; tailwater stage at 8 a.m.; precipitation and pan evaporation in inches for the preceding 24 hours (7 a.m. to 7 a.m.); and wind velocity and direction (at 8 a.m.).

b. Each gate operation. Date and time of operation, number and heights of gates open before and after 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 Arkansas River Control Section as they occur.

c. During flood periods. In addition to subparagraphs a and b above, additional reports may be required by Arkansas River Control Section.

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

(1) At 8 a.m. all precipitation that occurred during the preceding 24 hours (7 a.m. to 7 a.m.) (covered by routine report on working days).

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

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

(4) Report at once the occurrence of 2.00 inches or more of precipitation that occurs during a period of 6 hours or less. During nonworking hours, the report should be made to one of the persons listed on page i.

(5) After office hours, rainfall reports should be made as indicated in (4) above; however, if no contact with Arkansas River Control Section personnel can be made, rainfall reports should be made to the National Weather Service, Oklahoma City, Oklahoma, telephone 1-405-366-6584.

5-08. Warnings. It is the responsibility of the Project Manager and project personnel authorized to make gate changes to maintain a list in current status of residents and/or property owners who would be endangered or inconvenienced by large and/or prolonged releases. If damaging releases are expected to occur, notification will be made by telephone or oral warning by Corps employees. Notification will be made in accordance with the Tulsa District supplements to ER 500-1-1. This would include radio, television, telephone, citizen band radio, use of law enforcement and civil defense agencies and their communication systems, National Guard and reserve units, supplemented by oral warning from Corps employees in Government vehicles. Studies have been made to determine the possible downstream flood conditions which could exist in the event of a maximum spillway release or failure of the dam at maximum pool. Approximate water surface profiles and flooded area maps giving the results of these studies are kept in the Kaw Lake Operation and Maintenance Manual, Volume II, Flood Emergency Plan. In every case when a gate change is made a horn is blown to give warning to people immediately downstream who are within hearing distance of the horn blast.

5-09. Frequency of gate changes. During flood periods, gate changes may be directed by the Arkansas River Control Section at any time. When the floodwaters have significantly risen into the flood control pool, gate changes can be expected two or three times daily. When the pool level is at or above the top of the flood control pool, gate changes may occur every hour. Only under the most unusual circumstances will changes be ordered more frequently than once every hour. Frequency of gate changes during low flow operation will generally be less than once a day.

VI - HYDROLOGIC FORECASTS

6-01. General. Hydrologic forecasts are necessary in predicting streamflow above and below Kaw Lake to determine if and when releases should be made.

a. Role of Corps of Engineers. Hydrologic forecasts are made by the Forecasting Subsection, Tulsa District, for use in regulation of lakes for flood control. The District furnishes information to the public of current and forecasted lake levels and lake releases. The District does not provide weather forecasts or flood forecasts to the public except to relay information already made available by the National Weather Service. On weekdays, Arkansas River Control Section prepares a telephone recording (918-669-7521) to provide the public a means of receiving current lake information such as pool levels and discharges. General news releases are made by the Public Affairs Office which is kept fully informed of the hydrologic situation as appropriate.

b. Role of other agencies. The National Weather Service (NWS), Norman, Oklahoma, is the agency responsible for making flood forecast information available to the public. This information is disseminated to the Corps of Engineers and other subscribing Government agencies and the various news media through the NWS Automated Field Operation System (AFOS). The NWS issues routine scheduled reports containing the following forecasts:

(1) Weather forecasts (daily, severe weather, 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: two 6-hour, one 24-hour, and one 48-hour quantitative precipitation forecasts).

(4) Three-day river stage forecasts (when available).

(5) Rainfall required to produce bankfull stages (weekly).

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

6-02. Flood condition forecasts.

a. Requirements. Flood condition forecasts are necessary whenever substantial rainfall has fallen on the basin above or below Kaw Dam. The requirements for timely and accurate inflow forecasts will vary depending on the severity of the storm and the condition of the reservoir.

b. Methods. The Forecasting Subsection makes individual lake inflow and pool elevation forecasts and forecasts of flow for the uncontrolled areas below the dams. These forecasts are made using computer program HEC-1F.

(1) Forecasting river stages. The official forecasts of river stages for dissemination to the public are made by the NWS. Forecasts are confirmed by the Arkansas River Control Section for its own use by applying the peak flows determined by the procedures described below to stage-discharge curves.

(2) Forecasting flows. Separate computer models exist for the drainage area above Kaw Dam and for the Arkansas River between Kaw Dam and Keystone Dam. These models are used separately or together to predict inflow into Kaw Lake and flows at downstream control points.

(a) Runoff estimate. Precipitation data is received from the NWS and automated precipitation gages and processed by the water control computer. It calculates estimates of the average precipitation over each forecast model subarea. Temporal distribution of the rainfall is determined from the distributions observed at the DCP's. Rainfall amounts and distributions from the Oklahoma City, Oklahoma, and Wichita, Kansas radar images are used to improve the basin average rainfall. After reviewing the rainfall data from all available sources, the data is used in the HEC-1F forecast models. The initial runoff estimates are refined as needed to match observed stream flows and reservoir inflows.

(b) Computer model. The HEC-1F model for Kaw Lake consists of 23 subareas as shown on plate 6-1. Runoff from the 23 subareas is combined and routed into and through the lake by storage routing. A sample of the input is shown on plate 6-2.

(c) Inflow computations. Computation of the inflow and pool elevations is accomplished by the HEC-1F computer model. Input requirements are runoff, or rainfall and loss rates, initial base flow if any, releases from Cheney and El Dorado Lakes, starting pool elevation, and controlled releases. The model is run interactively on the Water Control Data System computer located in the Hydrology and Hydraulics Branch of the Tulsa District office. A sample of the summary output is shown on plate 6-3. After the actual pool elevation is reported by the project, the observed inflow is computed. The predicted inflow hydrograph is verified and adjusted as necessary by comparing it to the developing observed inflow hydrograph. The developing inflow hydrograph is computed from known pool elevations and releases.

6-03. Conservation purpose forecasts.

a. Requirements. Conservation forecasts may be required to predict pool levels during fish spawning season, special recreation events, and water supply. Forecasts may also be required for water quality.

b. Methods. Forecasts for conservation purposes during non-flood periods would rely largely on statistical interpretation of historical data. Historical flows at the damsite for the period October 1921 through September 1993, shown in table 4-6; the flow duration curve, plate 4-2; and the peak inflow probability curve, plate 8-4; would be considered in conjunction with NWS forecasts in making conservation forecasts during non-flood periods.

6-04. Long range forecasts.

a. Requirements. A foreknowledge of the water volume to be handled would facilitate 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.

b. Methods. Reliable methods for long range runoff forecasts are not presently available. The NWS publishes an "Average Monthly Weather Outlook" semimonthly 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. Construction of Kaw Lake was authorized by the Flood Control Act approved 23 October 1962 (Project Document SD 143, 87th Congress, 2d session) for the primary purpose of flood control, water supply, water quality, recreation, and fish and wildlife. Kaw Lake will be operated as part of the Arkansas River Basin multiple-purpose system. The flood control storage will be utilized to provide optimum benefits, categorized as method A in paragraph 3-3c(2)(b) of EM 1110-02-3600 dated November 1987.

7-02. Major constraints. The channel capacity downstream of Kaw Dam is currently estimated to be about 40,000 c.f.s. based on operating experience in the 1986 and 1993 floods. The limiting discharge at the Ralston gage on the Arkansas River is about 83,500 c.f.s. (stage 16 feet). The spillway and outlet works are capable of discharging 497,600 c.f.s at the top of the flood control pool (elevation 1044.5). The invert of the outlet works is at elevation 940.0 which is the lowest elevation from which water can be released from the dam.

7-03. Overall plan for water control.

a. General. Kaw Lake is regulated as a unit in a multipurpose system for the benefit of water resources in the Arkansas River Basin. Development of these water resources is discussed in the Arkansas River Basin Water Control Master Manual, while the specific purposes of each of the various projects are detailed in the appropriate appendix.

b. System regulation. Kaw Lake will be regulated in a system with Keystone Lake for control of floods on the Arkansas River from Kaw Dam to Muskogee, Oklahoma and in the total Arkansas River system for control of floods on the Arkansas River from Muskogee, Oklahoma, to Van Buren, Arkansas. When floodwaters are being accumulated in the system, each lake shall be regulated to retain equivalent levels of flood control storage, as shown on curve "B" plate 7-54, of the Arkansas River Basin Water Control Master Manual. When there is competition between reservoirs for downstream channel capacity, the reservoir at the highest level will be given first priority, second priority will be given to the next highest, and so on until the available channel capacity or the downstream target flow has been used. Section VII of the Arkansas River Basin Water Control Master Manual provides detailed information on the Arkansas River system regulation. In addition, Kaw Lake will be regulated for fish and wildlife, recreation, water quality, water supply, navigation, and hydroelectric power.

c. Kaw-Keystone subsystem flood control regulations. The Arkansas River system regulation plan discussed in the previous paragraph will be used to determine a release schedule for Keystone Lake, taking into account the total flood control storage (storage volume plus inflow) in Keystone and Kaw Lakes. When Keystone Lake is forecast to have a greater percent of flood storage utilized than Kaw Lake and the release schedule for Keystone is set as described above, a release schedule for Kaw will be determined that will strive to equalize the flood control storage in the project within a reasonable time. If Kaw Lake has or is forecast to have a greater percent of flood control storage utilized, the release from Kaw will be at channel capacity or at a rate which will strive to balance the subsystem within a reasonable time. The release for Keystone Lake as determined by the Arkansas River system regulation will not be reduced solely to achieve a balance between the two lakes. When a reasonable subsystem balance is achieved, releases from Kaw Lake will be at a rate which will continue the balance and empty both reservoirs at approximately the same time.

7-04. Standing instructions to Project Manager. During flood periods, the lake will be regulated in accordance with the normal regulations for flood control operation as directed in subparagraph 7-05a and exhibit C of this manual. Instructions for the storage and discharge of floodwater will be issued by the Arkansas River Control Section. In the event communication with the Tulsa District Office is disrupted, the lake regulation will become the responsibility of the Project Manager and will be carried out in accordance with subparagraph 7-05b and exhibit C of this manual. In addition, the Project Manager will immediately make every effort to reestablish communications with the Tulsa District Office. The Project Manager will make daily observations of the weather station and pool level data and report those observations as directed by the Arkansas River Control Section. Should an emergency situation occur in which communication is not lost, such as inoperable gates, drowning accident, excessive trash in gates, broken buoy line, or power outage, the Arkansas River Control Section will be notified immediately.

7-05. Flood control.

a. Normal regulation for flood control operations. Kaw Lake will be regulated for optimum flood reductions on the Arkansas River from the dam to Van Buren, Arkansas. The following regulations, as shown in Table 7-1, will govern releases from Kaw Lake. During flood control regulation the tainter gates are to be operated at uniform settings with no more than a 1 foot difference in opening between any gates.

TABLE 7-1

NORMAL FLOOD CONTROL REGULATION SCHEDULE

<u>LAKE STAGE</u>	<u>: POOL CONDITIONS:</u>	<u>REGULATION</u>
Below 1010.0	: ---	: Releases are made to
	:	: maintain elevation 1010.0
	:	: but will not be less
	:	: than the downstream low-
	:	: flow requirements defined
	:	: in paragraph 7-07.
1010.0 - 1044.5	: Rising	: Make releases prescribed by
and forecasted	:	: the Arkansas River system
not to exceed	:	: regulating plan, except that
1044.5	:	: the release, when combined
	:	: with intervening flow downstream,
	:	: shall not exceed a stage of 16.5
	:	: feet (currently estimated to
	:	: pass 40,000 c.f.s.) at the
	:	: Ponca City gage.
1044.5 - 1047.5	: Rising	: -Releases will be made to reduce
or forecasted	:	: the downstream damage as much as
to exceed	:	: practical and to limit the pool
1044.5	:	: elevation to 1047.5 (top of
	:	: induced surcharge pool).
	:	: -Plate 7-1, "Spillway Gate
	:	: Regulation Schedule Inflow
	:	: Parameter", will be used as
	:	: a guide for determining releases.
	:	: -If the pool rises to elevation
	:	: 1047.5, release will be made
	:	: equal the inflow.
	:	: -Releases will be made by
	:	: operating all the spillway gates
	:	: uniform openings.
	:	: -Hydropower releases may be
	:	: curtailed to limit the downstream
	:	: discharge during induced surcharge
	:	: operations.

TABLE 7-1 (CONT)

LAKE STAGE	: POOL CONDITIONS:	REGULATION
1047.5 or above	: Rising	: Gates shall be progressively
	:	: opened to maintain elevation
	:	: 1047.5 or until the gates are
	:	: in the fully opened position.
1044.5 or above	: Falling	: The maximum gate opening
	:	: attained shall be held until
	:	: the pool elevation recedes
	:	: to elevation 1044.5.
1044.5 - 1010.0	: Falling	: Make releases prescribed by
	:	: the system regulation plan
	:	: except that the release,
	:	: when combined with intervening
	:	: area flows downstream, shall
	:	: not exceed the regulating
	:	: stage at Ponca City or Ralston.

b. Emergency flood control regulations. When communication with the Tulsa District Office is disrupted, the Project Manager will, on his own initiative, direct regulation of the lake in accordance with the schedule shown in Table 7-2 until communication is restored. In addition, the Project Manager will make every effort to reestablish communication with the Tulsa District Office. The spillway gates shall be operated at uniform openings as discussed in paragraph 7-05a.

TABLE 7-2
EMERGENCY FLOOD CONTROL REGULATION SCHEDULE
KAW LAKE

LAKE STAGE	: POOL CONDITIONS:	REGULATION
Below 1010.0	: Rising	: Continue the releases : being made.
1010.0 - 1044.5	: Rising	: -Maintain releases being : made until communication : is restored or 12 hours : have elapsed. : -If communication is not : restored or the pool rises : to elevation 1038.0 during : the 12-hour waiting period, : begin releases in accordance : with plate 7-1, Spillway Gate : Regulation Schedule, Inflow : Parameter. : -Releases shall be adjusted : every 2 hours using the previous : 6-hour time interval to compute : the inflow. Plate 7-2 is a : nomograph for computing inflow. : -If the pool is above elevation : 1038.0, the releases should not : be less than indicated by the : the minimum discharge curve on : plate 7-1. : -At no time shall releases be : reduced if the pool is rising. 1044.5 - 1047.5 : Rising : -Releases shall be made : in accordance with the : inflow curves on Plate 7-1, : "Spillway Gate : Regulation Schedule - : Inflow Parameter". : -The previous 6-hour time : interval shall be used to : compute the inflow as : shown on Plate 7-2 (use : present pool elevation : and pool elevation : 6-hours earlier). : Plate 7-2 is a nomograph : for computing inflow.

TABLE 7-2 (CONT)

LAKE STAGE	POOL CONDITIONS:	REGULATION
		-Inflow shall be computed and releases adjusted every 2 hours. At no time when the lake level is above 1044.5 and rising shall releases be decreased
1047.5 or above	Rising	-Releases shall be increased by raising the spillway gates to maintain elevation 1047.5 or until all gates are fully open.
1044.5 or above	Falling	-Maximum sluice and spillway gate openings attained shall be held until the pool level recedes to elevation 1044.5.
1044.5 - 1038.0	Falling	Releases shall be equal to the previous 6-hour inflow or 40,000 c.f.s., whichever is greater (see plate 7-2 for 6-hour inflow calculation).
1038.0 - 1031.0	Falling	Releases shall be equal to the previous 6-hour inflow or 30,000 c.f.s., whichever is greater (see plate 7-2 for 6-hour inflow calculation).
1031.0 - 1015.0	Falling	Releases shall be equal to the previous 6-hour inflow or 20,000 c.f.s., whichever is greater (see plate 7-2 for 6-hour inflow calculation).
1015.0 - 1012.0	Falling	Releases shall be gradually reduced by amounts not to exceed 5,000 c.f.s. in any 4 hours, until the releases are 5,500 c.f.s. (rated turbine flow).
1012.0 - 1010.0	Falling	Releases shall be 5,500 c.f.s. At elevation 1010.0, releases shall be made equal to inflow.

c. Constraints. The regulation schedules provide that the channel capacity of 40,000 c.f.s in the reach from the dam to the confluence with the Salt Fork is not to be exceeded insofar as practicable; however, experience gained during the May 1993 flood indicate that up to 60,000 c.f.s. can be released without flooding structures. The catwalk providing access to the tainter gates is at elevation 1046.5. During induced surcharge operations, extreme care must be taken by personnel making gate changes.

The minimum discharges for one foot of surcharge (elevation 1045.5) and three feet of surcharge (elevation 1047.5) are 2,500 c.f.s. and 7,500 c.f.s., respectively. If the pool rises above elevation 1046.5, the catwalk will be inundated and a bulkhead must be installed to prevent entry of water into the control room.

In order to minimize turbulence and backflow at the downstream buoy line, sluice gates are not opened wider than 4 feet. This is a longstanding agreement made with local fishermen and has proven to be satisfactory. Additional discharge capability is available through spillway tainter gates.

7-06. Recreation. Recreation is included as a project purpose; however, there is no storage or releases specifically designated for recreation. Recreation areas begin to be inundated at elevation 1017.0.

7-07. Water quality.

a. General water quality constraints. The water quality storage (31,800 acre-feet) in Kaw Lake will provide a dependable yield of 61 c.f.s. which was the average annual downstream water quality control requirements recommended by the Public Health Service. The scheduled monthly water quality control requirement varies from near 0 to a maximum of about 160 c.f.s. Requirements in summer months generally are about three times the average amount. The schedule of the monthly water quality releases is shown in Table 7-3. Water quality releases shall not be made when the pool level is below elevation 978.0. Additional releases shall be made as necessary to alleviate or respond to emergency conditions such as fish kills and flow augmentation for pollution abatement or aesthetics.

b. OMPA Water Quality Constraints. The Oklahoma Municipal Power Authority (OMPA) is constrained by their licensing requirements to ensure that hydropower releases meet appropriate water quality standards. The area downstream of Kaw Lake is designated a Primary Warm Water Fishery. Applicable water quality standards vary with season. From April 1 through June 15, the minimum criterion for dissolved oxygen is 6 mg/l, with a one mg/l deficit allowed up to 8 hours within any 24 hour

period. From June 16 through October 15, the minimum criterion is 5 mg/l, with a one mg/l deficit allowed up to 8 hours within any 24 hour period. From October 16 through March 31, the dissolved oxygen shall be an absolute minimum of 5 mg/l.

Monitoring devices have been installed in the penstock, draft tube, stilling basin, and downstream areas to measure dissolved oxygen. Supplemental releases will be made through sluice gates, if necessary, for OMPA to meet water quality standards and the daily minimum release.

The OMPA has completed remote control access to sluice gate controls. This will more easily accommodate their need to balance sluice and hydropower releases for water quality requirements. Within the agreed limits, the OMPA will be able to adjust the sluice gates to ensure good water quality and maximize hydropower benefits.

The primary role of the Corps of Engineers is to cooperate with the OMPA with regard to supplemental releases. The OMPA is aware of the Corps' normal operating constraints which affect this coordination.

TABLE 7-3

WATER QUALITY AND WATER RIGHTS RELEASES

Month	Water quality (c.f.s.)	Water rights (c.f.s.)
January	0.0	113.0
February	0.0	113.0
March	11.0	113.0
April	44.6	113.0
May	89.3	113.0
June	122.8	113.0
July	156.2	113.0
August	156.2	113.0
September	89.3	113.0
October	44.3	113.0
November	11.0	113.0
December	0.0	113.0
Average	60.8	113.0

7-08. Fish and Wildlife.

Fish and wildlife is a project purpose pursuant to Public Law 85-624; however, no specific storage is provided in the project. The Oklahoma Department of Wildlife Conservation manages 16,255 acres of project lands for wildlife purposes. The Kansas Forestry, Fish and Game Commission manages 3,729 acres of project land in Kansas. Additionally, the Corps manages approximately 8,000 acres for wildlife purposes.

7-09. Water Supply.

a. General. Kaw Lake has water supply storage of 171,200 acre-feet with a dependable yield of 167 mgd. Oklahoma Gas and Electric (OG&E) has a contract for 9,150 acre-feet of present water supply storage and 30,200 acre-feet of future storage. The Stillwater Utility Authority has a contract for 6,662 acre-feet of present water supply storage and 44,788 acre-feet of future storage. The remaining 80,400 acre-feet has not been contracted.

b. Regulation procedure for water supply. Water can be supplied through a 48-inch circular conduit located in the outlet works structure. The invert elevation of the water supply pipe is 970.0. Water supplied to OG&E from their contracted storage is released through the turbine or flood gates for withdrawal downstream.

7-08. Fish and wildlife. Fish and wildlife is a project purpose pursuant to Public Law 85-624; however, no specific storage is provided in the project. The Oklahoma Department of Wildlife Conservation manages 16,255 acres of project lands for wildlife purposes. The Kansas Forestry, Fish and Game Commission manages 3,729 acres of project land in Kansas. Additionally, the Corps manages approximately 8,000 acres for wildlife purposes. The Tulsa District has also coordinated with the Oklahoma Department of Wildlife Conservation and other interested agencies to enact a lake level manipulation plan. The lake level manipulation plan is for the enhancement of fish spawning and attraction of wildlife. From 10-20 January, the pool is drawn down to 1007.5. This level is then held until 1 March to provide additional storage and lessen the possibility of a spring drawdown. From 1 March to 20 April, the pool is allowed to rise to elevation 1010.00 to create a favorable environment for fish spawning and nursery conditions. This level is held until 25 July to provide stable spawning conditions and allow young-of-the-year game fish to reach survival size. From 25 July to 5 August, the pool is drawn down to elevation 1008.5 to expose shallow mud flats and concentrate forage species. This level is held until 15 September to allow seeding of exposed mud flats. The seeding will allow vegetation time to grow and increase predation on concentrated forage fish and produce waterfowl food. From 15 September to 15 November, the pool is allowed to rise to elevation 1010.00 to flood the seeded millet and make it available for waterfowl. From 15 November to 10 January, the pool is held at elevation 1010.00 to attract late season waterfowl. Plate 7-3 shows the current manipulation plan, which is approved for use until a reevaluation is deemed necessary.

7-09. Water supply.

a. General. Kaw Lake has water supply storage of 171,200 acre-feet with a dependable yield of 167 mgd. Oklahoma Gas and Electric (OG&E) has a contract for 9,150 acre-feet of present water supply storage and 30,200 acre-feet of future storage. The Stillwater Utility Authority has a contract for 6,662 acre-feet of present water supply storage and 44,788 acre-feet of future storage. The remaining 80,400 acre-feet has not been contracted.

b. Regulation procedure for water supply. Water can be supplied through a 48-inch circular conduit located in the outlet works structure. The invert elevation of the water supply pipe is 970.0. Water supplied to OG&E from their contracted storage is released through the turbine or flood gates for withdrawal downstream.

c. Accounting procedures for conservation storage.

Accounting procedures for conservation storage in multipurpose projects have been developed by the Tulsa District and approved by the Southwestern Division to regulate the withdrawal of water from lakes by each water supply user. No accounting is necessary where all conservation storage is contracted for by one user or when the Corps is not the contracting agency. Losses are charged to each user's account in proportion to its average remaining storage. Inflows, after deductions for downstream water rights and for users with vested rights and no storage, are credited to the storage account of the user in proportion to its contracted storage. Any inflow above the conservation storage will be released. When a user has 50 percent or less of contracted storage remaining, the contracting officer will be notified and will advise the user of this storage on a monthly basis, or more frequently if necessary, throughout the critical period. Should the storage of a user be depleted, no additional withdrawal from storage will be made without an additional contract. An example of the water supply storage accounting procedures is shown on plate 7-4.

7-10. Water rights.

a. General. The Oklahoma Water Resources Board has issued water rights on the Arkansas River below Kaw Lake. These water rights locations and amounts are shown in Table 7-4 on pages T7-1 through T7-2. Plates 7-5 and 7-6 show these locations in map form.

b. Regulation procedure for water rights. Releases from inflow to satisfy downstream water rights will be made at the request of the Oklahoma Water Resources Board (OWRB). The OWRB will inform the Reservoir Control Section as to the amount and time distribution of the required release. No withdrawal from storage in the lake will be made for downstream water rights unless the water-right holder has contracted storage available in the lake.

7-11. Hydroelectric power. The hydropower operation at Kaw Lake is a run of river operation with provisions for daily storage. Kaw Dam has one 37,000 KW generator. The discharge from the turbine at full power production is about 5,500 c.f.s. at elevation 1010.0. The turbine is used in conjunction with the spillway and outlet works for flood control releases. Flood control releases of 5,500 c.f.s. or less are made through the turbine, if operable. The Arkansas River Control Section will notify the Oklahoma Municipal Power Authority of the required turbine release. The spillway or outlet works may be used to meet downstream water rights or water quality requirements if the turbine is inoperable or to alleviate fish distress problems in the stilling basin.

If as proposed by OMPA, the top of the power pool is raised to elevation 1013.00, hydropower operations would be affected. The proposal results in 3 feet of power pondage which would result in more allowable fluctuation in the pool elevation between elevation 1010.00 and elevation 1013.00. If the pool were between these two elevations, the water could be stored or released according to the power company's preference. If the proposal were adopted, power generation would be more flexible resulting in even more power being generated during peak load periods.

7-12. Navigation. Kaw Lake will be regulated for flood control in conjunction with the other reservoirs in the navigation system to help provide a tapered recession of flows along the Arkansas River navigation channel. The coordinated regulation of the reservoirs is discussed in Chapter VII of the Arkansas River Basin Water Control Master Manual.

7-13. Drought contingency plan. A drought contingency plan for the mid-Arkansas River basin was approved in June 1991. This plan identifies water uses and needs within the basin and outlines steps which can be taken to alleviate the problems encountered during a drought.

7-14. Flood emergency action plans. A flood emergency action plan is outlined in the Operation and Maintenance Manual, Volume II, for Kaw Lake. The purpose of the manual is to specify procedures to protect the public from possible property damage or loss of life as a result of uncontrolled releases of water due to failure or severe damage to the dam or appurtenant works.

7-15. Deviation from normal regulation. The District Commander is occasionally requested to deviate from normal regulation of the lakes. Prior approval is obtained from the Southwestern Division Office (SWDO) for the subsequent action, except as noted in subparagraph a, below. Deviation requests usually fall into the following categories:

a. Emergencies. Some emergencies that can be expected are: drowning and other accidents, failure of operation facilities, and flushing of pollution where water quality is not a project purpose. Necessary action under emergency conditions is taken immediately unless such action would create equal or worse conditions. The Southwestern Division is informed as soon as practicable. A written confirmation showing the deviation and conditions will be furnished to CESWD-ED-WR (Form SWD 898).

b. Unplanned minor deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulation of the lake, although they are not

considered emergencies. Construction accounts for the major portion of these incidents and includes utility stream crossings, bridge work, and major construction contracts. Changes in releases are sometimes necessary for maintenance and inspection. Requests for changing 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 lakes, and possible alternative measures. In the interest of maintaining good public relations, requests are complied with providing there are no adverse effects on the overall operation of the project for maximum benefits to the authorized purposes. Approval for these minor deviations will normally be obtained from SWD by telephone. A written confirmation showing the deviation and conditions will be furnished to CESWD-ED-WR (Form SWD 898). Form SWD 898 is normally used to confirm deviation requests of duration less than one week. For deviations of longer duration, a letter is written which includes a justification. All documentation addressing coordination with interested, and/or potentially affected parties of deviations will be attached to deviation requests to CESWD-ED-WR.

c. Planned deviations. Other instances include anticipated or planned deviation. Each condition would be analyzed on its merits. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes will be presented by letter, telephone or facsimile to Southwestern Division along with Tulsa District recommendations for review or approval.

7-16. Rate of release change. The increase and decrease in releases from the lake shall be accomplished in a manner which minimizes damage to the reservoir area and downstream channel as shown in Table 7-5. Every reasonable precaution will be made to eliminate bank sloughing, undercutting, excessive erosion, and danger to human and animal lives, if possible. Situations will arise which will not allow an orderly increase and/or decrease in releases. Examples of these situations are large flood releases, as described in paragraph 7-05, and drownings which occur downstream of the dam.

TABLE 7-5

RELEASE RATE CHANGES
INCREASING RELEASES TO CHANNEL CAPACITY (1)

<u>Current Release Range</u> <u>(c.f.s.)</u>	<u>Maximum Increase</u> <u>(c.f.s)</u>	<u>Minimum Time Between</u> <u>Changes (hours) (2)</u>
0-40,000	6,600	3

DECREASING RELEASES BELOW CHANNEL CAPACITY (1)

<u>Current Release Range</u> <u>(c.f.s)</u>	<u>Maximum Decrease</u> <u>(c.f.s)</u>	<u>Minimum Time Between</u> <u>Changes (hours) (2)</u>
40,000-0	6,600	3

- (1) See paragraph 7-05(a) for releases that will exceed channel capacity and also decrease in releases above channel capacity.
- (2) A maximum of 3 gate changes per day under normal operating conditions.

7-17. Operational curves. The spillway rating curves are shown on plates 7-7 and 7-8 and the sluice gate rating curves are on Plates 7-9 and 7-10. The "Spillway Gate Regulation Schedule-Inflow Parameter" is shown on plate 7-1. The "Inflow vs. Rate-of-Rise Nomograph" is shown on plate 7-2. Evaporation curves are shown on plate 7-11. Current and ultimate tailwater curves at the damsite are shown on plate 7-12. A discharge rating curve at the Ponca City gage is shown on plate 7-13. Area and capacity information is shown on plate 7-14. Elevation versus area and capacity data are compiled in Table 7-6 on pages T7-3 through T7-9. Rating curves used by the Reservoir Control Section are adjusted for changing conditions and are maintained in current status.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. The effects of emergency flood control regulations on the probable maximum flood and the standard project flood and examples of the normal and emergency regulations on a major flood are presented in the following paragraphs. The floods were selected to show the effects of the flood control regulations for Kaw Lake on a variety of possible flood conditions.

8-02. Flood Control.

a. Spillway design flood. The spillway design flood was patterned after the May 1943 storm (SW 2-20) increased 28 percent, transposed 150 miles northwest, and rotated 3 degrees counterclockwise. The flood has a duration of 9 days with a peak inflow of 755,000 c.f.s. and a total volume of 4,510,000 acre-feet. The maximum flood volume stored is 1,313,900 acre-feet and the maximum discharge is 653,000 c.f.s. at the maximum pool, elevation 1053.91, under emergency regulations. Plate 8-1 shows the operational hydrographs for the spillway design flood routed through Kaw Lake by emergency regulations on both an empty and full flood control pool.

b. Standard project flood. The standard project flood was developed by the method described in paragraph 8-02(a) with no increase. The flood has a duration of 7 days with a peak inflow of 430,000 c.f.s., and a total volume of 2,345,000 acre-feet, which is about 51 percent of the spillway design flood. The maximum flood volume stored is 1,044,500 acre-feet and the maximum discharge is 428,000 c.f.s., and the maximum pool elevation is 1047.50 under full pool conditions. The maximum flood stored is 986,600 acre-feet and the maximum discharge is 234,000 c.f.s., and the maximum pool elevation is 1046.23 under empty pool conditions. Plate 8-2 shows the operational hydrographs for this flood routed by emergency regulations.

c. Flood of October 1986. This flood was the result of a stalled cold front followed by the remnants of a hurricane that resulted in basin average rainfall of 5.9 inches from September 29 to October 4. The flood had a volume of 1,298,000 acre-feet with over a 10-day period. The peak inflow was 190,000 c.f.s., the peak discharge was 40,000 c.f.s., and the peak pool was 1039.82 feet, NGVD, using emergency regulations. Plate 8-3 shows the operational hydrographs for Kaw Lake for both experienced and emergency regulations.

8-03. Recreation. Recreation areas begin to be inundated at elevation 1017.0. Access roads to recreation areas are constructed above the top of the flood pool, elevation 1044.5.

8-04. Water quality. The releases to meet the minimum flow requirements discussed in paragraph 7-07 will provide some flow in the river below the dam at all times thus avoiding periods of no flow and stagnation. All water released for the low flow (either through the turbine or sluices) will come from the lower portion of the lake.

8-05. Fish and wildlife. Kaw Lake provides an improved fishery over the natural river, allowing some species of sport fish to flourish in contrast to previous natural river conditions. Minimum releases allow striped bass to exist in the river below the dam by eliminating periods of no flow. Studies are presently underway to examine the effects of Kaw operations on the endangered least tern. Some wildlife habitat was inundated due to impoundment; however, wildlife management of lake perimeter lands strives to replace these losses.

8-06. Water supply. Presently, OG&E and the Stillwater Utility Authority have water supply storage contracts for Kaw Lake. APAC-Oklahoma, Inc. Standard Industries Division has use of surplus water, and the Kaw Tribe of Oklahoma has an interim use contract. The release of water from storage for the present use has no major effects on the lake.

8-07. Hydroelectric power. During normal operations releases will be made primarily through the turbine to maintain the pool at elevation 1010.0 feet. No storage is currently allocated to hydroelectric power generation; therefore the pool will not be drawn down for hydropower purposes.

8-08. Navigation. The coordination of releases from Kaw Lake with other reservoirs (discussed in Chapter VII of the Arkansas River Basin Water Control Master Manual) will significantly benefit navigation along the McClellan-Kerr Navigation system by providing a tapered recession of flows along the system. This controlled recession will enable navigation to continue while shoals are removed from the navigation channel.

8-09. Drought contingency plan. The drought contingency plan has carefully addressed the problems encountered during a drought. It provides a base for implementing actions necessary for conservation of water supply and has been structured according to the severity of the drought. This will enable the Arkansas River Control Section to more effectively coordinate with the public and district elements during such emergencies.

8-10. Flood emergency action plans. Preparation of these reports has focused attention upon the need for effective coordination during floods. Coordination strategy has been established between H&H Branch and other district elements which deal with the media and local government. This has proven to yield positive results during the more recent flood events.

8-11. Frequencies.

a. Peak inflow probability. Peak inflows were obtained for Kaw Lake from historical hydrographs (1922-1974), reservoir monthly charts (1975-1976), and daily computations (1977-1990). The peak inflows 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," dated September 1981, with SWD requirements as stated in DF dated 22 August 1979. The peak daily inflow probability curve is shown on plate 8-4.

b. Pool elevation duration and frequency. The pool elevation hydrographs resulting from the Arkansas River system routing of the computed flows at the damsite were used to compute maximum and minimum annual pool elevations. The pool elevation probability and duration data were obtained from "SUPER" run A90X02. Plate 8-5 shows the pool elevation probability curve and plate 8-6 shows the pool elevation duration curve.

c. Key control points. Discharge rating curves used in the regulation of Kaw Lake are shown on plates 4-3 through 4-9, and 7-13.

8-12. Other studies.

a. Examples of regulation. Studies are in progress to improve the forecasting techniques presented in section VI of this manual. Computer programs have been developed to forecast inflows into the lake, the resulting pool elevations, and the effects of releases at the downstream gage. Use of these programs has greatly shortened the reaction time in preparing regulation schedules.

b. Channel and floodway improvement. A flood insurance study has been made for Ponca City. The Arkansas River is covered by this study. This report includes profiles of the 500-, 100-, 50-, and 10-year floods. Ground and aerial reconnaissance are made as required to determine if revised channel capacities and maximum discharge limits are warranted.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and organizations.

a. Corps of Engineers. Kaw Lake is owned by the U.S. Government. The Tulsa District of the Corps of Engineers is the operating agency. Kaw Lake is the responsibility of the Project Manager, operating through the Resident Manager, Keystone Resident Office, and the Operations Division, Tulsa District Office. Project reporting instructions and an organization chart are presented in Chapter V. Project regulating instructions are presented in Chapter VII of this manual.

(1) Responsibilities and duties during normal operations. The Arkansas River Control Section, Hydrology-Hydraulics Branch, Tulsa District Office, is charged with the following responsibilities and duties under general supervision of the Engineering Division.

(a) Routine regulation of lakes and dissemination of routine data.

(b) Investigations and refinement of regulation procedures.

1. Analysis of past floods.
2. Reconnaissance to determine channel capacities.
3. Improvement of forecasting techniques.
4. Plan and coordinate the hydrologic reporting network with the National Weather Service and the U. S. Geological Survey.

(c) Train personnel in flood control duties.

1. Periodic visits to projects by personnel of the section to familiarize themselves with regulation facilities, become acquainted with the operating personnel, discuss emergency regulation procedures with operating personnel, and provide the background for improving facilities and methods.

2. Instruct personnel of the Hydrology-Hydraulics Branch in flood control procedures to supplement the Reservoir Control Section during flood emergencies, when necessary.

(d) Prepare reports on lake regulation.

1. Recurring reports.

2. Water control manuals.

3. Postflood reports.

(2) Responsibilities and duties during flood emergencies. During flood emergencies, the Arkansas River Control Section is responsible for the following:

(a) Evaluation of current hydrologic and meteorologic data.

(b) Presentation of storm and flood analysis to the District Commander and other interested District personnel.

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

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

(e) Furnish information to higher authority.

1. Initial reports to the Southwestern Division and the Office of the Chief of Engineers by telephone.

2. Supply the Emergency Operations Center with information in support of situation reports.

(f) Furnish information to the Reservoir Information Control Center. The duties of the project operating personnel under flood conditions are set forth in Chapter VII 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, instructions for the routine regulation of the lake are accomplished by the Reservoir Control Section. However, during flood periods, assistance of other personnel may be required to maintain effective regulation of the lake. Plate 5-2 shows the organization of the Reservoir Control Section during a major flood. The area and magnitude of the flood will determine the number of people engaged in each activity.

(4) Provision for 24-hour alert. The National Weather Service (NWS) and project personnel are provided with a list of names, addresses, and telephone numbers of key personnel of the Engineering Division 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 at the project or on call at all times.

(5) Role of Project Manager. The Project Manager will regulate the lake according to instructions issued by personnel of the Reservoir Control Section. The instructions follow the "Normal Regulations for Flood Control", included in Chapter VII and paragraph 3 of Exhibit C. If the Project Manager 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 VII and paragraph 3 of Exhibit C. The Project Manager will make daily observations as directed in paragraph 5-07.

b. Other Federal agencies. The NWS and the U.S. Geological Survey (USGS) cooperate together with the Arkansas River Control Section, Hydrology-Hydraulics Branch, Tulsa District Office, to accumulate rainfall and streamflow data. The Environmental Protection Agency, together with the State of Oklahoma, establishes the standards for water quality releases.

c. State agencies. Management of the fish and wildlife resources of the Kaw project is the responsibility of the Oklahoma Department of Wildlife Conservation.

d. Private organizations. The Oklahoma Municipal Power Authority (OMPA) cooperates with the Corps of Engineers to market hydropower produced by the project.

9-02. Interagency coordination.

a. Local press and Corps bulletins. The Corps of Engineers, the NWS, and the USGS coordinate in forecasting flood stages, streamflow, and pool elevations. Local press will be provided with information of flood forecasts as is furnished by the NWS (officially responsible for issuing flood warning). This information will be supplemented by the Corps of Engineers 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 of Engineers further assists in flood fighting, through the office of the Emergency Operations Manager, who furnishes sandbags and other necessary equipment based on equipment on hand and need.

b. National Weather Service. The Tulsa District Office and the Tulsa River Forecast Center, NWS, exchange hydro-meteorologic data and reports in order to prevent duplication of effort in obtaining and disseminating data. The NWS is the responsible agency for issuing public forecasts of stream stages. This exchange of data is discussed in greater detail in Chapter VI of this manual.

c. U.S. Geological Survey. The Corps of Engineers 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 of Engineers and the USGS coordinate field activities to maximize the number of stream discharge measurements.

d. Power marketing agency. The OMPA is responsible for the sale and delivery to utility companies of all electric power generated at Kaw Dam. Close coordination is maintained between the Tulsa District and the OMPA.

e. Other Federal, State, or local agencies. The Tulsa District Office exchanges information with state and local government officials, the State Highway Department, Oklahoma State Highway Patrol, and others during flood emergencies. The Tulsa District also coordinates with federal and state fish and wildlife agencies throughout normal operation.

9-03. Interagency agreements. Presently, there are no agreements with respect to lake regulations.

9-04. Commissions, river authorities, compacts, and committees. There are no commissions or a river authority on the Arkansas River. Arkansas River Basin compacts have been established between the States of Arkansas and Oklahoma and the States of Kansas and Oklahoma and the Arkansas River Coordination Committee. The major purposes of these compacts are:

a. To promote interstate comity between the States of Arkansas and Oklahoma and the States of Kansas and Oklahoma.

b. To provide for an equitable apportionment of the waters of the Arkansas River between Arkansas and Oklahoma, and Kansas and Oklahoma and to promote the orderly development thereof.

c. To provide an agency for administering the water apportionment agreed to in the compacts.

d. To encourage the maintenance of an active pollution abatement program in each of the three states and to seek the further reduction of both natural and manmade pollution in the waters of the Arkansas River Basin.

e. To facilitate the cooperation of the water administration agencies of the States of Arkansas and Oklahoma and the States of Kansas and Oklahoma in the total development and management of the water resources of the Arkansas River Basin. The Arkansas River Basin Coordinating Committee is made up of State and Federal agencies interested in the water resources development within the Arkansas River Basin. The committee meets annually to discuss the previous year's activities and to exchange information and ideas to better serve specific project purposes.

9-05. Non-Federal Hydropower. Oklahoma Municipal Power Authority operates the run-of-river power facility at Kaw Lake. The construction of the penstock and similar facilities were authorized by the 1962 Flood Control Act. Application for a FERC license was made by KAMO Electric Cooperative, Inc. in July 1983, after establishing the economic feasibility of the facility. A license was issued in November 1984 under Part I of the Federal Power Act for a period of 50 years, for construction, operation, and maintenance of the project. The issuance of the license was later amended to name OMPA as the operating agency.

9-06. Reports.

a. Morning report. This report is prepared in accordance with OM 1130-2-12 by the Reservoir Control Section daily, except Saturday, Sunday, and holidays, to cover a period of 24 hours. The report provides data for use by personnel whose work requires knowledge pertaining to the regulation of reservoirs, field investigations, stream gaging, and construction of flood control projects affected by releases from reservoirs, answering public inquiries, and preparing public releases. The report is prepared on SWT Form 813 and includes a summary of hydrologic conditions as of 8 A.M. of that date, weather forecast, including the extended outlook for the next 4 days, any quantitative precipitation forecasts or general rain-fall data, and lake data for the previous and present days. The report is completed and dispatched from the Hydrology-Hydraulics Branch by 10 a.m. daily under normal conditions.

b. Monthly lake reports. The Arkansas River Control Section prepares monthly reports in accordance with paragraph 6-04 of EM 1110-2-3600 and paragraph 13(d) of ER 1110-2-240. These reports are records for all flood control, navigation, and multiple-purpose storage lakes under supervision of or of direct interest to the Tulsa District Office. Supplemental information on the regulation of the reservoirs, such as explanation of deviations from approved schedules, is added as a note on the reports or as an attachment. These tabulations are promptly prepared each month and maintained in such form as to be readily available for transmittal to the Chief of Engineers or others, upon request. Each month a copy is forwarded to SWD for their records. Plate 9-1 is an example of a monthly lake report.

c. Flood situation reports. The Arkansas River Control Section provides daily information to the Emergency Management Division for situation reports during floods in accordance with ER 500-1-1. The report contains various types of information relative to the floods. Pertinent data specifically required for reservoirs are as follows: name of reservoir, reservoir stage, predicted maximum stage and anticipated date, rates of inflow and outflow in c.f.s., percent of flood control storage utilized to date and at predicted maximum stage, and any special information particularly pertinent to the flood situation.

d. Post flood reports. This report is prepared in accordance with ER 500-1-1 as soon as practicable after a flood which has caused major damages. The report describes flood emergency operations by the Corps of Engineers and others. Included in summary form are: available hydrologic information, damage estimate, and other engineering data as are considered to be essential for flood control and flood plain studies or in the review or possible claims against the United States for damages. The report is prepared by the District Office Planning Division personnel, using information compiled and prepared by the Reservoir Control Section. The report should be completed within approximately 3 months of the time of flooding, including statement of final cost.

e. Annual reports. This report is prepared by the Arkansas River Control Section. The report contains a summation of the general conditions of the river basins and the individual projects in the District for the preceding fiscal year. The report also presents the activities and accomplishments of the Reservoir Control Section for the past year. The report is forwarded to the SWD Reservoir Control Center for inclusion in the Division's annual report.

f. 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	FORM NUMBER	REGULATION REQUIRING REPORTING
Morning Report (CESWT-EC-H)	Daily, except Saturday Sunday, and holidays	SWT Form 813	OM 1130-2-12
Monthly Lake Report	Monthly	-----	ER 1110-2-240 and EM 1110-2-3600
Flood Situation Report	During floods	-----	ER 500-1-1
Postflood Report	Following a flood causing major damage	-----	ER 500-1-1
Annual Report	Annually	-----	ER-1110-2-240

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TABLES

TABLE 4-4

FLOODS FOR PERIOD OF RECORD AT ARKANSAS CITY GAGE
(Flood Stage 16.0 Feet)

Month	Day	Year	Stage (ft.)	Discharge (c.f.s.)	Month	Day	Year	Stage (ft.)	Discharge (c.f.s.)
4	11	1922	17.62	19,300	11	17	1964	23.25	54,400
7	14	1922	19.10	24,900	6	6	1965	19.36	31,300
6	11	1923	25.46	103,000	6	28	1965	18.40	26,500
5	2	1924	18.52	22,400	9	22	1965	17.85	21,100
10	4	1927	20.97	45,300	6	30	1967	17.04	17,700
6	18	1928	16.49	19,900	8	18	1968	17.97	25,000
6	24	1929	16.43	19,500	10	18	1968	19.28	32,300
5	1	1935	18.17	28,300	4	28	1969	18.10	25,700
5	21	1938	16.53	19,600	6	24	1969	17.20	21,400
6	22	1942	21.86	45,800	4	19	1970	19.90	31,500
4	24	1944	25.24	73,500	6	13	1970	16.30	15,800
4	18	1945	21.97	46,400	2	2	1973	17.27	19,100
4	15	1957	20.10	36,000	3	12	1973	21.59	41,500
7	25	1948	19.64	35,000	4	2	1973	22.84	49,900
2	13	1949	16.50	20,100	9	30	1973	22.00	44,000
2	19	1949	16.40	19,700	10	13	1973	23.72	56,800
6	8	1949	16.73	20,800	4	22	1974	21.39	40,300
6	21	1949	16.74	20,800	11	3	1974	17.85	22,400
7	19	1950	17.30	24,800	6	19	1975	19.85	32,800
8	2	1950	19.77	36,200	4	30	1976	17.86	22,800
5	2	1951	17.60	25,300	7	4	1976	17.99	23,400
5	19	1951	23.50	66,000	9	3	1977	19.57	30,800
6	9	1951	17.20	23,800	11	2	1979	22.48	47,400
7	1	1951	21.05	44,400	3	22	1979	17.44	20,300
7	14	1951	18.43	29,000	3	31	1980	17.44	21,200
9	8	1951	16.38	21,500	11	3	1981	17.00	19,400
5	18	1957	22.55	73,100	4	6	1983	17.60	23,800
6	29	1957	22.20	41,800	3	25	1984	20.71	37,300
7	4	1958	17.70	22,100	4	9	1984	18.20	23,800
9	18	1958	17.32	20,600	9	23	1985	18.00	22,900
10	3	1959	21.01	39,100	10	12	1985	26.10	85,200
3	28	1960	16.89	17,600	10	4	1986	20.31	34,900
8	25	1960	18.38	23,900	3	25	1987	20.52	35,500
5	6	1961	23.68	46,100	5	28	1987	20.33	35,000
7	24	1961	17.66	19,200	7	7	1987	18.82	26,800
8	19	1961	16.60	16,000	4	2	1988	16.82	18,600
10	10	1961	16.33	15,200					
11	2	1961	18.20	20,800					
6	3	1962	18.50	26,100					

TABLE 4-4 (CONT.)

FLOODS FOR PERIOD OF RECORD AT WINFIELD AND RALSTON GAGES

WINFIELD
(Flood Stage 30.0 Feet)

RALSTON
(Flood Stage 16.0 Feet)

Month	Day	Year	Stage (ft.)	Discharge (c.f.s.)	Month	Day	Year	Stage (ft.)	Discharge (c.f.s.)
7	13	1922	31.63	26,700	6	11	1923	23.80	200,000
6	10	1923	38.70	76,000	10	6	1926	18.70	(1)
4	9	1927	30.35	23,000	5	21	1935	16.00	(1)
4	20	1927	33.88	36,900	5	22	1938	16.44	75,600
6	19	1928	32.37	32,900	6	24	1942	18.54	94,000
11	18	1928	41.00	94,400	5	20	1943	18.12	97,200
5	20	1943	33.53	37,600	4	25	1944	22.82	179,000
4	23	1944	38.30	105,000	4	19	1945	19.55	124,000
12	7	1944	30.24	30,600	10	2	1945	19.48	110,000
4	17	1945	35.93	60,600	4	16	1947	18.50	114,000
9	30	1945	33.96	47,400	8	4	1950	17.60	92,800
4	14	1947	30.88	28,700	5	20	1951	19.23	106,000
8	2	1950	33.48	31,600	7	3	1951	21.45	135,000
7	1	1951	37.80	83,000	7	16	1951	20.28	120,000
5	19	1957	30.37	30,100	5	20	1957	21.41	120,000
10	4	1959	31.59	30,500	6	13	1957	17.46	77,900
5	6	1961	35.36	57,600	7	1	1957	19.88	112,000
11	17	1964	33.90	46,700	10	5	1959	21.62	158,000
6	6	1965	35.97	61,800	5	8	1961	21.22	165,000
4	19	1970	31.85	34,800	9	14	1961	18.50	114,000
3	11	1973	30.78	31,800	11	4	1961	17.83	103,000
10	12	1973	33.80	46,000	11	18	1964	22.60	171,000
7	5	1976	34.51	45,100	6	27	1969	16.42	77,000
6	24	1977	32.01	35,600	4	20	1970	18.33	101,000
6	10	1979	35.24	56,500	3	12	1973	19.41	121,000
10	4	1986	32.83	39,100	4	3	1973	16.92	95,000
					10	13	1973	22.98	211,000
					3	11	1974	17.72	106,000
					11	5	1974	18.62	111,000
					10	4	1986	22.20	174,000

(1) High water mark or stage only.

TABLE 4-6

ESTIMATED MONTHLY AND ANNUAL FLOWS IN ACRE-FEET
KAW LAKE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	ANNUAL
1921	-	-	-	-	-	-	-	-	-	2070.	1040.	2090.	5200.
1922	6200.	9500.	167000.	492900.	482500.	104000.	613500.	55300.	22600.	17700.	125200.	37700.	2134100.
1923	11200.	5900.	11400.	16200.	196900.	1625600.	151000.	157300.	157400.	273600.	161300.	95900.	2863700.
1924	61900.	115900.	199300.	215900.	322400.	72500.	55200.	64800.	17900.	23700.	21900.	23000.	1194400.
1925	25200.	36400.	27400.	59800.	59400.	33800.	10500.	47500.	28200.	20800.	36300.	22600.	407900.
1926	31000.	32800.	34500.	73900.	38600.	22600.	15300.	36800.	195800.	754500.	85600.	55500.	1376900.
1927	45700.	41600.	79200.	975000.	141300.	305800.	95300.	867100.	255100.	189300.	65300.	54100.	3114800.
1928	58200.	64000.	128100.	176900.	122100.	1055300.	250300.	80900.	24500.	22100.	453700.	185500.	2621600.
1929	241700.	69200.	118200.	313800.	358500.	486500.	448400.	107600.	33600.	28700.	57240.	62800.	2326240.
1930	37700.	66700.	46500.	33200.	315900.	134400.	27900.	22000.	99700.	57400.	77100.	73800.	992300.
1931	54700.	45000.	43600.	102500.	101300.	219000.	29600.	13600.	22400.	11800.	217400.	64300.	925200.
1932	58500.	58400.	53400.	43400.	41500.	210600.	159700.	25600.	13700.	10300.	12300.	17300.	704700.
1933	20800.	18700.	26700.	21200.	71500.	34200.	18000.	263800.	189300.	31700.	22200.	22400.	740500.
1934	30000.	20900.	28100.	73100.	59400.	28500.	7900.	4200.	24900.	42700.	83500.	23700.	426900.
1935	26200.	21900.	23200.	27600.	790000.	701100.	226200.	30900.	28000.	46500.	93000.	40800.	2055400.
1936	32500.	17400.	29000.	19500.	48600.	119600.	20600.	32700.	22200.	136600.	25100.	28300.	532100.
1937	54800.	102200.	69300.	69600.	175400.	291100.	257900.	78400.	97600.	26300.	19700.	25500.	1267800.
1938	23200.	22200.	48800.	68000.	719200.	389800.	104900.	142600.	79200.	29600.	70200.	35700.	1733400.
1939	33500.	26800.	41000.	76500.	39100.	199700.	121800.	101900.	20900.	11700.	12200.	14900.	700000.
1940	10300.	22600.	33100.	103300.	235400.	109100.	81900.	25200.	126800.	20100.	41200.	47500.	856500.
1941	75200.	88200.	74100.	202100.	142600.	495000.	249700.	85500.	148000.	402900.	284600.	146900.	2394800.
1942	107000.	148200.	134000.	574200.	610600.	751500.	328300.	182800.	394800.	370700.	128500.	259800.	3990400.
1943	203500.	146400.	108200.	97500.	584900.	237900.	147100.	49600.	41500.	44600.	39000.	38400.	1738600.
1944	48900.	49600.	468600.	1632600.	727200.	298600.	205800.	178700.	157900.	239000.	82900.	495900.	4585700.
1945	128400.	108600.	327700.	1165600.	310000.	175100.	210800.	78100.	31400.	592200.	88200.	71700.	3287800.
1946	150300.	97700.	153600.	101500.	78400.	54000.	30000.	14800.	30900.	97800.	120100.	79800.	1008900.
1947	57000.	47600.	217500.	976700.	498200.	435500.	250800.	63600.	27400.	23400.	26300.	61100.	2685100.
1948	37100.	57600.	316900.	98200.	79200.	406000.	1350000.	422700.	115600.	70300.	97300.	82000.	3132900.
1949	431600.	799400.	368600.	305800.	723700.	715100.	252000.	131300.	171400.	129700.	74000.	73100.	4175700.
1950	87900.	77200.	68500.	51400.	94000.	191100.	576300.	1200400.	324600.	198600.	95000.	92500.	3057500.
1951	87800.	106000.	122500.	162100.	1441300.	1139300.	1807300.	296900.	749500.	244400.	260300.	161900.	6579300.
1952	166100.	130000.	317100.	286500.	217500.	157000.	51300.	47600.	23000.	18500.	29600.	44600.	1488800.
1953	54200.	49700.	74700.	85700.	146500.	48000.	49600.	59600.	17800.	14800.	31200.	38500.	670300.
1954	29100.	35200.	37300.	30300.	96500.	54700.	14000.	4900.	4100.	8400.	9500.	12400.	336400.
1955	18700.	22400.	24300.	27100.	139100.	193700.	68000.	20400.	23700.	293800.	33600.	28900.	893700.
1956	29500.	34100.	31500.	29400.	23600.	21200.	23000.	5400.	2000.	3300.	7400.	8800.	219200.
1957	8400.	12600.	22600.	207600.	986800.	1245300.	586200.	99600.	169000.	96200.	120100.	74800.	3629200.
1958	76100.	72100.	542700.	356600.	269100.	156100.	834700.	364100.	329900.	126600.	82700.	80500.	3291200.
1959	78000.	89500.	106500.	126200.	289500.	119600.	533200.	146300.	113300.	1042500.	144200.	127500.	2916300.
1960	150000.	223000.	528400.	299300.	372400.	262600.	165100.	367200.	150300.	163200.	143900.	102500.	2927900.

TABLE 4-6 (cont)

ESTIMATED MONTHLY AND ANNUAL FLOWS IN ACRE-FEET
KAW LAKE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	ANNUAL
1961	70200.	99600.	196000.	214500.	1118000.	243100.	399600.	314800.	541700.	472200.	690300.	216800.	4576800.
1962	208600.	284900.	139700.	110900.	97200.	388600.	357100.	178800.	312200.	133000.	80700.	85100.	2376800.
1963	70600.	75400.	117200.	58400.	68400.	95800.	168500.	37500.	174000.	87400.	46600.	33300.	1033100.
1964	45100.	37900.	36700.	80200.	86400.	120000.	34700.	94200.	74400.	50200.	739700.	169600.	1569100.
1965	89400.	70800.	118800.	337500.	177800.	1095600.	422000.	94000.	638700.	57300.	113400.	98800.	3314100.
1966	88400.	117500.	103800.	74400.	75400.	93400.	31800.	48100.	43200.	16900.	16900.	17100.	726900.
1967	27300.	28100.	23200.	34600.	21400.	298700.	558000.	164800.	160700.	198800.	68700.	50500.	1634800.
1968	51000.	50300.	60100.	117300.	192000.	189000.	116700.	175200.	117900.	314400.	229700.	131300.	1744900.
1969	105600.	127500.	322800.	424100.	692300.	676900.	149000.	58500.	286100.	127100.	85400.	113300.	3168600.
1970	88700.	84200.	89400.	673100.	142100.	379700.	65600.	29500.	102400.	110000.	39200.	38800.	1842700.
1971	74300.	71000.	189500.	77200.	125700.	230600.	111600.	67300.	51000.	71400.	206100.	173100.	1448800.
1972	80300.	55500.	44400.	51700.	125000.	68000.	77900.	31700.	81000.	30300.	165100.	163900.	974800.
1973	403500.	395300.	1487400.	1036400.	302300.	94500.	35200.	35900.	275200.	1547300.	262600.	363700.	6239300.
1974	304000.	214700.	525900.	378700.	582300.	527600.	85000.	137200.	102600.	83500.	406200.	283100.	3630800.
1975	232300.	382200.	416100.	239200.	544400.	992400.	256700.	131800.	92300.	27000.	38500.	58200.	3411100.
1976	37500.	35900.	48000.	159200.	381400.	137100.	513000.	37600.	30300.	27700.	29300.	26900.	1463900.
1977	24400.	36700.	37800.	117900.	459600.	694600.	194300.	430000.	483600.	131000.	218200.	77400.	2905500.
1978	53200.	226900.	313100.	208100.	370000.	249600.	78400.	22400.	45900.	20200.	22700.	24400.	1634900.
1979	29600.	68900.	501600.	207600.	218800.	438800.	173800.	100300.	39600.	41400.	550800.	110000.	2481200.
1980	111000.	138200.	252800.	549700.	137900.	79600.	22500.	52800.	18800.	18400.	17900.	28200.	1427800.
1981	24200.	22900.	30600.	27800.	107200.	143100.	100900.	83600.	41600.	93500.	338900.	76800.	1091100.
1982	51200.	190000.	180800.	71600.	477800.	793200.	212000.	52800.	28600.	25900.	27400.	38500.	2149800.
1983	43700.	93900.	273000.	712800.	306100.	346100.	272500.	39200.	30500.	57300.	42600.	35100.	2252800.
1984	44400.	63500.	807200.	717800.	418800.	233200.	54000.	23100.	13300.	46100.	48700.	206600.	2676700.
1985	142700.	355100.	208500.	149700.	243100.	412900.	85000.	183500.	250700.	931300.	409500.	146400.	3518400.
1986	102900.	101800.	86900.	163700.	491700.	226900.	283600.	136700.	228100.	1219000.	150300.	173900.	3365500.
1987	124800.	300900.	1038500.	351700.	575300.	307200.	482400.	313100.	125800.	63800.	91000.	244100.	4018600.
1988	211830.	103340.	264300.	584330.	178510.	69120.	78640.	33620.	30350.	21920.	31640.	28560.	1636160.
1989	34120.	27970.	47800.	43740.	125950.	381720.	163640.	209650.	736260.	123370.	65750.	45620.	2005590.
1990	98180.	114640.	572830.	169390.	152530.	224530.	37590.	39470.	29160.	22710.	29950.	20630.	1511610.
1991	27170.	27370.	30150.	119800.	64260.	94410.	20930.	33020.	48690.	14780.	56730.	80130.	617440.
1992	44130.	32130.	93210.	71010.	56330.	522050.	190810.	171070.	65650.	40660.	460760.	399470.	2147280.
1993	288390.	513320.	402545.	340760.	2041785.	579867.	1209322.	270545.	141223.	102347.	91239.	85289.	6066632.
1994	91140.	65851.	75669.	468495.	264991.	77157.	122380.	47801.	24000.	-	-	-	1237484.
MEAN	87835.	106951.	197115.	259206.	322916.	339802.	241017.	135031.	136321.	168031.	129484.	93967.	2187707.
MAXIMUM	431600.	799400.	1487400.	1632600.	2041785.	1625600.	1807300.	1200400.	749500.	1547300.	739700.	495900.	6579300.
MINIMUM	6200.	5900.	11400.	16200.	21400.	21200.	7900.	4200.	2000.	2070.	1040.	2090.	219200.

TABLE 7-4

ACTIVE WATER RIGHTS HOLDERS
ARKANSAS RIVER DOWNSTREAM OF KANSAS

APPLICANT NAME	PERMIT NUMBER	AUTHORIZED AMOUNT (AC-FT)	POINT OF DIVERSION
Cleveland, City of	34-59	417	19 21N 07E, I.M. 20 21N 07E, I.M.
Ponca City, City of	34-60	9662	19 26N 03E, I.M.
Ponca City, City of	81-159	16,501	25 26N 03E, I.M.
(b) (6)	54-253	12	NE NE 25 26N 02E, I.M.
Cleveland, City of	73-168	100	20 21N 07E, I.M.
(b) (6)	77-81	4	SW SW 36 26N 03E, I.M.
(b) (6)	77-82	4	SW SW 36 26N 03E, I.M.
(b) (6)	53-211	10	NE 31 22N 06E, I.M.
Enid, City of	81-180	25,000	SE NW SE 25 66N 03E, I.M.
Pawnee, City of	82-3	166	SW NE NE 30 22N 05E, I.M.
Pawnee, City of	82-4	320	NE SW NE 31 22N 05E, I.M.
Tonkawa, City of	87-31	2800	SW NE SE 25 26N 03E, I.M.
Payne County Rural Water Dist #3	74-309	65	SE NW SE 25 26N 03E, I.M. 18N 02E, I.M. 19N 03E, I.M.
Osage Oil and Transportation, Inc.	69-437	2	S2 05 21N 08E, I.M. S2 16 21N 08E, I.M. S2 06 19N 08E, I.M. S2 05 21N 08E, I.M. S2 16 21N 08E, I.M. S2 06 19N 08E, I.M.
Perkins, City of	69-478	583	25 26N 03E, I.M.
Conoco, Inc.	70-168	12,000	36 26N 03E, I.M.
Stillwater, City of	72-491	56,210	25 26N 03E, I.M.
Oklahoma Gas & Electric Co.	73-235	73,000	NE NE 21 23N 03E, I.M. SE SE 16 23N 03E, I.M.

TABLE 7-4
(cont)

APPLICANT NAME	PERMIT NUMBER	AUTHORIZED AMOUNT (AC-FT)	POINT OF DIVERSION
Pawnee, City of	32-40	344	20 22N 05E, I.M.
Brensing Ranch & Cattle Co.	48-202	90	W2 NE 32 33N 06E, I.M. NW 32 22N 06E, I.M. NE SW 32 22N 06E, I.M. N2 SE 32 22N 06E, I.M.
(b) (6)	77-83	4	SW SW 36 26N 03E, I.M.

TABLE 7-6
KAW LAKE
ELEVATION-AREA-CAPACITY TABLE

DATA BASED ON
1 MAY 1986 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
930.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
931.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
932.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
933.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
934.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
935.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
936.0	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.003	0.003
	0.000	0.001	0.002	0.002	0.003	0.004	0.005	0.006	0.006	0.007
937.0	0.004	0.005	0.006	0.007	0.008	0.009	0.011	0.012	0.013	0.015
	0.008	0.009	0.010	0.011	0.012	0.013	0.013	0.014	0.015	0.016
938.0	0.017	0.018	0.020	0.022	0.024	0.026	0.029	0.031	0.033	0.036
	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026
939.0	0.039	0.041	0.044	0.048	0.051	0.055	0.059	0.063	0.067	0.071
	0.027	0.029	0.031	0.033	0.035	0.038	0.040	0.042	0.044	0.046
940.0	0.076	0.081	0.086	0.091	0.096	0.101	0.107	0.112	0.118	0.124
	0.048	0.049	0.050	0.051	0.052	0.054	0.055	0.056	0.057	0.058
941.0	0.130	0.136	0.142	0.150	0.157	0.165	0.174	0.183	0.192	0.203
	0.059	0.064	0.069	0.074	0.079	0.084	0.088	0.093	0.098	0.103
942.0	0.213	0.224	0.235	0.246	0.257	0.268	0.280	0.291	0.302	0.314
	0.108	0.109	0.110	0.111	0.112	0.113	0.113	0.114	0.115	0.116
943.0	0.326	0.338	0.351	0.365	0.380	0.395	0.412	0.430	0.448	0.468
	0.117	0.126	0.135	0.144	0.153	0.163	0.172	0.181	0.190	0.199
944.0	0.488	0.509	0.532	0.555	0.580	0.605	0.632	0.659	0.688	0.718
	0.208	0.219	0.229	0.240	0.250	0.261	0.271	0.282	0.292	0.303
945.0	0.749	0.780	0.812	0.844	0.876	0.908	0.941	0.973	1.006	1.040
	0.313	0.315	0.318	0.320	0.322	0.325	0.327	0.329	0.331	0.334
946.0	1.073	1.107	1.141	1.175	1.209	1.244	1.278	1.313	1.349	1.384
	0.336	0.338	0.340	0.342	0.344	0.347	0.349	0.351	0.353	0.355
947.0	1.420	1.455	1.492	1.528	1.565	1.602	1.640	1.678	1.716	1.755
	0.357	0.361	0.364	0.368	0.371	0.375	0.378	0.382	0.385	0.389
948.0	1.794	1.834	1.874	1.916	1.958	2.002	2.046	2.091	2.137	2.185
	0.392	0.401	0.411	0.420	0.429	0.439	0.448	0.457	0.466	0.476
949.0	2.233	2.282	2.332	2.383	2.435	2.488	2.542	2.598	2.654	2.712
	0.485	0.496	0.506	0.517	0.527	0.538	0.548	0.559	0.569	0.580

TABLE 7-6 (continued)
KAW LAKE
ELEVATION-AREA-CAPACITY TABLE

DATA BASED ON
 1 MAY 1986 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
950.0	2.770	2.829	2.889	2.949	3.010	3.071	3.133	3.195	3.257	3.321
	0.590	0.595	0.600	0.604	0.609	0.614	0.619	0.624	0.628	0.633
951.0	3.384	3.448	3.513	3.578	3.643	3.709	3.776	3.843	3.910	3.979
	0.638	0.643	0.648	0.653	0.658	0.663	0.668	0.673	0.678	0.683
952.0	4.047	4.116	4.186	4.256	4.327	4.399	4.471	4.544	4.617	4.691
	0.688	0.694	0.700	0.707	0.713	0.719	0.725	0.731	0.738	0.744
953.0	4.766	4.842	4.918	4.996	5.074	5.154	5.235	5.317	5.400	5.484
	0.750	0.761	0.771	0.782	0.792	0.803	0.813	0.824	0.834	0.845
954.0	5.569	5.654	5.741	5.829	5.917	6.006	6.096	6.186	6.278	6.370
	0.855	0.863	0.871	0.878	0.886	0.894	0.902	0.910	0.917	0.925
955.0	6.463	6.557	6.653	6.751	6.850	6.951	7.054	7.159	7.266	7.374
	0.933	0.951	0.969	0.986	1.004	1.022	1.040	1.058	1.075	1.093
956.0	7.485	7.596	7.710	7.824	7.941	8.058	8.177	8.298	8.420	8.544
	1.111	1.126	1.140	1.155	1.169	1.184	1.199	1.213	1.228	1.242
957.0	8.669	8.795	8.923	9.053	9.184	9.317	9.451	9.587	9.724	9.863
	1.257	1.273	1.288	1.304	1.320	1.336	1.351	1.367	1.383	1.398
958.0	10.004	10.146	10.291	10.437	10.585	10.734	10.886	11.040	11.195	11.352
	1.414	1.433	1.451	1.470	1.489	1.508	1.526	1.545	1.564	1.582
959.0	11.512	11.672	11.834	11.996	12.159	12.323	12.489	12.655	12.822	12.989
	1.601	1.610	1.619	1.628	1.637	1.647	1.656	1.665	1.674	1.683
960.0	13.158	13.328	13.499	13.672	13.846	14.021	14.198	14.376	14.555	14.736
	1.692	1.706	1.719	1.733	1.746	1.760	1.774	1.787	1.801	1.814
961.0	14.918	15.103	15.290	15.481	15.675	15.873	16.074	16.278	16.485	16.696
	1.828	1.861	1.893	1.926	1.959	1.992	2.024	2.057	2.090	2.122
962.0	16.910	17.126	17.346	17.568	17.793	18.021	18.252	18.485	18.721	18.960
	2.155	2.182	2.210	2.237	2.264	2.292	2.319	2.346	2.373	2.401
963.0	19.201	19.444	19.689	19.934	20.181	20.428	20.677	20.927	21.177	21.429
	2.428	2.439	2.449	2.460	2.470	2.481	2.492	2.502	2.513	2.523
964.0	21.682	21.936	22.192	22.450	22.709	22.970	23.233	23.497	23.763	24.030
	2.534	2.551	2.567	2.584	2.601	2.618	2.634	2.651	2.668	2.684
965.0	24.300	24.571	24.847	25.125	25.407	25.692	25.981	26.273	26.569	26.867
	2.701	2.735	2.769	2.802	2.836	2.870	2.904	2.938	2.971	3.005
966.0	27.170	27.474	27.780	28.088	28.396	28.706	29.018	29.331	29.645	29.961
	3.039	3.053	3.067	3.081	3.095	3.109	3.122	3.136	3.150	3.164
967.0	30.278	30.597	30.917	31.239	31.563	31.888	32.215	32.543	32.873	33.205
	3.178	3.195	3.211	3.228	3.244	3.261	3.277	3.294	3.310	3.327
968.0	33.539	33.874	34.212	34.551	34.893	35.237	35.583	35.932	36.282	36.635
	3.343	3.365	3.386	3.408	3.429	3.451	3.473	3.494	3.516	3.537
969.0	36.990	37.346	37.704	38.063	38.424	38.785	39.148	39.513	39.878	40.245
	3.559	3.572	3.585	3.598	3.611	3.624	3.636	3.649	3.662	3.675

TABLE 7-6 (continued)
KAW LAKE
ELEVATION-AREA-CAPACITY TABLE

DATA BASED ON
1 MAY 1986 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
970.0	40.613	40.983	41.356	41.732	42.111	42.492	42.876	43.263	43.652	44.045
	3.688	3.716	3.744	3.771	3.799	3.827	3.855	3.883	3.910	3.938
971.0	44.440	44.838	45.237	45.638	46.040	46.445	46.851	47.258	47.668	48.079
	3.966	3.983	4.000	4.018	4.035	4.052	4.069	4.086	4.104	4.121
972.0	48.492	48.907	49.323	49.741	50.161	50.583	51.006	51.431	51.858	52.287
	4.138	4.155	4.173	4.190	4.208	4.225	4.242	4.260	4.277	4.295
973.0	52.717	53.149	53.583	54.018	54.455	54.893	55.333	55.775	56.218	56.663
	4.312	4.328	4.344	4.360	4.376	4.393	4.409	4.425	4.441	4.457
974.0	57.110	57.558	58.008	58.459	58.912	59.367	59.824	60.282	60.742	61.203
	4.473	4.490	4.507	4.523	4.540	4.557	4.574	4.591	4.607	4.624
975.0	61.667	62.131	62.597	63.065	63.534	64.004	64.475	64.948	65.423	65.898
	4.641	4.655	4.668	4.682	4.695	4.709	4.722	4.736	4.749	4.763
976.0	66.375	66.854	67.334	67.817	68.302	68.789	69.278	69.769	70.262	70.757
	4.776	4.797	4.817	4.838	4.859	4.880	4.900	4.921	4.942	4.962
977.0	71.255	71.754	72.256	72.761	73.268	73.778	74.290	74.805	75.323	75.843
	4.983	5.009	5.034	5.060	5.085	5.111	5.136	5.162	5.187	5.213
978.0	76.365	76.890	77.418	77.947	78.480	79.014	79.552	80.091	80.633	81.178
	5.238	5.262	5.287	5.311	5.335	5.360	5.384	5.408	5.432	5.457
979.0	81.725	82.274	82.828	83.384	83.945	84.508	85.075	85.646	86.220	86.798
	5.481	5.516	5.550	5.585	5.619	5.654	5.689	5.723	5.758	5.792
980.0	87.379	87.963	88.549	89.139	89.731	90.325	90.923	91.523	92.125	92.731
	5.827	5.854	5.880	5.907	5.933	5.960	5.987	6.013	6.040	6.066
981.0	93.339	93.949	94.561	95.175	95.791	96.409	97.029	97.651	98.275	98.900
	6.093	6.112	6.132	6.151	6.170	6.190	6.209	6.228	6.247	6.267
982.0	99.528	100.158	100.789	101.423	102.059	102.697	103.338	103.980	104.624	105.271
	6.286	6.307	6.328	6.349	6.370	6.391	6.412	6.433	6.454	6.475
983.0	105.919	106.570	107.222	107.877	108.533	109.191	109.851	110.513	111.177	111.843
	6.496	6.515	6.534	6.554	6.573	6.592	6.611	6.630	6.650	6.669
984.0	112.511	113.183	113.861	114.545	115.235	115.931	116.634	117.342	118.056	118.777
	6.688	6.749	6.810	6.871	6.932	6.993	7.053	7.114	7.175	7.236
985.0	119.504	120.235	120.970	121.708	122.450	123.196	123.945	124.697	125.453	126.213
	7.297	7.332	7.367	7.402	7.437	7.472	7.507	7.542	7.577	7.612
986.0	126.976	127.741	128.510	129.280	130.054	130.829	131.607	132.387	133.170	133.955
	7.647	7.671	7.695	7.719	7.743	7.767	7.790	7.814	7.838	7.862
987.0	134.742	135.532	136.326	137.122	137.922	138.725	139.531	140.341	141.154	141.970
	7.886	7.918	7.950	7.982	8.014	8.047	8.079	8.111	8.143	8.175
988.0	142.789	143.611	144.435	145.262	146.092	146.924	147.759	148.596	149.436	150.279
	8.207	8.233	8.258	8.284	8.309	8.335	8.361	8.386	8.412	8.437
989.0	151.124	151.972	152.823	153.677	154.535	155.396	156.261	157.129	158.000	158.874
	8.463	8.496	8.529	8.562	8.595	8.629	8.662	8.695	8.728	8.761

TABLE 7-6 (continued)
KAW LAKE
ELEVATION-AREA-CAPACITY TABLE

DATA BASED ON
 1 MAY 1986 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
990.0	159.752	160.633	161.517	162.405	163.295	164.189	165.086	165.987	166.890	167.797
	8.794	8.826	8.858	8.890	8.922	8.955	8.987	9.019	9.051	9.083
991.0	168.707	169.619	170.534	171.452	172.372	173.294	174.219	175.146	176.076	177.008
	9.115	9.139	9.163	9.188	9.212	9.236	9.260	9.284	9.309	9.333
992.0	177.943	178.880	179.820	180.763	181.708	182.657	183.609	184.563	185.520	186.481
	9.357	9.386	9.415	9.443	9.472	9.501	9.530	9.559	9.587	9.616
993.0	187.444	188.410	189.379	190.352	191.327	192.306	193.288	194.274	195.262	196.254
	9.645	9.677	9.709	9.741	9.773	9.806	9.838	9.870	9.902	9.934
994.0	197.249	198.247	199.249	200.253	201.261	202.271	203.285	204.302	205.323	206.346
	9.966	9.998	10.029	10.061	10.092	10.124	10.155	10.187	10.218	10.250
995.0	207.373	208.403	209.436	210.474	211.515	212.559	213.608	214.660	215.716	216.775
	10.281	10.318	10.355	10.392	10.429	10.466	10.503	10.540	10.577	10.614
996.0	217.839	218.905	219.975	221.047	222.122	223.201	224.282	225.366	226.453	227.543
	10.651	10.680	10.709	10.739	10.768	10.797	10.826	10.855	10.885	10.914
997.0	228.636	229.731	230.829	231.930	233.033	234.138	235.246	236.357	237.470	238.586
	10.943	10.968	10.993	11.018	11.043	11.068	11.093	11.118	11.143	11.168
998.0	239.704	240.824	241.946	243.071	244.198	245.327	246.458	247.591	248.726	249.864
	11.193	11.214	11.236	11.257	11.279	11.300	11.321	11.343	11.364	11.386
999.0	251.004	252.146	253.291	254.440	255.591	256.746	257.903	259.064	260.228	261.395
	11.407	11.438	11.469	11.500	11.531	11.562	11.592	11.623	11.654	11.685
1000.0	262.565	263.740	264.920	266.107	267.300	268.499	269.704	270.916	272.133	273.356
	11.716	11.777	11.838	11.899	11.960	12.021	12.081	12.142	12.203	12.264
1001.0	274.586	275.822	277.064	278.314	279.571	280.835	282.105	283.383	284.667	285.958
	12.325	12.394	12.463	12.533	12.602	12.671	12.740	12.809	12.879	12.948
1002.0	287.257	288.560	289.869	291.181	292.498	293.820	295.145	296.476	297.810	299.149
	13.017	13.061	13.104	13.148	13.192	13.236	13.279	13.323	13.367	13.410
1003.0	300.492	301.840	303.191	304.547	305.907	307.271	308.639	310.011	311.387	312.768
	13.454	13.495	13.536	13.578	13.619	13.660	13.701	13.742	13.784	13.825
1004.0	314.152	315.541	316.933	318.330	319.730	321.134	322.542	323.954	325.370	326.790
	13.866	13.905	13.944	13.984	14.023	14.062	14.101	14.140	14.180	14.219
1005.0	328.214	329.644	331.081	332.525	333.976	335.436	336.902	338.376	339.857	341.346
	14.258	14.332	14.406	14.480	14.554	14.628	14.702	14.776	14.850	14.924
1006.0	342.842	344.344	345.851	347.363	348.879	350.400	351.926	353.457	354.992	356.532
	14.998	15.045	15.093	15.140	15.187	15.235	15.282	15.329	15.376	15.424
1007.0	358.077	359.626	361.179	362.737	364.299	365.866	367.436	369.011	370.591	372.174
	15.471	15.514	15.557	15.600	15.643	15.686	15.728	15.771	15.814	15.857
1008.0	373.762	375.355	376.953	378.557	380.166	381.781	383.402	385.028	386.659	388.296
	15.900	15.955	16.011	16.066	16.121	16.177	16.232	16.287	16.342	16.398
1009.0	389.939	391.585	393.235	394.888	396.543	398.202	399.864	401.528	403.196	404.866
	16.453	16.483	16.512	16.542	16.571	16.601	16.631	16.660	16.690	16.719

TABLE 6 (continued)
KAW LAKE
ELEVATION-AREA-CAPACITY TABLE

DATA BASED ON
 1 MAY 1986 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
1010.0	406.540	408.218	409.902	411.593	413.291	414.995	416.705	418.422	420.146	421.876
	16.749	16.814	16.878	16.943	17.008	17.073	17.137	17.202	17.267	17.331
1011.0	423.612	425.355	427.106	428.865	430.631	432.404	434.185	435.974	437.770	439.574
	17.396	17.471	17.547	17.622	17.698	17.773	17.848	17.924	17.999	18.075
1012.0	441.385	443.203	445.028	446.858	448.695	450.538	452.388	454.243	456.105	457.974
	18.150	18.213	18.275	18.338	18.400	18.463	18.526	18.588	18.651	18.713
1013.0	459.848	461.728	463.612	465.501	467.394	469.292	471.194	473.101	475.012	476.927
	18.776	18.821	18.865	18.910	18.954	18.999	19.044	19.088	19.133	19.177
1014.0	478.847	480.772	482.701	484.636	486.576	488.520	490.470	492.425	494.384	496.349
	19.222	19.272	19.322	19.372	19.422	19.472	19.521	19.571	19.621	19.671
1015.0	498.319	500.293	502.272	504.256	506.244	508.236	510.234	512.236	514.242	516.253
	19.721	19.767	19.813	19.859	19.905	19.951	19.996	20.042	20.088	20.134
1016.0	518.269	520.289	522.313	524.341	526.374	528.410	530.450	532.495	534.543	536.596
	20.180	20.221	20.261	20.302	20.342	20.383	20.424	20.464	20.505	20.546
1017.0	538.652	540.713	542.778	544.848	546.922	549.000	551.083	553.171	555.263	557.359
	20.586	20.630	20.675	20.719	20.763	20.808	20.852	20.896	20.941	20.985
1018.0	559.460	561.564	563.673	565.785	567.901	570.020	572.143	574.270	576.401	578.535
	21.029	21.066	21.103	21.140	21.176	21.213	21.250	21.287	21.324	21.360
1019.0	580.673	582.814	584.960	587.110	589.265	591.423	593.586	595.752	597.923	600.098
	21.397	21.439	21.480	21.522	21.563	21.605	21.647	21.688	21.730	21.772
1020.0	602.278	604.462	606.653	608.851	611.055	613.265	615.482	617.706	619.936	622.172
	21.813	21.878	21.943	22.008	22.073	22.138	22.203	22.267	22.332	22.397
1021.0	624.415	626.664	628.919	631.179	633.446	635.718	637.995	640.279	642.568	644.863
	22.462	22.519	22.577	22.634	22.691	22.748	22.805	22.862	22.920	22.977
1022.0	647.163	649.470	651.786	654.109	656.439	658.778	661.124	663.479	665.841	668.211
	23.034	23.112	23.191	23.269	23.347	23.426	23.504	23.582	23.660	23.739
1023.0	670.589	672.973	675.362	677.756	680.155	682.558	684.967	687.381	689.799	692.222
	23.817	23.866	23.915	23.964	24.013	24.062	24.111	24.160	24.209	24.258
1024.0	694.651	697.084	699.522	701.966	704.415	706.869	709.328	711.793	714.262	716.737
	24.307	24.359	24.411	24.463	24.515	24.567	24.618	24.670	24.722	24.774
1025.0	719.217	721.702	724.192	726.687	729.188	731.693	734.203	736.718	739.239	741.764
	24.826	24.876	24.927	24.977	25.027	25.077	25.127	25.178	25.228	25.278
1026.0	744.294	746.829	749.369	751.913	754.462	757.015	759.573	762.135	764.702	767.273
	25.328	25.374	25.419	25.464	25.510	25.555	25.601	25.646	25.691	25.737
1027.0	769.849	772.430	775.017	777.609	780.206	782.809	785.418	788.032	790.652	793.277
	25.782	25.837	25.893	25.948	26.003	26.059	26.114	26.169	26.224	26.280
1028.0	795.908	798.544	801.187	803.835	806.490	809.151	811.818	814.491	817.170	819.855
	26.335	26.396	26.457	26.517	26.578	26.639	26.700	26.761	26.821	26.882
1029.0	822.547	825.244	827.948	830.657	833.374	836.096	838.824	841.559	844.300	847.047
	26.943	27.005	27.067	27.130	27.192	27.254	27.316	27.379	27.441	27.503

TABLE 7-6 (continued)
KAW LAKE
ELEVATION-AREA-CAPACITY TABLE

DATA BASED ON
 1 MAY 1986 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
1030.0	849.801	852.560	855.327	858.100	860.880	863.667	866.461	869.261	872.068	874.882
	27.565	27.632	27.700	27.767	27.834	27.902	27.969	28.036	28.103	28.171
1031.0	877.702	880.529	883.363	886.204	889.052	891.906	894.768	897.636	900.511	903.393
	28.238	28.306	28.375	28.443	28.511	28.579	28.647	28.715	28.784	28.852
1032.0	906.281	909.177	912.080	914.991	917.909	920.834	923.767	926.708	929.655	932.611
	28.920	28.995	29.069	29.144	29.218	29.293	29.367	29.442	29.516	29.591
1033.0	935.574	938.544	941.523	944.509	947.503	950.506	953.516	956.534	959.561	962.595
	29.665	29.745	29.824	29.904	29.984	30.064	30.143	30.223	30.303	30.382
1034.0	965.637	968.687	971.743	974.807	977.877	980.954	984.038	987.128	990.226	993.330
	30.462	30.531	30.599	30.668	30.736	30.805	30.873	30.942	31.010	31.079
1035.0	996.442	999.559	1002.682	1005.811	1008.946	1012.087	1015.233	1018.385	1021.542	1024.706
	31.147	31.204	31.261	31.319	31.376	31.433	31.490	31.548	31.605	31.662
1036.0	1027.875	1031.050	1034.231	1037.419	1040.614	1043.815	1047.022	1050.236	1053.457	1056.683
	31.719	31.784	31.848	31.913	31.978	32.042	32.107	32.171	32.236	32.300
1037.0	1059.917	1063.157	1066.404	1069.659	1072.921	1076.190	1079.467	1082.751	1086.042	1089.341
	32.365	32.438	32.511	32.584	32.657	32.730	32.803	32.876	32.949	33.022
1038.0	1092.647	1095.959	1099.278	1102.604	1105.936	1109.274	1112.618	1115.969	1119.327	1122.690
	33.095	33.159	33.223	33.286	33.350	33.414	33.478	33.542	33.605	33.669
1039.0	1126.061	1129.437	1132.820	1136.208	1139.603	1143.004	1146.412	1149.825	1153.245	1156.671
	33.733	33.795	33.857	33.918	33.980	34.042	34.104	34.166	34.227	34.289
1040.0	1160.103	1163.544	1166.999	1170.468	1173.949	1177.444	1180.953	1184.474	1188.009	1191.557
	34.351	34.484	34.617	34.750	34.883	35.016	35.149	35.282	35.415	35.548
1041.0	1195.119	1198.692	1202.278	1205.874	1209.482	1213.102	1216.733	1220.375	1224.029	1227.694
	35.681	35.795	35.910	36.024	36.138	36.253	36.367	36.481	36.595	36.710
1042.0	1231.371	1235.059	1238.759	1242.470	1246.192	1249.926	1253.671	1257.427	1261.195	1264.974
	36.824	36.938	37.052	37.166	37.280	37.394	37.508	37.622	37.736	37.850
1043.0	1268.765	1272.567	1276.381	1280.207	1284.044	1287.892	1291.752	1295.624	1299.508	1303.403
	37.964	38.080	38.196	38.312	38.428	38.545	38.661	38.777	38.893	39.009
1044.0	1307.310	1311.228	1315.157	1319.098	1323.050	1327.014	1330.989	1334.975	1338.972	1342.981
	39.125	39.238	39.352	39.465	39.579	39.692	39.805	39.919	40.032	40.146
1045.0	1347.002	1351.032	1355.070	1359.117	1363.172	1367.235	1371.307	1375.387	1379.475	1383.572
	40.259	40.342	40.426	40.509	40.592	40.676	40.759	40.842	40.925	41.009
1046.0	1387.677	1391.789	1395.905	1400.027	1404.153	1408.284	1412.420	1416.560	1420.706	1424.856
	41.092	41.141	41.189	41.238	41.286	41.335	41.383	41.432	41.480	41.529
1047.0	1429.012	1433.171	1437.333	1441.499	1445.667	1449.839	1454.014	1458.191	1462.372	1466.556
	41.577	41.608	41.639	41.670	41.701	41.732	41.763	41.794	41.825	41.856
1048.0	1470.744	1474.933	1479.125	1483.320	1487.516	1491.715	1495.916	1500.119	1504.325	1508.533
	41.887	41.909	41.932	41.954	41.977	41.999	42.021	42.044	42.066	42.089
1049.0	1512.743	1516.955	1521.170	1525.387	1529.607	1533.830	1538.055	1542.283	1546.513	1550.745
	42.111	42.136	42.162	42.187	42.213	42.238	42.263	42.289	42.314	42.340

TABLE 5 (continued)
KAW LAKE
ELEVATION-AREA-CAPACITY TABLE

DATA BASED ON
 1 MAY 1986 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
1050.0	1554.981	1559.245	1563.566	1567.942	1572.375	1576.863	1581.408	1586.008	1590.665	1595.378
	42.365	42.925	43.485	44.045	44.605	45.166	45.726	46.286	46.846	47.406
1051.0	1600.146	1604.947	1609.756	1614.575	1619.401	1624.236	1629.080	1633.933	1638.793	1643.663
	47.966	48.052	48.138	48.223	48.309	48.395	48.481	48.567	48.652	48.738
1052.0	1648.541	1653.426	1658.316	1663.211	1668.111	1673.016	1677.927	1682.842	1687.762	1692.688
	48.824	48.875	48.925	48.976	49.026	49.077	49.128	49.178	49.229	49.279
1053.0	1697.618	1702.553	1707.491	1712.432	1717.377	1722.325	1727.276	1732.231	1737.189	1742.151
	49.330	49.364	49.397	49.431	49.464	49.498	49.531	49.565	49.598	49.632
1054.0	1747.116	1752.084	1757.055	1762.029	1767.006	1771.985	1776.968	1781.954	1786.943	1791.935
	49.665	49.695	49.725	49.755	49.785	49.815	49.844	49.874	49.904	49.934
1055.0	1796.930	1801.928	1806.928	1811.932	1816.937	1821.946	1826.957	1831.972	1836.988	1842.008
	49.964	49.991	50.018	50.046	50.073	50.100	50.127	50.154	50.182	50.209
1056.0	1847.030	1852.055	1857.083	1862.114	1867.148	1872.185	1877.225	1882.268	1887.313	1892.362
	50.236	50.266	50.295	50.325	50.354	50.384	50.413	50.443	50.472	50.502
1057.0	1897.414	1902.468	1907.525	1912.585	1917.648	1922.713	1927.781	1932.851	1937.925	1943.001
	50.531	50.558	50.585	50.612	50.639	50.666	50.693	50.720	50.747	50.774
1058.0	1948.080	1953.160	1958.241	1963.323	1968.406	1973.489	1978.573	1983.658	1988.743	1993.830
	50.801	50.808	50.815	50.823	50.830	50.837	50.844	50.851	50.859	50.866
1059.0	1998.917	2004.007	2009.103	2014.206	2019.314	2024.429	2029.550	2034.676	2039.809	2044.948
	50.873	50.934	50.994	51.055	51.116	51.177	51.237	51.298	51.359	51.419

EXHIBITS

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

KAW LAKE

**EXHIBIT A
SUPPLEMENTARY PERTINENT DATA
KAW LAKE**

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1. GENERAL INFORMATION

Other names for project	None
Location	Arkansas River Basin, Arkansas River, river mile 653.7, State of Oklahoma
Type of project	Dam and lake
Objectives of regulation	Multipurpose - Flood control, hydro- power, water supply, navigation, fish and wildlife, recreation and stream- flow aesthetics
Project owner	U.S. Government
Operating agency	U.S. Army Corps of Engineers. The working hours of operation for weekdays are 7:45 a.m. to 4:30 p.m; working hours for weekends, holidays, and nights vary but generally are the same as weekdays; working hours during flood emergency conditions are 24 hours a day.
Regulating agency	U.S. Army Corps of Engineers
Water rights	Water rights have been granted in the Arkansas River basin between Kaw Dam and Keystone Lake in the amount of 197,294 acre-feet. Releases may be required from Kaw Lake to meet some of these water rights.
Project cost	\$123,000,000
Closure date	The project was placed in operation in May 1977. A single generating unit became operational in August 1989.

2. LAKE INFORMATION

ELEVATIONS, AREAS, AND STORAGES

Feature	Elevation (Feet NGVD)	Area (Acres) (1)	Storage	
			(Acre-feet) (1)	(Inches) (2)
Top of dam	1056.5	--	--	
Max. pool elev.	1053.9	--	--	
Top Induced surcharge	1047.5	39,800	1,466,500	4.61
Top flood control pool	1044.5	38,000	1,348,000 (3)	4.13
Top of conserv. pool	1010.0	17,000	428,600	1.21
Crest of Spillway	997.5	11,760	250,700	.71
Top of Inactive Pool	978.0	5,590	85,000	.24
Flood Control Storage	1010.0- 1044.5	---	919,400	2.59
Streambed @ Dam	931.5	---	---	

(1) Based on 1986 resurvey

(2) Runoff from normal contributing basin area of 6,652 sq. miles

(3) 140,500 acre-feet for sediment reserve

MAXIMUM FLOODS PAST THE DAM SITE

Date	Peak Flow (c.f.s.)	Volume (Acre-feet)	Runoff (inches) (1)
Sept 29 - Oct 4, 1986	185,700	2,377,000	6.70
Apr 19 - Apr 23, 1944	148,000	1,490,100	4.20
Jun 6 - Jun 11, 1923	133,000 (1)	1,216,900	3.43
Apr 30 - May 6, 1961	114,400	1,773,900	5.00
Jun 28 - Jul 13, 1957	94,000	1,270,100	3.58
Nov 15 - Nov 19, 1964	88,000	1,653,200 (1)	4.66

(1) One inch of runoff = 354,773 acre-feet

Real estate taking line
for fee title

The fee taking line is a blocked
perimeter to elevation 1050.0 and
contains 49,000 acres

Real estate taking line
for easement

Flowage easements were acquired in
the flat pool area above the fee
taking line to elevation 1050.0.
In the upper reaches the flowage
easement is to the elevation of
the backwater envelope curve for
a 50-year flood after 50 years
of sedimentation, whichever was
higher. This contains 2,600
acres.

Range of clearing

Lower limit - elevation 996.6
Upper limit - elevation 1013.0

Pool elevation corresponding
to discharge capability
of maximum non-damaging flow
rate downstream

The non-damaging channel capacity
immediately below Kaw Dam is
estimated to be 40,000 c.f.s.
This flow rate can be discharged
when the lake level is at
elevation 1004.8 and above. At
Ralston, channel capacity is
83,600 c.f.s.

Reservoir length at top of
conservation pool

23 miles - Arkansas River arm
13 miles - Walnut River arm

Shoreline length at top of
conservation pool

168 miles

Safety aspects, possibly
requiring warning

At elevation 1017.0 (about 1-yr
flood frequency), recreation areas
would be inundated. The Project
Manager will make every effort to
inform campsite users when roads
and campsites are closed. When
water is released for power or
flood control purposes, a horn
will sound to warn visitors down-
stream of potential danger.

Emergency drawdown

Kaw Lake has eight 50'x 47' tainter gates with a spillway crest at elevation 997.5. The dam also has two 5'8" x 10' sluices, controlled by vertical lift gates, with an invert elevation of 940.0. All water in the reservoir can be emptied through the sluices. The minimum time required to empty when the water level is at the top of the conservation pool is 105 days. The total time required to empty the lake from the top of the flood pool would be 108 days.

3. HYDROLOGY

Drainage area

The total contributing drainage area is 6,652 square miles. The total drainage area above Kaw Lake is 46,530 square miles.

Spillway Design Flood

Max. water surface elevation	1,053.91
Peak inflow (into full pool)	755,000 c.f.s.
Total storm runoff (natural channel flow)	12.71 inches
Volume (into full pool)	4,510,000 acre-feet
Maximum outflow	653,000 c.f.s.
Flood duration	9 days

Standard Project Flood

Maximum water surface elevation	1047.50
Peak inflow (into full pool)	430,000 c.f.s.
Total runoff (natural channel flow)	6.61 inches
Volume (natural channel flows)	2,345,000 acre-feet

Maximum outflow	428,000 c.f.s.
Flood duration	7 days
Climate	Moderate
One inch runoff	354,773 acre-feet
Storm types	Primarily thunderstorms
Flood season	Primary flood period March through July with a secondary period September through November; however, floods are possible in any month of the year.
Low flow season	Primarily August, September, December through February; however, low flow can occur at any time of the year.
Minimum daily flow*	14 c.f.s. (October 22, 1971)
Minimum monthly flow*	1,000 acre-feet (November, 1921)
Minimum annual flow*	219,200 acre-feet (1956)
Average annual flow*	2,187,700 acre-feet
Maximum daily flow*	164,400 c.f.s. (October 3, 1986)
Maximum instantaneous flow	190,000 c.f.s. (October 3, 1986)
Maximum monthly flow*	1,807,300 acre-feet (July 1951)
Maximum annual flow*	6,579,300 acre-feet (1951)
Maximum flood volume	1,298,000 acre-feet (29 September-4 October 1986)

* (Based on 1940-1986 period of record with Kaw, Cheney and Great Salt Plains Lakes in operation.)

Name and location of key gages	Arkansas City gage is located upstream of Kaw Lake on the Arkansas River at river mile 701.4. The Ralston gage is located downstream of Kaw Lake on the Arkansas River at river mile 594.0. The Winfield gage is located on the Walnut River at river mile 24.80.
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Type of data recorded
at damsite

Maximum and minimum air
temperature, recording and
standard rainfall gages,
evaporation pan, anemometer,
pool elevation (recording and
staff) and tailwater elevation
(recording and staff)

Number of precipitation
stations used in hydrologic
forecasting of Kaw Lake

Thirty-nine recording and twelve
non-recording.

Number of sediment ranges

64

Number of degradation ranges

26

4. EMBANKMENTS

Location

Arkansas River at river mile 653.7

Purpose

Protection of agriculture lands
and rural and urban structures,
against loss of life and property,
hydropower, water supply,
navigation and recreation

Type

Non-overflow embankment

Type of fill

Rolled earthfill with impervious
earth core

Slope protection

Riprap upstream and grassed on
downstream

Height

125 feet above streambed

Length

9,466 feet

Top elevation

1056.5

Design flood

Spillway Design Flood

Freeboard
elevation

2.7 feet above maximum pool

Used for roadway

Yes, a Corps of Engineers access
road crosses the embankment and
spillway with a 24-foot wide
asphalt roadway

Elevation of streambed

931.5

5. SPILLWAY

Location	In right abutment
Type	Gated controlled spillway, gravity ogee weir
Crest elevation	997.5
Net overflow length	400 feet
Number, type, and size of gates	Eight 50'x 47' tainter gates operated by individual electric powered hoists
Top of gate elevation	1044.5
Induced surcharge	3 feet
Design head	54 feet
Maximum discharge capacity	653,000 c.f.s.
Type energy dissipator	Concrete slab stilling basin with 2 rows of baffles and a 10 foot high end sill
Time required to open/close gates	45 minutes from top to bottom positions for tainter gates
Type emergency closure	Diesel powered generating unit is located at project
Spillway activation	The tainter gates and sluices, except for periodic maintenance, are activated only during flood conditions. During normal conditions, all discharges including low flow requirements are released through the penstocks and turbines.

6. LEVEE

Location	West, south and east sides of Arkansas City, Kansas.
Purpose	Urban protection.

Type	Non overflow, rolled earth levee.
Type of Fill	Sandy soil.
Slope protection	Grass.
Height (maximum)	19 feet
Length	4.3 miles
Top elevation	1080.0
Level of Protection on the Arkansas River	45-year flood.
Flood closure structure	None.
Drainage structures	Area 1: One 36-inch diameter cmp gravity drain with flap gate. One 12-inch diameter steel pump line with one 3,650-GPM pump. Area 2: One 24-inch diameter cmp gravity drain with flap gate. Area 3: One 42-inch diameter cmp gravity drain with flap gate.

7. OUTLET FACILITIES

a. Sluices

Location	Through first two intermediate piers on right side of spillway
Purpose	Low flow and drawdown releases
Type of outlet	Rectangular sluices
Number and size of gates	Two 5' 8" wide by 10' 0" high
Type of service gates	Hydraulically operated lift gates
Entrance invert elevation	940.0
Discharge at pertinent elevations	Bottom of conservation pool (978.0) - 4,300 c.f.s. Top of conservation pool (1010.0) - 6,000 c.f.s. (tainter gates open)

	Top of flood control pool (1044.5) - 7,500 c.f.s (tainter gates closed)
	Top of maximum pool (1053.9) - 6,900 c.f.s. (tainter gates open)
Minimum pool elevation when operative	940.0
Minimum time required to open or close service gates	Average time is 10 minutes from completely closed to completely opened positions
Type of emergency closure and time required	Hydraulically operated slide gates similar to operating gates
Type energy dissipator	Tetrahedral deflectors
b. <u>Water supply outlet</u>	
Location	In outlet works structure
Purpose	Water supply
Number, type and size outlet	One 48" circular conduit
Type service gate	Deferred (pipe blind flanged)
Entrance invert elevation	970.0

8. HYDROELECTRIC POWER FACILITIES

Location	Near left abutment
Type	Run of river
Installed capacity	37,000 kilowatts
Number, type and capacity	One 37,000 kilowatt unit
Power on line date	Aug 1989
Number and size penstocks	One 20-foot diameter
Turbine discharge	Top of power pool; 5,600 c.f.s.
Design head (net head)	76.0 feet

Gross head for power

Top of Flood Control Pool 113.5 feet

Top of Conservation Pool 79.0 feet *

Average net head

Power pool full (1 unit) 78.0 feet **

Dependable capacity 37,000 kilowatts

Annual firm energy 104,000,000 kilowatt-hours

Specific hydroelectric power storage Run of river

Critical tailwater elevation 937.0

Constraints Downstream channel capacity is 40,000 c.f.s.; minimum time "on line" one unit is 10 minutes; normal time "on line" is 10 minutes; maximum fluctuation downstream is 10 feet.

* Numbers computed using tailwater elevation corresponding to 5,000 c.f.s.

** A head loss of approximately one foot is caused by friction in the penstock and turbine housing.

9. CONTROL POINTS

a. Ralston Gage (Arkansas River)

Location At river mile 594.0 on Arkansas River, near left bank on downstream side of bridge on U.S. Highway 18 east of Ralston.

Purpose Measure discharge and serve as control point for flood releases from Kaw Lake

Channel description

Channel meanders over wide sandy bed

Drainage area

54,465 square miles of which
7,615 square miles is probably
noncontributing

Target flow rate

Bankfull stage is 16 feet, 83,500
c.f.s. (current rating)

Time of water travel from
Kaw Dam to gage

Approximately 20 hours

Description of equipment

Water-stage recorder

Zero of gage

Elevation 776.70

EXHIBIT B

WATER SUPPLY CONTRACTS

KAW LAKE

EXHIBIT B
FORMAL AGREEMENTS
KAW LAKE

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SURPLUS WATER CONTRACT
BETWEEN THE UNITED STATES OF AMERICA
AND
APAC-OKLAHOMA, INC., STANDARD INDUSTRIES DIVISION
FOR
SURPLUS OF WATER FROM KAW LAKE

THIS CONTRACT, entered into this 15th day of September 1989 by and between the UNITED STATES OF AMERICA (hereinafter called the "Government") represented by the Contracting Officer executing this contract, and APAC-OKLAHOMA, INC., STANDARD INDUSTRIES DIVISION, (hereinafter called the "User");

WITNESSETH THAT:

WHEREAS, pursuant to the Flood Control Act of 1962, Public Law 87-874, 87th Congress, 2d Session, approved 23 October 1962, the Government has constructed and is operating Kaw Lake, (hereinafter called the "Project"); and,

WHEREAS, Section 6 of the Flood Control Act of 1944 (Public Law 78-534), as amended, provides that the Secretary of the Army is authorized to make contracts with states, municipalities, private concerns, or individuals, at such prices and on such terms as he may deem reasonable, for domestic and industrial uses for surplus water that may be available at any reservoir under his control provided that no contracts for such water shall adversely affect this existing lawful uses of such water; and,

WHEREAS, on the 19th day of August 1989, Contract No. DACW56-79-C-0222 between the Government and the User providing the User the right to withdraw 2 acre-feet of water per calendar year from Kaw Lake for municipal and industrial water supply purposes expired; and,

WHEREAS, the Government will approve the five (5) year extension of an existing easement to the User on which the User has already constructed and is operating and maintaining water conveyance facilities, across and upon Government-owned land of the Project; and,

WHEREAS, the User desires to contract with the Government for the privilege of withdrawing water from the Project;

NOW, THEREFORE, the parties do mutually agree as follows:

ARTICLE 1 - Water Supply and Withdrawals.

a. The Government will reserve 2 acre-feet of storage space in the Project in order to meet the water demands of the User. From this storage space the User shall have the privileges of withdrawing water at a rate not to exceed 2 acre-feet of water per calendar year during the term of this contract as specified in Article 6 hereof.

b. The User shall have the right to construct, operate and maintain installations and facilities, or to contract with third parties therefor, for the purpose of withdrawing water from the Project, subject to the approval of the Contracting Officer as to design and location of such installation and facilities. All costs associated with such installations and facilities or any modifications thereof or any future construction in connection therewith, shall be without expense to the Government.

c. The Government reserves the right to maintain at all times minimum downstream releases through the gates or spillway of the dam to meet established water requirements. The Government further reserves the right to take such measures as may be necessary in the operation of the Project to preserve life and/or property, including the right not to make downstream releases during such periods of time as are deemed necessary, in its sole discretion, to inspect, maintain, or repair the Project.

d. The User recognizes that this contract provides storage space for raw water only. The Government makes no representation with respect to the quality or availability of water and assumes no responsibility therefor, or for treatment of the water.

ARTICLE 2 - Metering. For the purpose of maintaining an accurate record of the water withdrawn from the Project, the User agrees to furnish and install, or cause to be installed, meters or measuring devices satisfactory to the Contracting Officer, without cost to the Government. As required, the User agrees to furnish to the Contracting Officer advance estimates of need and records of the quantity of water actually withdrawn.

ARTICLE 3 - Federal and State Laws.

a. The User shall utilize the water withdrawn from the Project in a manner consistent with Federal, State, and local laws.

b. The User furnishes, as part of the contract, an assurance (Exhibit A) that the User will comply with Title VI of the Civil Rights Act of 1964 (78 Stat. 252; 42 U.S.C. 2000d, et seq) and Department of Defense Directive 5500.11 issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations.

c. Any discharges of water or pollutants into a navigable stream or tributary thereof resulting from the User's facilities and operations undertaken under this contract shall be performed only in accordance with applicable Federal, State and local laws and regulations.

ARTICLE 4 - Regulation of the Use of Water. The regulation of the use of and water rights needed for the water withdrawn or released from the storage space shall be the sole responsibility of the User and under the sole authority of the User in accord with Federal, State, and local laws and shall not be considered a part of this contract. The Government shall not be responsible for the use of water by the User, nor will it become a party to any controversies involving the water use, except as such controversies may affect the operations of the Project.

ARTICLE 5 - Consideration and Payment.

a. In consideration of the right to withdraw 2 acre-feet per calendar year for five (5) years from the Project for domestic water supply purposes, the User shall pay the Government \$200 which, as shown in Exhibit "B" attached to and made a part of this contract, shall be due and payable within thirty (30) days of the effective date of the contract as set forth in Article 6 herein.

b. The repayment amount shown in Article 5(a) and Exhibit "B" is based upon joint-use and specific water supply construction costs updated to October 1988 price levels using appropriate indices and the Fiscal Year 1989 water supply interest rate of 9.25 percent as computed by the Secretary of the Treasury in accordance with Section 932 of the Water Resources Development Act of 1986 (PL99-662).

c. If the User shall fail to make any payment under this contract within 30 days of the date due, interest thereon shall accrue at the rate as determined by the Department of Treasury's Treasury Fiscal Requirement Manual (1 TFRM 6-8000, "Cash Management") and shall compound annually from the date due until paid. This provision shall not be construed as waiving any other rights the Government may have in the event of default by the User, including but not limited to the right to terminate this contract for default.

ARTICLE 6 - Duration of Contract. This contract shall become effective as of the date of the approval by the Contracting Officer, and shall continue in full force and effect under the conditions set forth herein, for a period of not to exceed 5 years from 20 August 1989, expiration date of User's existing withdrawal contract. Upon expiration, this contract may be extended by mutual agreement for additional periods of not to exceed 5 years each. All such contract extensions shall be subject to recalculation of reimbursement.

ARTICLE 7 - Termination of Contract.

a. Either party may terminate this contract and the privilege of withdrawing water upon thirty (30) days written notice. In the event of termination under this paragraph, the Government will make pro rata refund for any balance of the contract term for which payment has been made and the User will pay all charges which have accrued through the date of the termination.

b. The Government may terminate this contract and the privilege of withdrawing water upon ninety (90) days written notice, if the User shall default in performance of any obligation of this contract. Upon such a termination, User shall continue to be liable to the Government for any monies owed and for any costs incurred by the Government as a result of the default.

c. In the event of any termination pursuant to this Article or Article 6, User shall, upon request of the Contracting Officer, promptly remove, at User's own expense, any facilities constructed on Project land for water withdrawal and restore premises around the removed facilities to a condition satisfactory to the Contracting Officer.

ARTICLE 8 - Rights-of-Way. Occupancy and use of Project lands shall be in accordance with any permits, rights-of-way, or easements granted to the User by the Government.

ARTICLE 9 - Release of Claims. The User shall hold and save the Government, including its officers, agents, and employees, harmless from liability of any nature or kind for or on account of any claim for damages which may be filed or asserted as a result of the withdrawal or release of water from the Project made or ordered by the User, or as a result of the construction, operation or maintenance of any facilities or appurtenances owned and operated by the User except for damages due to the fault or negligence of the Government or its contractors.

ARTICLE 10 - Transfer or Assignment. The User shall not transfer or assign this contract nor any rights acquired thereunder, nor suballot said water or storage space or any part thereof, nor grant any interest, privilege or license whatsoever in connection with this contract, without the approval of the Secretary of the Army or his duly authorized representative provided that, unless contrary to public interest this restriction shall not be construed to apply to any water which may be withdrawn or obtained from the water supply storage space by the User and furnished to any third party or parties or to the rates charged therefor.

ARTICLE 11 - Officials Not to Benefit. No member of or delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this contract, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

ARTICLE 12 - Covenant Against Contingent Fees. The User warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the User for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability, or in its discretion, to add to the contract price or consideration the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE 13 - Approval of Contract. This contract shall be subject to the written approval of the Secretary of the Army or his duly authorized representative and shall not be binding until so approved.

IN WITNESS WHEREOF, the parties have executed this contract as of the day and year first above written.

APPROVED:

APAC-OKLAHOMA, INC.,
STANDARD INDUSTRIES DIVISION

THE UNITED STATES OF AMERICA

By

Mearl Percy
Mearl Percy
President

F. L. Smith, Jr.
F. L. Smith, Jr.
Colonel, U.S. Army
District Engineer
Contracting Officer

DATE:

9-15-89

DATE:

89 SEP 15

TECHNICAL REVIEW

By

W.C. 9/15/89

Reviewed for Legal Sufficiency

By

K.H. - 9/15/89

CERTIFICATION

I, DAN A. DENARDIS, certify, that I am
the SECRETARY of the APAC-Oklahoma,
Inc., Standard Industries Division named as the User herein;
that MEARL C. PEARCY who signed this contract on behalf of the
User was then PRESIDENT of said User; that said contract
was duly signed for and on behalf of said User by authority of its governing
body and is within the scope of its corporation powers.

IN WITNESS WHEREOF, I have hereunto affixed my hand and the seal of
said User this 15 day of SEPTEMBER, 1989.

(Corporate Seal)


DAN A. DENARDIS

**ASSURANCE OF COMPLIANCE WITH THE DEPARTMENT OF DEFENSE DIRECTIVE
UNDER TITLE VI OF THE CIVIL RIGHTS ACT OF 1964**

APAC-OKLAHOMA, INC., STANDARD INDUSTRIES DIVISION
(hereinafter called "Applicant-Recipient")

HEREBY AGREES THAT it will comply with title VI of the Civil Rights Act of 1964 (Public Law 88-352) and all requirements imposed by or pursuant to the Directive of the Department of Defense (32 Code of Federal Regulations Part 300, issued as Department of Defense Directive 5500.11, 28 December 1964) issued pursuant to that title, to the end that, in accordance with title VI of that Act and the Directive, no person in the United States shall, on the ground of race, color, or national origin be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant-Recipient receives Federal financial assistance from Department of the Army and HEREBY GIVES ASSURANCE THAT it will immediately take any measures necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Applicant-Recipient by the Department of the Army, assurance shall obligate the Applicant-Recipient, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the

Applicant-Recipient for the period during which it retains ownership or possession of the property. In all other cases, this assurance shall obligate the Applicant-Recipient for the period during which the Federal financial assistance is extended to it by Department of the Army.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contracts, property, discounts or other Federal financial assistance extended after the date hereof to the Applicant-Recipient by the Department, including installment payments after such date on account of arrangements for Federal financial assistance which were approved before such date. The Applicant-Recipient recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant-Recipient, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign this assurance on behalf of the Applicant-Recipient.

Sections IV and VII of Department of Defense Directive 5500.11 setting forth prohibited discriminatory actions and compliance information is on the reverse hereof.

Dated September 15, 1989

APAC-OKLAHOMA, INC., STANDARD INDUSTRIES DIV.

(Applicant-Recipient)

By MEARL C. PEARCY
MEARL C. PEARCY
PRESIDENT

SWI Form 553
Rev 23 Jun 72

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

EXHIBIT "A"

EXHIBIT B

RESERVOIR CONTROL

<u>Feature</u>	<u>Elevation</u> (ft NGVD)	<u>Usable</u> <u>Storage (1)</u> (ac-ft)	<u>Conservation</u> <u>Storage</u>	<u>Percent of</u> <u>Water Supply</u> <u>Storage</u>
Flood Control	1010.0 - 1044.5	835,000		
Conservation	978.0 - 1010.0	203,000	100.000	
Water Supply		171,200	84.335	100.000
Standard Industries		2	0.001	0.001
Others		171,198	84.334	99.999
Water Quality Control		<u>31,800</u>	15.665	
TOTAL		1,038,000		

'1) Storage remaining after 100 years sedimentation from the date the Project became operational for water supply purposes, 1 May 1976.

SURPLUS WATER
STORAGE COST UPDATE
FOR FY 1989
\$1,000.00

PROJECT, KAW LAKE

Construction Initiated, June 1966

Construction Completed, 22 April 1976

Construction Mid-Point, May 1971

	Joint Use Costs As of 1 October <u>1977</u>	Mid-Point Construction May 1971 (1) ENR or (2) CWCCIS <u>Index</u>	October (1) ENR or (2) CWCCIS 1988 <u>Index</u>	<u>Update Factor</u>	October 1988 Joint Use Costs
Lands and Damages	28,875.0	Updated by a qualified Corps of Engineers Real Estate appraiser			26,799.1
Relocations	24,703.0	1,551 (1)	4,555 (1)	2.937	72,552.7
Reservoir	1,509.0	147 (2)	411 (2)	2.796	4,219.2
Dam and Spillway	33,312.0	131 (2)	382 (2)	2.916	97,137.8
Outlet Works	-	- (2)	- (2)	-	-
Auxiliary	-	- (2)	- (2)	-	-
Roads	669.0	135 (2)	390 (2)	2.889	1,932.7
Recreation facilities	-	- (2)	- (2)	-	-
Buildings, grounds & utilities	332.0	1,551 (1)	4,555 (1)	2.937	975.1
Permanent operating equipment	360.0	1,551 (1)	4,555 (1)	2.937	1,057.3
TOTAL	89,670.0				204,673.9

(1) Engineering News Record Index

(2) Civil Works Construction Cost Index System

EXHIBIT B (Cont)

DACW56 - 89 - C - 0063
Contract No.

EXHIBIT B (Cont)

DACW56 - 89 - C - 0063

Contract No.

SURPLUS WATER

COST PER ACRE-FOOT OF STORAGE
FOR FY 1989PROJECT: KAW LAKESTORAGE TO SUPPLY SURPLUS WATER - 171,200 AC-FTYIELD OF STORAGE TO SUPPLY SURPLUS WATER - 167 MGD 187,040 AC-FT/YRPROJECT USABLE STORAGE AFTER 100 YEARS SEDIMENTATION

FLOOD CONTROL	<u>835,000</u>	AC-FT
WATER SUPPLY	<u>171,200</u>	AC-FT
WATER QUALITY	<u>31,800</u>	AC-FT
POWER	<u>-</u>	AC-FT
NAVIGATION	<u>-</u>	AC-FT
IRRIGATION	<u>-</u>	AC-FT

A. TOTAL PROJECT USABLE STORAGE - 1,038,000 AC-FTB. OCTOBER 1988 PROJECT UPDATED
JOINT-USE COST- \$204,673,900 (SEE ATTACHED
(TABLE))C. PRIOR YEAR FY88 ACTUAL JOINT-USE
OPERATION AND MAINTENANCE COST- \$ 641,956D. ESTIMATED PROJECT ANNUAL JOINT-USE
MAJOR REPLACEMENT COST- \$ E. ESTIMATED PROJECT ANNUAL JOINT-USE
MAJOR REHABILITATION COST- \$

COST OF ONE (1) ACRE-FOOT OF STORAGE

= (1/1,038,000) = 0.00000096 X \$204,673,900 = 196

ANNUAL COST OF ONE (1) ACRE-FOOT OF STORAGE

STORAGE

REPAYMENT PERIOD - 30 YEARS

REPAYMENT INTEREST RATE - 9.25% FY 1989

H REPAYMENT FACTOR - 0.091077

196 X 0.091077 = 17.85

OPERATION AND MAINTENANCE

641,956 X 0.00000096 = 0.61

EXHIBIT B (Cont)

Contract No.

MAJOR REPLACEMENT & REHABILITATION

 D X 0.00000096 =

MAJOR REHABILITATION

 E X 0.00000096 =

TOTAL ANNUAL COST OF ONE (1)
ACRE-FOOT OF STORAGE = 18.46

FY89 COST OF WATER

167 MGD/171,200 AC-FT = 0.00098 MGD/AC-FT
[\$18.46 ANNUAL COST/AC-FT/0.00098 MGD/AC-FT]/3,650 = 5.2 cents PER 1,000 GAL.

STANDARD INDUSTRIES
KAW LAKE
 WATER SUPPLY COSTS

171,200 AF storage = 167 MGD = 187,040 AF/year
 Water needs - 2 acre-feet per year
 Required storage = $\frac{171,200 \times 2}{187,040}$ = 2 acre-feet storage

Annual cost of one (1) acre-foot
 of storage = \$ 18.46
 2 acre-feet of storage X 2

ANNUAL COST OF STORAGE = \$ 36.92
 5 years X 5

\$184.60
 Administrative Cost + 15.40

TOTAL COST \$200.00

CONTRACT BETWEEN THE UNITED STATES OF AMERICA
AND

THE KAW TRIBE OF OKLAHOMA

FOR

INTERIM USE OF WATER FROM KAW LAKE

THIS CONTRACT, entered into this 4th day of March, 1988, by and between the UNITED STATES OF AMERICA (hereinafter called the "Government") represented by the Contracting Officer executing this contract, and THE KAW TRIBE OF OKLAHOMA, (hereinafter called the "User");

WITNESSETH THAT:

WHEREAS, the Flood Control Act of 1962, approved 23 October 1962, (Public Law 87-874, 87th Congress 2d session), authorized the construction, operation, and maintenance of the Kaw Lake on the Arkansas River, Oklahoma, (hereinafter called the "Project"); and

WHEREAS, pursuant to Section 8 of the Act of December 22, 1944, (Public Law 78-534), as amended by Section 931 of the Water Resources Development Act of 1986 (Public Law 99-662), the User desires to contract with the Government for the interim use for agricultural irrigation of storage included in the Project for municipal and industrial water supply which is not under contract for delivery, until such storage space is required for municipal and industrial water supply; and,

WHEREAS, the Government, through the Secretary of the Army, will approve the grant of an easement to the User, and right of entry will be issued the User, to construct, operate, and maintain water conveyance facilities, across and upon Government-owned land of the Project;

NOW, THEREFORE, the parties do mutually agree as follows:

ARTICLE 1 - Water Supply and Withdrawals.

(a) The User shall have the privilege of withdrawing water from the Project for agricultural irrigation purposes only at a rate not to exceed 6 (six) acre-feet per calendar year between elevations 978.0 feet National Geodetic Vertical Datum and 1010.0 feet National Geodetic Vertical Datum during the term of this contract as specified in Article 6 hereof.

(b) The User shall have the right to construct, operate, and maintain installations and facilities, or to contract with third parties therefor, for the purpose of withdrawing water from the Project, subject to the approval of the Contracting Officer as to design and location of such installation and facilities. All costs associated with such installations and facilities or any modifications thereof or any future construction in connection therewith, shall be without expense to the Government.

(c) The Government reserves the right to take such measures as may be necessary in the operation of the Project to preserve life and/or property, to preserve the safety of the Project, or to satisfy Project purposes.

(d) The User recognizes that this contract provides only for withdrawals of water from the Project and that any water withdrawn will be raw water. The Government makes no representation with respect to the quality or availability of water and assumes no responsibility therefor, or for treatment of the water withdrawn. The water level of the Project will be maintained at elevations which the Government deems will best serve the authorized purposes of the Project, and this contract shall not be construed as giving the User any rights to have the water level maintained at any elevation. The User further recognizes that it is acquiring no right to the use of storage space in the Project.

ARTICLE 2 - Metering. For the purpose of maintaining an accurate record of the water withdrawn from the Project, the User agrees to furnish and install, or cause to be installed, meters or measuring devices satisfactory to the Contracting Officer, without cost to the Government. As required, the User agrees to furnish to the Contracting Officer advance estimates of need and records of the quantity of water actually withdrawn.

ARTICLE 3 - Federal and State Laws.

(a) The User shall obtain any permits required pursuant to the Clean Water Act of 1977 in connection with any facilities constructed, as well as any other permits or approvals required by Federal, State, or local governments in connection with User activities hereunder.

(b) The User shall utilize the water withdrawn from the Project in a manner consistent with Federal, State, and local laws.

(c) The User furnishes, as part of the contract, an assurance (Exhibit A) that the User will comply with Title VI of the Civil Rights Act of 1964 (78 Stat. 252; 42 U.S.C. 2000d, et seq) and Department of Defense Directive 5500.11 issued pursuant

thereto and published in Part 300 of Title 32, Code of Federal Regulations.

ARTICLE 4 - Regulation of the Use of Water. The regulation of the use of the water withdrawn shall be the sole responsibility of the User and under the sole authority of the User in accordance with Federal, State, and local laws and shall not be considered a part of this contract. The Government shall not be responsible for the use of water withdrawn by the User, nor will it become a party to any controversies involving the water withdrawn, except as such controversies may affect the operations of the Project.

ARTICLE 5 - Consideration and Payment.

(a) In consideration of the right to withdraw six (6) acre-feet per calendar year for five (5) years from the Project for agricultural irrigation purposes, the User shall pay the Government \$80 per year which shall be due and payable within 30 days of the effective date of the contract as set forth in Article 6 herein. Thereafter, \$80 yearly payments shall be payable on the anniversary date of this contract.

(b) If the User shall fail to make any payment under this contract within 30 days of the date due, interest thereon shall accrue at the rate of thirteen percent per annum compounded annually from the date due until paid. This provision shall not be construed as waiving any other rights the Government may have in the event of default by the User, including but not limited to the right to terminate this contract for default.

ARTICLE 6 - Period of Contract. This contract shall become effective as of the date of the approval by the Contracting Officer, and it shall continue in full force and effect under the conditions set forth herein, for a period of five (5) years from said date of approval. Upon expiration, this contract may be extended by mutual agreement for additional periods of not to exceed five (5) years each.

ARTICLE 7 - Recalculation of Reimbursement and Extension of Contract. It is understood that the relative value of services from the Project may change from time to time, and the Government shall redetermine the amount of payment required under this contract from time to time, but at intervals of not more than five (5) years. The Contracting Officer shall advise the User in writing of any such redetermination of the amount of payment and the basis for such redetermination. If the User finds the new basis for the charges unacceptable, then within twenty-five days from the date of receipt of the letter, the User may appeal the decision of the Contracting Officer through the Contracting Officer to the Chief of Engineers, whose decision on the matter shall be binding without the right of further appeal. The User may at this time terminate this contract. If User neither

accepts the Contracting Officer's letter nor appeals the basis, within the twenty-five day period, this contract shall expire at the conclusion of such period.

ARTICLE 8 - Termination of Contract.

(a) Either party may terminate this contract and the privilege of withdrawing water upon 30 days written notice. In the event of termination under this paragraph, the Government will make pro rata refund for any balance of the contract term for which payment has been made and the User will pay all charges which have accrued through the date of the termination.

(b) The Government may terminate this contract and the privilege of withdrawing water upon ninety (90) days written notice, if the User shall default in performance of any obligation of this contract. Upon such a termination, the User shall continue to be liable to the Government for any monies owed and for any costs incurred by the Government as a result of the default.

(c) In the event of any termination pursuant to this Article or Article 6 or 7, the User shall, upon request of the Contracting Officer, promptly remove, at User's own expense, any facilities constructed on Project land for water withdrawal and restore premises around the removed facilities to a condition satisfactory to the Contracting Officer.

ARTICLE 9 - Rights-of-Way. Occupancy and use of Project lands shall be in accordance with any permits, rights-of-way, or easements granted to the User by the Government.

ARTICLE 10 - Release of Claims. The User shall hold and save the Government, including its officers, agents, and employees, harmless from liability of any nature or kind for or on account of any claim for damages which may be filed or asserted as a result of the withdrawal of water from the Project by the User, or as a result of the construction, operation, or maintenance of any facilities or appurtenances owned and operated by the User.

ARTICLE 11 - Transfer or Assignment. The User shall not transfer or assign this contract nor any rights acquired thereunder, nor suballot said water or any part thereof, nor grant any interest, privilege or license whatsoever in connection with this contract, without the approval of the Chief of Engineers or his duly authorized representative provided that this restriction shall not be construed to apply to any water which may be withdrawn by the User from the Project under the terms of this contract and furnished to any third party or parties or to the rates charged therefor.

ARTICLE 12 - Officials Not to Benefit. No member of or delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this contract, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

ARTICLE 13 - Covenant Against Contingent Fees. The User warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the User for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability; or in its discretion, to add to the contract price or consideration the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE 14 - Definitions.

(a) The term "Contracting Officer" as used herein means the person executing this contract on behalf of the Government and includes a duly-appointed successor or authorized representative.

(b) As used in Article 7, the term "Chief of Engineers" means the Chief of Engineers, the Deputy Chief of Engineers, or the Director of Civil Works.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the day and year first above written.

KAW TRIBE OF OKLAHOMA

By W. A. McHugh
Chairman

DATE: December 3, 1987

THE UNITED STATES OF AMERICA

APPROVED:

By Frank M. Patete
FRANK M. PATETE
Colonel, Corps of Engineers
District Engineer
Contracting Officer

DATE: 9 Mar 1988

Reviewed for Legal Sufficiency

By 24 3/1/88

TECHNICAL REVIEW

By James W. Sherman
14 FEB 88

CERTIFICATION

"I, _____, Attorney for the Kaw Tribe of Oklahoma, (hereinafter called the "User"), hereby certify that the foregoing agreement executed by _____, Chairman of the User, is within the scope of his authority to act upon behalf of the User, and that in my capacity as Attorney for the User, I have considered the legal effect of Section 221 of the 1970 Flood Control Act (Public Law 91-611) and find that the User, is legally and financially capable of entering into the contractual obligations contained in the foregoing agreement and that, upon acceptance, it will be legally enforceable.

Given under my hand, this _____ day of _____ 198__.

Attorney for the Kaw Tribe of Oklahoma



KAW TRIBE OF OKLAHOMA

Handwritten signature
Hud. Sec.

Drawer 50 • Kaw City, Oklahoma 74641 • (405) 269-2552

KAW TRIBE OF OKLAHOMA RESOLUTION 87-102

APPROVAL OF CONTRACT FOR WITHDRAWAL OF WATER FROM KAW LAKE

- WHEREAS, the Kaw Tribe of Oklahoma is federally recognized by the Secretary of the Interior by a Governing Resolution adopted and ratified on October 7, 1958, and
- WHEREAS, the Kaw Tribal Business Committee is the governing body of the Kaw Tribe of Oklahoma, and
- WHEREAS, the Kaw Tribe owns a wholesale growing nursery located on its tribal trust lands at Kaw Lake, and
- WHEREAS, the tribe has, with the approval of the Corps of Engineers, installed a buried water line from Kaw Lake to supply this growing nursery with lake water, and
- WHEREAS, federal laws governing the administration of the lake require that any user of that water enter into a contract with the Corps of Engineers regulating the withdrawal of this water, and
- WHEREAS, the Corps of Engineers has drawn up such a contract agreement (Exhibit A), which is subject to the approval of the Kaw Tribal Business Committee,

THEREFORE BE IT RESOLVED, with full authority and approval, that the Kaw Tribal Business Committee authorizes that such a contract be negotiated and signed by Kaw Tribal Chairman, Mr. William A. Mehojah, and that he be hereby instructed to implement any actions required by the contract's provisions.

CERTIFICATION

I, W. A. Mehojah, Chairman of the Kaw Tribal Business Committee, do hereby certify that said resolution was approved and adopted on December 3, 1987 as an official act by quorum vote of the Kaw Tribal Business Committee and that the vote was: 5 for; 0 against; 0 abstentions; and 1 absent.

W. A. Mehojah
W. A. MEHOJAH, CHAIRMAN

ATTEST:

Paula Stone
SECRETARY-TREASURER

Contract No.

DACW56 - 80-C-0113

CONTRACT BETWEEN THE UNITED STATES OF AMERICA

AND

STILLWATER UTILITIES AUTHORITY

FOR

WATER STORAGE SPACE IN KAW LAKE

(5/ 4 March 81)

This CONTRACT, entered into this _____ day of 180 SEP 2, 19, by and between THE UNITED STATES OF AMERICA (hereinafter called the "Government") represented by the Contracting Officer executing this contract, and the STILLWATER UTILITIES AUTHORITY, OKLAHOMA, (hereinafter called the "User");

WITNESSETH THAT:

WHEREAS, the Flood Control Act of 1962, approved 23 October 1962, (Public Law 87-874) authorized the construction, operation, and maintenance of the Kaw Lake on the Arkansas River, Oklahoma, (hereinafter called the "Project"); and

WHEREAS, the User desires to contract with the Government for the use of storage included in the Project for municipal and industrial water supply, and for payment of the cost thereof in accordance with the provisions of the Water Supply Act of 1958, as amended (43 USC 390b-f); and

WHEREAS, the User is empowered so to contract with the Government and is vested with all necessary powers for accomplishment of the purposes of this contract;

NOW, THEREFORE, the Government and the User agree as follows:

ARTICLE 1 - WATER STORAGE SPACE

a. Project Construction. The Government, subject to the directions of Federal law and any limitations imposed thereby, has constructed the Project so as to include therein space for the storage of water by the User.

b. Rights of User.

(1) The User shall have the right to utilize an undivided 25.345 percent (estimated to contain 51,450 acre-feet after adjustment for sediment deposits) of the total storage space in the Project between elevations 978.0 feet above mean sea level and 1010.0 feet above mean sea level, which total storage space is estimated to contain 203,000 acre-feet after adjustment for sediment deposits. This storage space is to be used to impound water for anticipated future demand or need for municipal and industrial water supply.

(2) The User shall have the right to withdraw water from the lake, or to order releases to be made by the Government through the outlet works in the Dam, subject to the provisions of Article 1(c) and to the extent the aforesaid storage space will provide; and shall have the right to construct all such works, plants, pipelines, and appliances as may be necessary and

Project outlet works shall be made in accordance with written schedules furnished by the User and approved by the Contracting Officer and shall be subject to Article 1c. The measure of all such releases shall be by means of a rating curve of the outlet works, or by such other suitable means as may be agreed upon prior to use of the water supply storage space.

ARTICLE 5 - Payments. In consideration of the right to utilize the aforesaid storage space in the Project for municipal and industrial water supply purposes, the User shall pay the following sums to the Government:

a. Project Investment Costs.

(1) The User shall repay to the Government, at the times and with interest on the unpaid balance as hereinafter specified, the amount which, as shown in Exhibit "A" attached to and made a part of this contract, constitutes the entire estimated amount of the construction costs, including interest during construction, allocated to the water storage right acquired by the User under this contract. The interest rate to be used for purposes of computing interest during construction and interest on the unpaid balance was determined by the Secretary of the Treasury as of the beginning of the fiscal year in which construction of the Project was initiated, on the basis set forth in the Water Supply Act of 1958, as amended. For the Project, construction of which was initiated in FY 1966, this interest rate is 3.222 percent. The User shall repay:

11.58 percent of the total Project joint-use construction costs, estimated at	\$10,384,500
---	--------------

Interest during construction, estimated at	<u>\$ 1,158,700</u>
--	---------------------

Total estimated amount of Project investment costs allocated to water supply	\$11,543,200
--	--------------

(2) The amount of the Project investment costs allocated to the storage space indicated in Article 1b(1) is currently estimated at \$11,543,200 on the basis of the costs presented in Exhibit "A". No principal or interest payment with respect to this storage for future water supply is required to be made during the first 10 years following the date the Project was operational for water supply purposes, unless all or a portion of such storage is used during this period. The amount to be paid for any portion of such storage which is used shall be determined by multiplying the percentage of the total storage for future water supply which is placed in use by the total amount of the Project investment costs allocated to future water supply. Interest at the rate provided above will be charged on the amount of the Project investment costs allocated to the storage for future water supply which is not being used from the tenth (10th) year following the date the Project was operational for water supply purposes (1 May 1976), until the time when such additional storage is first used. The User may at its option pay the interest as it becomes due or allow the interest to accumulate until additional storage is used. If this latter option is exercised, the interest will be compounded annually and added to the principal amount. When any portion of the storage for future

d. Delinquent Payments. If the User shall fail to make any of the aforesaid payments when due, then the overdue payments shall bear interest compounded annually until paid. The interest rate to be used for overdue payments due under the provisions of Articles 5a, 5b, and 5c above, shall be that determined by the Secretary of the Treasury on the basis of the Water Supply Act of 1958, as amended, for use in the Government fiscal year in which each period of delinquency occurs. The amount charged on payments overdue for a period of less than one year shall be figured on a monthly basis. For example, if the payment is made within the first month after being overdue (31 to 60 days after the anniversary date), one month's interest shall be charged. This provision shall not be construed as giving the user a choice of either making payments when due or paying interest, nor shall it be construed as waiving any other rights of the Government, at law or in equity, which might result from any default by the User.

ARTICLE 6 - Construction Cost Adjustments. All construction cost dollar amounts in this contract, including those in the exhibits, are tentative only, based on the Government's best estimates. They will be adjusted upward or downward by the Contracting Officer when final construction costs become known, and the contract will be modified to reflect the adjustments.

ARTICLE 7 - Duration of Contract. This contract shall be effective when approved by the Secretary of the Army and shall continue in full force and effect for the life of the Project.

ARTICLE 8 - Permanent Rights to Storage. Upon completion of payments by the User, as provided in Article 5a herein, the User shall have a permanent right, under the provisions of the Act of 16 October 1963 (Public Law 88-140, 43 USC 390e), to the use of the water supply storage space in the Project as provided in Article 1, subject to the following:

a. The User shall continue payment of annual operation and maintenance costs allocated to water supply.

b. The User shall bear the costs allocated to water supply of any necessary reconstruction, rehabilitation or replacement of Project features which may be required to continue satisfactory operation of the Project. Such costs will be established by the Contracting Officer and repayment arrangements shall be in writing in accordance with the terms and conditions set forth in Article 5b for major capital replacement costs, and be made a part of this contract.

c. Upon completion of payments by the User as provided in Article 5a hereof, the Contracting Officer shall redetermine the storage space for municipal and industrial water supply, taking into account such equitable reallocation of reservoir storage capacities among the purposes served by the Project as may be necessary due to sedimentation. Such findings, and the storage space allocated to municipal and industrial water supply, shall be defined and described in an exhibit which will be made a part of this contract. Following the same principle, such reallocation of reservoir storage capacity may be further adjusted from time to time as the result of sedimentation resurveys to reflect actual rates of sedimentation and the exhibit revised to show the revised storage space allocated to municipal and industrial water supply.

ARTICLE 13 - Environmental Quality. During any construction, operation, and maintenance by User of any facilities, specific actions will be taken to control environmental pollution which could result from such activity and to comply with applicable Federal, State and local laws and regulations concerning environmental pollution. Particular attention should be given to (1) reduction of air pollution by control of burning, minimization of dust, containment of chemical vapors, and control of engine exhaust gases, and of smoke from temporary heaters; (2) reduction of water pollution by control of sanitary facilities, storage of fuels and other contaminants, and control of turbidity and siltation from erosion; (3) minimization of noise levels; (4) onsite and offsite disposal of waste and spoil; and (5) prevention of landscape defacement and damage.

ARTICLE 14 - Water Conservation. There is a strong Federal interest in the efficient use of Federal projects, and this objective may be served by effective management of the use of water from the system into which a Federal project is integrated. Therefore, prior to the first use of storage space indicated in Article 1(b)(1), the User shall submit to the Contracting Officer for his approval a management plan which incorporates loss reduction measures and demand management practices which ensure that the available supply is used in an economically efficient and environmentally sensitive manner. The plan shall contain a program for implementation of specific time-phased measures. At not-to-exceed five-year intervals, the User and the Contracting Officer shall review and modify the plan as the results of the implementation of measures are made apparent and as the system supplies and user demands change.

ARTICLE 15 - Federal and State Laws.

a. In acting under its rights and obligations hereunder, the User agrees to comply with all applicable Federal and State laws and regulations, including but not limited to the provisions of the Davis-Bacon Act (40 USC 276a et seq); the Contract Work Hours and Safety Standards Act (40 USC 327-333); and Title 29, Code of Federal Regulations, Part 3.

b. The User furnishes, as part of this contract, an assurance (Exhibit B) that it will comply with Title VI of the Civil Rights Act of 1964 (78 Stat 241, 42 USC 2000d, et seq) and Department of Defense Directive 5500.11 issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations.

ARTICLE 16 - Definitions.

a. Joint-use costs - The costs of features used for any two or more project purposes.

b. Project investment costs - The initial cost of the Project, including: land acquisition; construction; interest during construction on the value of land, labor, and materials used for planning and construction of the Project.

c. Specific costs - The costs of project features normally serving only one particular project purpose.

CERTIFICATION

DACW56 - 80-C-0113

"I Larry R. Shockey Attorney for the Stillwater Utilities Authority, Oklahoma, named as User herein, hereby certify that the foregoing agreement executed by C.W. "Bill" Thomas, Chairman of the User is within the scope of his authority to act upon behalf of the User, and that in my capacity as Attorney for the User, I have considered the legal effect of Section 221 of the 1970 Flood Control Act (Public Law 91-611) and find that the User is legally and financially capable of entering into the contractual obligations contained in the foregoing agreement and that, upon acceptance, it will be legally enforceable.

Given under my hand, this 27th day of August, 1980."

Larry R. Shockey
Attorney for the Stillwater Utilities
Authority, Oklahoma

EXHIBIT A

I - RESERVOIR STORAGE

<u>Feature</u>	<u>Elevation (ft. msl)</u>	<u>Usable Storage (1) (ac-ft)</u>	<u>Percent of Conservation Storage</u>	<u>Percent of Water Supply Storage</u>
Flood Control	1010.0-1044.5	835,000		
Conservation	978.0-1010.0	203,000	100.000	
Water Supply		171,200	84.335	100.000
Stillwater Utilities Authority		51,450	25.345	30.053
Immediate Use (Storage Space No. 1)		6,662	03.282	03.891
Future Use		44,788	22.063	26.162
Others		119,750	58.990	69.947
Water Quality Control		31,800	15.665	
Total		1,038,000		

(1) Storage remaining after 100 years sedimentation from the date the Project became operational for water supply purposes, 1 May 1976.

REV. 02/01/89

EXHIBIT A (CONT)

 II - ALLOCATION OF ACTUAL FIRST COST

<u>Feature</u>	<u>Cost (\$)</u>	<u>Percent of Joint-Use Construction Cost</u>
Flood Control		
Specific	0	
Joint-Use	38,643,264	42.07
Water Quality		
Specific	0	
Joint-Use	6,723,763	7.32
Recreation		
Specific	11,465,104	
Joint-Use	10,737,812	11.69
Water Supply		
Specific	353,000	
Joint-Use	35,391,608	38.53
Fish & Wildlife		
Specific	0	
Joint-Use	<u>358,233</u>	<u>0.39</u>
Total allocated first cost		
Specific	11,818,104	
Joint-Use	91,854,680	100.00
Road betterments (Specific)	2,040,000	
Power (Specific)	<u>3,530,221</u>	
TOTAL PROJECT FIRST COST	109,243,005	

REV. 02/01/89

EXHIBIT A (CONT)

 III - COSTS TO BE REPAYED BY THE USER
 FOR WATER SUPPLY

PRESENT USE:

Storage Space No. 1

Cost of 6,662 acre-feet of water supply storage (3.891¢ x \$35,391,608)	=	1,377,087.00
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Interest during construction (3.891¢ x \$3,940,280)	=	<u>153,316.00</u>
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PRESENT USE INVESTMENT COST	=	1,530,403.00
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Less credit for 4 principal payments made thru September 1988	=	- <u>96,217.61</u>
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Remaining Present Use cost to be amortized over 46 years	=	1,434,185.39
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FUTURE USE:

Cost of 44,788 acre-feet of water supply storage (26.162¢ x \$35,391,608)	=	9,259,152.00
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Interest during construction (26.162¢ x \$3,940,280)	=	<u>1,030,856.00</u>
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FUTURE USE INVESTMENT COST	=	10,290,008.00
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EXHIBIT A (CONT)

 IV - ANNUAL COSTS TO USER FOR PRESENT USE OF WATER SUPPLY STORAGE SPACE

Storage Space No. 1

Interest and Amortization (3)		
Storage	$0.041982 \times \$1,434,185.39$	= \$60,210
Operation and Maintenance (4)		
Joint-Use		
	$3.891\% \times 18.58\% (5) = 0.723\% \times \$641,956 (FY88)$	= <u>4,641</u>
Major Replacement (6)		
Joint-Use		
	$3.891\% \times 31.58\% (7) = 1.229\% \times \$0 (FY88)$	= <u>0</u>
TOTAL ESTIMATED ANNUAL COSTS		= \$64,851

- (2) Based on 46 payments with interest at 3.222 percent interest rate.
 (3) The first payment shall be due and payable on the date specified in Article 5a(2).
 (4) Percent of Project joint-use operation and maintenance cost allocated to water supply.
 (5) Major replacement costs are payable only when incurred.
 (6) Percent of Project joint-use major replacement cost allocated to water supply.

EXHIBIT B
STORAGE SPACE NO. 1
AMORTIZATION SCHEDULE

TOTAL COST.....		\$1,434,185.39	
NUMBER OF PAYMENTS.....		46	
INTEREST RATE, PERCENT.....		3.2220	
PAYMENT NUMBER	AMOUNT OF PAYMENT	APPLICATION INTEREST	BALANCE ALLOC COST
			\$
1	60,210.00	46,209.45	14,000.55
2	60,210.00	45,758.36	14,451.64
3	60,210.00	45,292.72	14,917.28
4	60,210.00	44,812.09	15,397.91
5	60,210.00	44,315.97	15,894.03
6	60,210.00	43,803.86	16,406.14
7	60,210.00	43,275.26	16,934.74
8	60,210.00	42,729.62	17,480.38
9	60,210.00	42,166.40	18,043.60
10	60,210.00	41,585.04	18,624.96
11	60,210.00	40,984.94	19,225.06
12	60,210.00	40,365.51	19,844.49
13	60,210.00	39,726.12	20,483.88
14	60,210.00	39,066.13	21,143.87
15	60,210.00	38,384.87	21,825.13
16	60,210.00	37,681.67	22,528.33
17	60,210.00	36,955.81	23,254.19
18	60,210.00	36,206.56	24,003.44
19	60,210.00	35,433.16	24,776.84
20	60,210.00	34,634.85	25,575.15
21	60,210.00	33,810.82	26,399.18
22	60,210.00	32,960.24	27,249.76
23	60,210.00	32,082.25	28,127.75
24	60,210.00	31,175.98	29,034.02
25	60,210.00	30,240.50	29,969.50
26	60,210.00	29,274.88	30,935.12
27	60,210.00	28,278.16	31,931.84
28	60,210.00	27,249.31	32,960.69
29	60,210.00	26,187.32	34,022.68
30	60,210.00	25,091.11	35,118.89
31	60,210.00	23,959.58	36,250.42
32	60,210.00	22,791.59	37,418.41
33	60,210.00	21,585.97	38,624.03
34	60,210.00	20,341.50	39,868.50
35	60,210.00	19,056.94	41,153.06
36	60,210.00	17,730.99	42,479.01
37	60,210.00	16,362.31	43,847.69
38	60,210.00	14,949.54	45,260.46
39	60,210.00	13,491.25	46,718.75
40	60,210.00	11,985.97	48,224.03
41	60,210.00	10,432.19	49,777.81
42	60,210.00	8,828.35	51,381.65
43	60,210.00	7,172.83	53,037.17
44	60,210.00	5,463.98	54,746.02
45	60,210.00	3,700.06	56,509.94
46	60,206.71	1,879.31	58,327.40

MAR 3 1986

Engineering/Hydrology-Hydraulics

Mr. Carl Weinaug
City Manager
Stillwater Utilities Authority
Post Office Box 1449
Stillwater, OK 74074

Dear Mr. Weinaug:

This will acknowledge notification from Mr. Charles A. Walker, Water Treatment Superintendent, that the Stillwater Utilities Authority initiated use of 6,662 acre-feet of storage in Kaw Lake with an estimated dependable yield of 7,280 acre-feet per year (6.5 mgd) on September 27, 1985, pursuant to Article 5(a)(2) of Contract No. DACW56-80-C-0113.

In accordance with Articles 5(a)(2) and (3), I am enclosing a repayment schedule for the storage.

Pursuant to Article 5(c), I am enclosing a statement for the annual payment on the principal plus a pro rata share of joint-use operation and maintenance cost.

Additionally, in accordance with Article 5(a)(3) and 6, Parts II and III of Exhibit A, revised to reflect actual construction costs as of October 16, 1979, are enclosed.

Article 5(a)(1), (2) of the contract provides that interest at the rate of 3.222 percent will be charged on the amount of project investment cost allocated to the storage of future water supply which is not being used from the 10th year following the plant-in-service date (May 1, 1976) until the time when such additional storage is first used. The Authority may at its option pay the interest as it becomes due or allow the interest to accumulate until additional storage is used. The 10-year interest-free period will end April 30, 1986, and interest at the rate of 3.222 percent will be compounded and added to the outstanding principal of \$8,974,500 unless paid each year, with the first interest payment due April 30, 1987.

-2-

If you have any questions, please contact Mr. Jake Gage of our Hydrology-Hydraulics Branch at (918) 581-7240.

Sincerely,

Franklin T. Tilton
Colonel, Corps of Engineers
District Engineer
Contracting Officer

Enclosures

CF:
Exec Ofc (w/o Encls)
Ofc of Counsel (T. Smith w/o Encls)
Comptroller (Hayes)
H-H Branch

RRH
NIGHT
7209

SCOGGINS
7208

SIMS
7860

T SMITH
7333

GAGE
7278

REDFORD
7311

LTC SMITH
7311

/s/ Franklin T. Tilton
COL TILTON
7311

**ASSURANCE OF COMPLIANCE WITH THE DEPARTMENT OF DEFENSE DIRECTIVE
UNDER TITLE VI OF THE CIVIL RIGHTS ACT OF 1964**

Stillwater Utilities Authority
(hereinafter called "Applicant-Recipient")

HEREBY AGREES THAT it will comply with title VI of the Civil Rights Act of 1964 (Public Law 88-352) and all requirements imposed by or pursuant to the Directive of the Department of Defense (32 Code of Federal Regulations Part 300, issued as Department of Defense Directive 5500.11, 28 December 1964) issued pursuant to that title, to the end that, in accordance with title VI of that Act and the Directive, no person in the United States shall, on the ground of race, color, or national origin be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant-Recipient receives Federal financial assistance from Department of the Army and HEREBY GIVES ASSURANCE THAT it will immediately take any measures necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Applicant-Recipient by the Department of the Army, assurance shall obligate the Applicant-Recipient, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the

Applicant-Recipient for the period during which it retains ownership or possession of the property. In all other cases, this assurance shall obligate the Applicant-Recipient for the period during which the Federal financial assistance is extended to it by Department of the Army.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contracts, property, discounts or other Federal financial assistance extended after the date hereof to the Applicant-Recipient by the Department, including installment payments after such date on account of arrangements for Federal financial assistance which were approved before such date. The Applicant-Recipient recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant-Recipient, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign this assurance on behalf of the Applicant-Recipient.

Sections IV and VII of Department of Defense Directive 5500.11 setting forth prohibited discriminatory actions and compliance information is on the reverse hereof.

Dated 8/27/80

Stillwater Utilities Authority

(Applicant-Recipient)

By *C.W. Thomas*
C.W. "Bill" Thomas, Chairman

CONTRACT BETWEEN THE UNITED STATES OF AMERICA
AND

OKLAHOMA GAS AND ELECTRIC COMPANY

FOR

WATER STORAGE SPACE IN KAW LAKE (S) 22 April 80

THIS CONTRACT, entered into this 78 SEP 22 1978 day of 1978, by and between THE UNITED STATES OF AMERICA (hereinafter called the "Government"; represented by the Contracting Officer executing this contract, and the OKLAHOMA GAS AND ELECTRIC COMPANY (hereinafter called the "User");

WITNESSETH THAT:

WHEREAS, the Flood Control Act of 1962, approved 23 October 1962, (Public Law 87-874, 87th Congress 2d session), authorized the construction, operation, and maintenance of the Kaw Lake on the Arkansas River, Oklahoma, (hereinafter called the "Project"); and

WHEREAS, the User desires to contract with the Government for the use of storage included in the Project for municipal and industrial water supply, and for payment of the cost thereof in accordance with the provisions of the Water Supply Act of 1958, as amended (43 USC 390b-f); and

WHEREAS, the User is empowered so to contract with the Government and is vested with all necessary powers for accomplishment of the purposes of this contract;

NOW, THEREFORE, the Government and the User agree as follows:

ARTICLE 1 - Water Storage Space.

(a) Project Construction. The Government, subject to the directions of Federal law and any limitations imposed thereby, has constructed the Project so as to include therein space for the storage of water by the User.

(b) Rights of User.

(1) The User shall have the right to utilize an undivided 19.384 percent (estimated to contain 39,350 acre-feet after adjustment for sediment deposits) of the total storage space in the Project between elevations 978.0 feet above mean sea level and 1010.0 feet above mean sea level, which total storage space is estimated to contain 203,000 acre-feet after adjustment for sediment deposits. This storage space is to be used to impound water for present and anticipated future demand or need for municipal and industrial water supply. 23.25 percent (an estimated 9,150 acre-feet) of the space which User has a right to utilize

is for present use water storage and 76.75 percent (an estimated 30,200 acre-feet) is for future use water storage.

(2) The User shall have the right to withdraw water from the lake, or to order releases to be made by the Government through the outlet works in the Dam, subject to the provisions of Article 1(c) and to the extent the aforesaid storage space will provide; and shall have the right to construct all such works, plants, pipelines, and appliances as may be necessary and convenient for the purpose of diversion or withdrawals, subject to the approval of the Contracting Officer as to design and location. The grant of an easement for right-of-way, across, in and upon land of the Government at the Project shall be by a separate instrument in a form satisfactory to the Secretary of the Army, without additional cost to the User, under the authority of and in accordance with the provisions of 10 USC 2669. Subject to the conditions of such easement, the User shall have the right to use so much of the Project land as may reasonably be required in the exercise of the rights and privileges herein granted.

(c) Rights Reserved. The Government reserves the right to maintain at all times minimum downstream releases through the gates or spillway of the dam to meet established water requirements. The Government further reserves the right to take such measures as may be necessary in the operation of the Project to preserve life or property, including the right not to make downstream releases during such periods of time as is deemed necessary, in its sole discretion, to inspect, maintain, or repair the Project.

(d) Quality or Availability of Water. The User recognizes that this contract provides storage space for raw water only. The Government makes no representations with respect to the quality or availability of water and assumes no responsibility therefor, or for the treatment of the water.

ARTICLE 2 - Regulation of and Right to Use of Water. The regulation of the use of water withdrawn or released from the aforesaid storage space shall be the sole responsibility of the User. The User has the full responsibility to acquire in accordance with state laws and regulations, and, if necessary, to establish or defend, any and all water rights needed for utilization of the storage provided under this contract. The Government shall not be responsible for diversions by others, nor will it become a party to any controversies involving the use of the storage space by the User except as such controversies may affect the operations of the Government.

ARTICLE 3 - Operation and Maintenance. The Government shall operate and maintain the Project and the User shall pay to the Government a share of the costs of such operation and maintenance as provided in Article 5. The User shall be responsible for operation and maintenance of all

installations and facilities which it may construct for the diversion or withdrawal of water, and shall bear all costs of construction, operation, and maintenance of such installations and facilities.

ARTICLE 4 - Measurement of Withdrawals and Releases. The User agrees to furnish and install, without cost to the Government, suitable meters or measuring devices satisfactory to the Contracting Officer for the measurement of water which is withdrawn from the Project by any means other than through the Project outlet works. Prior to the construction of any facilities for withdrawal of water, the User will obtain the Contracting Officer's approval of the design, location, and installation of the facilities including the meters or measuring devices. Such devices shall be available for inspection by Government representatives at all reasonable times. The User shall furnish to the Government monthly statements of all such withdrawals. Releases from the water supply storage space through the Project outlet works shall be made in accordance with written schedules furnished by the User and approved by the Contracting Officer and shall be subject to Article 1(c). The measure of all such releases shall be by means of a rating curve of the outlet works, or by such other suitable means as may be agreed upon prior to use of the water supply storage space.

ARTICLE 5 - Payments. In consideration of the right to utilize the aforesaid water supply storage space in the Project for municipal and industrial water supply purposes, the User shall pay the following sums to the Government:

(a) Project Investment Costs.

(1) The User shall repay to the Government, at the times and with interest on the unpaid balance as hereinafter specified, which, as shown in Exhibit "A" attached to and made a part of this contract, constitutes the entire estimated amount of the construction costs, including interest during construction, allocated to the water supply storage right acquired by the User under this contract. The interest rate to be used for purposes of computing interest during construction and interest on the unpaid balance will be determined by the Secretary of the Treasury as of the beginning of the fiscal year in which construction of the Project is initiated, on the basis set forth in the Water Supply Act of 1958, as amended. For the Project, this interest rate is 3.222 percent. The User shall repay:

8.857 percent of the total Project joint-use construction costs, estimated at	\$7,942,200
Interest during construction, estimated at	<u>\$ 886,200</u>
Total estimated amount of Project investment costs allocated to water supply to be repaid by the User	\$8,828,400

First use initiated 24 Nov 1982

(2) The Project investment costs allocated to the storage space indicated in Article 1(b)(1) as being provided for present demand is currently estimated at \$2,053,000 on the basis of the cost presented in Exhibit "A." The amount of the Project investment costs allocated to the storage for present demand shall be paid in not to exceed 50 consecutive annual installments, the first of which shall be due and payable within 30 days of the effective date of the contract, as set forth in Article 7, herein. Annual installments thereafter will be due and payable on the anniversary date the first payment is due. Except for the first payment which will be applied solely to the retirement of principal, all installments shall include accrued interest on the unpaid balance at the rate provided above. The last annual installment shall be adjusted upward or downward when due to assure repayment of all of the investment costs allocated to the storage for present demand within 50 years.

(3) The amount of the Project investment costs allocated to the remaining portion of the storage space, that provided for future use, is currently estimated at \$6,775,400 on the basis of the costs presented in Exhibit "A". No principal or interest payment with respect to this storage for future water supply is required to be made during the first 10 years following the date the Project is operational for water supply purposes, unless all or a portion of such storage is used during this period. The amount to be paid for any portion of such storage which is used shall be determined by multiplying the percentage of the total storage for future water supply which is placed in use by the total amount of the Project investment costs allocated to future water supply. Interest at the rate provided above will be charged on the amount of the Project investment costs allocated to the storage for future water supply which is not being used from the tenth (10th) year following the date the Project is operational for water supply purposes until the time when such additional storage is first used. The User may at its option pay the interest as it becomes due or allow the interest to accumulate until additional storage is used. If this latter option is exercised, the interest will be compounded annually and added to the principal amount. When any portion of the storage for future water supply is used, payment of both principal and interest for the portion used must be started, and the amount of the Project investment costs allocated thereto, with interest on the unpaid balance as provided above, shall be paid within the life of the Project in not to exceed 50 consecutive annual installments commencing with the next anniversary of the payment date stipulated in Article 5a(2). The first payment shall include interest on the investment cost of such portion from the date of first use of such portion to the next anniversary date stipulated in Article 5a(2).

(4) An estimated schedule of annual payments for the storage provided for present demand is attached as Exhibit "B" of this contract. The annual payments as provided therein shall be made until the actual construction costs of the Project are determined. When the actual

construction costs of the Project are determined, the annual payments due thereafter will be adjusted to reflect any increase or decrease in the actual costs, including interest during construction, from the estimated amounts shown in Exhibit "A". Payment schedules for the storage provided for future water supply demands will be furnished by the Contracting Officer when use of such storage is started, and if based on estimated costs will be subject to revision when actual costs are known.

(6) The User shall have the right at any time it so elects to prepay the indebtedness under this Article 5(a), in whole or in part, with accrued interest thereon to the date of such prepayment.

(b) Major Capital Replacement Costs. The User shall pay to the Government up to 7.259 percent of the costs of joint-use major capital replacement items when incurred. The required repayment for joint-use costs will be commensurate with the User's percentage of storage space being used. Payment shall be paid either in lump sum on demand at the time such costs are incurred or annually with interest on the unpaid balance. If paid annually, the User's share shall be paid within the life of the Project in not to exceed 25 consecutive annual installments with the first payment to be made with the first annual payment on the Project investment costs becoming due after the date said major capital replacement costs are incurred. Annual payments thereafter will be due and payable on said anniversary date. All annual payments for replacement of joint-use items shall include accrued interest on the unpaid balance at the interest rate computed in accordance with the Water Supply Act of 1958 as of the beginning of the fiscal year in which the major capital replacement is initiated. The last annual payment shall be adjusted upward or downward when due to assure repayment of all the incurred costs within the repayment period.

(c) Annual Operation and Maintenance Costs. The User shall pay 0.993 percent of the annual experienced joint-use operation and maintenance costs of the Project until such time as additional storage is used. As additional water supply storage is used, the share of the annual experienced joint-use operation and maintenance costs, which the User will be required to pay will be increased commensurate with the percentage of the water supply storage being used, up to a total of 4.271 percent of such costs. Payments are due and payable in advance on the date for payment of project investment costs as set forth in Article 5a(2) and shall be based on operation and maintenance costs for the Project in the Government fiscal year most recently ended. Should additional usage commence on other than the anniversary date of present usage, operation and maintenance costs for that portion of a year would be prorated by months in use prior to said anniversary date on the basis of the actual experienced operation and maintenance costs for the Government fiscal year most recently ended. The first payment shall be due and payable within 30 days from the date of scheduled first use of storage space. Subsequent annual payments shall be made on the anniversary date of present usage.

(d) Delinquent Payments. If the User shall fail to make any of the aforesaid payments when due, then the overdue payments shall bear interest compounded annually until paid. The interest rate to be used for overdue payments due under the provisions of Articles 5(a), 5(b), and 5(c) above shall be that determined by the Secretary of the Treasury on the basis of the Water Supply Act of 1958, as amended, for use in the Government fiscal year in which each period of delinquency occurs. The amount charged on payments overdue for a period of less than one year shall be figured on a monthly basis. For example, if the payment is made within the first month after being overdue (31 to 60 days after the anniversary date), one month's interest shall be charged. This provision shall not be construed as giving the User a choice of either making payments when due or paying interest, nor shall it be construed as waiving any other rights of the Government, at law or in equity, which might result from any default by the User.

ARTICLE 6 - Construction Cost Adjustments. All construction cost dollar amounts in this contract, including those in the exhibits, are tentative only, based on the Government's best estimates. They will be adjusted upward or downward by the Contracting Officer when final construction costs become known, and the contract will be modified to reflect the adjustments.

ARTICLE 7 - Duration of Contract. This contract shall become effective when approved by the Secretary of the Army and shall continue in full force and effect for the life of the Project.

ARTICLE 8 - Permanent Rights to Storage. Upon completion of payments by the User as provided in Article 5(a) herein, the User shall have a permanent right, under the provisions of the Act of 16 October 1963 (Public Law 88-140, 43 USC 390e), to the use of the water supply storage space in the Project as provided in Article 1, subject to the following:

(a) The User shall continue payment of annual operation and maintenance costs allocated to water supply.

(b) The User shall bear the costs allocated to water supply of any necessary reconstruction, rehabilitation or replacement of Project features which may be required to continue satisfactory operation of the Project. Such costs will be established by the Contracting Officer. Repayment arrangements including schedules will be in writing and will be made a part of this contract.

(c) Upon completion of payments by the User as provided in Article 5(a) hereof, the Contracting Officer shall redetermine the storage space for municipal and industrial water supply, taking into account such equitable reallocation of reservoir storage capacities among the purposes served by the Project as may be necessary due to sedimentation. Such findings, and the storage space allocated to municipal and industrial water supply, shall be defined and described in an exhibit which will be

made a part of this contract. Following the same principle, such reallocation of reservoir storage capacity may be further adjusted from time to time as the result of sedimentation resurveys to reflect actual rates of sedimentation and the exhibit revised to show the revised storage space allocated to municipal and industrial water supply.

(d) .The permanent rights of the User under this contract shall be continued so long as the Government continues to operate the Project. In the event the Government no longer operates the Project, such rights may be continued subject to the execution of a separate contract, or additional supplemental agreement providing for:

(1) continued operation by the User of such part of the facility as is necessary for utilization of the water supply storage space allocated to it;

(2) terms which will protect the public interest; and

(3) effective absolvment of the Government by the User from all liability in connection with such continued operation.

ARTICLE 9 - Release of Claims. The User shall hold and save the Government, including its officers, agents and employees harmless from liability of any nature or kind for or on account of any claim for damages which may be filed or asserted as a result of the storage in the Project, or withdrawal or release of water from the Project, made or ordered by the User or as a result of the construction, operation, or maintenance of the facilities and appurtenances thereto owned and operated by the User, provided, that this shall not be construed as obligating the User to hold and save the Government harmless from damages or liability resulting from the sole negligence of the Government or its officers, agents, or employees and not involving negligence on the part of User or its officers, agents, or employees.

ARTICLE 10 - Assignment. The User shall not transfer or assign this contract or any rights acquired thereunder, nor suballot said water supply storage space or any part thereof, nor grant any interest, privilege or license whatsoever in connection with this contract, without the approval of the Secretary of the Army, provided that, unless contrary to the public interest, this restriction shall not be construed to apply to any water that may be obtained from the water supply storage space by the User and furnished to any third party or parties, nor any method of allocation thereof.

ARTICLE 11 - Officials Not to Benefits. No member of or delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this contract, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

ARTICLE 12 - Covenant Against Contingent Fees. The User warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee excepting bona fide employees or bona fide established commercial or selling agencies maintained by the User for the purpose of securing business. For breach or violation of this warranty the Government shall have the right to annul this contract without liability or in its discretion to add to the contract price or consideration, or otherwise recover the full amount of such commission, percentage, brokerage or contingent fee.

ARTICLE 13 - Environmental Quality. During any construction, operation, and maintenance by User of any facilities, specific actions will be taken to control environmental pollution which could result from such activity and to comply with applicable Federal, State and local laws and regulations concerning environmental pollution. Particular attention should be given to (1) reduction of air pollution by control of burning, minimization of dust, containment of chemical vapors, and control of engine exhaust gases, and of smoke from temporary heaters; (2) reduction of water pollution by control of sanitary facilities, storage of fuels and other contaminants, and control of turbidity and siltation from erosion; (3) minimization of noise levels; (4) onsite and offsite disposal of waste and spoil; and (5) prevention of landscape defacement and damage.

ARTICLE 14 - Federal and State Laws.

(a) In acting under its rights and obligations hereunder, the User agrees to comply with all applicable Federal and State laws and regulations, including but not limited to the provisions of the Davis-Bacon Act (40 USC 276a et seq); the Contract Work Hours and Safety Standards Act (40 USC 327-333); and Title 29, Code of Federal Regulations, Part 3.

(b) The User furnished, as part of this contract, an assurance (Exhibit C) that it will comply with Title VI of the Civil Rights Act of 1964 (78 Stat 241, USC 2000d, et seq) and Department of Defense Directive 5500.11 issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations.

ARTICLE 15 - Definitions.

(a) Joint-use costs - The costs of features used for any two or more project purposes.

(b) Project investment costs - The initial cost of the Project, including: land acquisition; construction; interest during construction on the value of land, labor, and materials used for planning and construction of the Project.

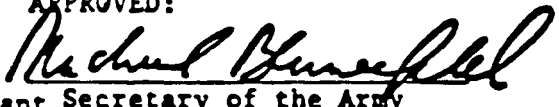
(c) Specific costs - The costs of project features normally serving only one particular project purpose.

(d) Interest during construction - An amount of interest which accrues on expenditures for the establishment of Project services during the period between the actual outlay and the time the Project is first made available to User for water storage.

ARTICLE 16 - Approval. This contract is subject to the written approval of the Secretary of the Army, and shall not be binding until so approved.

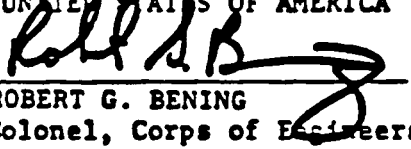
IN WITNESS WHEREOF, the parties have executed this contract as of the day and year first above written.

APPROVED:


Assistant Secretary of the Army
(Civil Works)

DATE: 22 April 1980

THE UNITED STATES OF AMERICA

By 
ROBERT G. BENING
Colonel, Corps of Engineers
District Engineer
Contracting Officer

DATE: 22 Sep 78

OKLAHOMA GAS & ELECTRIC COMPANY

By 
L. E. Taylor
C.E.

SEAL

CERTIFICATION

"I Steven E. Moore, Attorney for the Oklahoma Gas and Electric Company, named as User herein, hereby certify that the foregoing agreement executed by H. E. Taylor, Vice-President of the User is within the scope of his authority to act upon behalf of the User, and that in my capacity as Attorney for the User, I have considered the legal effect of Section 221 of the 1970 Flood Control Act (Public Law 91-611) and find that the User is legally and financially capable of entering into the contractual obligations contained in the foregoing agreement and that, upon acceptance, it will be legally enforceable.

Given under my hand, this 14th day of September 1978.

Steven E. Moore
Attorney
Oklahoma Gas & Electric Company

FEB 6 1989

Engineering and Construction Division
Hydrology and Hydraulics Branch

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Mr. Zack Williams
Senior Environmental Control Specialist, Water
Oklahoma Gas and Electric Company
Post Office Box 321
Oklahoma City, OK 73101

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Dear Mr. Williams:

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This letter is to provide you updated cost information in accordance with our contract for water supply storage, Kaw Lake, Oklahoma. Article 5(a)(4) and (6) of Contract No. DACW56-78-C-0270 provides for the application of actual construction costs to the repayment provisions of the contract.

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Therefore, in accordance with Article 5(a)(4) and (6), enclosed are Exhibit A and Exhibit B, revised to reflect application of actual cost of the project as of September 30, 1988. Your 1989 statement will be based on the new costs.

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Article 5(a)(3) of the contract provides that interest at the rate of 3.222 percent will be charged on the amount of project investment cost allocated to the storage of future water supply which is not being used from the 10th year following the plant-in-service date (May 1, 1976) until the time when such additional storage is first used. The Company may at its option pay the interest as it becomes due or allow the interest to accumulate until additional storage is used. The 10-year interest-free period ended April 30, 1986, and interest at the rate of 3.222 percent is being compounded and added to the outstanding principal of \$6,938,145 unless paid each year. The principal and interest allocated to the future-use storage must be paid by April 21, 2030.

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If you have any questions, please contact Mr. Guy Cabbiness of our Hydrology and Hydraulics Branch at 918-581-7240.

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Sincerely,

/s/ Frank M. Pateta

COL PATET
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Frank M. Pateta
Colonel, Corps of Engineers
District Engineer
Contracting Officer

EXHIBIT A

I - RESERVOIR STORAGE

<u>Feature</u>	<u>Elevation (ft. msl)</u>	<u>Usable Storage (1) (ac-ft)</u>	<u>Percent of Conservation Storage</u>	<u>Percent of Water Supply Storage</u>
Flood Control	1010.0-1044.5	835,000		
Conservation	978.0-1010.0	203,000	100.000	
Water Supply		171,200	84.335	100.000
Oklahoma Gas & Electric Co.		39,350	19.384	22.985
Present (23.25%)		9,150	4.507	5.345
Future (76.75%)		30,200	14.877	17.640
Others		131,850	64.951	77.015
Water Quality Control		<u>31,800</u>	15.665	
Total		1,038,000		

(1) Storage remaining after 100 years sedimentation, beginning from the date the Project became operational, 1 May 1976.

EXHIBIT A (CONT)

II - ALLOCATION OF ACTUAL FIRST COST

<u>Feature</u>	<u>Cost (\$)</u>	<u>Percent of Joint-Use Construction Cost</u>
Flood Control		
Specific	0	
Joint-Use	38,643,264	42.07
Water Quality		
Specific	0	
Joint-Use	6,723,763	7.32
Recreation		
Specific	11,465,104	
Joint-Use	10,737,812	11.69
Water Supply		
Specific	353,000	
Joint-Use	35,391,608	38.53
Fish & Wildlife		
Specific	0	
Joint-Use	<u>358,233</u>	<u>0.39</u>
Total allocated first cost		
Specific	11,818,104	
Joint-Use	91,854,680	100.00
Road betterments (Specific)	2,040,000	
Power (Specific)	<u>3,530,221</u>	
TOTAL PROJECT FIRST COST	109,243,005	

EXHIBIT A (CONT)

**III - COSTS TO BE REPAID BY THE USER
FOR WATER SUPPLY**

PRESENT USE:

Cost of 9,150 acre-feet of water supply storage (5.345% x \$35,391,608)	=	1,891,681.00
Interest during construction (5.345% x \$3,940,280)	=	<u>210,608.00</u>
PRESENT USE INVESTMENT COST	=	2,102,289.00
Less credit for 9 principal payments made thru April 1988	=	- <u>233,304.96</u>
Remaining Initial Use cost to be amortized over 41 years	=	1,868,984.04

FUTURE USE:

Cost of 30,200 acre-feet of water supply storage (17.640% x \$35,391,608)	=	6,243,080.00
Interest during construction (17.640% x \$3,940,280)	=	<u>695,065.00</u>
FUTURE USE INVESTMENT COST	=	6,938,145.00

EXHIBIT A. (CONT)**IV - ANNUAL CHARGES TO USER FOR PRESENT USE OF WATER SUPPLY STORAGE SPACE**

Interest and Amortization (2)		
0.044288 x \$1,868,984.04	=	\$82,773
Operation and Maintenance		
Joint-Use		
5.345% x 18.58% (3) = 0.993% x \$641,956 (FY88)	=	<u>6,375</u>
Major Replacement (4)		
Joint-Use		
5.345% x 31.58% (5) = 1.688% x \$0 (FY88)	=	<u>0</u>
TOTAL ESTIMATED ANNUAL COSTS	=	\$89,148

- (2) Based on 41 payments with interest at 3.222 percent interest rate.
 (3) Percent of Project joint-use operation and maintenance cost allocated to water supply.
 (4) Major replacement cost are payable only when incurred.
 (5) Percent of Project joint-use major replacement cost allocated to water supply.

EXHIBIT B

AMORTIZATION SCHEDULE

TOTAL COST.....		\$1,868,984.04	
NUMBER OF PAYMENTS.....		41	
INTEREST RATE, PERCENT.....		3.2220	

PAYMENT NUMBER	AMOUNT OF PAYMENT	APPLICATION INTEREST ALLOC COST	BALANCE ALLOC COST

	\$	\$	\$
1	82,773.00	60,218.67	22,554.33
2	82,773.00	59,491.97	23,281.03
3	82,773.00	58,741.85	24,031.15
4	82,773.00	57,967.57	24,805.43
5	82,773.00	57,168.34	25,604.66
6	82,773.00	56,343.35	26,429.65
7	82,773.00	55,491.79	27,281.21
8	82,773.00	54,612.79	28,160.21
9	82,773.00	53,705.47	29,067.53
10	82,773.00	52,768.91	30,004.09
11	82,773.00	51,802.18	30,970.82
12	82,773.00	50,804.30	31,968.70
13	82,773.00	49,774.27	32,998.73
14	82,773.00	48,711.05	34,061.95
15	82,773.00	47,613.57	35,159.43
16	82,773.00	46,480.74	36,292.26
17	82,773.00	45,311.40	37,461.60
18	82,773.00	44,104.39	38,668.61
19	82,773.00	42,858.48	39,914.52
20	82,773.00	41,572.44	41,200.56
21	82,773.00	40,244.96	42,528.04
22	82,773.00	38,874.70	43,898.30
23	82,773.00	37,460.30	45,312.70
24	82,773.00	36,000.33	46,772.67
25	82,773.00	34,493.31	48,279.69
26	82,773.00	32,937.74	49,835.26
27	82,773.00	31,332.05	51,440.95
28	82,773.00	29,674.62	53,098.38
29	82,773.00	27,963.79	54,809.21
30	82,773.00	26,197.84	56,575.16
31	82,773.00	24,374.98	58,398.02
32	82,773.00	22,493.40	60,279.60
33	82,773.00	20,551.19	62,221.81
34	82,773.00	18,546.40	64,226.60
35	82,773.00	16,477.02	66,295.98
36	82,773.00	14,340.97	68,432.03
37	82,773.00	12,136.09	70,636.91
38	82,773.00	9,860.17	72,912.83
39	82,773.00	7,510.91	75,262.09
40	82,773.00	5,085.97	77,687.03
41	82,747.20	2,582.89	80,164.31

SECTIONS IV AND VII DEPARTMENT OF DEFENSE DIRECTIVE 5500.11

IV. POLICY

A. GENERAL. No person in the United States shall, on the ground of race, color, or national origin be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program to which this Directive applies.

B. SPECIFIC DISCRIMINATORY ACTIONS PROHIBITED.

1. A recipient under any program to which this Directive applies may not, directly or through contractual or other arrangements, on the ground of race, color, or national origin:

a. Deny an individual any service, financial aid, or other benefit provided under the program;

b. Provide any service, financial aid, or other benefit to an individual which is different, or is provided in a different manner, from that provided to others under the program;

c. Subject an individual to segregation or separate treatment in any matter related to his receipt of any service, financial aid, or other benefit under the program;

d. Restrict an individual in any way in the enjoyment of any advantage or privilege enjoyed by others receiving any service, financial aid, or other benefit under the program;

e. Treat an individual differently from others in determining whether he satisfies any admission, enrollment, quota, eligibility, membership or other requirement or condition which individuals must meet in order to be provided any service, financial aid, or other benefit provided under the program.

f. Deny an individual an opportunity to participate in the program through the provision of services or otherwise or afford him an opportunity to do so which is different from that afforded others under the program.

2. A recipient, in determining the types of services, financial aid, or other benefits, or facilities which will be provided under any such program, or the class of individuals to whom, or the situations in which, such services, financial aid, other benefits, or facilities will be provided under any such program, or the class of individuals to be afforded an opportunity to participate in any such program, may not, directly or through contractual or other arrangements, utilize criteria or methods of administration which have the effect of subjecting individuals to discrimination because of their race, color, or national origin, or have the effect of defeating or substantially impairing accomplishment of the objectives of the program as respect individuals of a particular race, color, or national origin.

3. As used in this Section the services, financial aid, or other benefits provided under a program receiving Federal financial assistance shall be deemed to include any service, financial aid, or other benefit provided in or through a facility provided with the aid of Federal financial assistance.

4. The enumeration of specific forms of prohibited discrimination in this Subsection does not limit the generality of the prohibition in Subsection IV. A. of this Section.

VII. Compliance Information

A. Cooperation and Assistance. Each responsible Department official shall to the fullest extent practicable seek the cooperation of recipients in obtaining compliance with this Directive and shall provide assistance and guidance to recipients to help them comply voluntarily with this Directive.

B. Compliance Reports. Each recipient shall keep such records and submit to the responsible Department official timely, complete and accurate compliance reports at such times, and in such form and containing such information, as the responsible Department official may determine to be necessary to enable him to ascertain whether the recipient has complied or is complying with this Directive. In the case of any program under which a primary recipient extends Federal assistance to any other recipient, such other recipient shall also submit compliance reports to the primary recipient as may be necessary to enable the primary recipient to carry out its obligations imposed pursuant to this Directive.

C. Access to Sources of Information. Each recipient shall permit access by the responsible Department official during normal business hours to such of its books, records, accounts, and other sources of information, and its facilities as may be pertinent to ascertain compliance with this Directive. Where any information required of a recipient is in the exclusive possession of any other institution or person and this institution or person shall fail or refuse to furnish this information, the recipient shall so certify in its report and shall set forth what efforts it has made to obtain the information.

D. Information to Beneficiaries and Participants. Each recipient shall make available to participants, beneficiaries, and other interested persons such information regarding the provisions of this Directive and its applicability to the program under which the recipient receives Federal financial assistance, and make such information available to them in such manner, as the responsible Department official finds necessary to apprise such persons of the protections against discrimination assured them by the Act and this Directive.

UNITED STATES
DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
AND OKLAHOMA MUNICIPAL POWER AUTHORITY

MEMORANDUM OF AGREEMENT NO. 3
KAW LAKE PROJECT, ARKANSAS RIVER, OKLAHOMA
ESTABLISHING PROCEDURES FOR HYDROPOWER OPERATION

This Memorandum of Agreement, entered into and effective this 21st day of February, 1989, between Oklahoma Municipal Power Authority, acting by and through its Board of Directors, and acting on behalf of KAMO Electric Cooperative, Incorporated, Co-Licensee, hereinafter referred to as the "Licensees", and the Corps of Engineers, United States Department of the Army, hereinafter referred to as the "Corps".

WHEREAS, the United States is the owner and operator of the Kaw Lake Project located in Kay and Osage Counties, Oklahoma, on the Arkansas River, a navigable waterway of the United States; and

WHEREAS, the Licensees filed a license application on July 19, 1983, and was issued a license, hereinafter referred to as the "License", on November 27, 1984, by the Federal Energy Regulatory Commission (FERC) to construct, operate, and maintain the Kaw Hydroelectric Project No. 3083-002, at Kaw Lake, located at Arkansas River Mile 653.7 and, by FERC Order dated January 14, 1986, the License was modified to make the Oklahoma Municipal Power Authority (OMPA), a co-licensee of the project; and,

WHEREAS, the Licensees and the Tulsa District, Corps of Engineers, have previously executed Memorandum of Agreement (MOA) No. 1, dated June 20, 1985, and Memorandum of Agreement No. 2, dated August 14, 1987, for use of the project for hydroelectric generation; and,

WHEREAS, the FERC license for Project No. 3083-002, issued November 27, 1984, grants authority for OMPA/KAMO to construct, operate, and maintain the Kaw

Hydroelectric Project. Further, OMPA was created and established by and pursuant to the provision of Oklahoma Statutes 1981, Title 11, Section 24-101 and following to plan, finance, acquire, construct, reconstruct, own, lease, operate, maintain, repair, improve, extend, or otherwise participate in projects as defined within the Act; and,

WHEREAS, the Kaw Lake Project was authorized for flood control, water supply, water quality, recreation, and fish and wildlife conservation. The existing Corps project was constructed to accommodate future hydroelectric power, even though generation of hydroelectric power is not one of the authorized Federal project purposes; and,

WHEREAS, Article 41 of the said License requires the Licensees to enter into a Memorandum of Agreement with the Corps, describing the mode of hydropower operation as acceptable to the Corps;

NOW, THEREFORE, in consideration of the mutual stipulations and agreements herein set forth, the parties agree as follows:

ARTICLE 1. DULY AUTHORIZED AGENT

OMPA shall be the Operations Manager and may appoint a duly authorized agent to operate and maintain the Kaw Hydroelectric Project. Should OMPA appoint such an agent, the Licensees shall remain fully responsible for compliance with this agreement, and shall require in any agreement with such agent that the agent also comply strictly with the terms hereof.

ARTICLE 2. RIGHT TO REVIEW AND REVISE

This operating agreement shall be subject to review from time to time upon request of either party as operating experience is gained and conditions warrant, and may be revised by mutual written consent of the Corps and Licensees.

ARTICLE 3. COOPERATION

The Corps and Licensees agree to cooperate in the coordinated operation of the Project. In its decisions affecting this project, the Corps will consider the

importance of this hydroelectric interest and will provide for the maximum generation of electric energy, provided such generation shall not significantly and adversely affect the authorized Federal purposes at the Kaw Lake Project. The Licensees shall operate the hydroelectric project at all times in such manner as reasonably deemed necessary by the Corps not to significantly and adversely affect the Federally authorized project purposes. The Licensees shall follow Corps directives and/or instructions pertaining to the operation of the hydroelectric project, as provided herein. Performance by the Corps of the terms of this agreement shall be subject to and conditioned upon compliance by the Licensees with applicable provisions of the FERC license, as determined by FERC, and the provisions of Memorandums of Agreement No. 1 and 2, which are incorporated by reference.

ARTICLE 4. PHYSICAL LOCATION AND DESCRIPTION

The Kaw Hydroelectric Project is located at the Corps dam at Kaw Lake, near Ponca City, Oklahoma. The hydroelectric project, described in the License, includes, but is not limited to, the project works consisting of:

1. Two trash racks, each of four panels, covering the two 17- x 40-foot intakes;
2. Draft tube stoplogs and intake stoplogs.
3. One 20-foot diameter butterfly valve;
4. A powerhouse, 132-foot by 75-foot, housing one turbine-generator unit rated at 37 megawatts at maximum net head of 105 feet;
5. A switchyard;
6. A 150-ton, overhead bridge crane;
7. A tailrace 50 feet wide and 135 feet long. Minimum tailwater elevation in the tailrace is of 931.0 feet N.G.V.D. based on zero discharge from the Kaw

Dam and the tailwater elevation of 935.2 feet N.G.V.D. is at maximum powerhouse discharge of 5,500 cfs;

8. A 69-kV transmission line, approximately 10 miles long; and
9. Appurtenant electrical and mechanical features.
10. All existing Corps hydropower facilities for which reimbursement was made pursuant to MOA No. 2.

ARTICLE 5. OPERATIONAL REQUIREMENTS

Section A. General

1. The Licensees shall operate the hydroelectric project in accordance with the License, the terms of this agreement, and the Water Control Manual for Kaw Lake, Arkansas River, Oklahoma and Kansas dated 19 December 1977 or as revised. The Corps shall consult with and consider any comments of the Licensees before implementing any change to the Water Control Manual which affects hydropower generation. The Corps is, however, and shall remain, responsible for development and revision of the Water Control Manual for Kaw Lake Project. The Corps shall provide the Licensees copies of the current Water Control Manual and revisions as they are adopted.
2. The Corps agrees to allow the release of all water, normally scheduled for release through the tainter or sluice gates, through the hydroelectric project to maximize power generation, consistent with the provisions of Article 3.

Section B. Specific Operational Details

1. The Corps is responsible for the overall operation of the Kaw Lake Project. Under this operating agreement, the hydroelectric project shall be operated as a run-of-river project, with provisions for daily pondage, in coordination with Tulsa District, Corps of Engineers, Reservoir Control Section.

2. The hydropower project shall be operated as follows:

- a. The Corps shall provide the Licensees with daily total release requirements. The Licensees shall schedule hourly releases through the turbine and coordinate with the Corps to manage daily releases from Kaw Lake in accordance with Section B, Paragraph 1.
- b. When scheduled discharges are sufficient for turbine operation, the project will operate 24 hours per day. Normally, all discharges will pass through the turbine from 570 cfs up to approximately 5,700 cfs. Discharges less than the turbine minimum capability will be passed through the plant using daily pondage. Discharges in excess of turbine maximum capability will be released by the Corps. Because the turbine will operate most efficiently (efficiencies greater than 90%) between 1,800 to 5,500 cfs, discharges will generally be within this range.
- c. When scheduled discharges are less than that required for efficient turbine operation, the Licensees may modify hourly releases in a ponding operation to optimize plant output during the daily peak power demand period.

OMPA's daily peak demand is from 4 to 6 hours in duration, usually centered between 5:00 p.m. and 6:00 p.m. The total volume of daily discharges scheduled by the Corps shall be released by the Licensees. No carryover of excess discharges not used during the peak period shall occur. Minimum water releases shall be maintained outside of the daily peak period if required of the Corps.

- d. The Licensees shall notify the Corps of the starting and stopping of the units as early as reasonably possible in advance, and shall promptly advise, in writing, the Corps of the initial plant operation procedures and any change in operation procedures that will affect the plant discharge or cause fluctuations in Kaw Lake or the downstream channel.

Minimum shutdown time, under emergency conditions, will depend upon turbine discharge, head, load, governor response time, and other factors, but shall be set at a predetermined minimum to limit surges in the lake, water passages, and tailrace.

- e. Deviations from scheduled release rates may occasionally occur due to emergency requirements in the power distribution system served by the project. Any time the actual hourly turbine release rates deviate from scheduled rates by more than 10 percent, the Licensees shall report such changes and expected additional changes to the Corps as soon as practical after the deviation occurs. Report shall be by telephone or other direct means of communications.

The Licensees shall cooperate fully with the Corps in the establishment of daily usage of the reservoir and release schedules for Kaw Lake. The Corps shall provide the Licensees full use and benefit of any flows consistent with the provisions of Article 3.

3. The Corps shall provide notification to the Licensees of any scheduled changes in discharge. Notification shall be made promptly after the fact for any unscheduled changes in the discharge or discharge capacity pertaining to Kaw Lake. The Licensees recognizes that deviations in operations of Kaw Lake may be required occasionally as reasonably determined by the Corps.
4. The Corps may take or direct that the Licensees take whatever emergency action the Corps deems is needed to prevent or reduce hazard to human life or substantial hazard to property. Under these emergency conditions, the Licensees shall operate the unit as directed by the Corps. Detailed procedures for emergency shutdown shall be addressed by separate instrument.

ARTICLE 6. INSPECTION

The Corps may inspect the Hydroelectric Project as a part of the Corps of Engineers' Periodic Inspection and Continuing Evaluation of Completed Civil

Works Structure Program and at such other reasonable times as it may determine necessary. The Corps shall schedule such inspections, to the extent practical, so as not to interfere with the optimal operation of the hydroelectric facilities. Any deficiencies or difficulties detected by the Corps shall be promptly reported to the Licensees and FERC. When the Corps determines that deficiencies may result in a situation causing imminent danger to the structural integrity and safety of the Kaw Lake Project, the Corps shall have the authority to direct the Licensees to stop hydroelectric operation and/or take appropriate action to resolve the problem. The Licensees shall timely comply with any directive of the Corps under such circumstances.

The Licensees shall reimburse the Corps for the direct costs incurred in performing its inspections, pursuant to Article 6 above, of those licensed facilities that affect the integrity or operation of the existing Kaw Lake Project, provided that charges for such inspections shall not exceed 50 man-hours per year. "Direct costs" as used herein shall be an hourly charge including overhead and administration for time expended by Corps personnel, as well as costs for travel and materials in performing such inspections; provided, however, that no charge shall be assessed for information, services, or relationships that would normally be provided to the public at no charge.

ARTICLE 7. COMMUNICATION NETWORK, INFORMATION EXCHANGE, AND REPORTING

1. The Licensees shall maintain communications between either the control room at the hydroelectric plant at Kaw Lake or the remote dispatcher for the Licensees and Tulsa District, Corps of Engineers, Reservoir Control Section, by means of telephone or other direct means of communications to coordinate the operation of the Hydroelectric Project.
2. Each Corps working day prior to 12:00 p.m., the Corps shall provide the Licensees an updated 4-day forecast of expected mean daily discharge volumes for Kaw Lake by telephone or other direct means of communications. Expected schedules for weekends and holidays shall be furnished on the last working day prior to the weekend or holiday and shall include the schedule for the next working day.

3. Each Licensees' working day prior to 2:00 p.m., the Licensees shall furnish the Corps hourly turbine release schedules expected for the remainder of the current day and the following day. Expected schedules for weekends and national holidays shall be furnished on the last working day prior to the weekend or national holiday and shall include the schedule for the next working day. The schedules shall be furnished by telephone or other direct means of communications. Modifications to these schedules shall be furnished to the Corps as soon as reasonably possible.
4. The Licensees shall provide the Corps a daily summary of actual hourly generation and release rates for the total hydroelectric plant. This summary shall be provided to the Corps prior to 8:30 a.m. on the following Corps working day.

ARTICLE 8. MAINTENANCE OR CONSTRUCTION BY TULSA DISTRICT

The Licensees shall cooperate with the Corps, its contractors, and their subcontractors regarding maintenance and repair work at Kaw Lake Project. The Corps shall provide the Licensees with maintenance schedules. Operation during the months of June, July, August, and September is particularly important to the Licensees. The Corps and the Licensees shall, to the extent practical, cooperate in the scheduling of any maintenance during this period.

ARTICLE 9. GAGING EQUIPMENT

The Licensees shall comply with gaging requirements as set forth in Article 8 of the FERC License.

ARTICLE 10. PUBLIC WARNING SYSTEM

The Licensees shall install and thereafter maintain a public warning system, consisting of warning devices (visual flasher and audible sirens) to notify the public prior to the loading or unloading of a unit. Such warning devices shall be installed in accordance with the drawings approved by the Corps, and shall be used, maintained, and modified in such manner as the Corps shall reasonably direct.

ARTICLE 11. OTHER PROVISIONS

Nothing in this Operating Agreement shall be deemed as a waiver of any requirement or obligation set forth in the Order Issuing License issued October 18, 1983 by the Federal Energy Regulatory Commission, or any amendments to the license, or the statutorily and regulatorily mandated responsibilities of the Corps in operating the Kaw Lake Project.

ARTICLE 12. LIABILITY

The Licensees agrees to indemnify and hold harmless the United States Army Corps of Engineers, the United States of America, and their agents or employees from any loss or damage or liability on account of personal injury, death, property damage, or other claims reduced to judgment arising out of the Licensees' activities under this agreement, unless occasioned by or resulting from the intentional or negligent act of the agents or employees of the United States Army Corps of Engineers.

ARTICLE 13. DISPUTE RESOLUTION

Disputes arising under this Agreement related to the operation of the hydroelectric facilities of the Kaw Project that cannot be resolved between the Corps and Licensees shall be referred to FERC. In cases where continued operation may, in the judgment of the Corps, reasonably result in an imminent danger to the integrity and safety of the Kaw Lake Project, the Corps shall have authority to stop operation of the hydropower facility while awaiting resolution of the dispute.

UNITED STATES
DEPARTMENT OF THE ARMY

By: _____

Robert C. Lee
Brigadier General, USA
Southwestern Division Engineer

OKLAHOMA MUNICIPAL
POWER AUTHORITY

By: _____

R. Harry Dawson
General Manager

EXHIBIT C

STANDING INSTRUCTIONS

TO PROJECT MANAGER

KAW LAKE

EXHIBIT C
STANDING INSTRUCTIONS TO PROJECT MANAGER
KAW LAKE

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EXHIBIT C
STANDING INSTRUCTIONS TO PROJECT MANAGER
KAW LAKE

I - GENERAL

1. Instructions. Detailed instructions to the project personnel at Kaw Lake are presented below.

a. Operation. During flood periods, the lake will be regulated in accordance with the normal regulations for flood control as directed in Chapter VII of this manual or paragraph 2 of this exhibit. Instructions for the storage and discharge of floodwater will be issued by the Arkansas River Control Section. In the event communications with the Tulsa District Office are disrupted, the lake will be regulated in accordance with the schedule of emergency regulations for flood control operation (see Chapter VII of this manual or paragraph 3 of this exhibit). In addition, the project manager will immediately make every effort to reestablish communications with the Tulsa District Office.

b. Data reporting instructions. Daily reservoir data (example on plate 5-3) will be submitted to the Arkansas River Control Section, Hydrology-Hydraulics Branch, Tulsa District Office (telephone 918-669-7096 or VHF-FM radio, call signal WUI-3). The Arkansas River Control Section office is manned from 7:45 a.m. to 4:30 p.m. daily and various hours on weekends and holidays. Data for nonworking days shall be read from the recorder chart and submitted the following workday. In the event that unusual conditions arise during nonworking hours, one of the persons listed on page i of this manual should be contacted. The following data should be included in the daily report.

(1) As of 8 a.m. Pool elevations at 12 noon, 4 p.m., and 12 midnight of the previous day and the current (8 a.m.) pool elevation (read from the recorder chart); number, type, and height of gate openings; outflow stage at 8 a.m.; precipitation and pan evaporation in inches for the preceding 24 hours (8 a.m. to 8 a.m.); wind direction and velocity (at 8 a.m.).

(2) Each gate operation. Date and time of operation, number and height of gates open before and after operation, lake elevation, and outflow stage. 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 Arkansas River Control Section as they occur.

(3) Power releases. Hourly power releases (midnight to midnight), 8 a.m. instantaneous power discharge, 8 a.m. total discharge, 24 hour average (midnight to midnight) power release, 24 hour average total release, and the 24 hour net power generation.

(4) During flood periods. In addition to subparagraphs (1) and (2) above, report at 1 p.m. and 7 p.m. or whenever instructed by Arkansas River Control Section personnel.

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

(a) At 8 a.m. all precipitation that occurred during the previous 24 hours, 8 a.m. to 8 a.m. (covered by routine report on working days).

(b) At 1 p.m. whenever 0.50 inch or more precipitation has occurred since 8 a.m. or if it has continued to rain since reporting at 8 a.m.

(c) At 7 p.m. whenever 0.50 inch or more precipitation has occurred since the 8 a.m. report and no 1 p.m. report was made or if it has continued to rain since reporting at 1 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. During nonworking hours, the report should be made to one of the persons listed on page i.

(e) After office hours rainfall reports should be made as indicated in (d) above; however, if no contact with Arkansas River Control Section personnel can be made, rainfall reports should be made to the National Weather Service, Oklahoma City, Oklahoma (telephone 1-800-366-6584).

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 such as a settlement, movement, or cracking of the earth embankment or abutments; unusual change in seepage rates or development of new seepage areas; mechanical malfunction or failure; structural settlement, movement, cracking, or vibration; landslides, rockslides, or indication of an impending movement; or an occurrence indicating any degree of jeopardy to the safety of the dam or to the safety of the public shall be reported promptly to the Ark Reg Unit, Arkansas River Control Section, Hydrology - Hydraulics Branch.

d. Warnings. It is the responsibility of the Project Manager and project personnel authorized to make gate changes, to maintain a list in current status of residents and/or property owners who would be endangered or inconvenienced by large and/or prolonged releases and to give them adequate warning of such impending releases. Notification will be made by whatever means are available. This would include radio, television, telephone, citizen band radio, use of law enforcement and Civil Defense agencies and their communication systems, National Guard and Reserve Units, supplemented by oral warning from Corps employees. Studies have been made to determine the possible downstream flood conditions which could exist in the event of a maximum spillway discharge or failure of the dam at maximum pool. Approximate water surface profiles and flooded area maps giving the results of these studies are kept in Operation and Maintenance Manual, Volume 2, Flood Emergency Plan. In every case, when a change in release rate is made, a warning horn is blown to give warning to people immediately downstream who are within hearing distances of the horn blast.

e. Frequency of gate changes. During flood periods, gate changes may be directed by the Arkansas River Control Section at any time. The initial transition from low flow releases to flood releases, or vice versa, may require gate changes every hour. When the floodwaters have significantly risen into the flood control pool, gate changes can be expected two or three times daily. When the pool level is at or above the top of the flood control pool, gate changes may occur every hour. Only under the most unusual circumstances will gate changes be ordered more frequently than once every hour. Frequency of gate changes during low flow operation will generally be less than once a day.

II - REGULATION PROCEDURES

1. Regulating river stages and discharges. The regulation schedules provide that the channel capacity of 40,000 c.f.s. 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. Factors considered in the determination of releases are: maximum inflow into the reservoir during a rise, general climatic conditions, season of the year with respect to the probability of floods, status of crops in low-lying farmlands, and minimum stages or discharges.

2. Normal regulation of flood control operations. Under normal procedures, instructions for storage and release of water for conservation and flood control will be issued by the Tulsa District, Arkansas River Control Section. The implementation of the instructions are to be confirmed back to

the Arkansas River Control Section as soon as the required action is completed. Instructions originating from any other source should not be processed. Kaw Lake will be regulated for optimum flood reductions on the Arkansas River.

3. Emergency flood control regulations. Should communication with the Tulsa District Office be disrupted, the Project Manager will, on his own initiative, direct regulation of the lake in accordance with the rules or regulation shown in Table C-1 until communication is restored. In addition, the Project Manager will immediately make every effort to reestablish communication with the Tulsa District Office. The spillway gates will be operated at uniform openings.

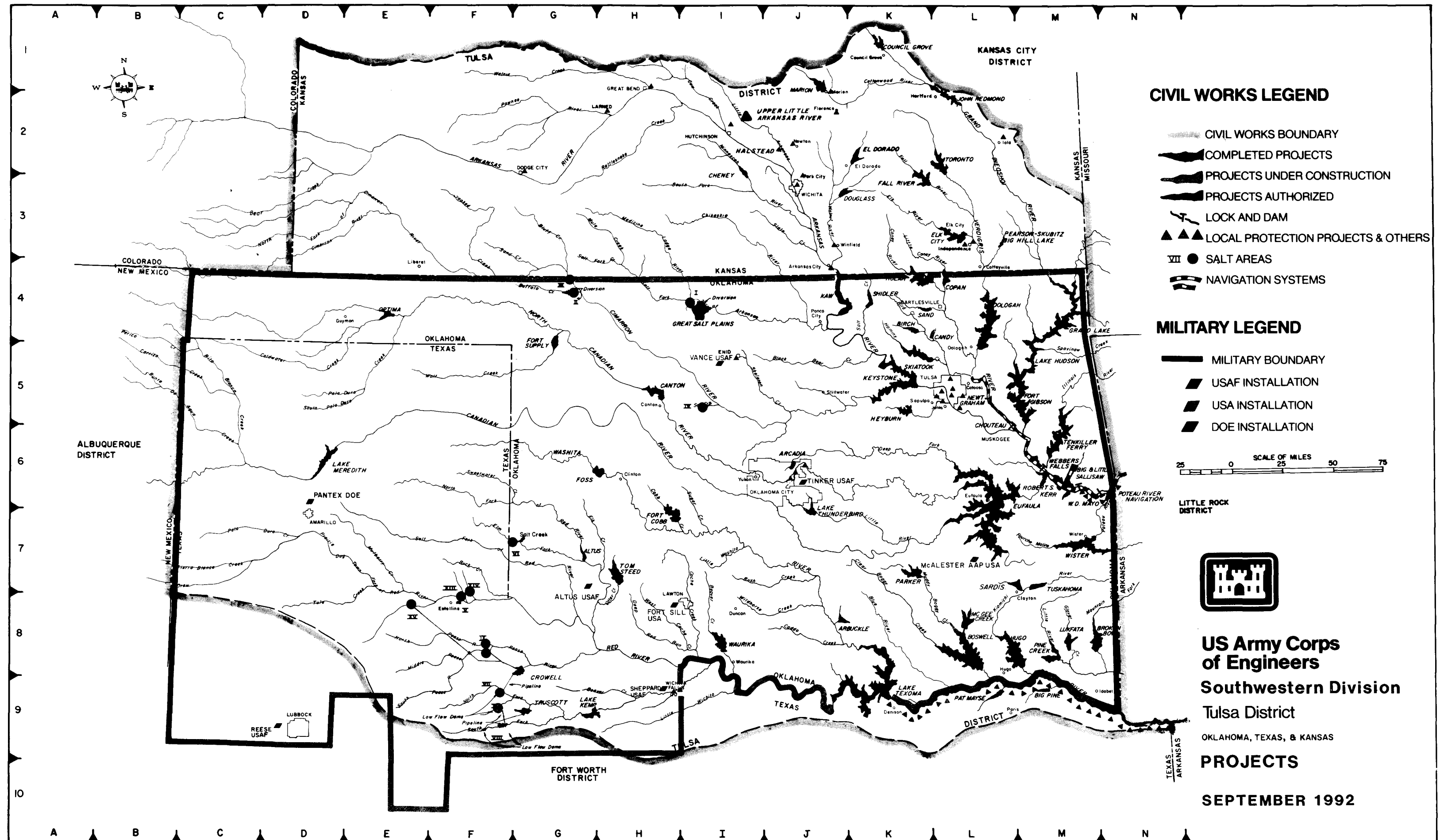
4. During emergency events. The Project Manager may temporarily deviate from the current release rates in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam or to avoid serious hazards to life. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing the same day to the Arkansas River Control Section and shall include justification for the action. Continuation of the deviation will require the express approval of the Arkansas River Control Section.

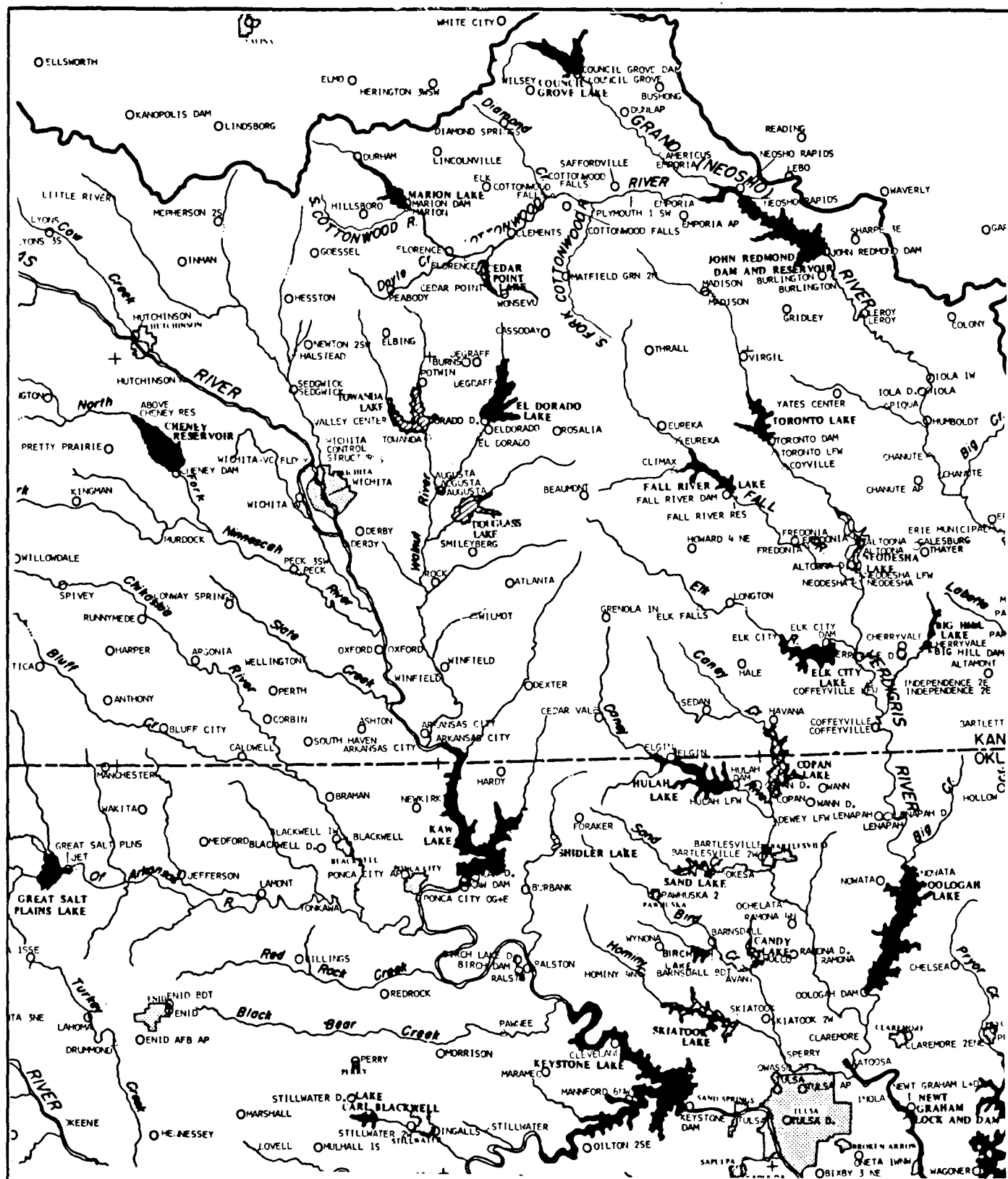
TABLE C-1
EMERGENCY FLOOD CONTROL REGULATION SCHEDULE
KAW LAKE

<u>LAKE STAGE</u>	<u>: POOL CONDITIONS:</u>	<u>REGULATION</u>
Below 1010.0	: Rising	: Continue the releases : being made.
1010.0 - 1044.5	: Rising	: -Maintain releases being : made until communication : is restored or 12 hours : have elapsed. : -If communication is not : restored or the pool rises : to elevation 1038.0 during : the 12-hour waiting period, : begin releases in accordance : with plate 7-1, Spillway Gate : Regulation Schedule, Inflow : Parameter. : -Releases shall be adjusted : every 2 hours using the previous : 6-hour time interval to compute : the inflow. : Plate 7-2 is a nomograph for : computing inflow. : -If the pool is above elevation : 1038.0, the releases should not : be less than indicated by the : the minimum discharge curve on : plate 7-1. : -At no time shall releases be : reduced if the pool is rising.
1044.5 - 1047.5	: Rising	: -Releases shall be made : in accordance with the : inflow curves on Plate 7-1, : "Spillway Gate Regulation : Schedule - Inflow Parameter." : -The previous 6-hour time : interval shall be used to : compute the inflow as shown : on Plate 7-2 (use present pool : elevation and pool elevation : 6-hours earlier.) : Plate 7-2 is a nomograph : for computing inflow.

TABLE C-1 (CONT)

LAKE STAGE	POOL CONDITIONS:	REGULATION
	:	: -Inflow shall be computed
	:	: and releases adjusted
	:	: every 2 hours. At no time
	:	: when the lake level is
	:	: above 1044.5 and rising
	:	: shall releases be decreased
1047.5 or above	: Rising	: -Releases shall be
	:	: increased by raising the
	:	: spillway gates to maintain
	:	: elevation 1047.5 or until
	:	: all gates are fully open.
1047.5 or above	: Falling	: -Maximum sluice and spillway
	:	: gate openings attained shall
	:	: be held until the pool level
	:	: recedes to elevation 1044.5.
1044.5 - 1038.0	: Falling	: Releases shall be equal to
	:	: the previous 6-hour inflow
	:	: or 40,000 c.f.s., whichever is
	:	: greater (see plate 7-2 for
	:	: 6-hour inflow calculation).
1038.0 - 1031.0	: Falling	: Releases shall be equal to
	:	: the previous 6-hour inflow
	:	: or 30,000 c.f.s., whichever
	:	: is greater (see plate 7-2 for
	:	: 6-hour inflow calculation).
1031.0 - 1015.0	: Falling	: Releases shall be equal to
	:	: the previous 6-hour inflow
	:	: or 20,000 c.f.s., whichever
	:	: is greater (see plate 7-2 for
	:	: 6-hour inflow calculation).
1015.0 - 1012.0	: Falling	: Releases shall be gradually
	:	: reduced by amounts not to
	:	: exceed 5,000 c.f.s. in any 4
	:	: hours, until the releases are
	:	: 5,500 c.f.s. (rated turbine flow).
1012.0 - 1010.0	: Falling	: Releases shall be 5,500 c.f.s.
	:	: At elevation 1010.0, releases
	:	: shall be made equal to inflow.





ARKANSAS RIVER WATERSHED
KAW LAKE

LOCATION MAP

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.

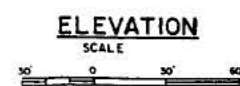
(b) (7)(F)

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

**GENERAL PLAN AND
ELEVATION OF DAM**

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.

(b) (7)(F)

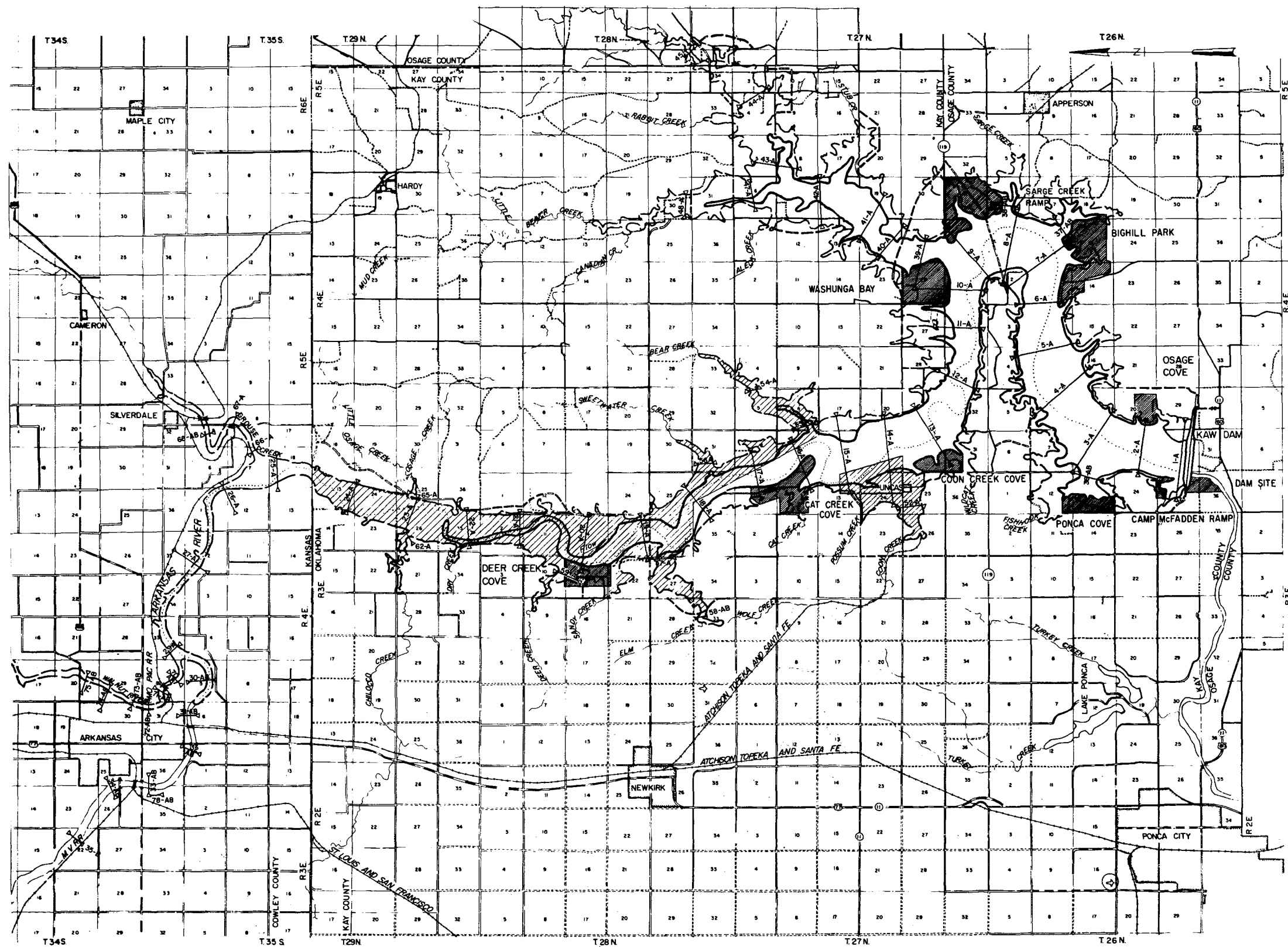


ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

KAW LAKE

**PLAN AND ELEVATION
OF SPILLWAY**

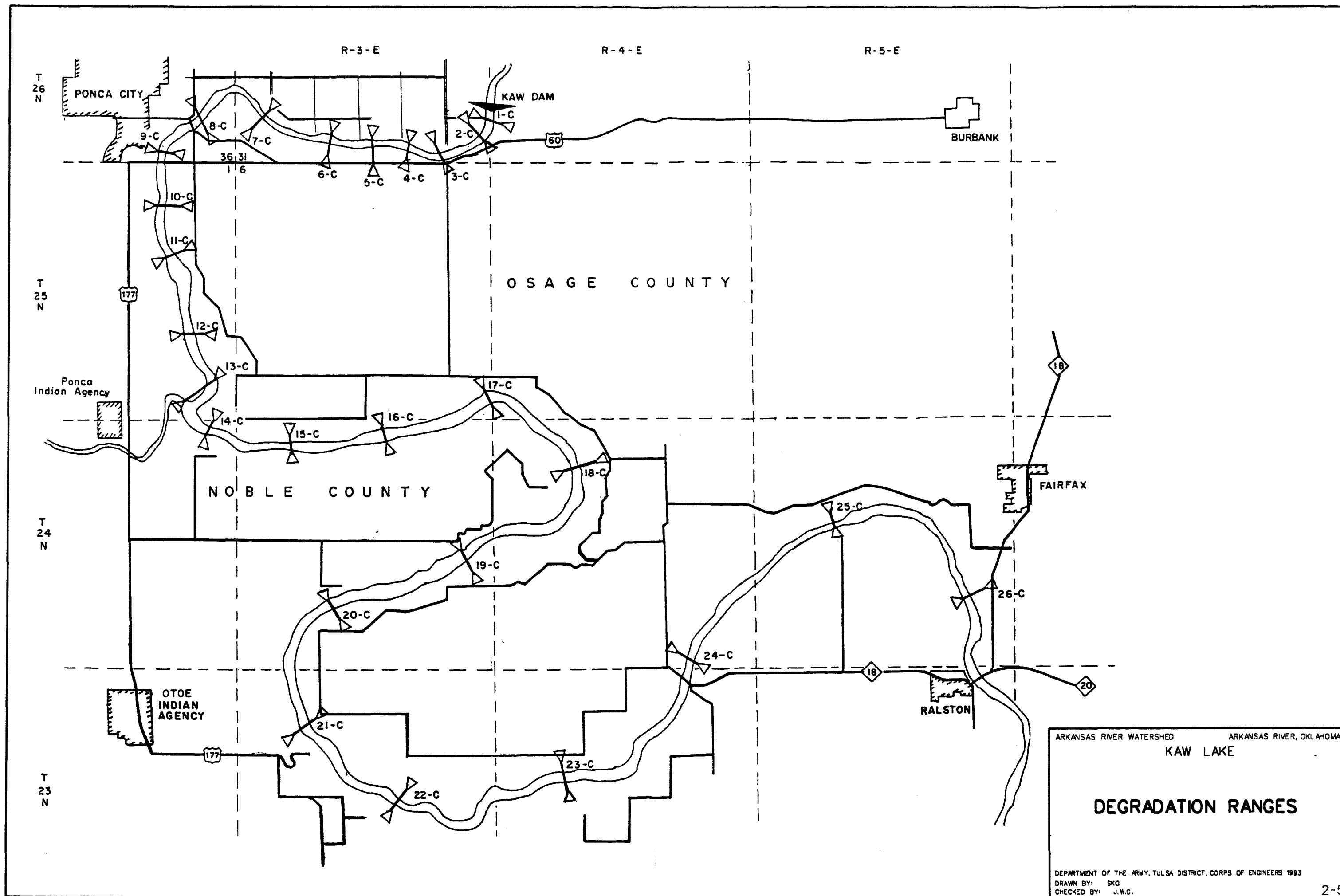
DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.

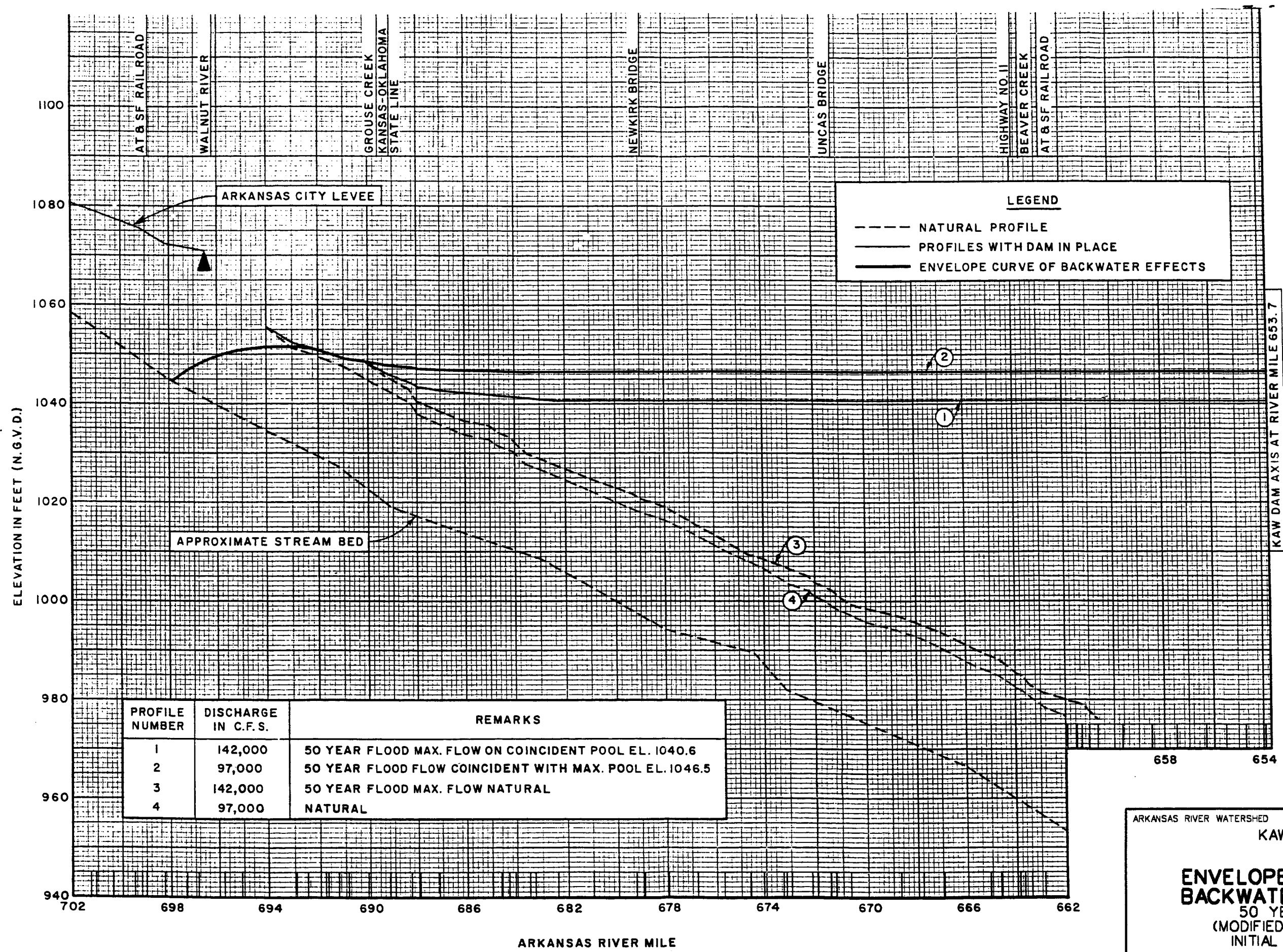


ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

SEDIMENTATION RANGES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1991
 DRAWN BY: SKG
 CHECKED BY: J.W.C.



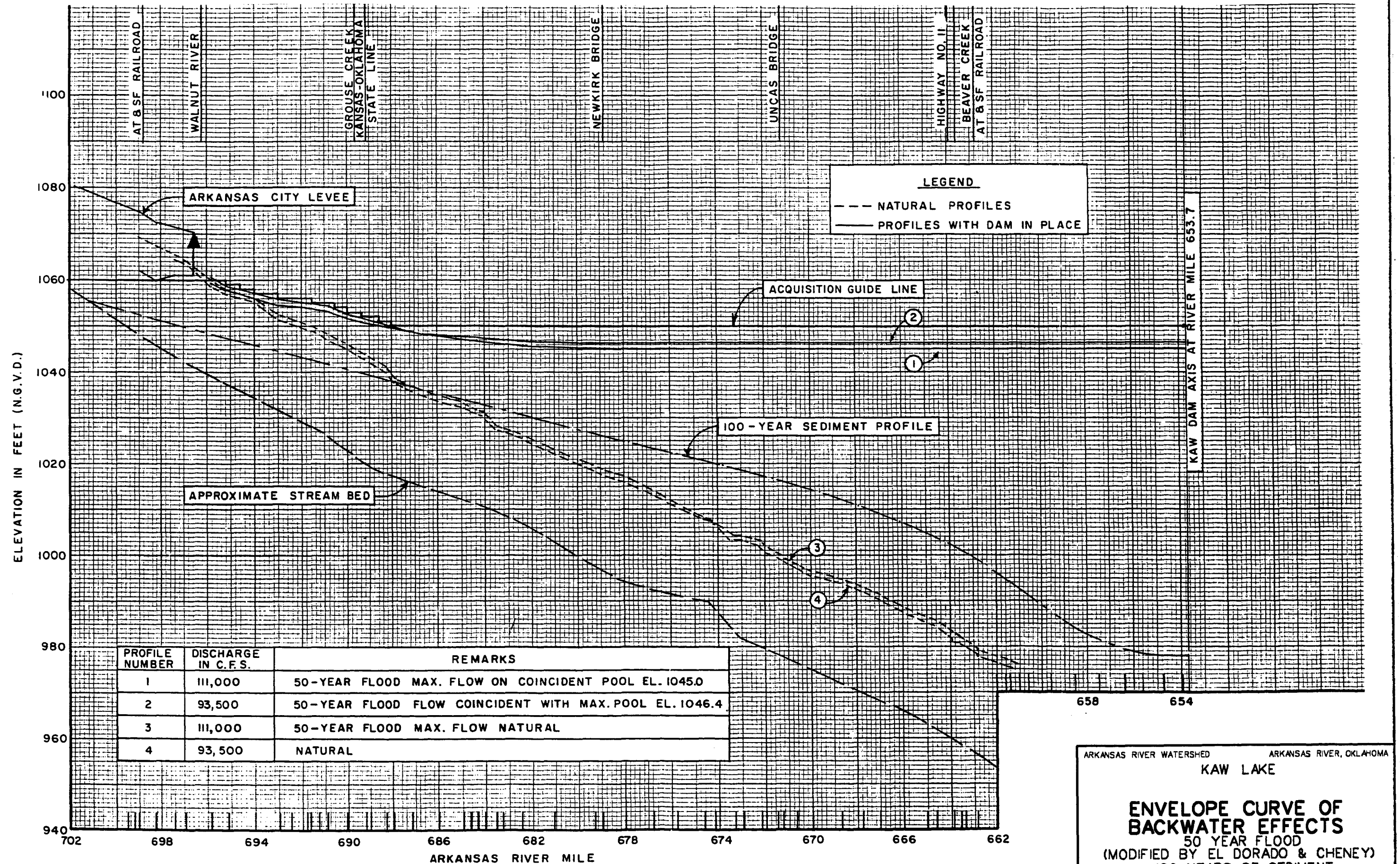


ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

KAW LAKE

ENVELOPE CURVE OF BACKWATER EFFECTS
 50 YEAR FLOOD
 (MODIFIED BY CHENEY)
 INITIAL CONDITIONS

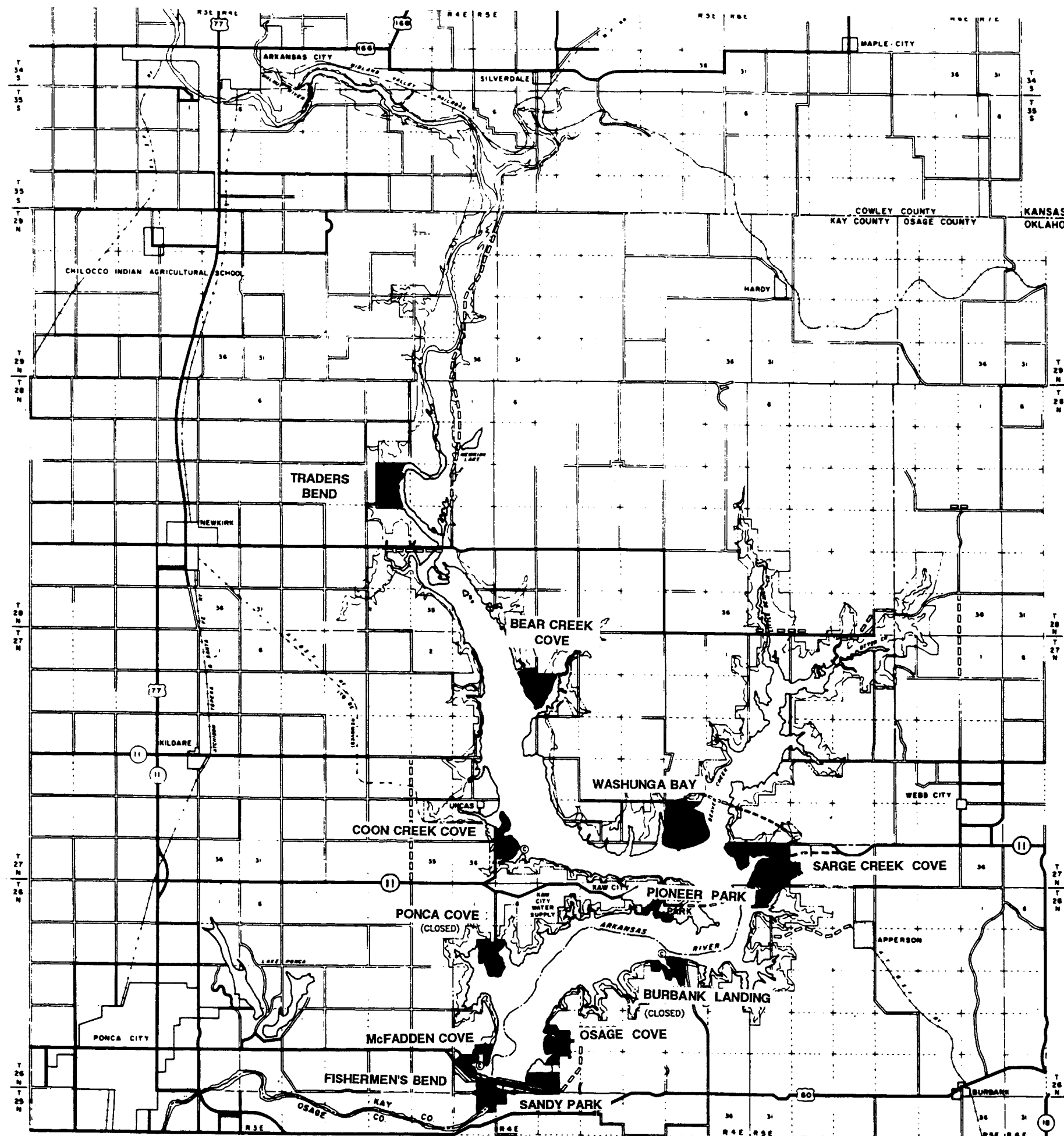
DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.



ARKANSAS RIVER WATERSHED
KAW LAKE

ENVELOPE CURVE OF BACKWATER EFFECTS 50 YEAR FLOOD (MODIFIED BY EL DORADO & CHENEY) 100 YEARS OF SEDIMENT

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.



LEGEND

- TOP CONSERVATION POOL EL 1010.0
- TOP FLOOD CONTROL POOL EL 1044.5
- 168 SHORELINE MILES AT EL 1015.0
- PROPOSED PUBLIC USE AREAS
- GOVERNMENT PROPERTY LINE
- PAVED ROAD
- GRAVEL ROAD
- RELOCATED ROAD
- CONCESSION SITE
- SCALE OF MILES 0 1 2 3

ARKANSAS RIVER WATERSHED
 ARKANSAS RIVER, OKLAHOMA
KAW LAKE

PUBLIC USE SITES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.

FLOW IN C.F.S.

28,000

24,000

20,000

16,000

12,000

8,000

4,000

0

0

20

40

60

80

100

PERCENT OF TIME EQUALLED OR EXCEEDED

OUTFLOW

INFLOW

NOTE:

BASED ON PERIOD OF RECORD
JAN 1940 THRU DEC 1986 FROM
SUPER RUN A90X02

NOTE:

INFLOW CURVE
APPROACHES ZERO AT 75,000 CFS
OUTFLOW CURVE
APPROACHES ZERO AT 20,000 CFS

ARKANSAS RIVER WATERSHED

ARKANSAS RIVER, OKLAHOMA

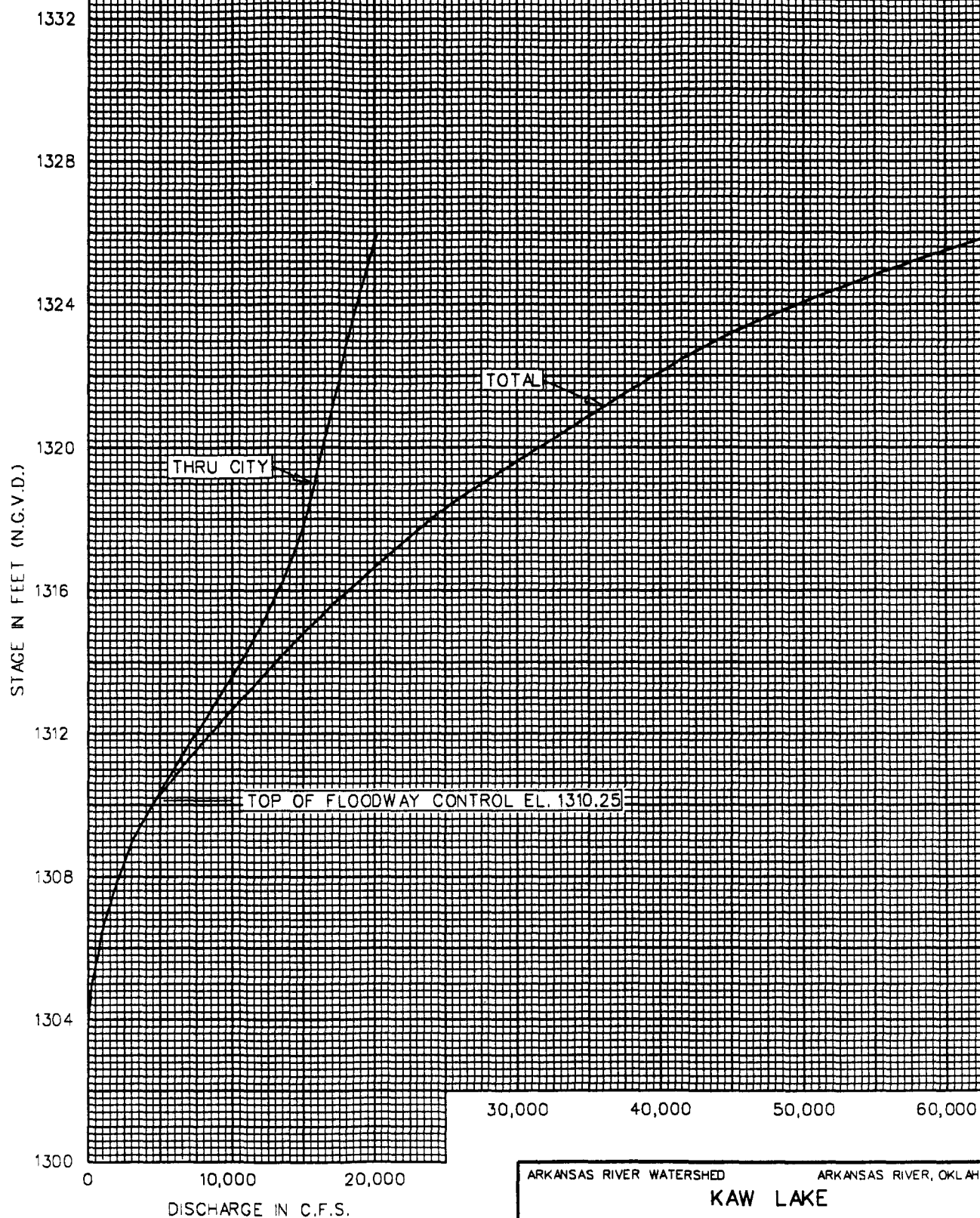
KAW LAKE

FLOW DURATION CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993

DRAWN BY: SKG

CHECKED BY: J.W.C.



ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

KAW LAKE

DISCHARGE RATING CURVE

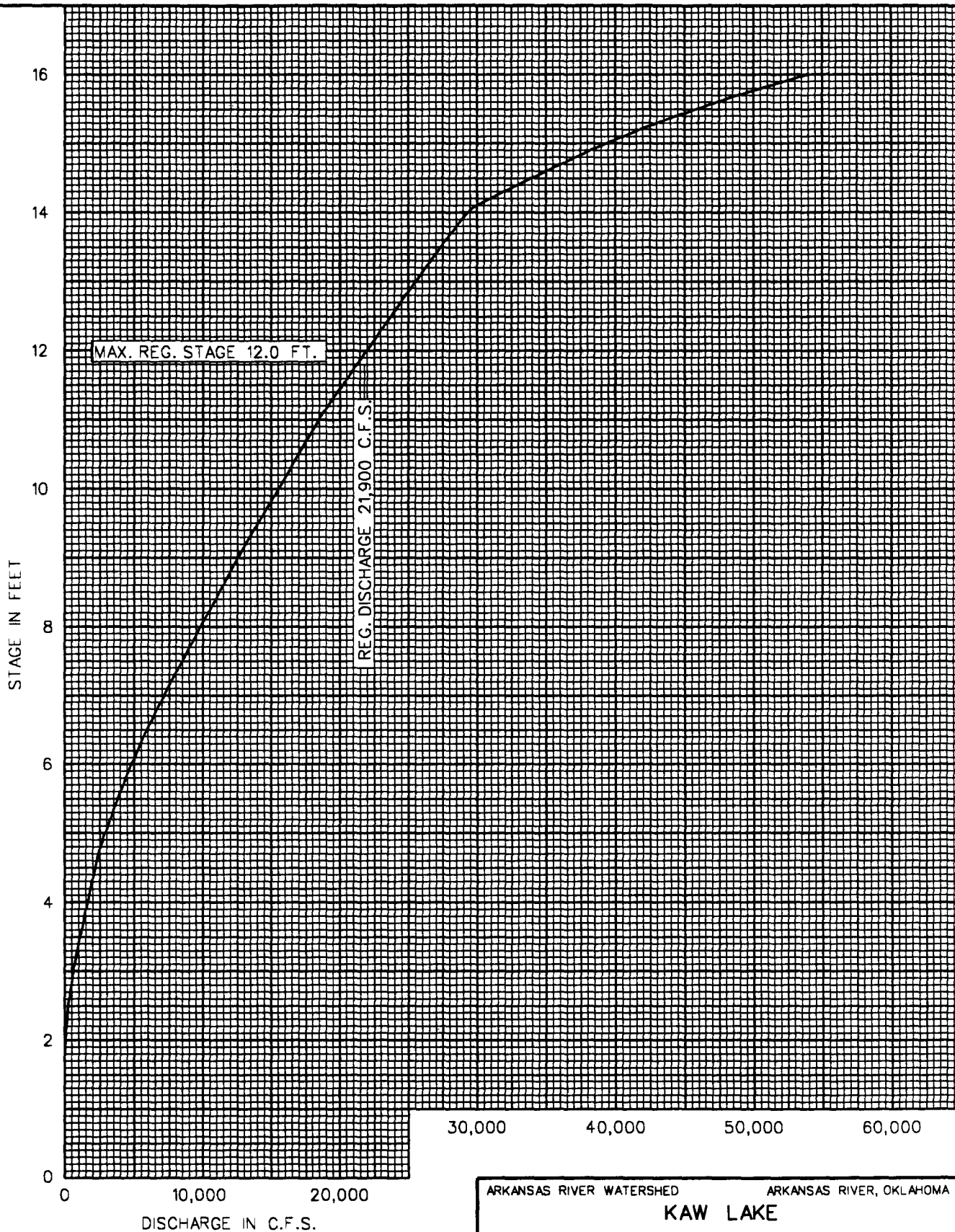
CONTROL STRUCTURE NO. 4

ARKANSAS RIVER AT
WICHITA, KANSAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993

DRAWN BY: SKG

CHECKED BY: J.W.C.

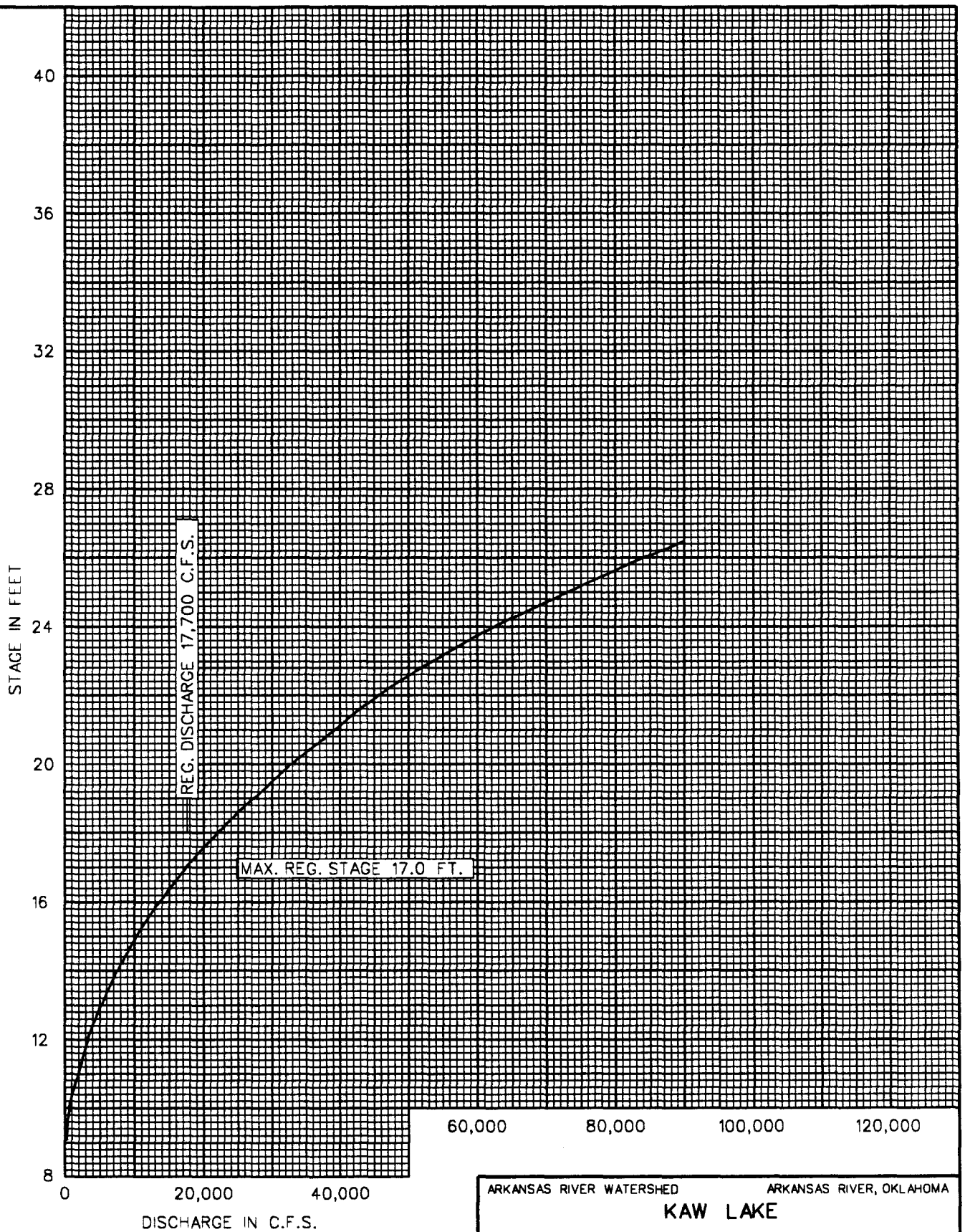


RATING NO. 28 (1989)

ARKANSAS RIVER WATERSHED
 ARKANSAS RIVER, OKLAHOMA
KAW LAKE

DISCHARGE RATING CURVE ARKANSAS RIVER AT DERBY, KANSAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.



RATING NO. 47 (1988)

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

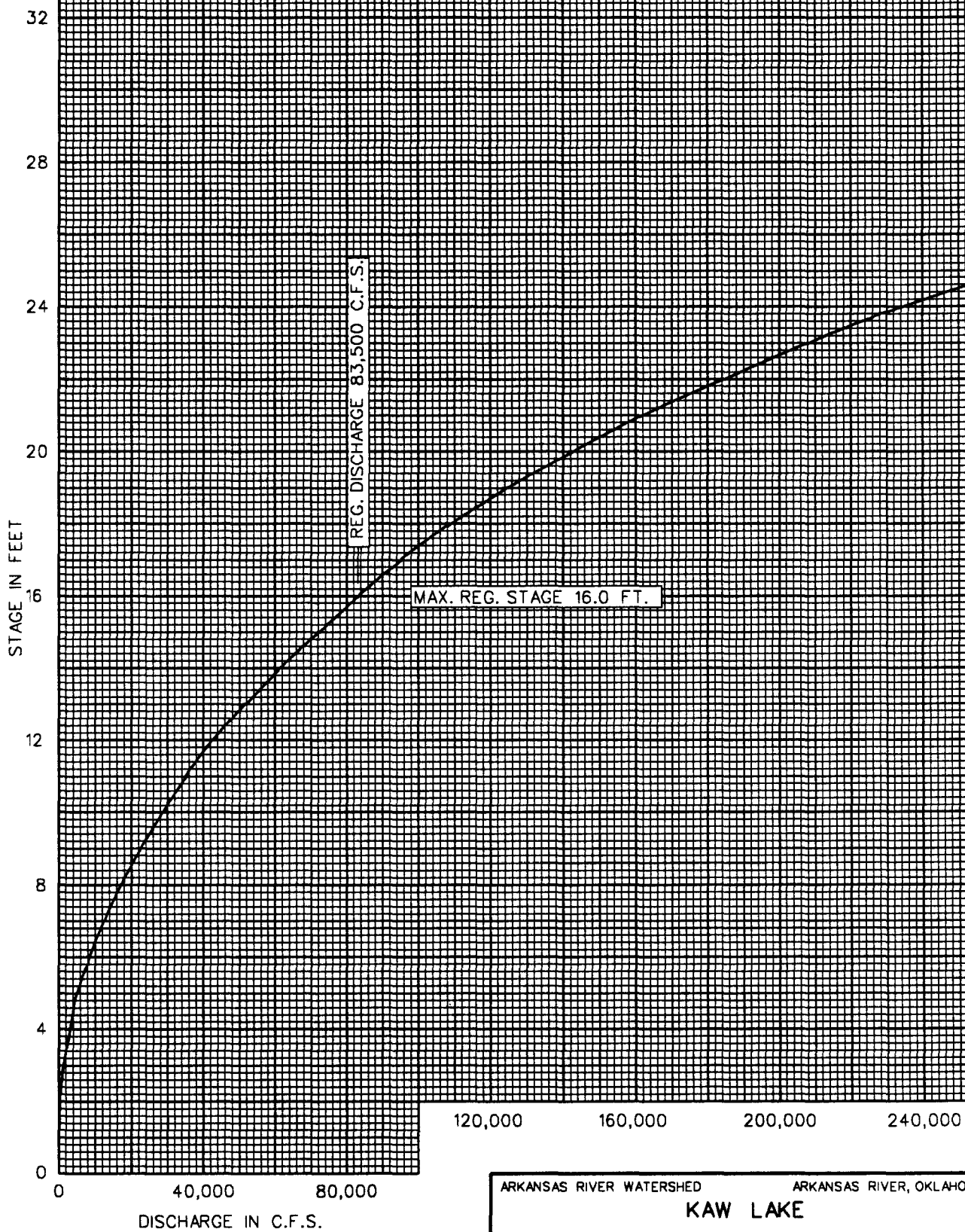
KAW LAKE

DISCHARGE RATING CURVE

ARKANSAS RIVER AT
ARKANSAS CITY, KANSAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993

DRAWN BY: SKG
CHECKED BY: J.W.C.

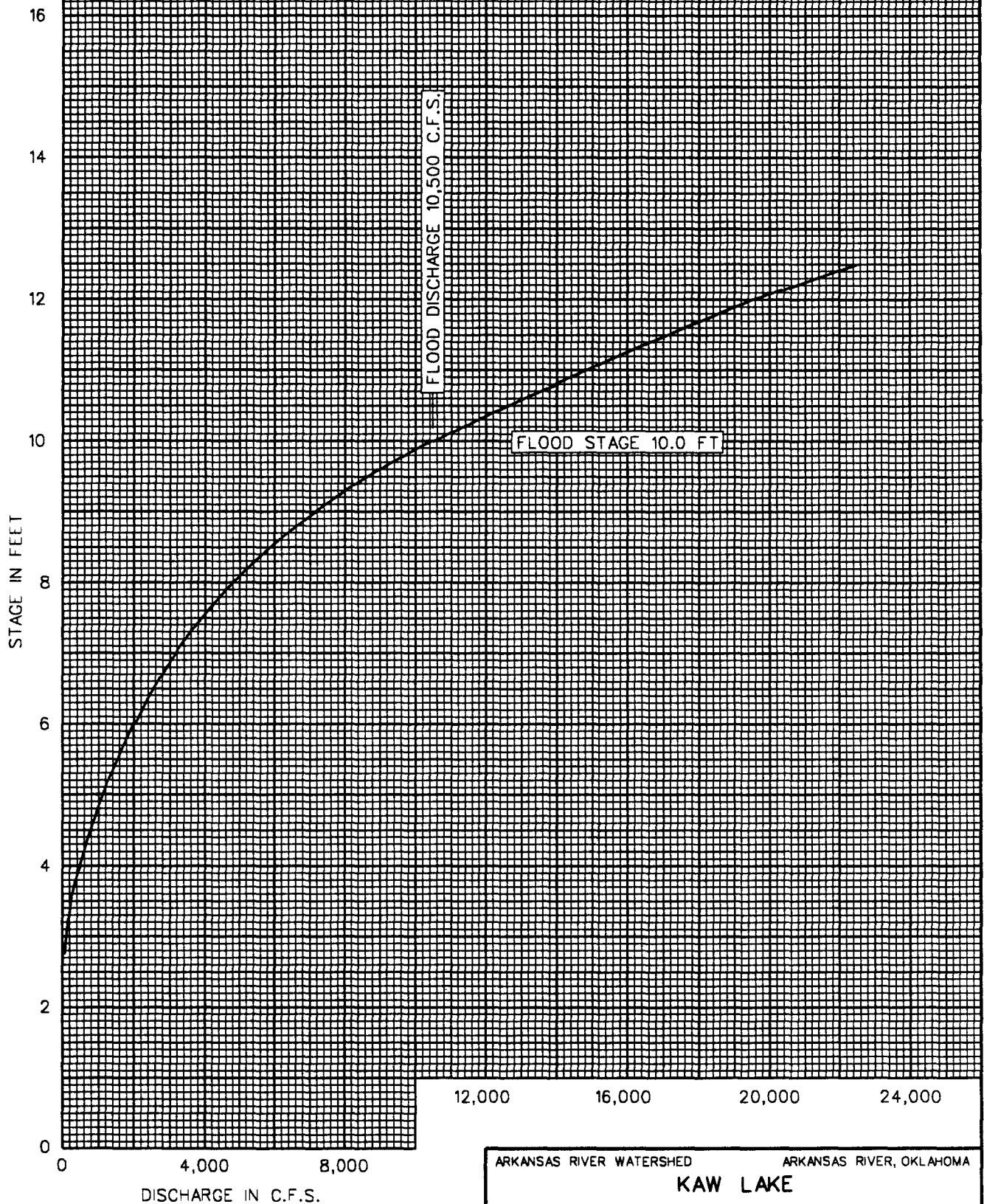


RATING NO. 8 (1988)

ARKANSAS RIVER WATERSHED
KAW LAKE
ARKANSAS RIVER, OKLAHOMA

DISCHARGE RATING CURVE ARKANSAS RIVER AT RALSTON, OKLAHOMA

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.



RATING NO. 40 (1989)

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

KAW LAKE

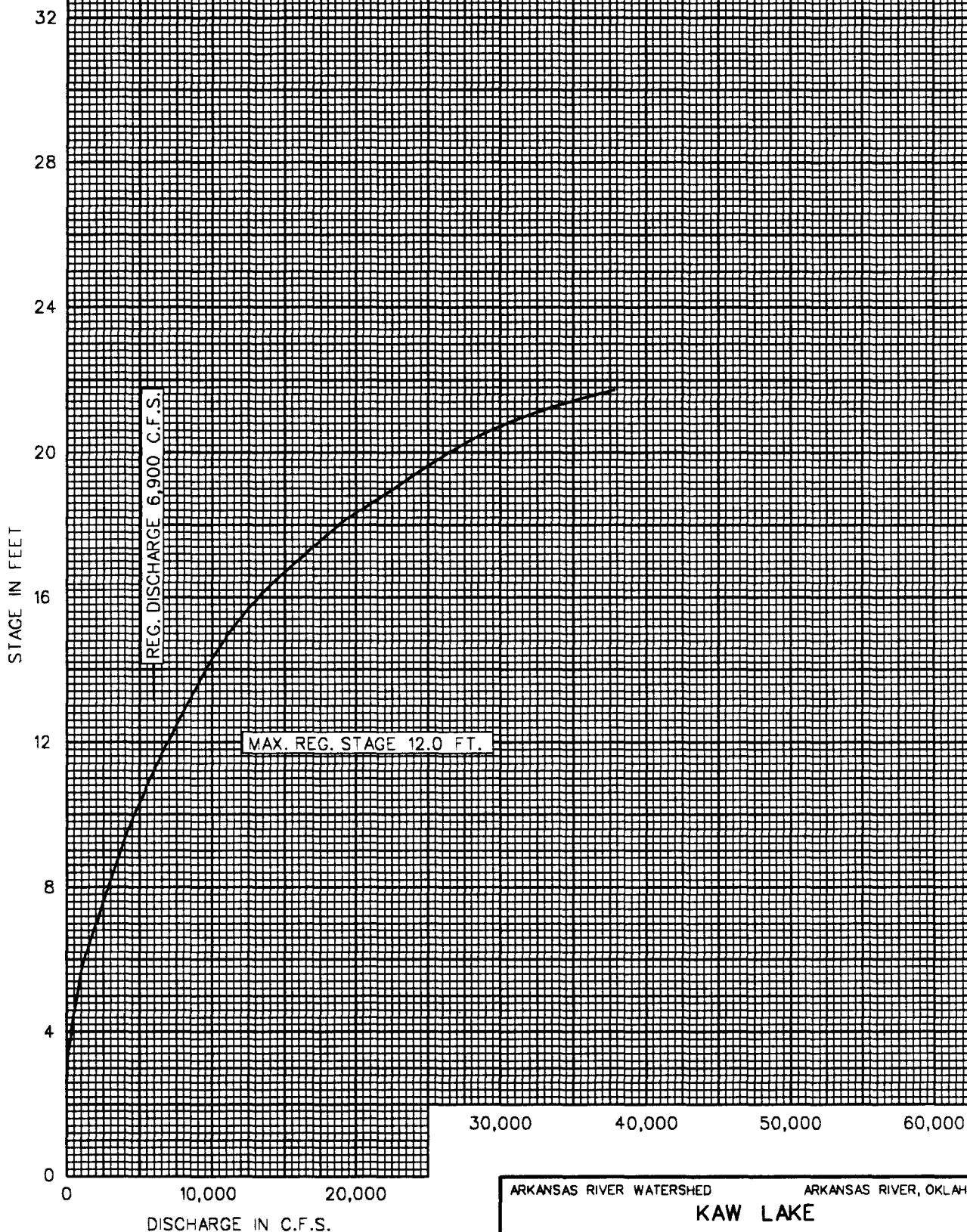
DISCHARGE RATING CURVE

ARKANSAS RIVER AT
HUTCHINSON, KANSAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993

DRAWN BY: SKG

CHECKED BY: J.W.C.



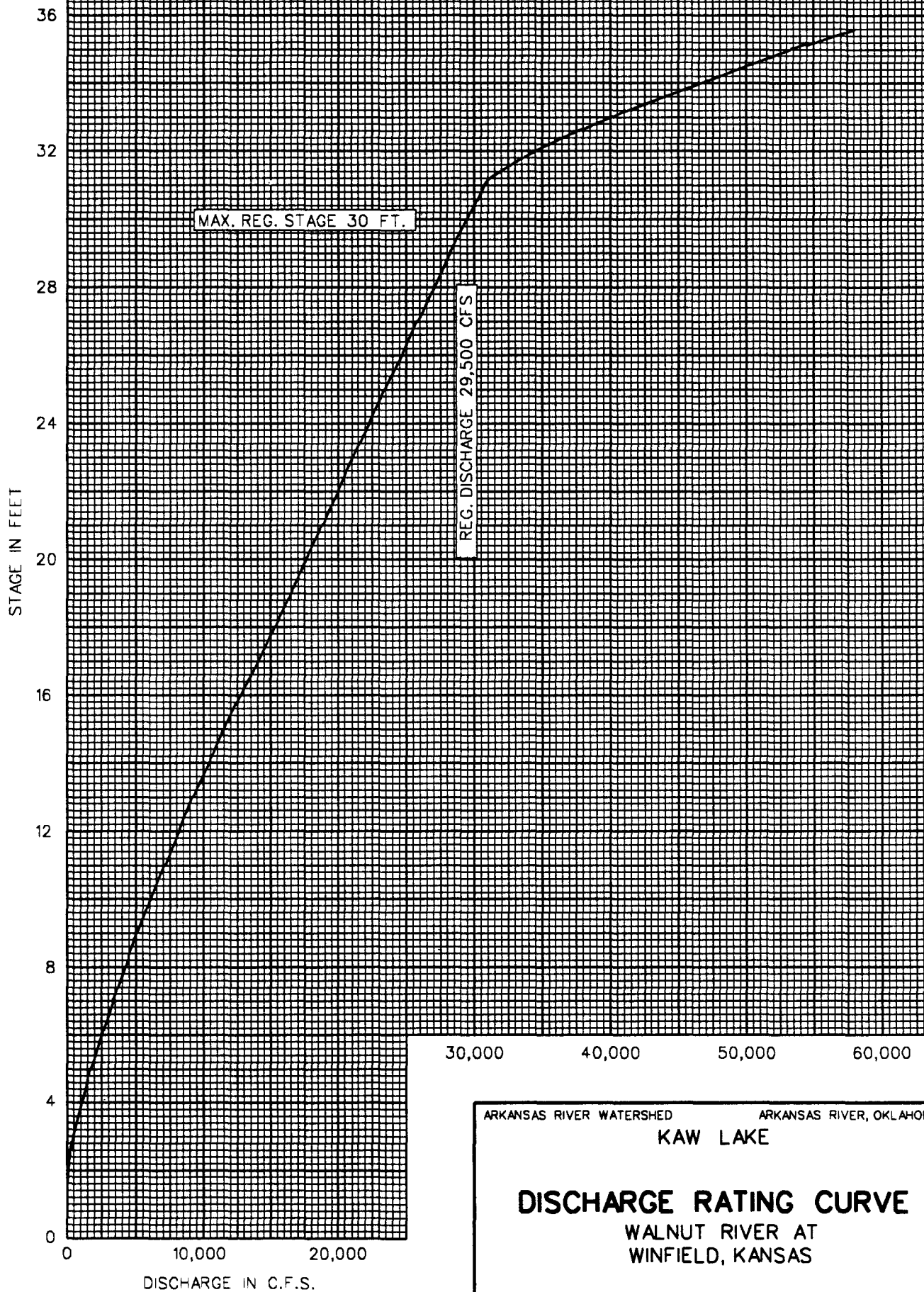
RATING NO. 27 (1989)

ARKANSAS RIVER WATERSHED
KAW LAKE
ARKANSAS RIVER, OKLAHOMA

DISCHARGE RATING CURVE

NINNESCAH RIVER AT
PECK, KANSAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.

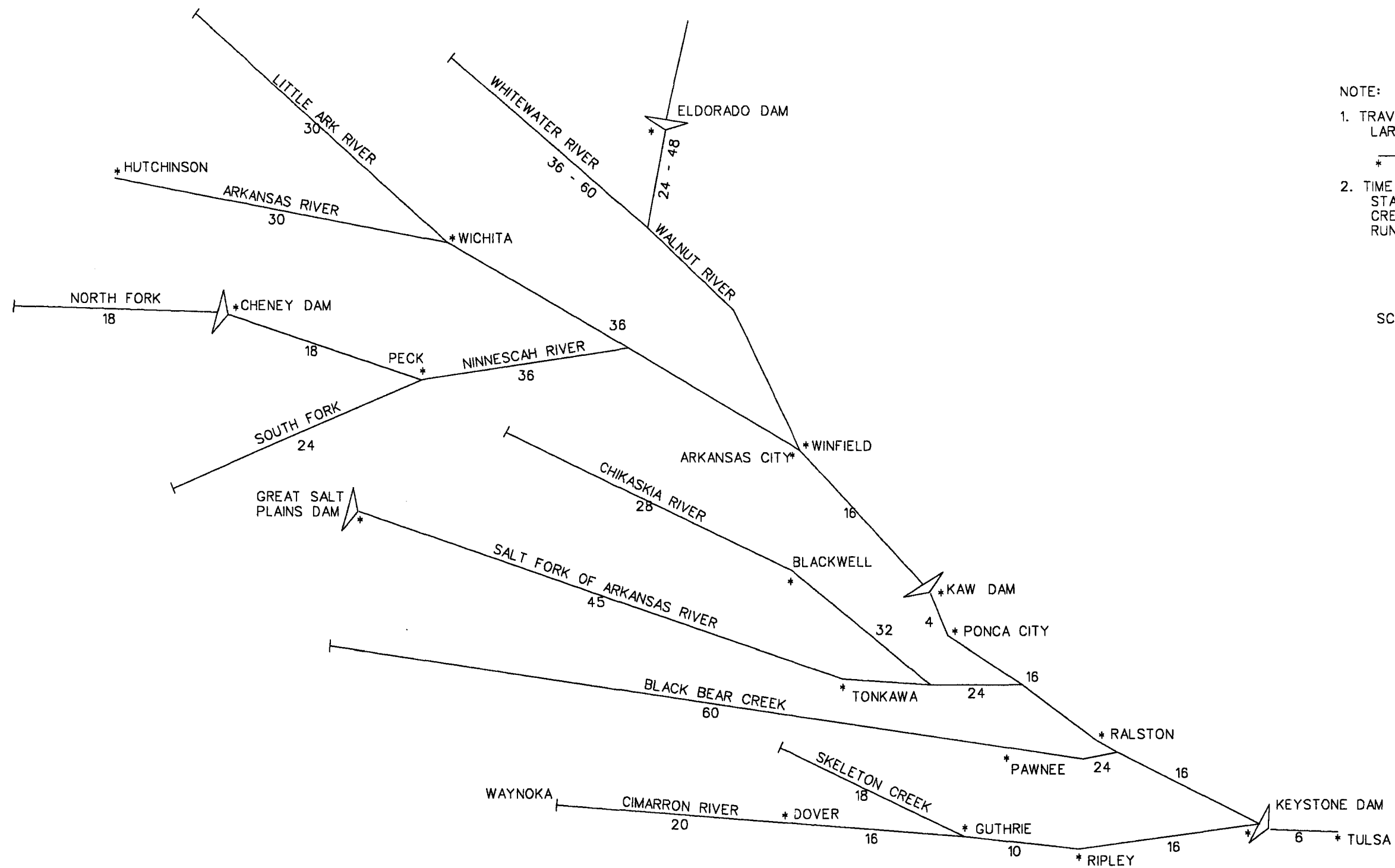


RATING NO. 32 (1988)

ARKANSAS RIVER WATERSHED
KAW LAKE

DISCHARGE RATING CURVE WALNUT RIVER AT WINFIELD, KANSAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.



NOTE:

1. TRAVEL TIME IN HOURS FOR LARGE RISES IS SHOWN:

* 16 *

2. TIME SHOWN ABOVE UPSTREAM STATION IS AVERAGE TIME TO CREST AFTER BEGINNING OF RUNOFF.

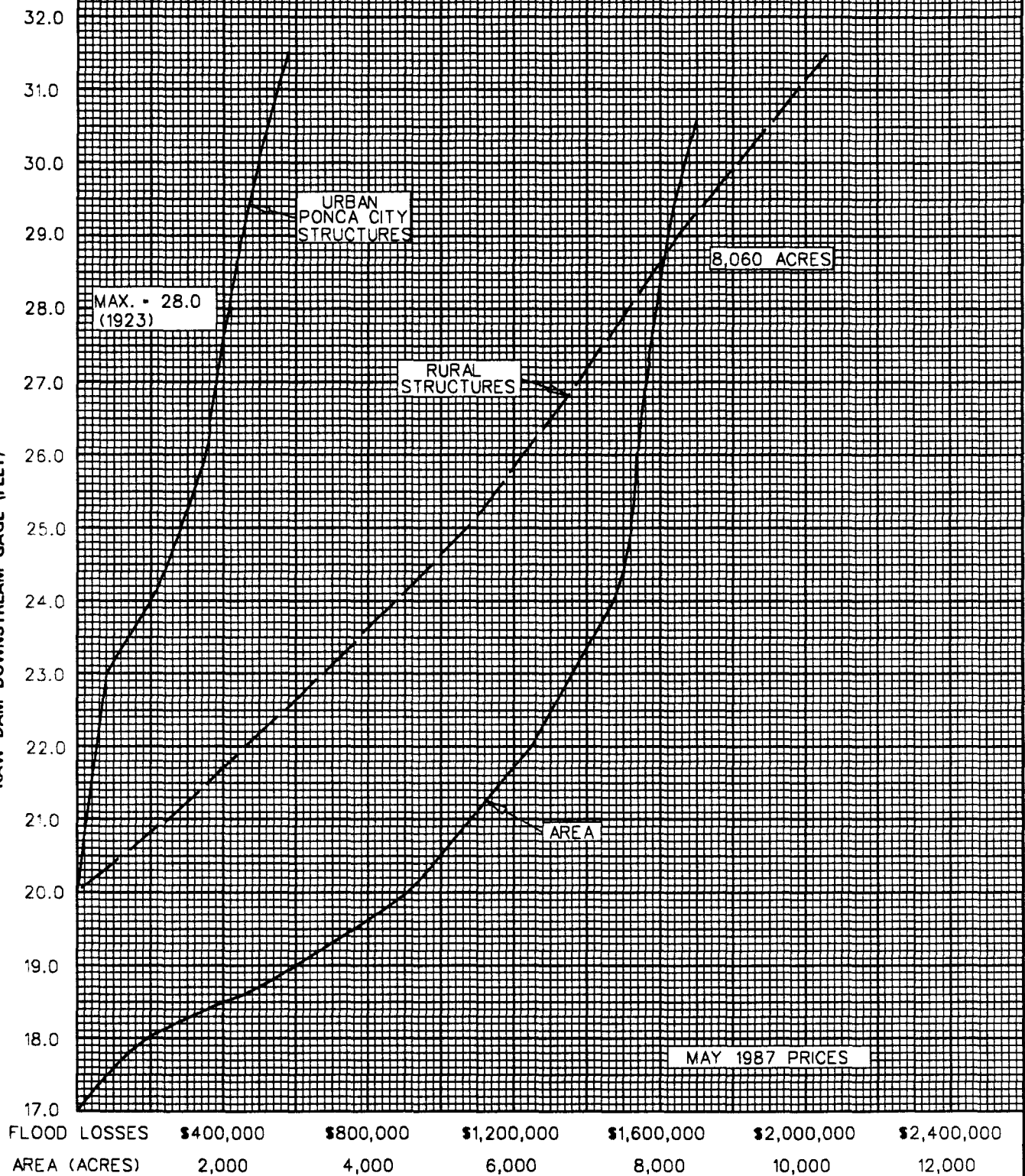
SCALE 1" = 10 HOURS

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

TIME OF CREST TRAVEL

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.

KAW DAM DOWNSTREAM GAGE (FEET)



BANKFULL STAGE = 17.0'

ACREAGE BEGINS AT 17.0'

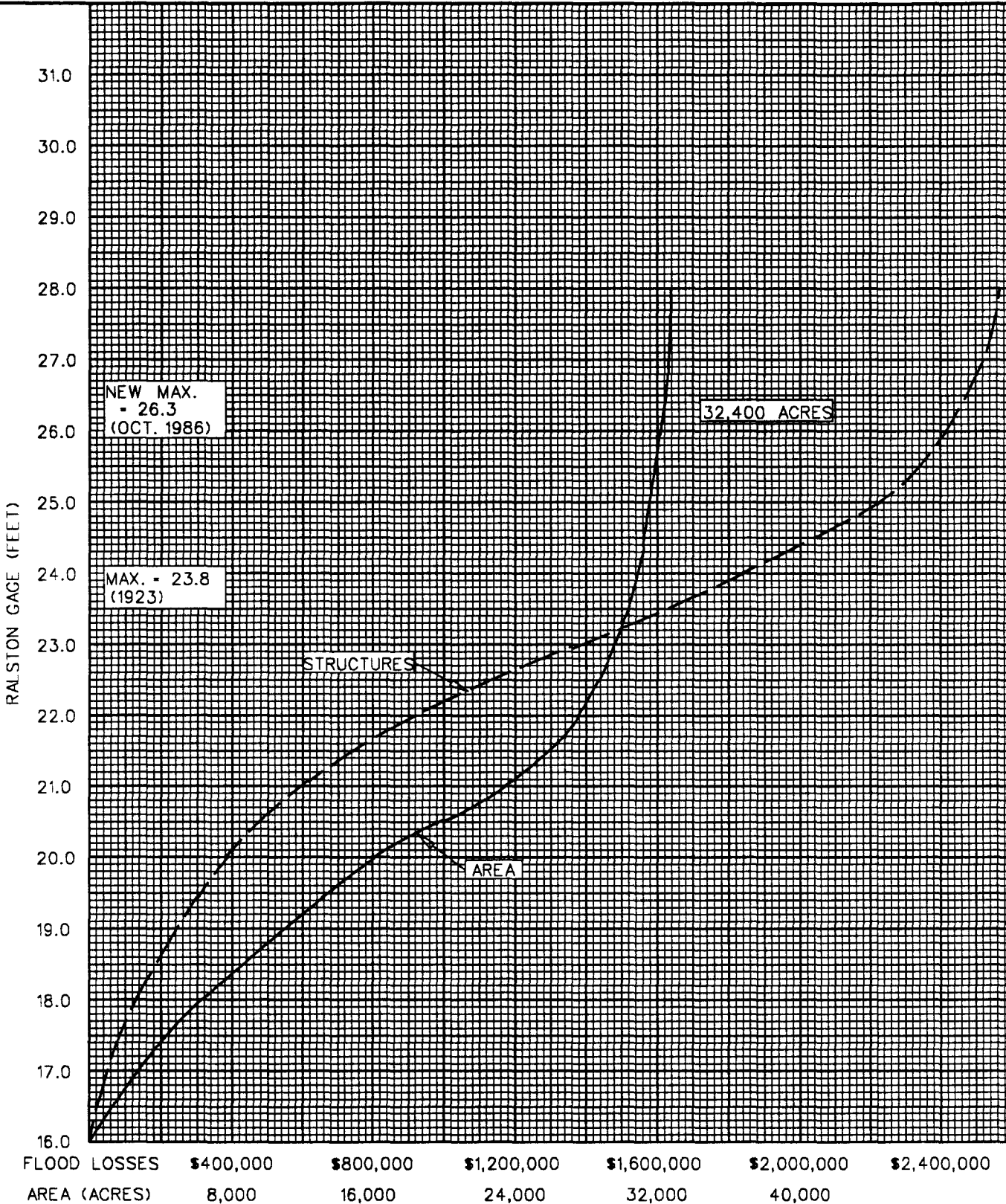
RURAL STRUCTURES BEGIN AT 20.0'

URBAN STRUCTURES BEGIN AT 20.0'

ARKANSAS RIVER WATERSHED
KAW LAKE
ARKANSAS RIVER, OKLAHOMA

AREA AND STRUCTURAL LOSS CURVES KAW DAM SITE TO SALT FORK OF ARKANSAS RIVER

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.



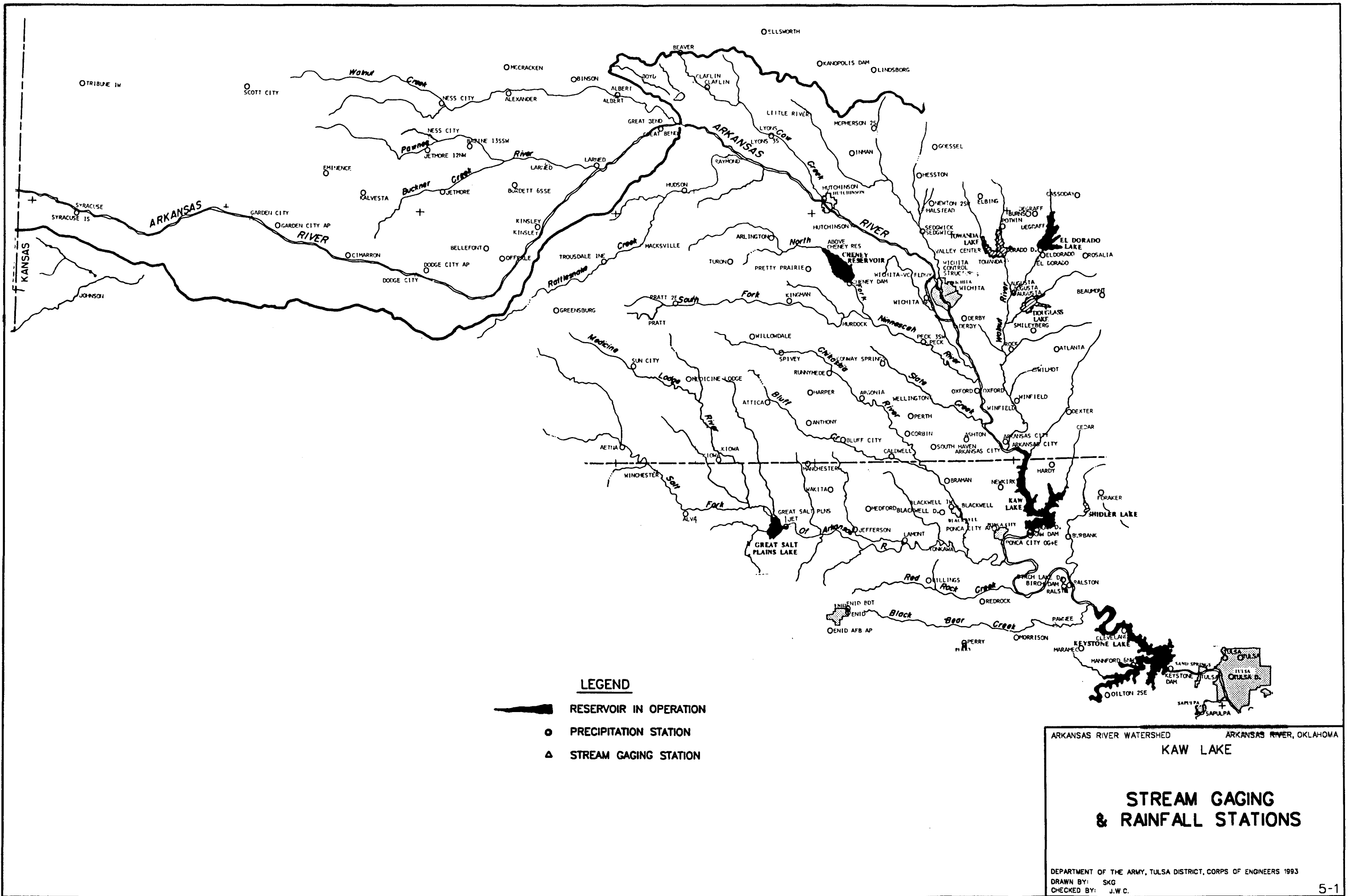
FLOOD LOSSES \$400,000 \$800,000 \$1,200,000 \$1,600,000 \$2,000,000 \$2,400,000
 AREA (ACRES) 8,000 16,000 24,000 32,000 40,000

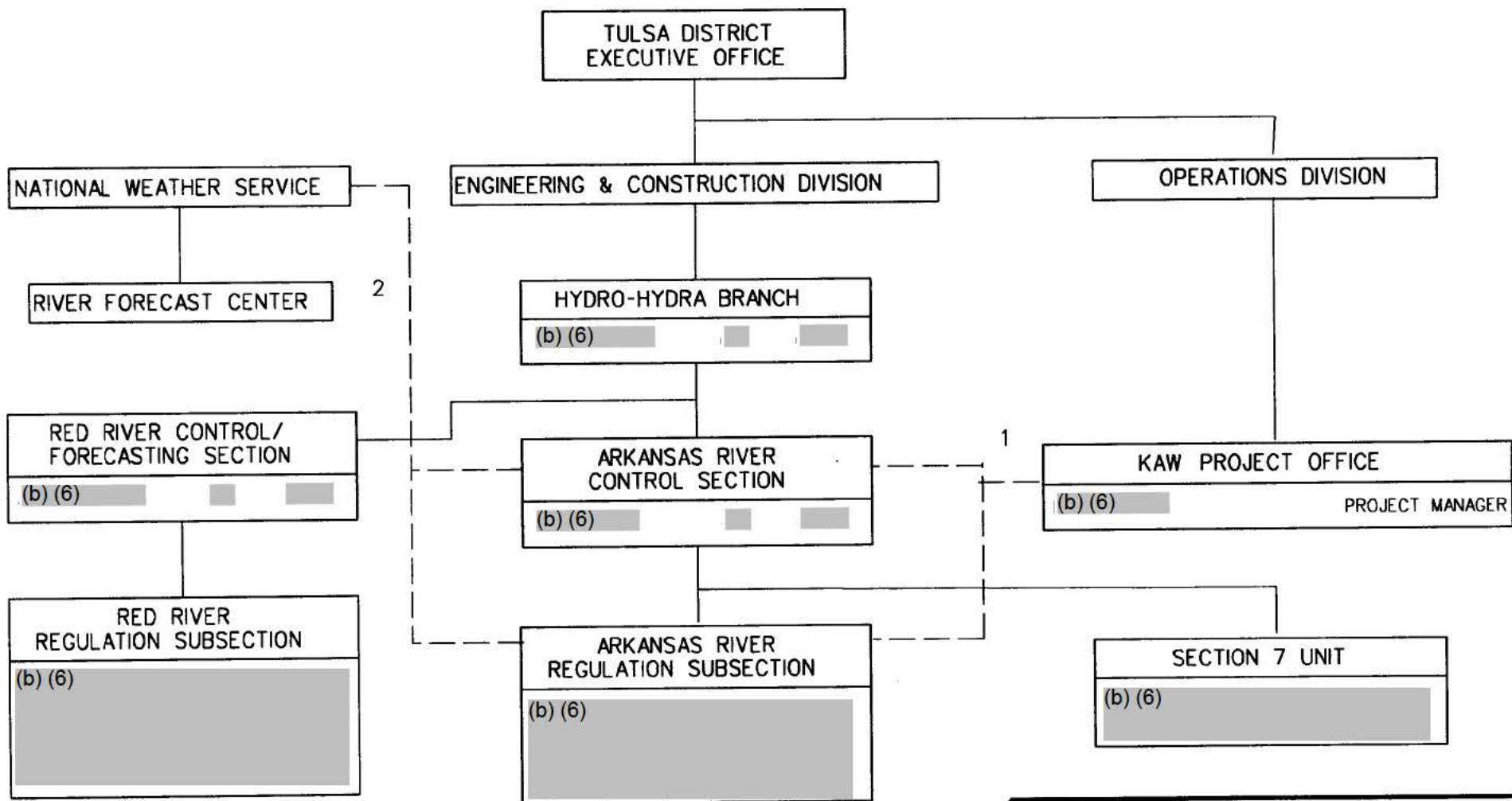
BANKFULL STAGE - 16.0'
 ACREAGE BEGINS AT 16.0'
 STRUCTURES BEGIN AT 16.0'

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

AREA AND STRUCTURAL LOSS CURVES SALT FORK OF ARKANSAS RIVER TO UPPER LIMITS OF KEYSTONE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.





1. DIRECT COMMUNICATIONS ARE MAINTAINED BETWEEN THE LAKES AND THE RESERVOIR CONTROL SECTION FOR TRANSMISSION OF LAKE DATA AND INSTRUCTIONS.
2. PRECIPITATION AND STREAM GAGE DATA ARE FURNISHED BY THE NATIONAL WEATHER SERVICE, RIVER FORECAST CENTER.

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

ORGANIZATIONAL CHART

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.

KAW
LAKE DATA

JULY 02

190X

LINE NUMBER	ITEM	TIME									
1	POOL ELEVATION	12N	1010.00								
2	POOL ELEVATION	4PM	1009.99								
3	POOL ELEVATION	12M	1009.99								
4	POOL ELEVATION	8AM	1009.98								
5	TAILWATER ELEVATION	8AM	3.94								
6	24 HR AV POWER DISCHARGE	12M	275								
7	24 HR AV TOTAL DISCHARGE	12M	324								
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	30								
12	LAKE CONDITIONS	8AM	CLEAR								
13	WEATHER CONDITIONS	8AM	CLOUDY								
14	TOTAL PRECEDING 6 HOUR PRECIPITATION ENDING AT	1PM									
		7PM	.08								
		1AM									
		7AM									
15	TOTAL 24 HOUR PRECIPITATION	7AM	.08								
16	COMMENTS ON PRECIP. DIST.		2P-6P								
17	EVAPORATION 24 HOURS	8AM	.32								
18	WIND DIRECTION	8AM	SW								
19	WIND VELOCITY	8AM	8-1								
20	WATER SUPPLY										
21	GATE SETTINGS NO. TYPE, OPENING	8AM	1SG .1'								
22	GATE DATE CHANGES - TIME		7-1-XX 1525								
23	POOL ELEVATION		1009.99								
24	FROM: GATE SETTING		1SG .2'								
25	TO: GATE SETTING		1SG .1'								
26	GATE DATE CHANGES - TIME										
27	POOL ELEVATION										
28	FROM: GATE SETTING										
29	TO: GATE SETTING										
30	RIVER STAGE - LOW FLOW WEIR										

SWT FORM 913
REVISED CE/SWT JAN 1984

ARKANSAS RIVER WATERSHED

ARKANSAS RIVER, OKLAHOMA

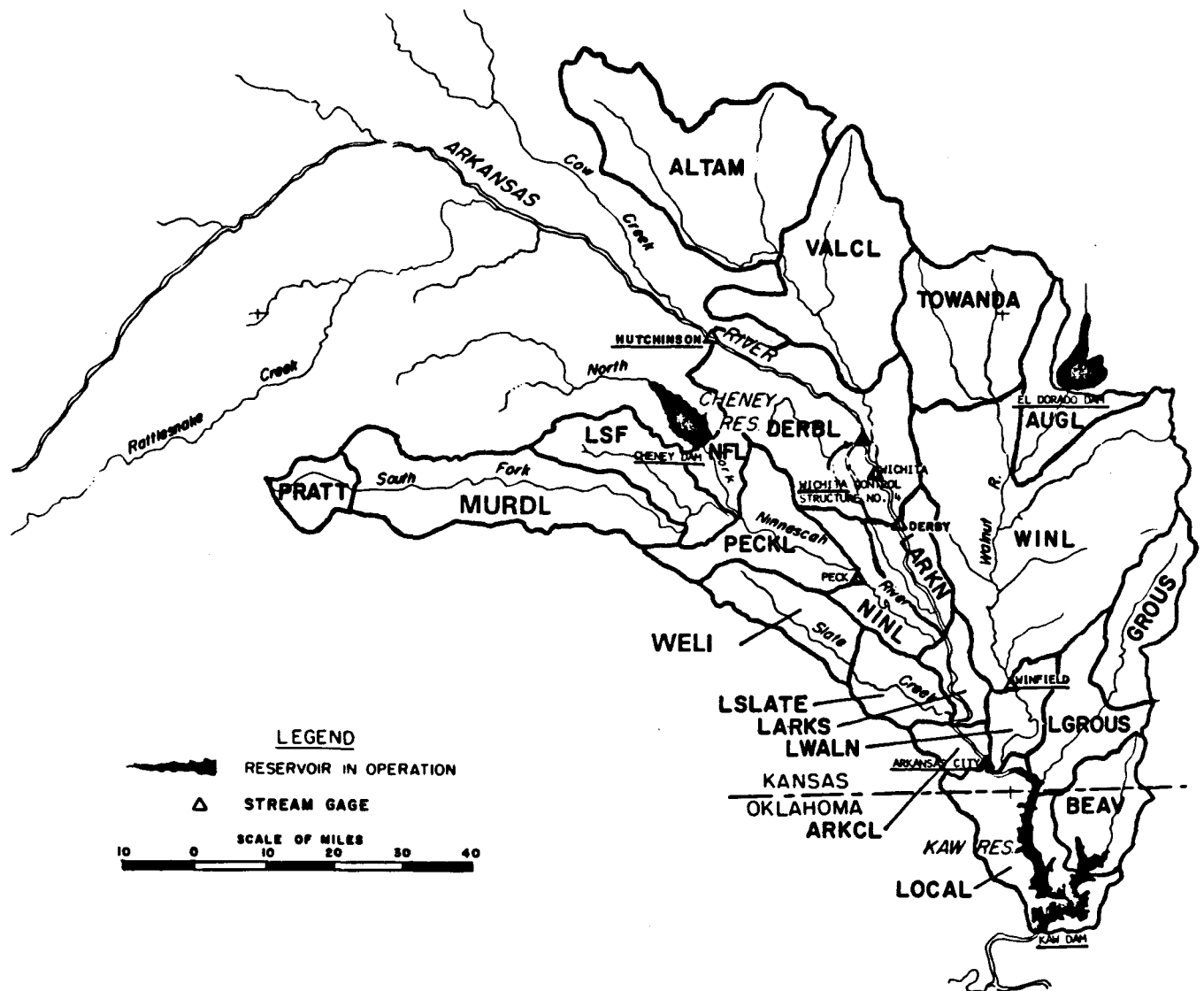
KAW LAKE

DAILY LAKE DATA REPORT

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993

DRAWN BY: SKG

CHECKED BY: J.W.C.



ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

FORECAST REACHES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.

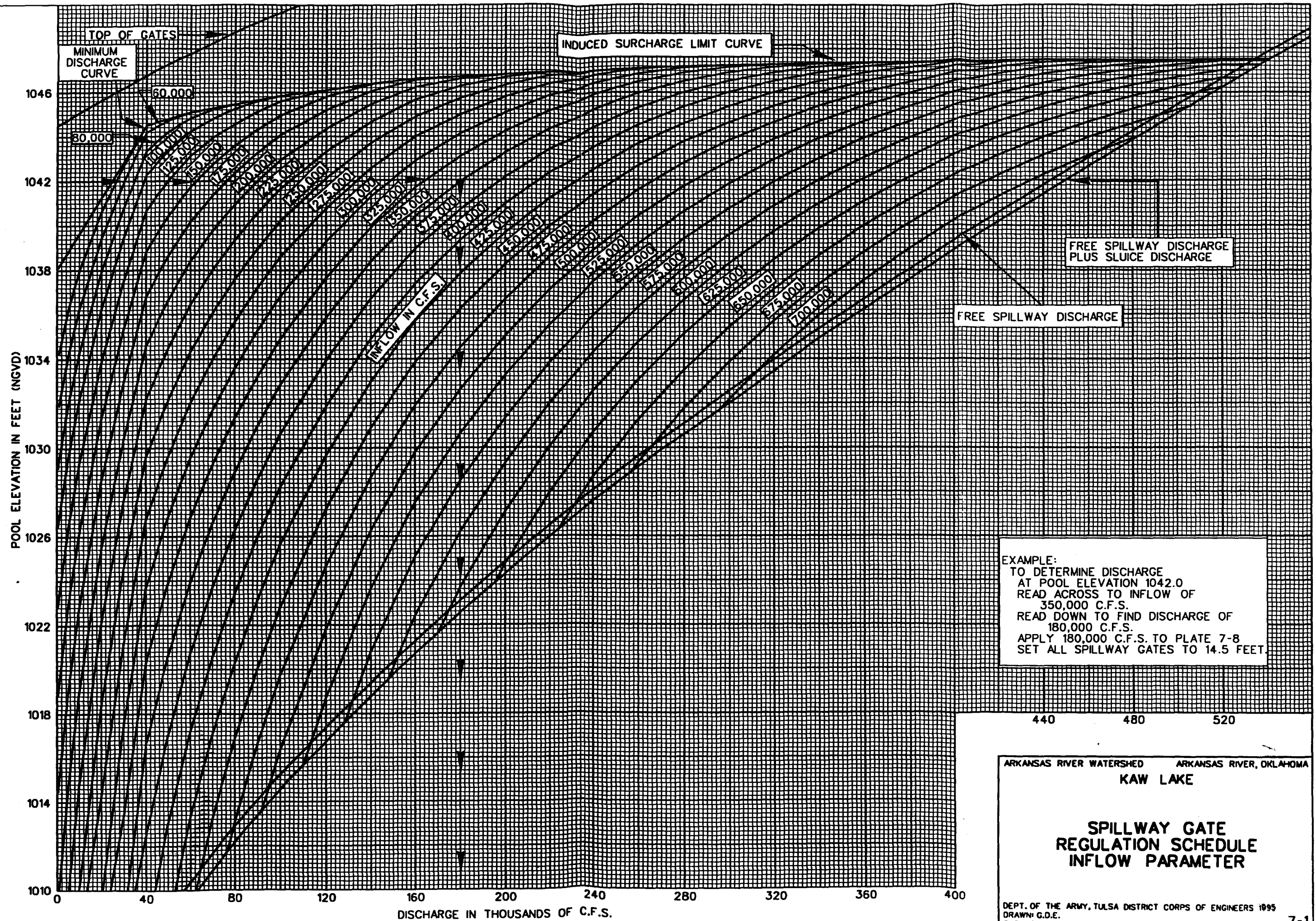
RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	WELI	3936.	18.00	3832.	2977.	1370.	154.70		
ROUTED TO	RWELI	2310.	46.00	2287.	2076.	1221.	154.70		
HYDROGRAPH AT	PRATT	1872.	6.00	1437.	641.	311.	21.00		
ROUTED TO	RPRAT	273.	94.00	272.	267.	230.	21.00		
HYDROGRAPH AT	MURDL	11640.	20.00	11409.	8972.	4089.	438.00		
2 COMBINED AT	MURD	11640.	20.00	11409.	8973.	4144.	459.00		
ROUTED TO	RMURD	10476.	24.00	10233.	8198.	3864.	459.00		
HYDROGRAPH AT	LSF	9681.	12.00	9245.	5823.	2441.	242.00		
HYDROGRAPH AT	CHENO	0.	2.00	0.	0.	0.	1.00		
ROUTED TO	RCHENO	0.	2.00	0.	0.	0.	1.00		
HYDROGRAPH AT	NFL	4804.	8.00	4092.	1976.	848.	74.00		
4 COMBINED AT	NR	16879.	14.00	16474.	14159.	7089.	776.00		
ROUTED TO	RNR	12170.	34.00	12095.	10965.	6196.	776.00		
HYDROGRAPH AT	PECKL	8374.	14.00	8073.	5625.	2467.	257.40		
2 COMBINED AT	PECK	14266.	28.00	14205.	13623.	8511.	1033.40		
ROUTED TO									

D-12

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

**SAMPLE OUTPUT
FOR HEC-1 MODEL**



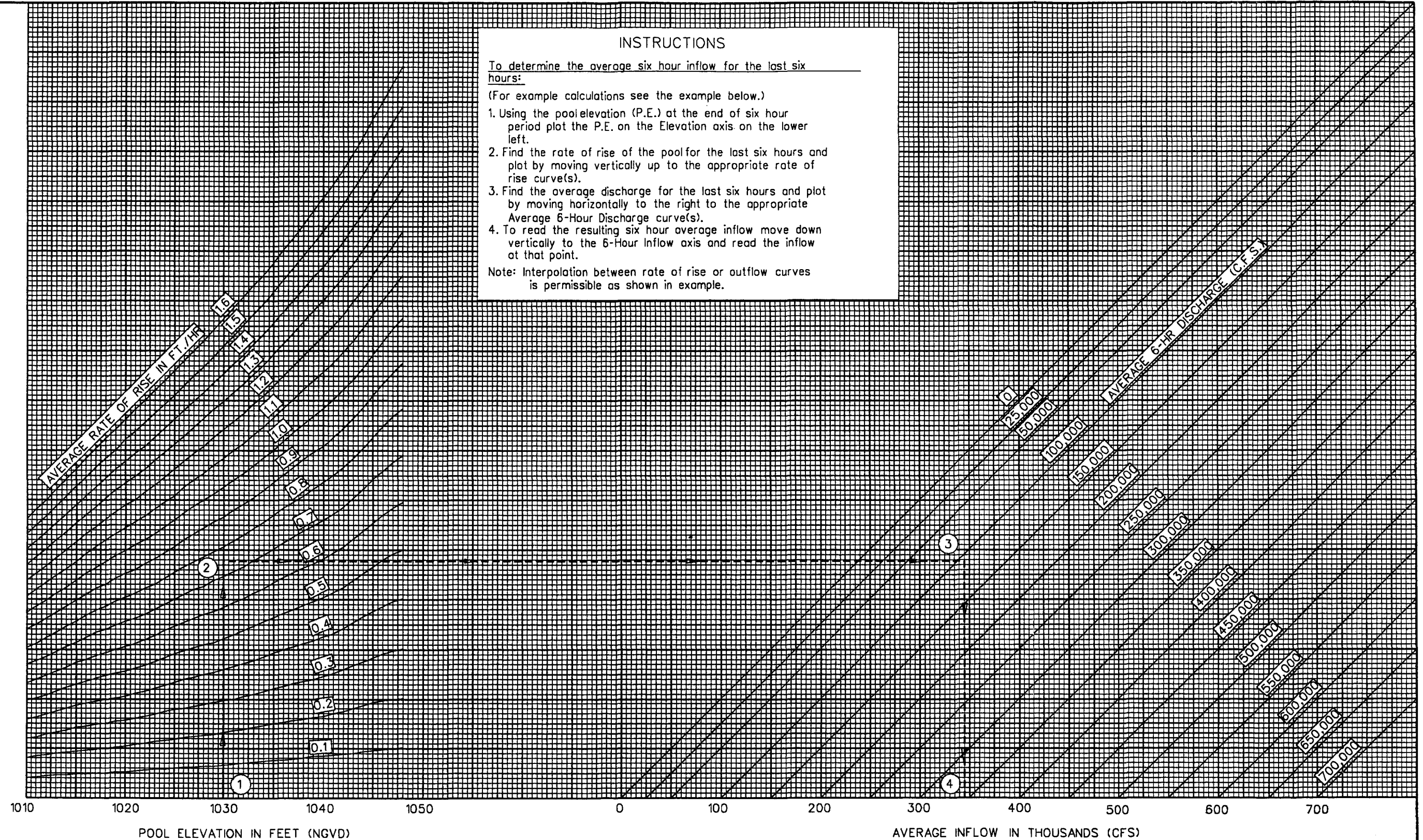
INSTRUCTIONS

To determine the average six hour inflow for the last six hours:

(For example calculations see the example below.)

1. Using the pool elevation (P.E.) at the end of six hour period plot the P.E. on the Elevation axis on the lower left.
2. Find the rate of rise of the pool for the last six hours and plot by moving vertically up to the appropriate rate of rise curve(s).
3. Find the average discharge for the last six hours and plot by moving horizontally to the right to the appropriate Average 6-Hour Discharge curve(s).
4. To read the resulting six hour average inflow move down vertically to the 6-Hour Inflow axis and read the inflow at that point.

Note: Interpolation between rate of rise or outflow curves is permissible as shown in example.



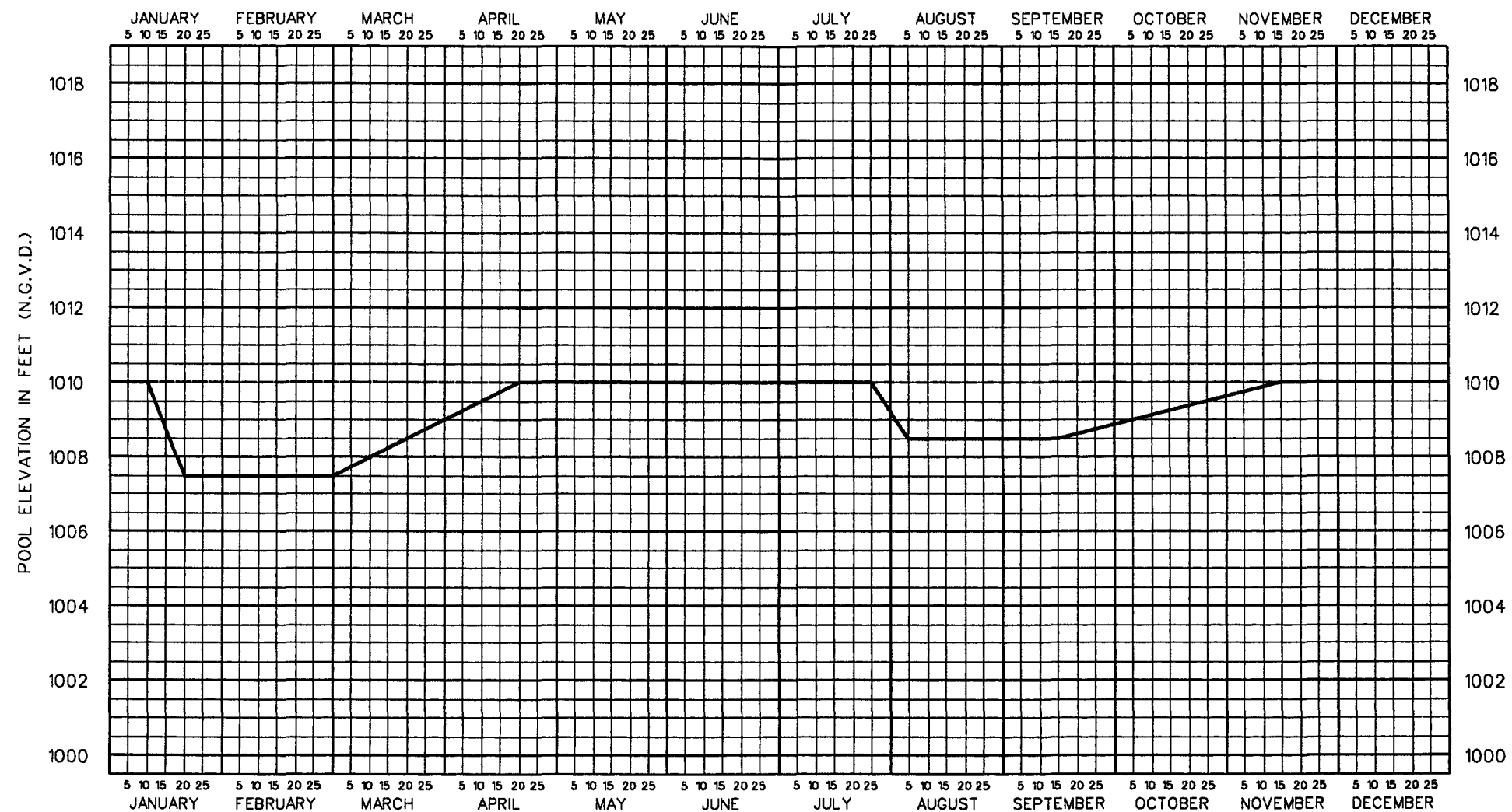
EXAMPLE CALCULATION

1. The current pool elevation is 1030 ft. Find this on the pool elevation axis (1.)
2. Six hours ago it was 1025.5 ft. The average rate of rise for this six hours is: $(1030.0 - 1025.5) / 6 \text{ hrs.} = 0.75 \text{ ft. per hour.}$ Move up vertically from (1) to find the rate of rise on the rate of rise curves (2.)
3. Six hours ago the discharge was 80,000 cfs, five hours ago it was changed to 100,000 cfs, and two hours ago it was changed to 125,000 cfs. The average discharge for the last six hours is $[1 \text{ hr.}(80,000 \text{ cfs}) + 3 \text{ hrs.}(100,000 \text{ cfs}) + 2 \text{ hrs.}(125,000)] / 6 = 105,000 \text{ cfs.}$ Move horizontally to read this six hour average discharge on the Outflow curves (3.)
4. From (3) read down vertically that the inflow for the last six hours is 345,000 cfs. (4.)

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

INFLOW VS. RATE OF RISE NOMOGRAPH

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.



LEGEND

- LAKE LEVEL
MANIPULATION PLAN
- CONSERVATION
POOL ELEVATION

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

LAKE LEVEL MANIPULATION PLAN

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.

KAW LAKE

Top F.C. Pool 1044.5
F.C. Storage 919,400 A.F.
Top Cons. Pool 1010.0
Cons. Storage 343,600 A.F. (Initial)
Cons. Storage 203,000 A.F. (Ultimate)
W.S. Storage 289,760 A.F. (Initial)
W.S. Storage 171,200 A.F. (Ultimate)
W.Q. Storage 53,840 A.F. (Initial)
W.Q. Storage 31,800 A.F. (Ultimate)
Top Inactive Pool 978.0
Inactive Storage 85,000 A.F.

WATER SUPPLY STORAGE ACCOUNTING
(EXAMPLE)

User No. 1
(O G & E)
Contracted Space:
66,590 A.F. (19.38%)
(Initial Condition)
Between El. 978.0 and 1010.0

User No. 2
(City of Stillwater)
Contracted Space:
87,070 A.F. (25.34%)
(Initial Condition)
Between El. 978.0 and 1010.0

User No. 3
(Kaw Reservoir Authority)
Contracted Space:
136,100 A.F. (39.61%)
(Initial Condition)
Between El. 978.0 and 1010.0

User No. 4
(Water Quality)
Contracted Space:
53,840 A.F. (15.67%)
(Initial Condition)
Between El. 978.0 and 1010.0

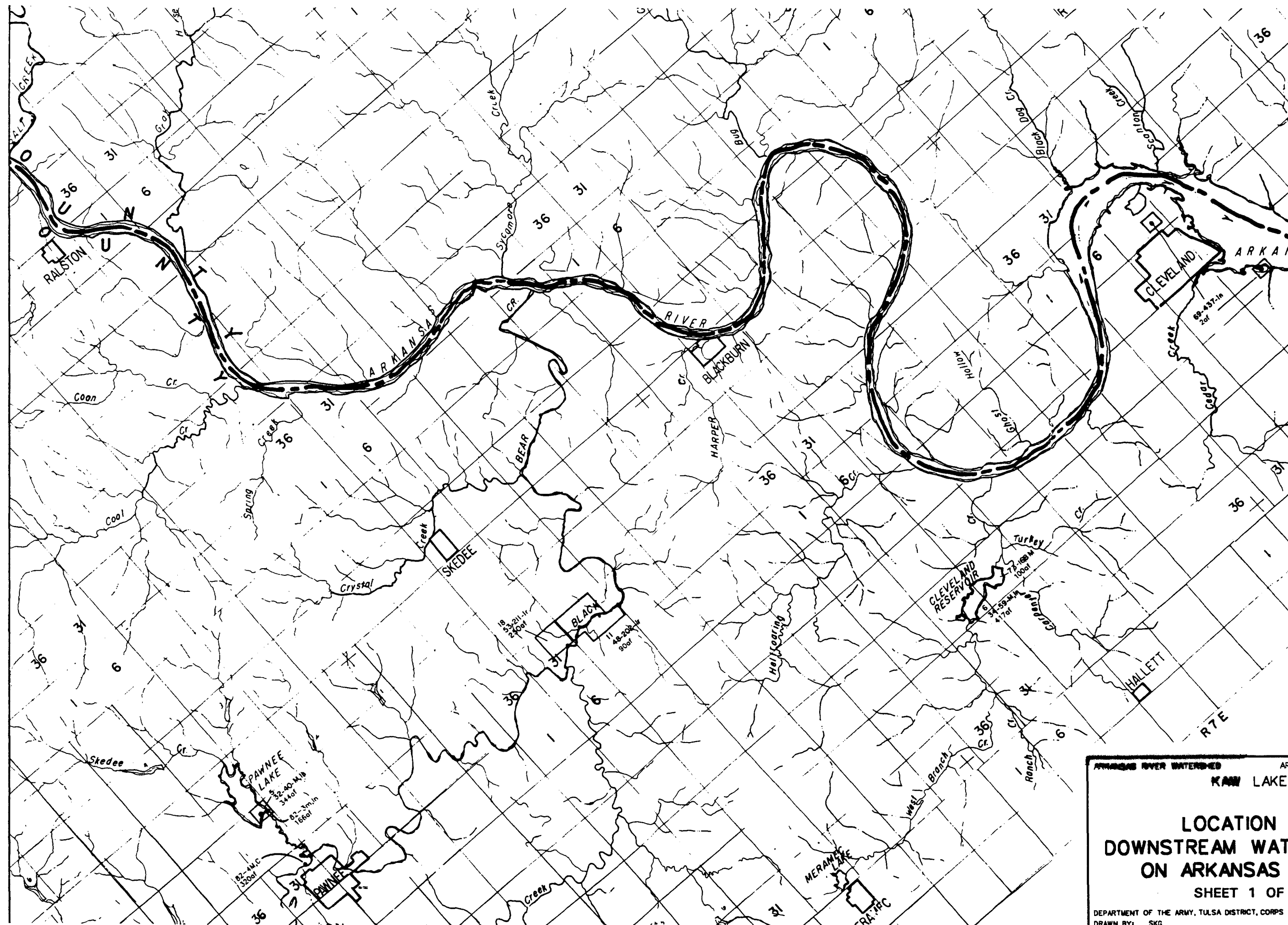
Date	Total Inflow A.F.	Water Rights A.F.	Net Inflow A.F.	Pool Elev. M.S.L.	Conservation Storage A.F.	Total Loss A.F.	Storage Remaining A.F.	Inflow Share A.F.	Loss A.F.	Withdrawal A.F.	Change in Storage A.F.	Storage Remaining A.F.	Inflow Share A.F.	Loss A.F.	Withdrawal A.F.	Change in Storage A.F.	Storage Remaining A.F.	Inflow Share A.F.	Loss A.F.	Withdrawal A.F.	Change in Storage A.F.	Storage Remaining A.F.	Inflow Share A.F.	Loss A.F.	Withdrawal A.F.	Change in Storage A.F.
11-1-00				1010.0	343,600		66,590					87,070					136,100					53,840				
12-1-00	34,000	6780	27,220	1009.9	342,260	3900	66,063	6227	754	6000	-527	87,070	6990	990	6000	0	135,287	12,729	1542	12,000	-813	53,840	1274	614	660	0
1-1-00	29,000	7005	21,995	1009.7	339,155	3100	66,063	5163	595	6000	-1432	87,070	5792	792	5000	0	135,287	10,551	1223	11,000	-1672	53,840	490	490	0	0
2-1-00	29,000	7005	21,995	1009.6	336,670	2480	64,631	5244	470	6000	-1226	87,070	5639	639	5000	0	133,615	10,717	976	11,000	-1259	53,840	395	395	0	0
3-1-00	34,000	6330	27,670	1009.5	335,980	3360	63,405	6657	628	7000	-971	87,070	6870	870	6000	0	132,356	13,606	1324	12,000	+282	53,840	538	538	0	0
4-1-00	31,000	7005	23,995	1009.1	329,025	5270	62,434	5162	967	7000	-2805	87,070	6749	1380	6000	-631	132,638	10,551	2070	12,000	-3519	53,840	1533	853	680	0
5-1-00	29,000	6780	22,220	1008.3	315,375	7200	59,629	4306	1288	7000	-3982	86,439	5631	1906	6000	-2275	129,119	8,801	2807	13,000	-7006	53,840	3482	1199	2670	-387
6-1-00	24,000	7005	16,995	1007.0	294,535	9300	55,647	3294	1631	6000	-4337	84,164	4306	2518	5000	-3212	122,113	6,732	3589	12,000	-8857	53,453	2663	1562	5535	-4434
							51,310					80,952					113,256					49,019				

ARKANSAS RIVER WATERSHED
KAW LAKE

WATER SUPPLY
STORAGE ACCOUNTING

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.

MATCH LINE TO PLATE 7-6

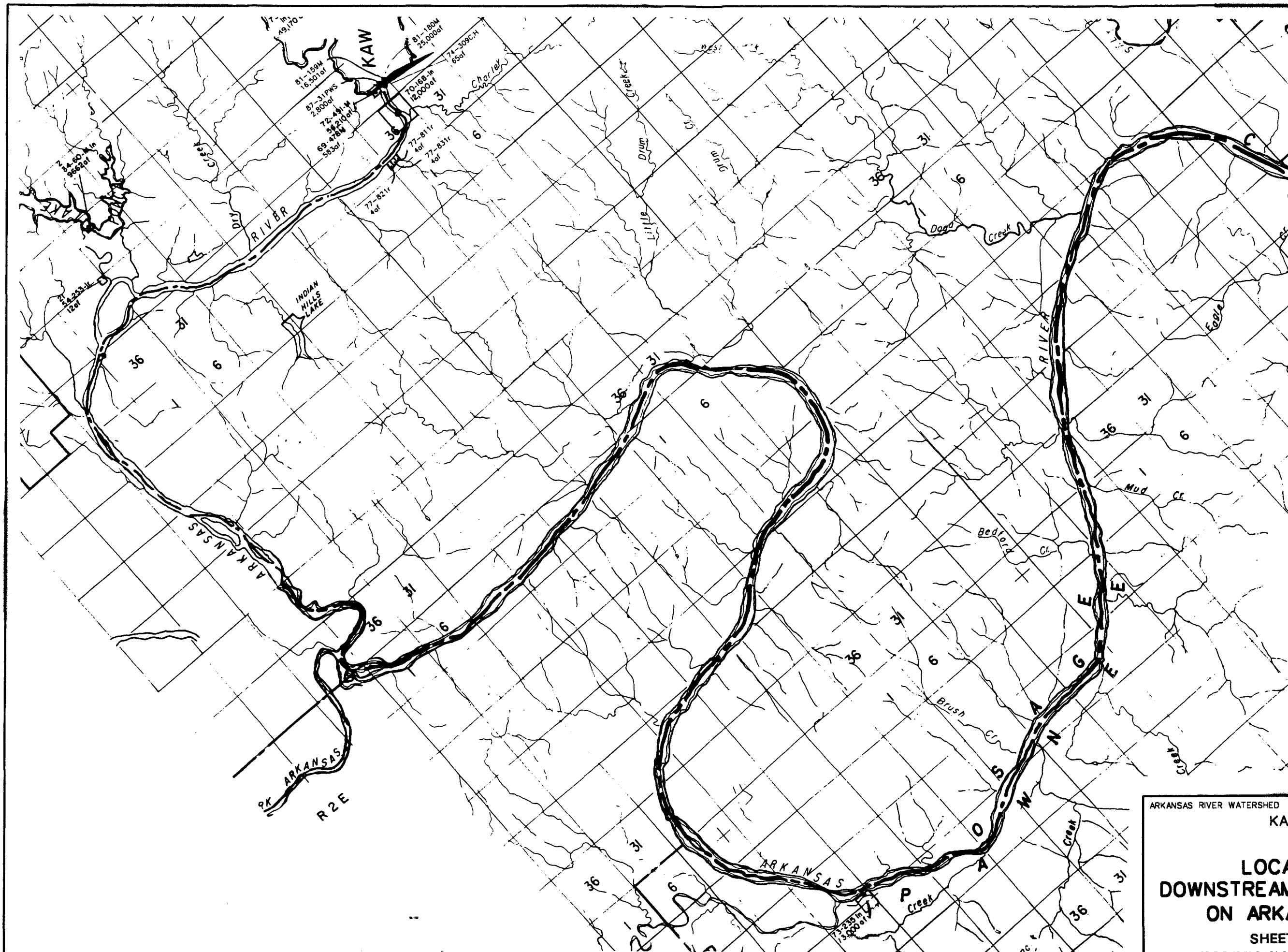


ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

**LOCATION OF
DOWNSTREAM WATER RIGHTS
ON ARKANSAS RIVER**

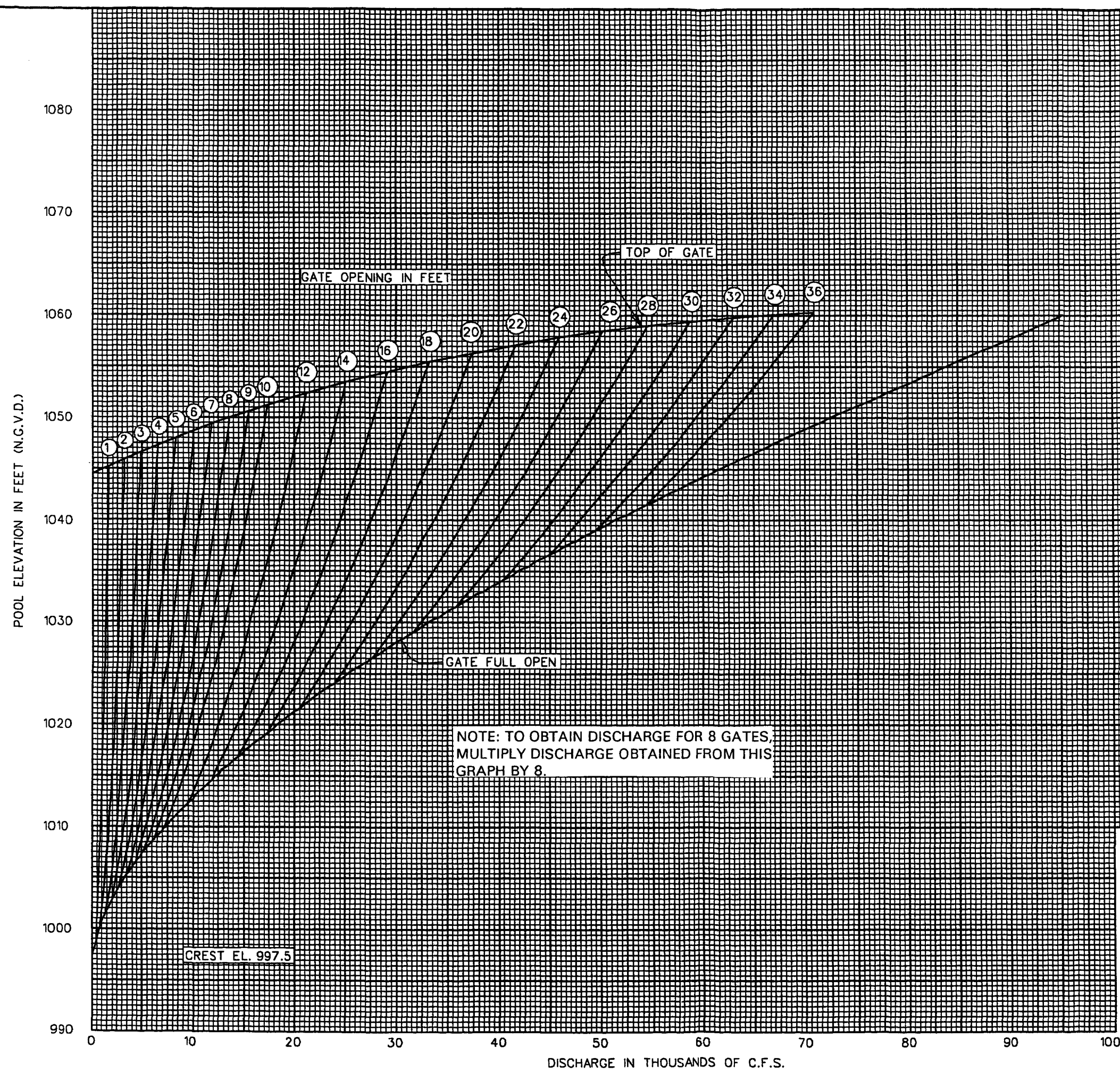
SHEET 1 OF 2

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.



MATCH LINE TO PLATE 7-5

ARKANSAS RIVER WATERSHED	ARKANSAS RIVER, OKLAHOMA
KAW LAKE	
LOCATION OF DOWNSTREAM WATER RIGHTS ON ARKANSAS RIVER	
SHEET 2 OF 2	
DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993	
DRAWN BY: SKG	
CHECKED BY: J.W.C.	



110
120
130

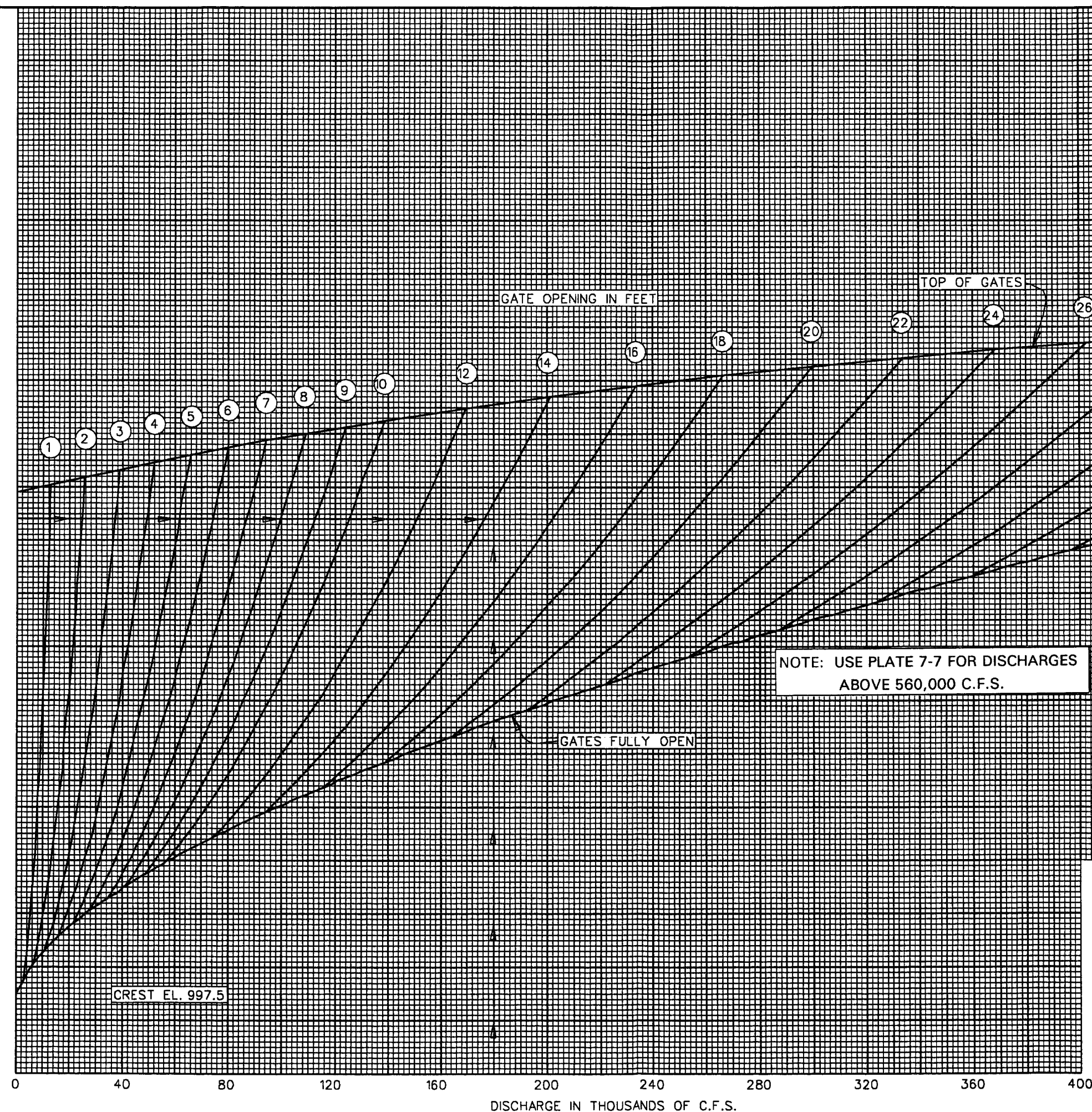
ARKANSAS RIVER WATERSHED
ARKANSAS RIVER, OKLAHOMA

KAW LAKE

SPILLWAY RATING CURVE
 PARTIAL GATE OPENINGS
 FOR 1-50'X47' TANTER GATE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.

POOL ELEVATION IN FEET (N.G.V.D.)



NOTE: USE PLATE 7-7 FOR DISCHARGES
ABOVE 560,000 C.F.S.

EXAMPLE: NEED GATE OPENING FOR
DISCHARGE OF 180,000 C.F.S.
1. POOL ELEVATION IS 1042.0
2. DISCHARGE IS 180,000 C.F.S.
3. READ 14.5 FEET

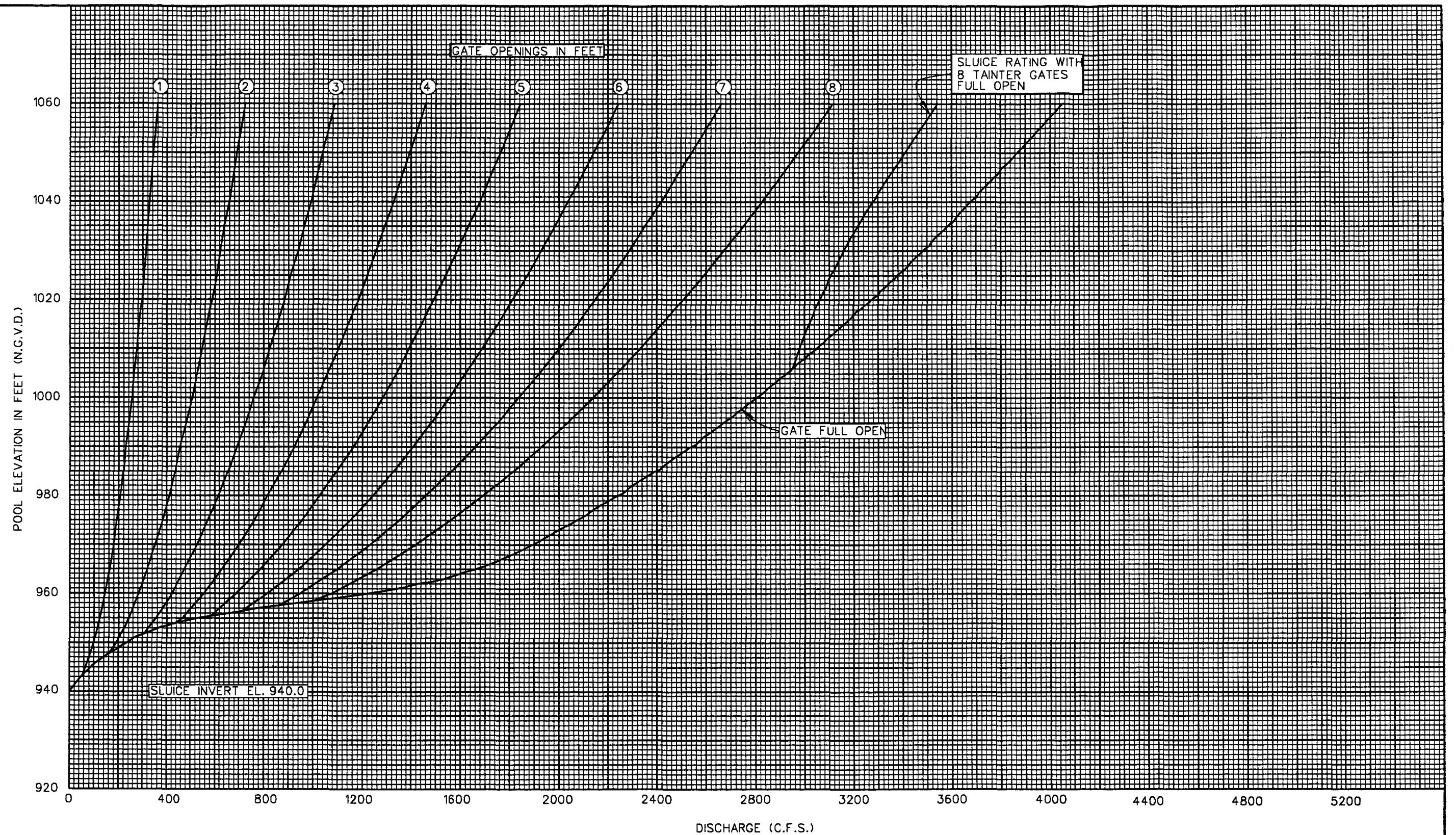
440 480 520

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

SPILLWAY RATING CURVE

PARTIAL GATE OPENINGS
8-50'X47' TANTER GATES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.



ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

SLUICE RATING CURVE
 PARTIAL OPENINGS
 1-5.67'X10' SLUICE GATE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.

7-9

POOL ELEVATION IN FEET (N.G.V.D.)

1060

1040

1020

1000

980

960

940

920

0

2000

4000

6000

8000

10,000

DISCHARGE (C.F.S.)

SLUICE RATING WITH
8 TANTER GATES
FULL OPEN

1 SLUICE
FULLY OPEN

2 SLUICES
FULLY OPEN

SLUICE INVERT EL. 940.0

ARKANSAS RIVER WATERSHED

ARKANSAS RIVER, OKLAHOMA

KAW LAKE

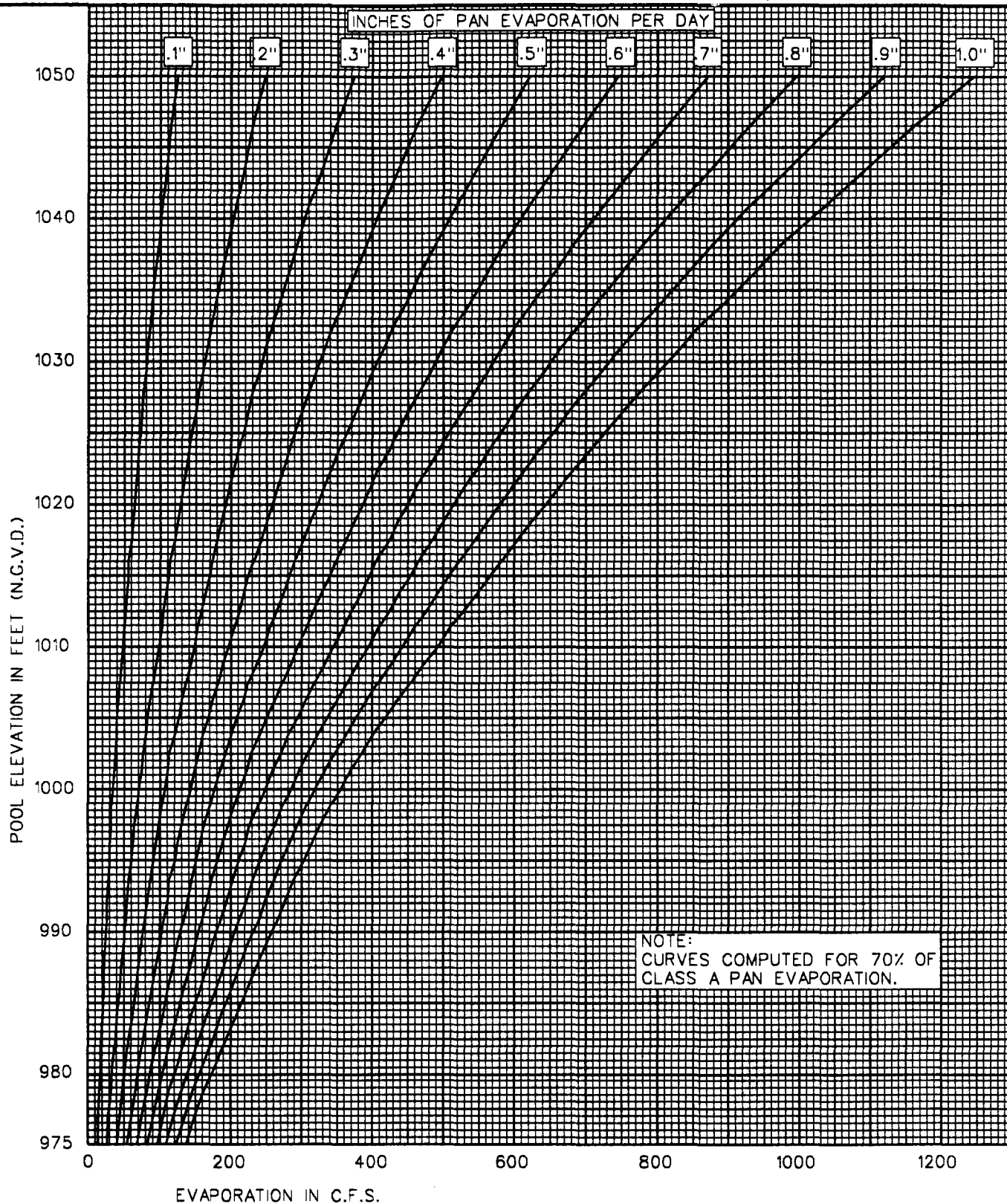
SLUICE RATING CURVES

2-5.67'X10' SLUICES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993

DRAWN BY: SKG

CHECKED BY: J.W.C.



ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

EVAPORATION CURVES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.

ELEVATION IN FEET (N.G.V.D.)

980

970

960

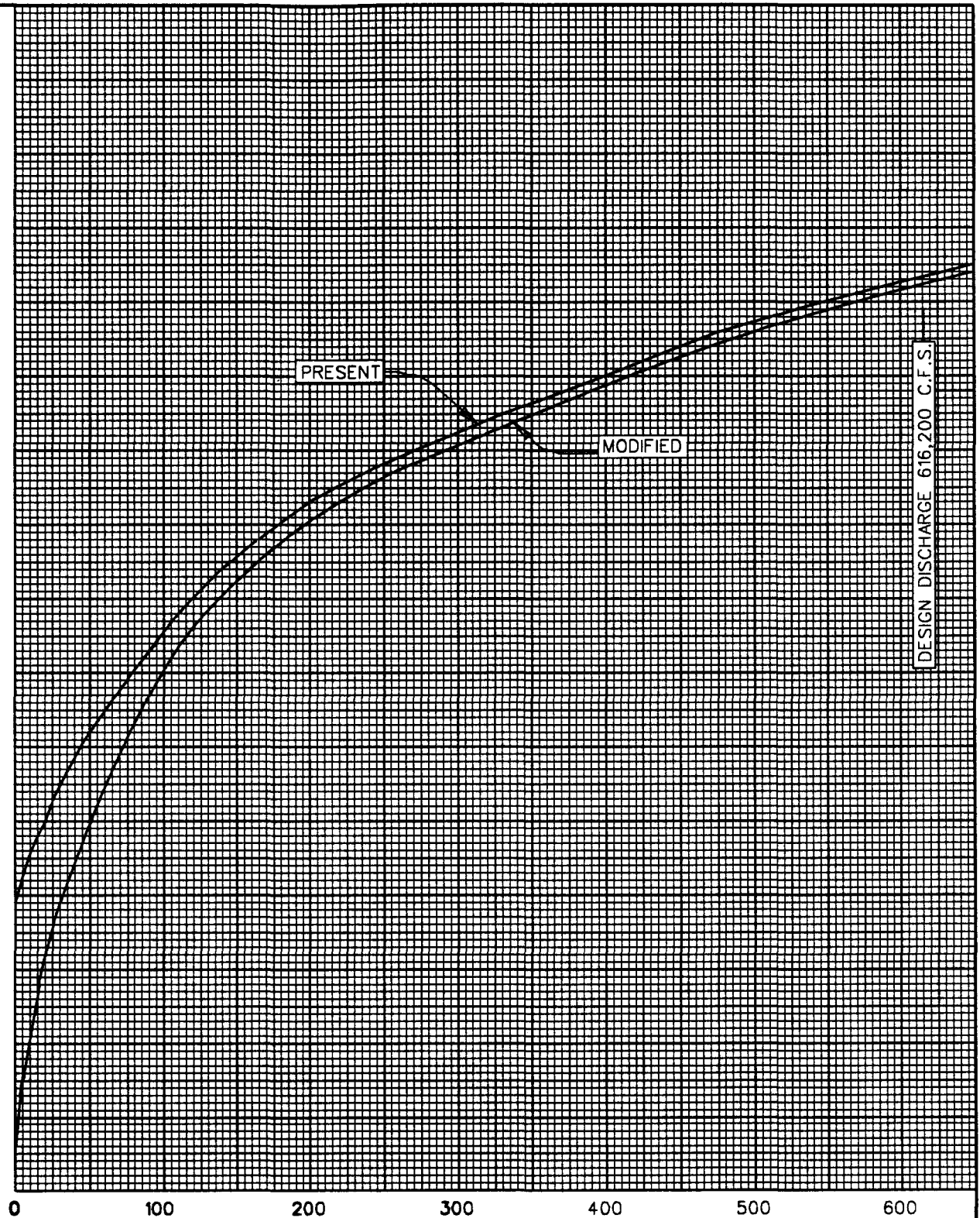
950

940

930

920

910



PRESENT

MODIFIED

DESIGN DISCHARGE 616,200 C.F.S.

NOTES:

1. PRESENT TAILWATER CURVE OBTAINED FROM MEASUREMENTS DURING MAY 1993 FLOOD AND REASONABLE EXTRAPOLATION.
2. MODIFIED TAILWATER CURVE BASED ON FREE FLOW DISCHARGE OVER VALLEY SPILLWAY WITH 8-50'x47' GATES AT CREST ELEVATION 997.5.
3. MODIFIED TAILWATER RATING CURVE BASED ON ULTIMATE DEGRADATION TO ELEVATION 909.0.
4. PRESENT TAILWATER RATING CURVE IS APPLICABLE AT END SILL OF SPILLWAY STILLING BASIN (APPROXIMATE R.M.653.6).

DISCHARGE IN THOUSANDS OF C.F.S.

ARKANSAS RIVER WATERSHED

ARKANSAS RIVER, OKLAHOMA

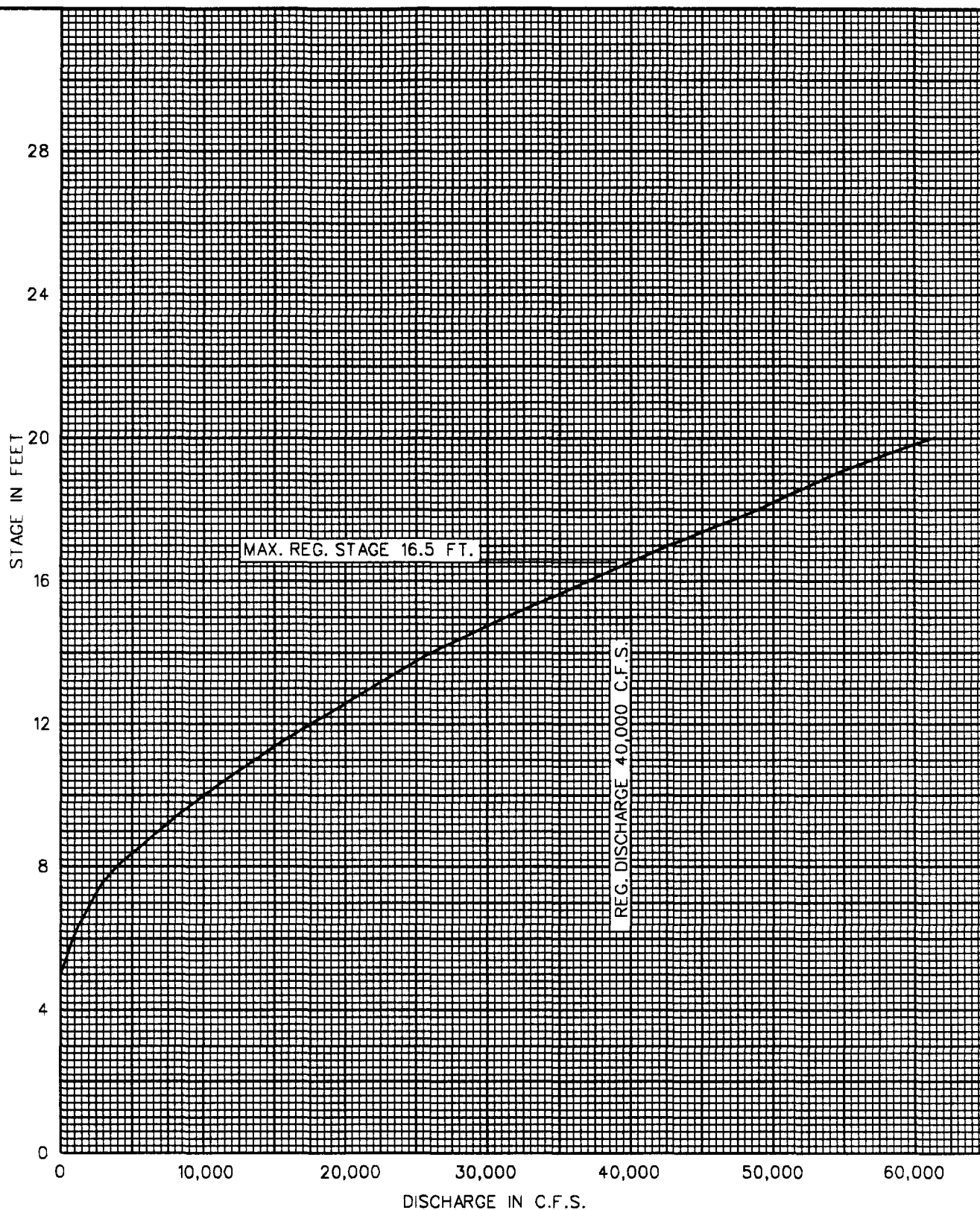
KAW LAKE

TAILWATER RATING CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993

DRAWN BY: SKG

CHECKED BY: J.W.C.



RATING NO. 3 (1989)
 DATUM = 923.66

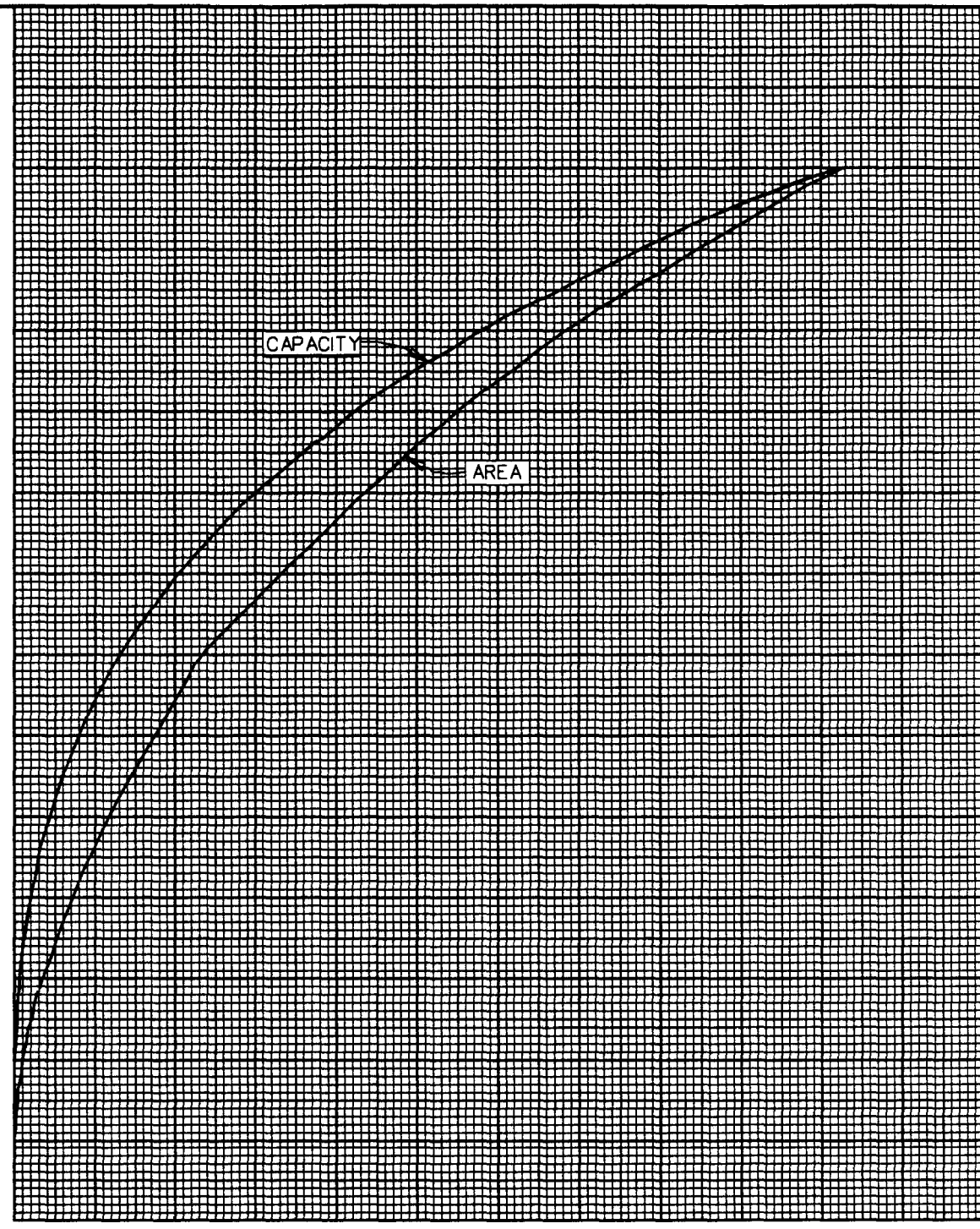
ARKANSAS RIVER WATERSHED
 KAW LAKE

DISCHARGE RATING CURVE (DOWNSTREAM OF KAW LAKE) PONCA CITY, OKLAHOMA

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.

POOL ELEVATION IN FEET (N.G.V.D.)

1070
1050
1030
1010
990
970
950
930



0 10 20 30 40 50
0 400 800 1200 1600 2000
AREA IN THOUSANDS OF ACRES
CAPACITY IN THOUSANDS OF ACRE-Feet

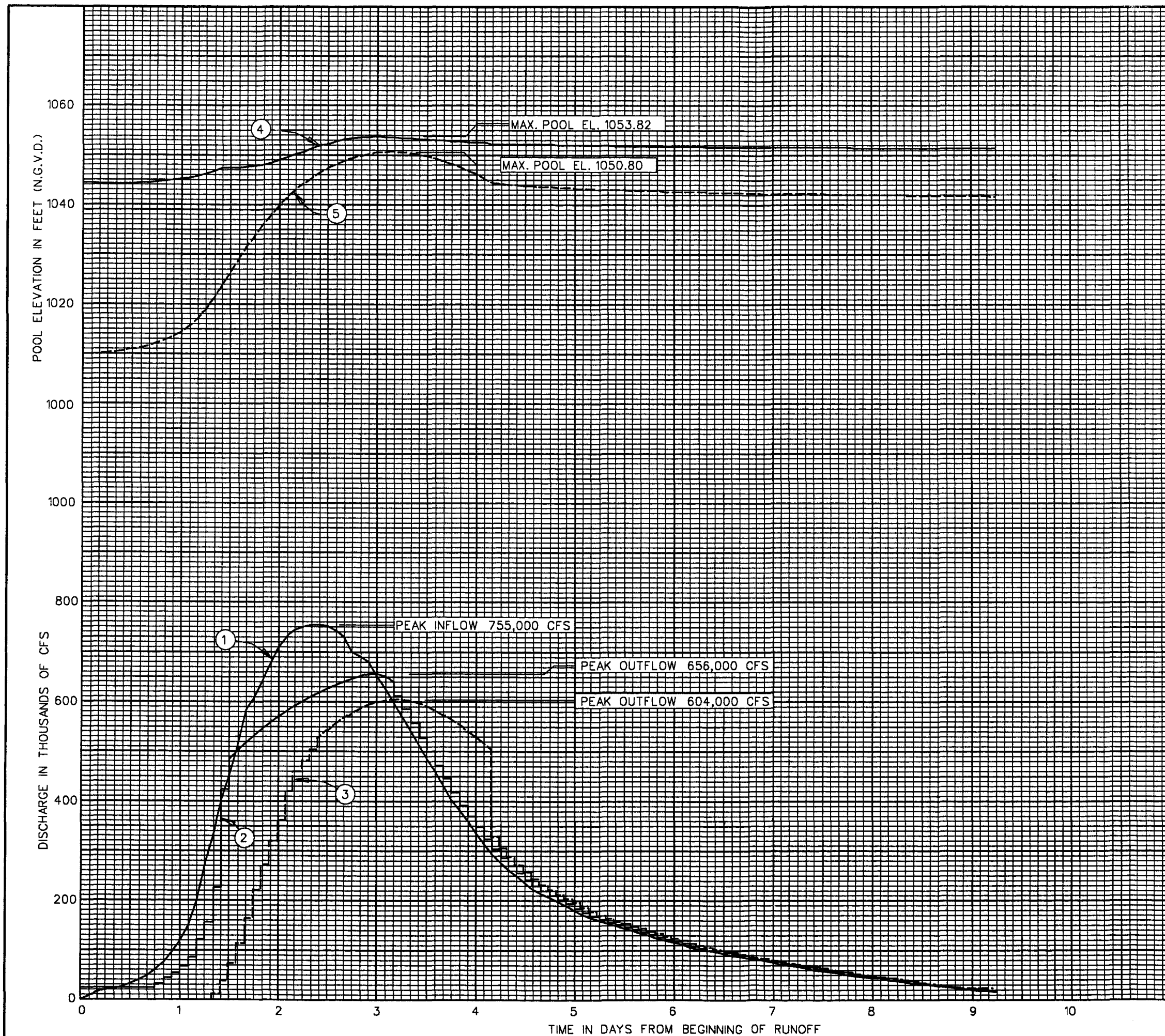
DRAINAGE AREA IN SQUARE MILES
TOTAL - 46,531
NORMALLY CONTRIBUTING - 6,652
1" RUNOFF FROM NORMALLY CONTRIBUTING
AREA - 354,773 ACRE FEET
DAM AXIS IS LOCATED IN SECTION 25
T26N, R3E KAY COUNTY & SECTIONS 29 & 30
T26N, R4E OSAGE COUNTY, OKLAHOMA

ARKANSAS RIVER WATERSHED
KAW LAKE

ARKANSAS RIVER, OKLAHOMA

AREA-CAPACITY CURVES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.



NOTES:
TIME TO EMPTY FLOOD CONTROL
POOL IS 32 DAYS FROM BEGINNING
OF RUNOFF, USING RELEASE
SCHEDULE FOR FALLING POOL.

FLOOD IS ROUTED USING ORIGINAL
CAPACITY DATA. APPROVAL IS
PENDING FOR 1986 RESURVEY.

- EMERGENCY REGULATION (PARA. 8-02c)
- 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

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

KAW LAKE

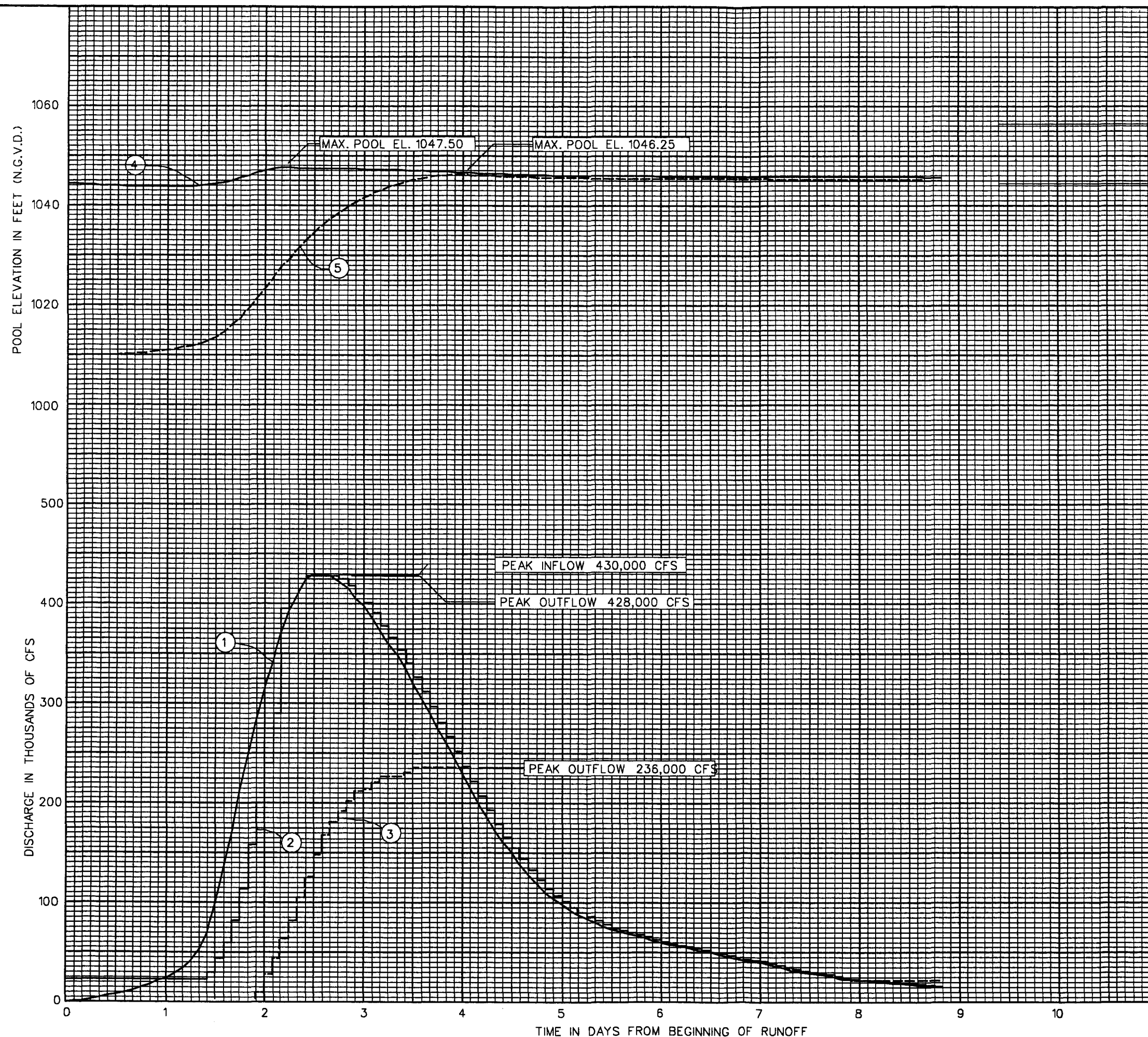
OPERATIONAL HYDROGRAPHS

SPILLWAY DESIGN FLOOD

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1992

DRAWN BY: SKG

CHECKED BY: J.W.C.



NOTES:

TIME TO EMPTY FLOOD CONTROL POOL IS 31 DAYS FROM BEGINNING OF RUNOFF, USING RELEASE SCHEDULE FOR FALLING POOL.

FLOOD IS ROUTED USING ORIGINAL CAPACITY DATA. APPROVAL IS PENDING FOR 1986 RESURVEY.

- EMERGENCY REGULATION (PARA. 8-02b)
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

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

KAW LAKE

OPERATIONAL HYDROGRAPHS

STANDARD PROJECT FLOOD

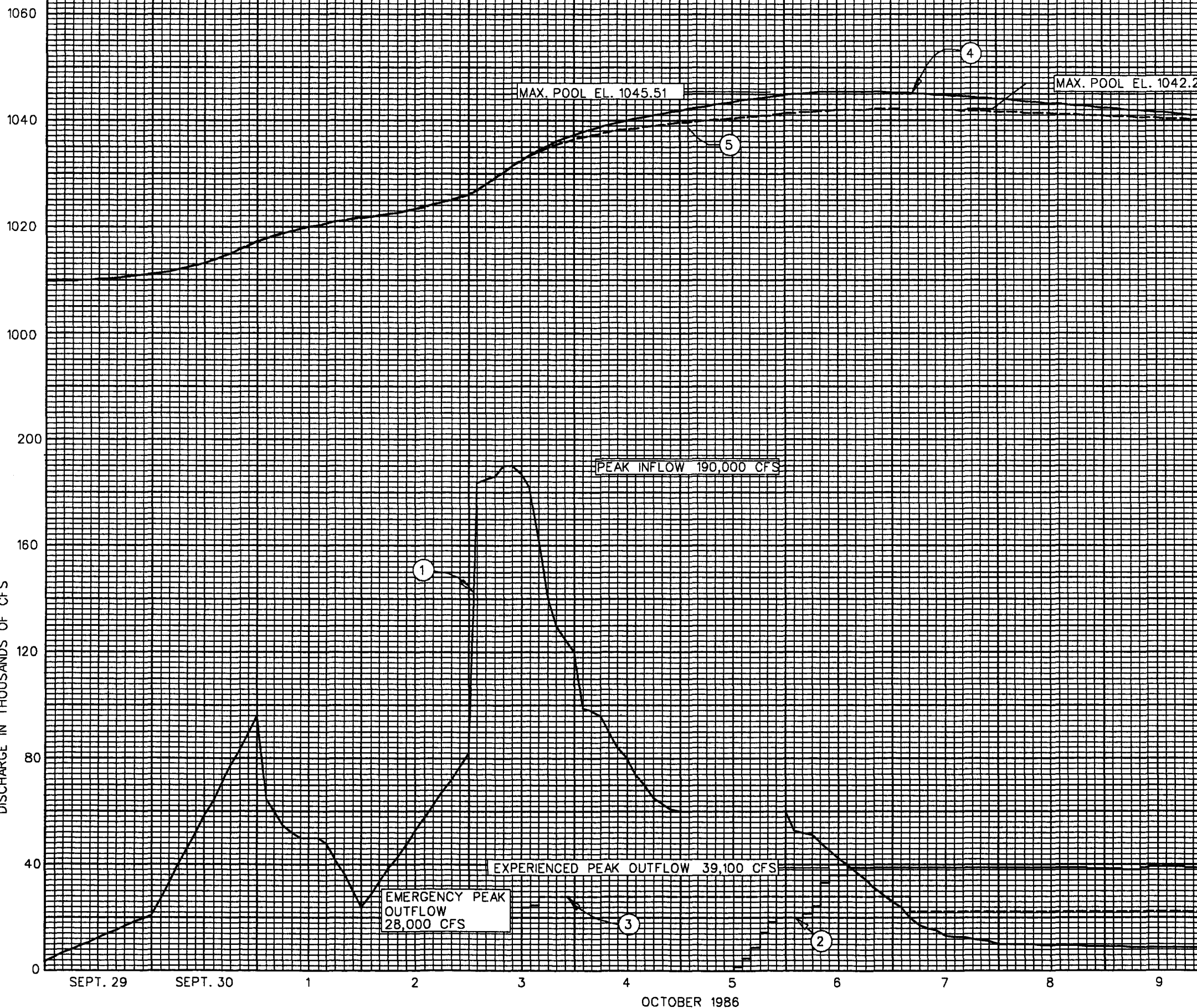
DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1992

DRAWN BY: SKG

CHECKED BY: J.W.C.

POOL ELEVATION IN FEET (N.G.V.D.)

DISCHARGE IN THOUSANDS OF CFS



NOTES:

TIME TO EMPTY FLOOD CONTROL
POOL IS 31 DAYS FROM BEGINNING
OF RUNOFF, USING RELEASE
SCHEDULE FOR FALLING POOL.

FLOOD IS ROUTED USING ORIGINAL
CAPACITY DATA. APPROVAL IS
PENDING FOR 1986 RESURVEY.

EMERGENCY REGULATION (PARA. 8-02c)

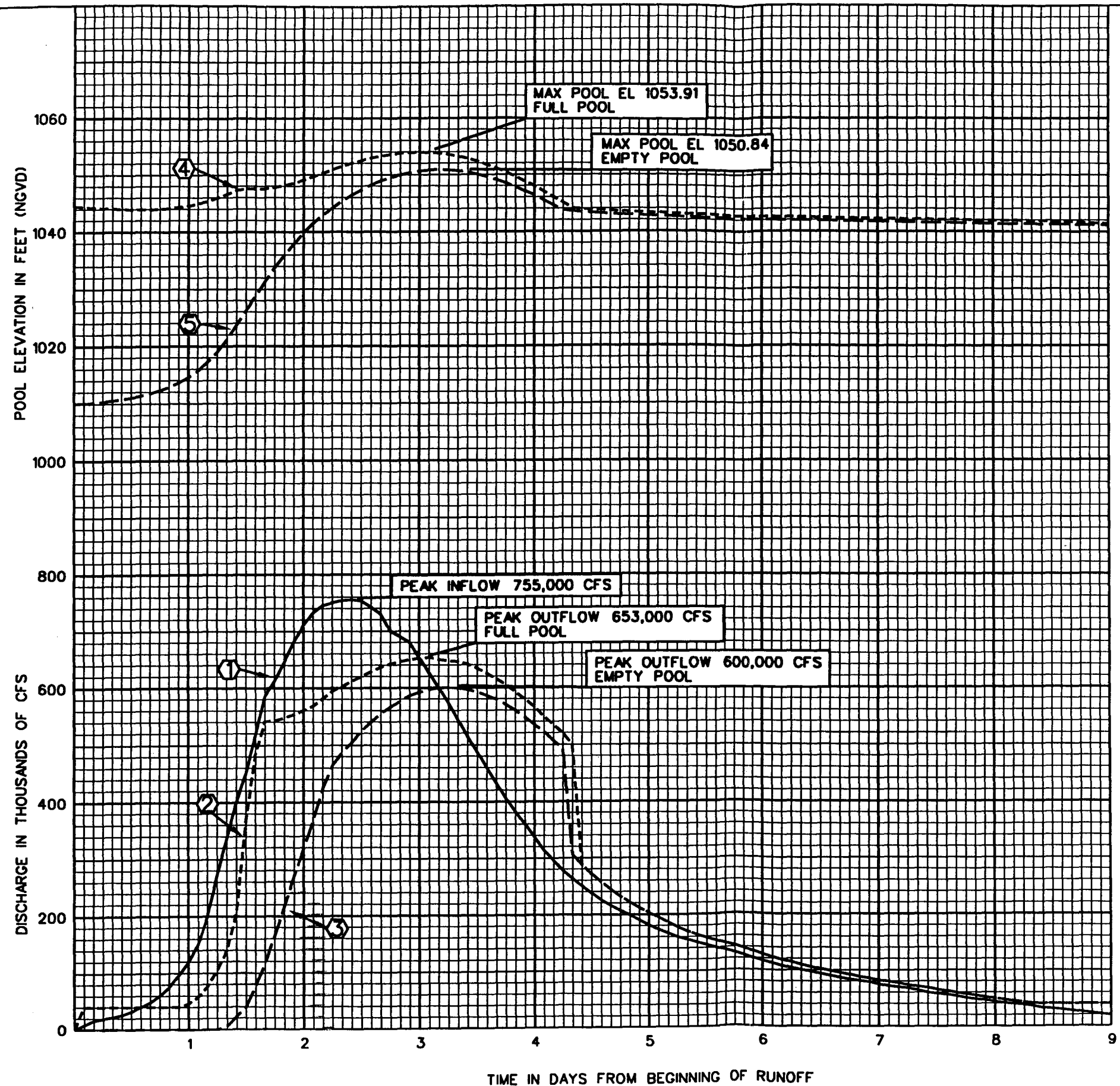
1. INFLOW HYDROGRAPH
2. OUTFLOW - EXPERIENCED
3. OUTFLOW - EMERGENCY
4. POOL ELEVATION - EXPERIENCED
5. POOL ELEVATION - EMERGENCY

10

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

OPERATIONAL HYDROGRAPHS
FLOOD OF OCTOBER, 1986

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
DRAWN BY: SKG
CHECKED BY: J.W.C.



NOTES:

TIME TO EMPTY FLOOD CONTROL POOL IS 21 DAYS FROM BEGINNING OF RUNOFF, USING RELEASE SCHEDULE FOR FALLING POOL.

FLOOD IS ROUTED USING ORIGINAL CAPACITY DATA. APPROVAL IS PENDING FOR 1986 RESURVEY.

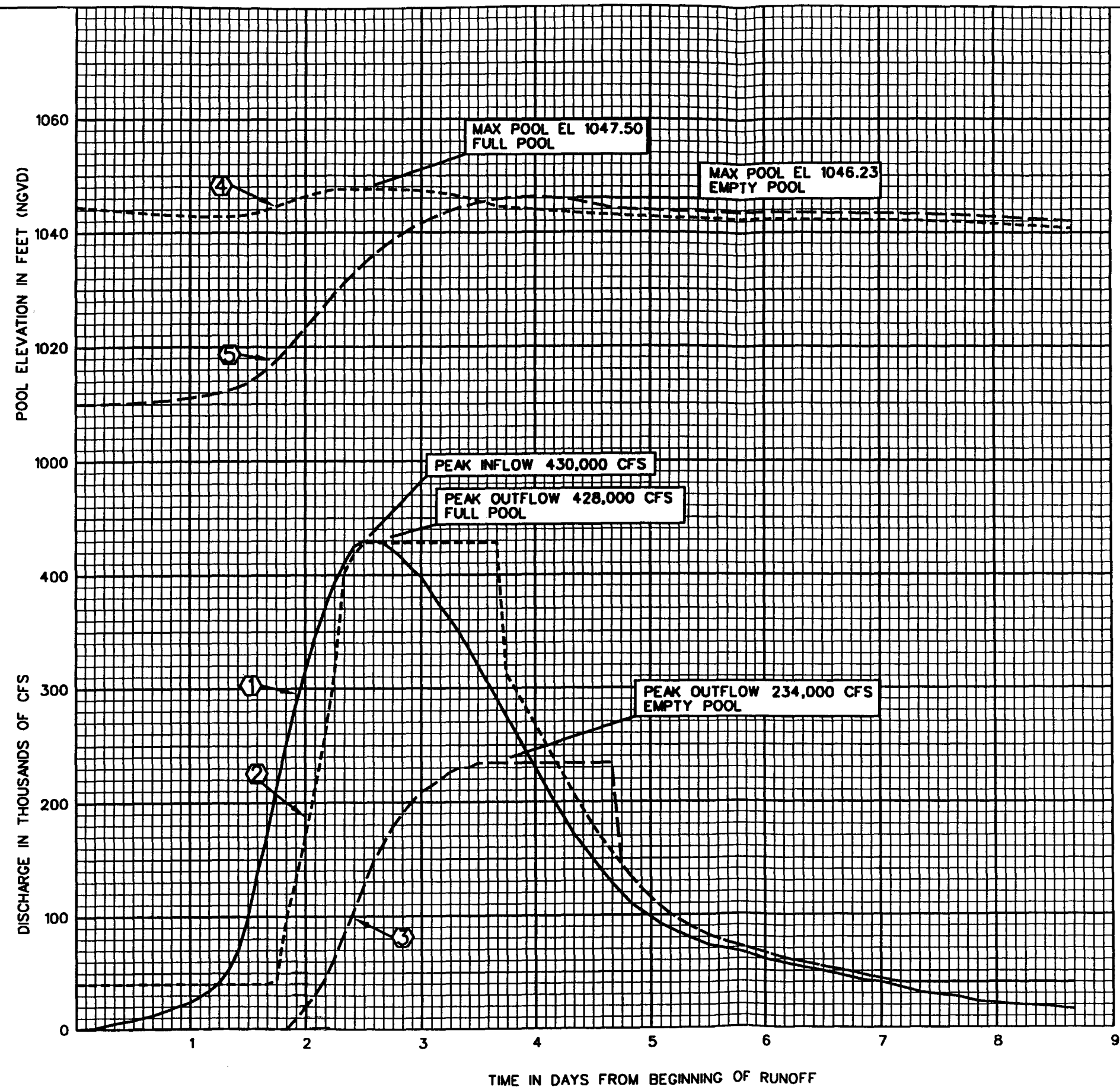
NOTES: EMERGENCY OPERATIONS (PARA. 8-02a)

1. INFLOW HYDROGRAPH
2. OUTFLOW - FLOOD ON FULL POOL
3. OUTFLOW - FLOOD ON EMPTY POOL
4. ELEVATION - FLOOD ON FULL POOL
5. ELEVATION - FLOOD ON EMPTY POOL

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

OPERATIONAL HYDROGRAPHS
SPILLWAY DESIGN FLOOD

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1995
DRAWN: G.D.E.
CHECKED: J.W.C.



NOTES:

TIME TO EMPTY FLOOD CONTROL POOL IS 21 DAYS FROM BEGINNING OF RUNOFF, USING RELEASE SCHEDULE FOR FALLING POOL.

FLOOD IS ROUTED USING ORIGINAL CAPACITY DATA. APPROVAL IS PENDING FOR 1986 RESURVEY.

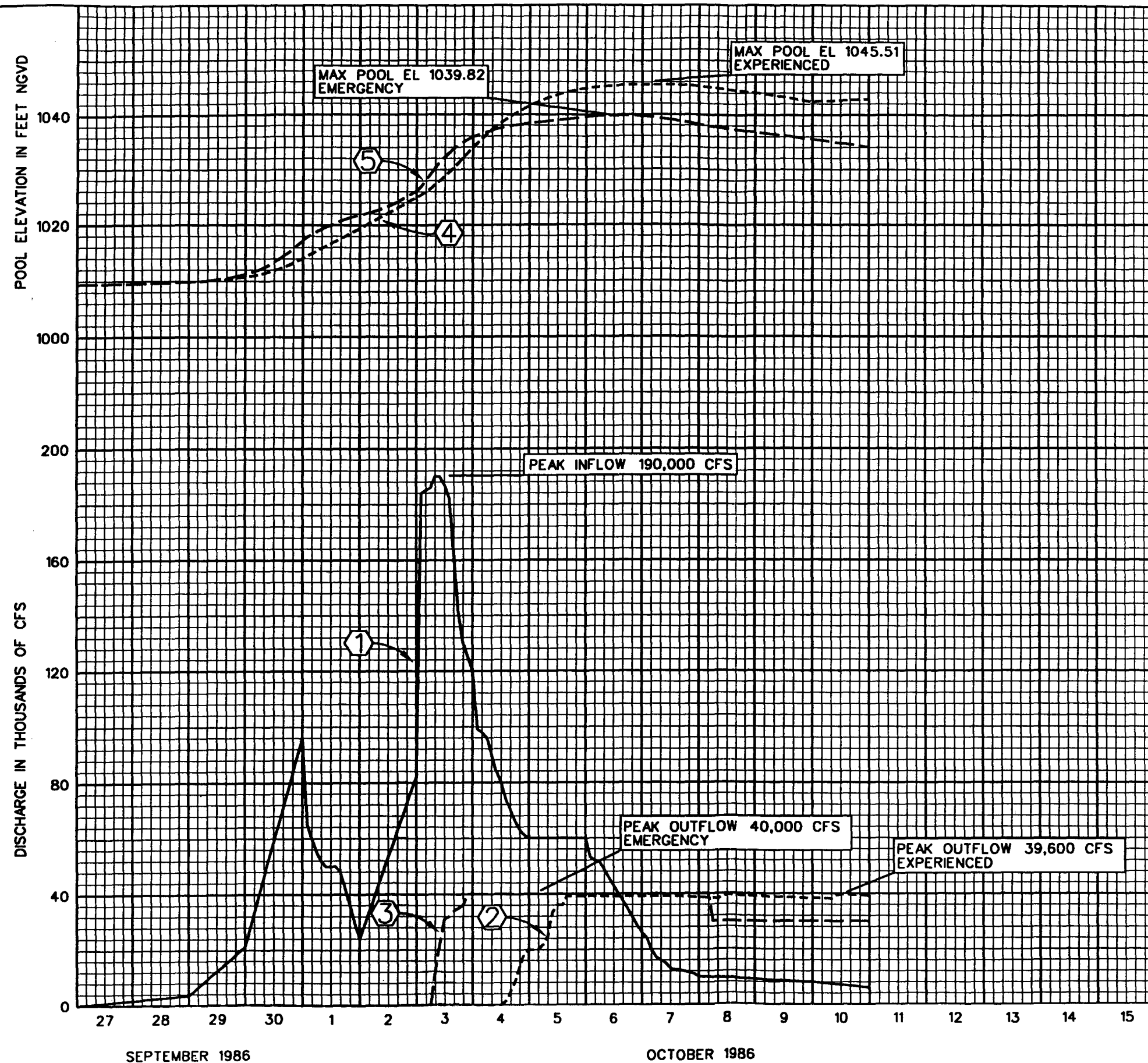
NOTES: EMERGENCY OPERATIONS (PARA. 8-02b)

1. INFLOW HYDROGRAPH
2. OUTFLOW - FLOOD ON FULL POOL
3. OUTFLOW - FLOOD ON EMPTY POOL
4. ELEVATION - FLOOD ON FULL POOL
5. ELEVATION - FLOOD ON EMPTY POOL

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

OPERATIONAL HYDROGRAPHS
STANDARD PROJECT FLOOD

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1995
DRAWN: G.D.E.
CHECKED: J.W.C.



- NOTES: EMERGENCY OPERATIONS
1. INFLOW HYDROGRAPH
 2. OUTFLOW-EXPERIENCED REGULATION
 3. OUTFLOW-EMERGENCY REGULATION
 4. ELEVATION-EXPERIENCED REGULATION
 5. ELEVATION-EMERGENCY REGULATION

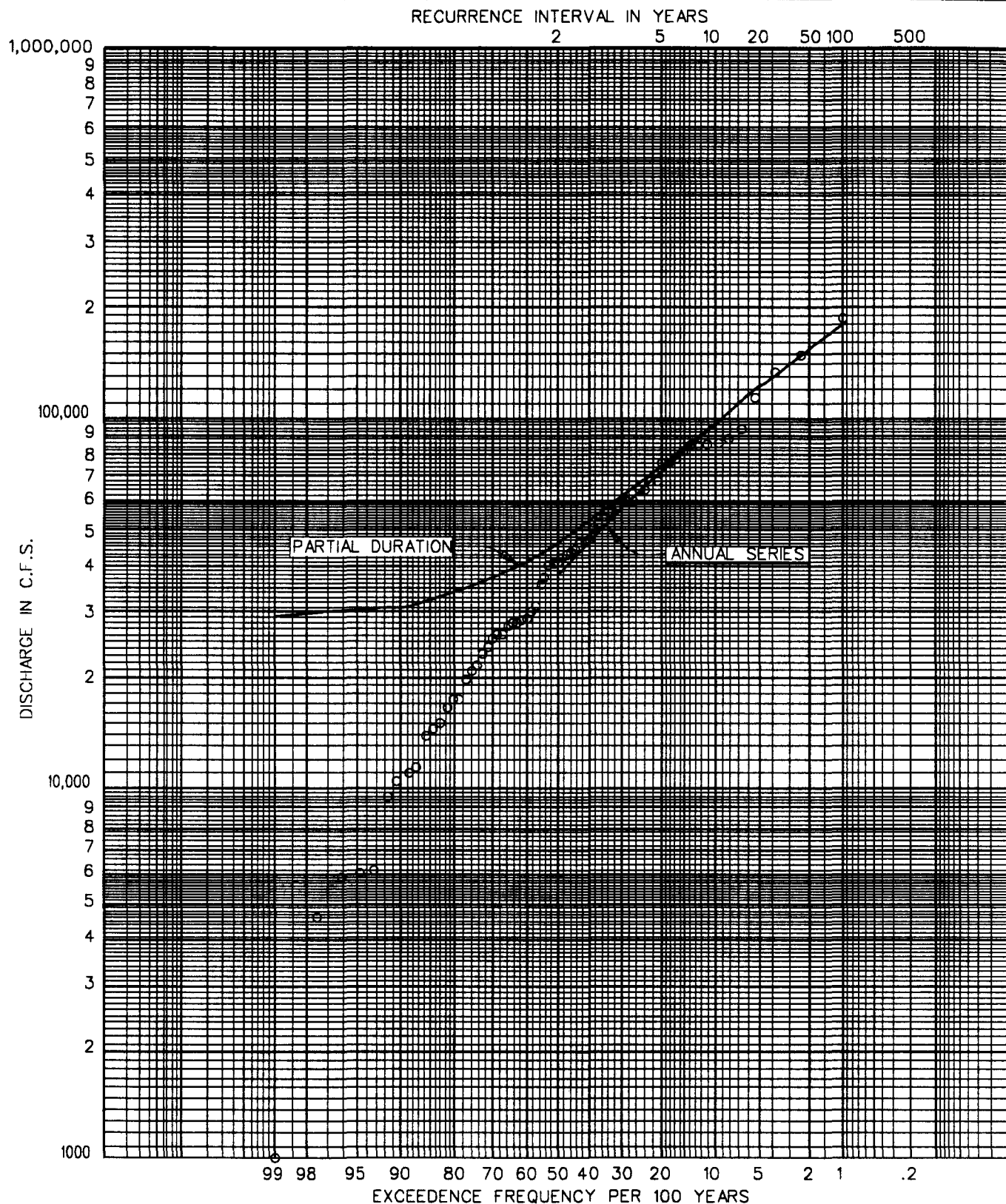
ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

OPERATIONAL HYDROGRAPHS

FLOOD OF SEP-OCT 1986

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1994
DRAWN: G.D.E.
CHECKED: J.W.C.

8-3



NOTES

1. BASED ON METHODS OUTLINED IN "STATISTICAL METHODS IN HYDROLOGY" LEO R. BEARD, JAN. 1962.
2. BASIC DATA ARE COMPUTED PEAK DISCHARGES AT THE DAM SITE FROM JANUARY 1922 THROUGH DECEMBER 1974, AND ACTUAL PEAK DISCHARGES FROM JANUARY 1975 THROUGH DECEMBER 1990.
3. THE ADOPTED SKEW COEFFICIENT OF -0.5 WAS USED.

ARKANSAS RIVER WATERSHED

ARKANSAS RIVER, OKLAHOMA

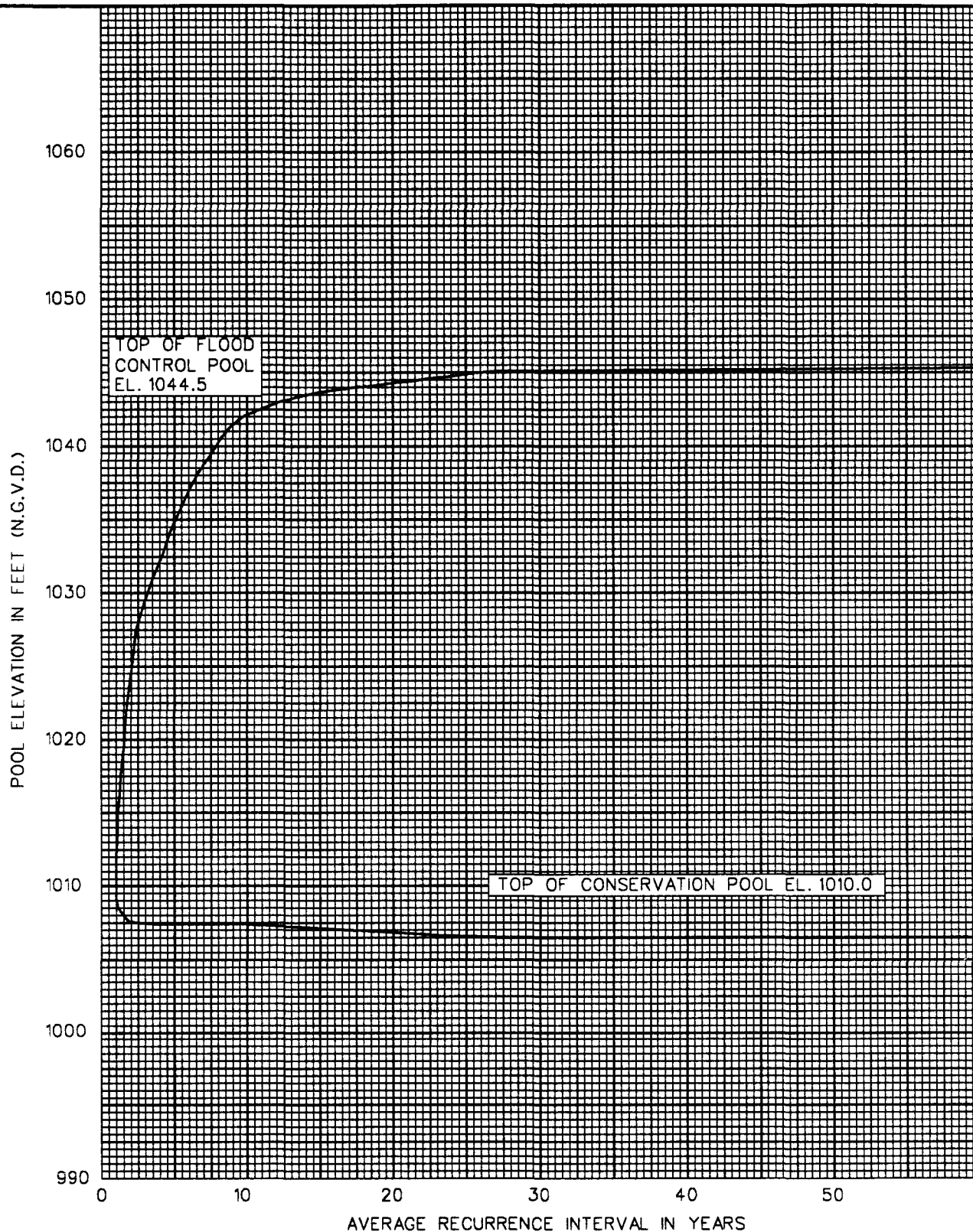
KAW LAKE

PEAK INFLOW PROBABILITY CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993

DRAWN BY: SKG

CHECKED BY: J.W.C.

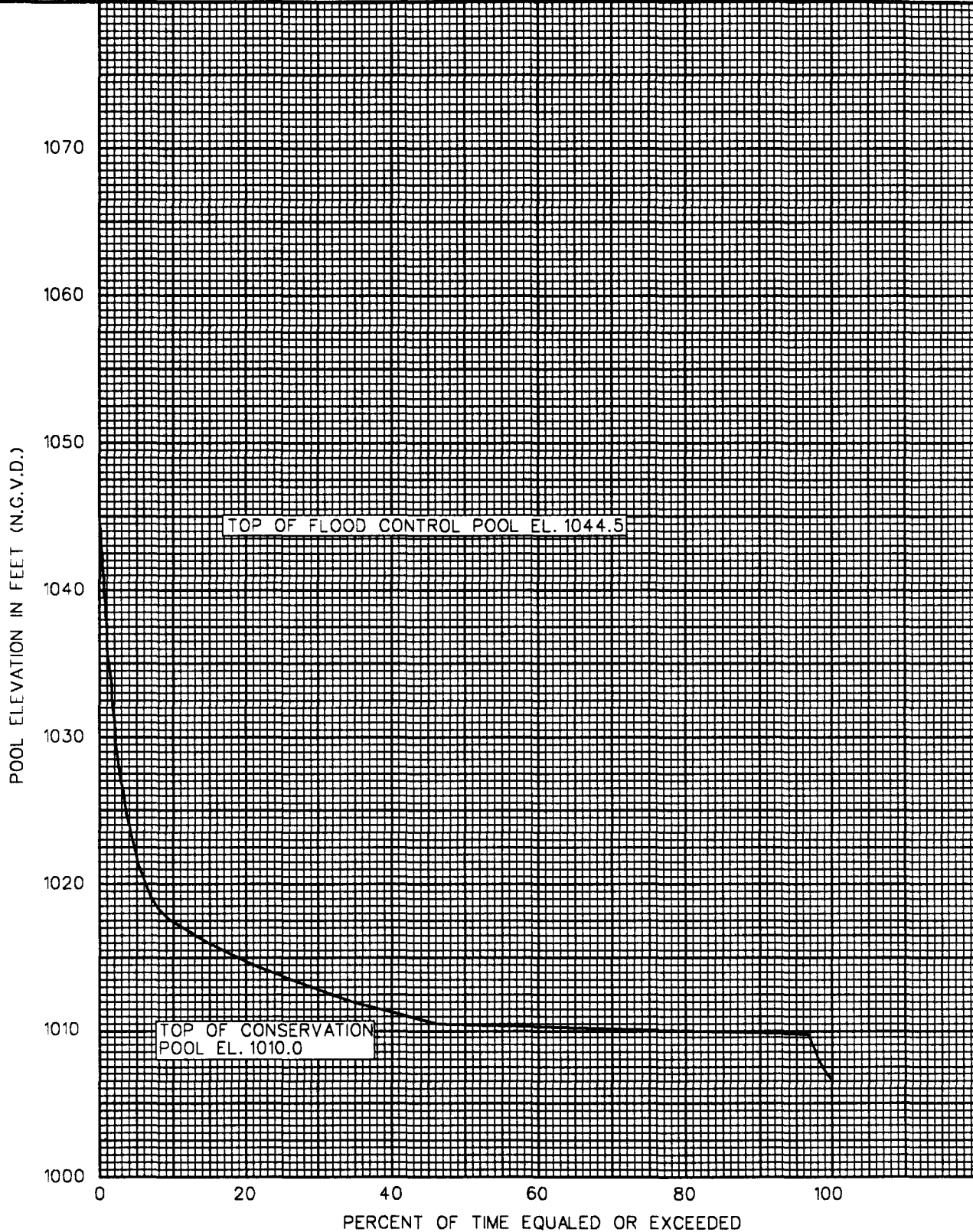


NOTE:
 CURVE IS BASED ON SUPER RUN
 A90X02 FOR THE PERIOD OF
 RECORD JANUARY 1940 THROUGH
 DECEMBER 1986.

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

POOL ELEVATION PROBABILITY CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.



NOTE:
 CURVE IS BASED ON SUPER RUN
 A90X02 FOR THE PERIOD OF
 RECORD JANUARY 1940 THROUGH
 DECEMBER 1986.

CURVE APPROACHES ZERO
 AT ELEV. 1044.4

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
KAW LAKE

POOL ELEVATION DURATION CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1993
 DRAWN BY: SKG
 CHECKED BY: J.W.C.

**KAW LAKE
MONTHLY LAKE REPORT
MAR 87**

DAY	POOL ELEVATIONS FT-NGVD		STORAGE 2400HR AC-FT	RELEASES DSF		EVAP INCHES 8A TO 8A	INFLOW ADJ DSF	RAINFALL INCHES 7A TO 7A	
	0800	2400		POWER	TOTAL				
PRIOR MONTH		1015.60	531879						
1	1016.82	1019.25	607650	0	7900	0.060	46200	1.02	0.65
2	1020.12	1021.92	667467	0	8250	0.160	38500	0.00	0.00
3	1022.75	1023.87	713579	0	10988	0.170	34300	0.00	0.00
4	1024.15	1024.40	726499	0	12883	0.140	19600	0.00	0.00
5	1024.36	1024.19	721354	0	12917	0.250	10500	0.00	0.00
6	1024.09	1023.67	708779	0	14395	0.250	8200	0.00	0.00
7	1023.40	1022.86	689423	0	16217	0.200	7000	0.00	0.00
8	1022.58	1022.09	671405	0	15967	0.200	6600	0.00	0.00
9	1021.79	1021.17	650292	0	15667	0.190	5100	0.00	0.00
10	1020.88	1020.19	628255	0	15300	0.070	4600	0.02	0.00
11	1019.91	1019.25	607650	0	15200	0.100	4600	0.00	0.00
12	1018.94	1018.28	586863	0	15200	0.100	4600	0.00	0.00
13	1017.95	1017.24	565091	0	14317	0.120	4000	0.00	0.00
14	1016.87	1016.30	545889	0	13550	0.210	3500	0.00	0.00
15	1015.92	1015.27	525345	0	12850	0.210	2600	0.00	0.00
16	1014.95	1014.50	510350	0	10852	0.210	3400	0.00	0.00
17	1014.64	1014.99	519806	0	8752	0.190	13600	1.70	1.48
18	1015.35	1016.48	549543	0	8925	0.120	24000	0.12	0.12
19	1017.21	1018.43	590058	0	13496	0.080	34000	0.00	0.00
20	1018.65	1018.75	596875	0	19645	0.170	23200	0.00	0.00
21	1018.63	1018.12	583455	0	20512	0.180	13900	0.25	0.01
22	1017.82	1017.24	565091	0	19987	0.180	10800	0.00	0.00
23	1016.93	1016.72	554415	0	16638	0.140	11300	0.00	0.20
24	1016.79	1017.51	570707	0	12518	0.130	20800	0.73	0.76
25	1018.06	1019.33	609393	0	16973	0.070	36500	0.00	0.01
26	1019.94	1020.54	636095	0	21444	0.120	35000	0.00	0.00
27	1020.60	1020.68	639231	0	21730	0.050	27000	0.00	0.00
28	1020.70	1020.90	644159	0	21817	0.100	21000	0.00	0.02
29	1020.95	1020.68	639231	0	21864	0.100	19000	0.00	0.00
30	1020.62	1020.21	628703	0	21661	0.050	16400	0.00	0.01
31	1020.05	1019.52	613535	0	21330	0.100	13800	0.00	0.00
TOTAL				0	474533	4.420	523600	3.84	3.26
AVERAGE	1019.48			0	15307		16890	NORMAL=1.88	
MAXIMUM	1024.40		726499	DATE= 4	TOP CONSERVATION POOL			1010.00	
MINIMUM	1014.50		510350	DATE=16	TOP FLOOD POOL			1044.50	

WATER SUPPLY: WITHDRAWN 554 AC-FT, RELEASED 0 AC-FT

INFLOW VOLUME = 1038545 AC-FT

NOTE: OPERATIONAL GUIDE CURVE 1007.5 ON 1ST TO 1009 ON 31ST

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

KAW LAKE

MONTHLY LAKE REPORT