ROBERT S. KERR LOCK & DAM 15
ARKANSAS RIVER, OKLAHOMA

WATER CONTROL MANUAL
APPENDIX S, PART III
TO
WATER CONTROL MASTER MANUAL
ARKANSAS RIVER BASIN

DECEMBER 1998

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be used in loose-leaf 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.

EMERGENCY REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during duty hours and at various hours during weekends and holidays, contact can be made by telephone to the Water Control Section, Tulsa District Office (918/669-7095). If the above office cannot be contacted, assistance can be achieved by contacting, in the order listed, one of the persons shown below. Section VII of this manual contains detailed instructions for emergency regulations. All project personnel associated with the regulation of the project must be thoroughly familiar with the procedure outlined in this section. A separate copy of this section has been provided to the powerhouse office and must be displayed on the bulletin board at all times.

EMERGENCY PERSONNEL ROSTER
(June 1997)

TITLE AND NAME	RESIDENCE TELEPHONE
Coordinator (b) (6)	
Backup Coordinator (b) (6)	
Chief, Water Control Section (b) (6)	
Chief, Hydrology-Hydraulics Branch (b) (6)	
Natural Disaster Specialist	(b) (6)
Readiness Branch (b) (6)	
Radio Call Signs	WUI 3 (Hydrology and Hydraulics Br.) WUI 3919 (Emergency/Readiness Br.)

ROBERT S. KERR
LOCK AND DAM 15

ROBERT S. KERR L&D
ARKANSAS RIVER, OKLAHOMA

WATER CONTROL MANUAL
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PERTINENT DATA
ROBERT S. KERR LOCK & DAM 15

LOCATION: Arkansas River at navigation mile 336.2, approximately 8 miles south of Sallisaw, Oklahoma.

DRAINAGE AREA: 147,756 square miles above the dam, which includes 22,241 square miles normally classified as non-contributing.

DAM:
Type: Rolled earth embankment.
Length: 7230 feet (including spillway and powerhouse intake).
Top of Dam: 483.5 NGVD.
Max. Height: 75 feet above streambed.
Crest Width: Left embankment: 16 feet.

SPILLWAY:
Location: Near right abutment.
Type: Gate controlled, concrete, gravity,ogee weir.
Crest Elevation: 417.0 feet, NGVD.
Length: 1070 feet gross, 900 feet net.
Control: 18 - 50' x 44' tainter gates.
Hoists: Individual electric-motored.

LOCK:
Location: Near left end of spillway.
Type and Size: Ohio one 48 foot high x 110 foot wide x 600 foot long bay.
Lower Sill Elevation: 396.0 feet, NGVD.
Upper Sill Elevation: 442.0.
Floor Elevation: Varies from 393-397 feet, NGVD.
Filling System: Side laterals.
Type and number of gates: Miter, 2 pair.
Out of service tailwater elevation: 440.0 ft. NGVD.

POWER FEATURES:
Location: Between spillway and right abutment.
Installed Capacity: 110,000 kW.
No. of Units: 4.
Draft tube Intake Invert Elevation: 396.0 feet, NGVD.
Draft tube Inlet dimensions: 74' x 36'; gates: 3-20.67' x 39'.
Draft tube Outlet dimensions: 74' x 30'; gates: 3-20.67' x 30'.

LAND ACQUISITION:

Category	Guide Contour Elevation (feet NGVD)	Area (acres)
Fee Simple	463	330,112
Easement	463.1 plus Backwater	5,953

ELEVATIONS, AREAS, AND STORAGES:

Feature	Elevation (feet NGVD)	Lake Area(1) (acres)	Lake Capacity	
			Accumulative (Acre-feet) (1)	Incremental (Acre-feet)
Top of Dam	483.5			
Maximum Pool	479.5			
Top of Power Pool	460.0	43,796	525,700	84,700
Bottom of Power Pool	458.0	40,757	441,000	440,600
Inactive	413.0	200	400	400
Spillway Crest	417.0	610	2,100	1,700
Power Storage	458.0-460.0	---	84,700	---
Streambed at Dam	409.0	---	---	---

(1) Based on 1976 sedimentation survey.
Drainage area is 147,756 square miles. Uncontributing drainage area is 22,241 square miles.

ROBERT S. KERR L&D & RESERVOIR
ARKANSAS RIVER, OKLAHOMA

WATER CONTROL MANUAL
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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, ER 1110-2-8156, and ER 1110-2-241.

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. This manual also updates the Robert S. Kerr Lock and Dam (L&D) and Reservoir Regulation Manual, Appendix S to the Arkansas River Basin Regulation Master Manual, and supersedes regulations contained in the Reservoir Regulation Manual for Robert S. Kerr L&D and Reservoir dated April 1971.

1-03. Related manuals. This manual is Appendix S Part III to the Arkansas River Water Control Master Manual. Other related manuals in this District are:

Appendix N	Eufaula	(January 1994)
Appendix D	Hulah	(April 1991)
Appendix E	Fort Gibson (Part III)	(July 1992)
Appendix G	Tenkiller	(July 1976)
Appendix L	Oologah	(May 1997)
Appendix M	Keystone	(November 1989)
Appendix V	Wister	(March 1974)
Appendix W	Copan	(February 1983)
Appendix DCP-6	Drought Contingency Plan	(October 1992)
Appendix S	Chouteau Part V	(April 1972)
	W.D. Mayo Part II	(October 1972)
	Webbers Falls Part IV	(July 1997)

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

1-04. Project owner. Robert S. Kerr L&D and Reservoir is owned by the U.S. Government.

1-05. Operating agency. The Corps of Engineers is the operating agency for Robert S. Kerr L&D and Reservoir. The Lockmaster, Robert S. Kerr L&D operating through the Area Engineer at the Robert S. Kerr Resident Office and the Operations Division, Tulsa District, has the responsibility for project operations concerning discharge releases and project operations dealing with lands and recreation. The project is manned 24 hours by lock personnel. When the project is in extensive flood control regulation, operating personnel will closely monitor the project and the downstream river reaches. The project office is furnished a list of the Hydrology and Hydraulics Branch personnel to contact when necessary. The Lockmaster will furnish the Water Control Section a list of home telephone numbers of project personnel who can be contacted, if necessary, to make gate changes. The Lockmaster resides as close to the project as is considered prudent to carry out his official duties.

1-06. Regulating agencies. The Corps of Engineers is the regulatory agency for Robert S. Kerr L&D and Reservoir and the Water Control Section, Hydrology and Hydraulics Branch, Tulsa District is responsible for the regulation. The Southwestern Power Administration (SWPA) is the responsible Federal agency for marketing hydroelectric power and energy from the project. SWPA schedules the generation from the project and coordinates releases with the Water Control Section.

II - DESCRIPTION OF PROJECT

2-01. Location. Robert S. Kerr L&D and Reservoir is located at navigation mile 336.2 on the Arkansas River and is approximately 8 miles south of the town of Sallisaw, OK in LeFlore County. The reservoir is located in Haskell, Muskogee, Sequoyah, and LeFlore Counties, Oklahoma. The project area is shown on Plate 2-1.

2-02. Purpose. Robert S. Kerr L&D and Reservoir is a multi-purpose project authorized for hydropower, navigation, recreation and fish and wildlife.

2-03. Physical components.

a. Embankment. The embankment consists of a centrally located impervious zone with upstream and downstream random sections. The crest of the embankment is at elevation 483.0 feet, NGVD. The maximum height of the structure is 75 feet. The width of the embankment at crest height is 16 feet. A fill cutoff trench with a bottom width of 25 feet is provided from station 8+10 to station 34+10, and from the lock wall to station 72+00. The upstream slopes of the embankment are protected by stone commensurate with computed wave heights. The downstream slopes are grass covered. A plan and section 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 1070 feet and a net overflow length of 900 feet, with a crest elevation of 417.0 feet, NGVD. The structure extends part-way across the existing river channel and across a portion of the right bank between the powerhouse and the navigation lock. Flows over the spillway are controlled by 18 - 50' x 44' high tainter gates, which are operated by individual electric powered hoists. Discharge capacity at maximum pool is 1,542,000 c.f.s. The rate of travel for each gate is approximately one foot of arc per minute. An emergency diesel powered generating unit is located at the project to provide electricity in case normal electric service is interrupted. A general plan and section through the spillway is shown on Plate 2-2.

c. Navigation Lock. The lock has a 110 foot by 600 foot chamber, with 616 foot lower guide wall, and a 723 foot upper guide wall, on the river side. The lift is 48 feet, and the filling and emptying operations are accomplished in approximately 10 minutes by lateral valves. Miter gates at the upstream and downstream ends control inlet and outlet traffic operations. A General Lock Plan is shown on Plate 2-3.

d. Sedimentation. Sediment deposition in the reservoir will be determined based upon periodic resurveys of fifty-one sediment ranges which have been established in and above the lake. The end of each range is marked by permanent monuments with known vertical and horizontal positions. The original sediment ranges were completed in October 1966. The sediment ranges for W. D. Mayo L&D and Reservoir are the degradation ranges for Robert S. Kerr L&D and Reservoir. The locations of the sediment deposition and degradation ranges are shown on Plate 2-4. The ranges were resurveyed in 1976.

e. Hydroelectric power. Hydroelectric power, which is generated at the dam, is scheduled and marketed by the Southwestern Power Administration. The powerhouse is located between the spillway and the right abutment and contains four 27,500 kilowatt Kaplan-type generators. Four draft tubes with an inlet invert elevation of 396.0 feet, NGVD, provide the water for the turbines. Inlet dimensions are 74' x 36' high and outlet dimensions are 74' x 30' high. The inlet of the draft tubes is controlled by three 20.67 foot by 39 foot vertical lift gates. The outlet is controlled by three 20.67 foot by 30 foot vertical lift gates. The power head with full power pool is 48.0 feet and 46.0 feet when the power pool is empty. The power head with full power pool for four units operating is 40.5 feet and 38.5 feet when the power pool is empty based on design data. As a result of channel degradation, 1998 data shows an additional 5 feet of available power head. Design studies show the average generation to be 459,000 mega-watt hours (MWh), with a minimum annual generation of 8760 MWh in 1956. The actual average generation from 1972 through 1997 was 592,900 MWh. A typical section through the powerhouse is shown on plate 2-5.

2-04. Related control facilities. There are no related control facilities.

2-05. Real estate acquisition. The fee taking line for Robert S. Kerr L&D and Reservoir is a blocked perimeter to elevation 463.0 feet, NGVD. Flowage easements were acquired in the pool area above the fee taking line to elevation 473.0 feet, NGVD. In the upper reaches the flowage easement is to elevation 473.0 feet, NGVD, or the elevation of envelope curve of backwater effects of the 50-year flood after 50 years of sedimentation, whichever is higher. The envelope curve of backwater effects for the Arkansas River above Robert S. Kerr L&D and Reservoir pre- and post- project conditions are shown on Plate 4-1. The Plate also gives backwater effects after 50 years of sedimentation. There are 330,112.45 acres in fee simple title and 5,953.58 acres in easement.

2-06. Public facilities. A public overlook shelter is located on the downstream side of the left abutment. The Corps of Engineers maintains five parks, the City of Tamaha maintains one park, the city of Gore maintains one park, and the city of Webbers Falls maintains one park. Boat ramps, picnic areas, camping areas (including drinking water, restrooms, and trailer dump), and swimming areas are available. Some campsites also include shower facilities and electrical outlets. One campsite has a marine dump. The public use areas are shown on Plate 2-6.

III - HISTORY OF PROJECT

3-01. Authorization. Robert S. Kerr L&D and Reservoir was authorized for construction by the River and Harbor Act approved July 24, 1946 (Public Law 525, 79th Congress, 2nd Session, H.R. 6407) for the purposes of navigation, hydroelectric power, and recreation, including fish and wildlife.

3-02. Planning and design. The Short Mountain Lock and Dam was authorized by the River and Harbor Act of July 1946. Modified comprehensive development plans for the Arkansas Basin were published in June 1948 and May 1950. A document authorizing incorporation of River and Harbor and Flood Control plans into a single plan of development was published in July 1960. The name Short Mountain was changed to Robert S. Kerr in July 1963 by Public Law No. 88-62. Portions of a feasibility study for additional hydropower were published in March 1981.

3-03. Construction. A summary of construction activities for Robert S. Kerr L&D and Reservoir is presented in Table 3-1.

TABLE 3-1

ROBERT S. KERR LOCK AND DAM AND RESERVOIR
SUMMARY OF CONSTRUCTION ACTIVITIES

Construction Began	April 1964
Date of Diversion	November 14, 1968
Final Storage Began	September 8, 1970
Conservation Pool Filled	December 23, 1970

3-04. Related projects. Robert S. Kerr L&D and Reservoir 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. Related projects upstream of Robert S. Kerr L&D and Reservoir include Webbers Falls L&D on the Arkansas River, Chouteau L&D on the Verdigris River, Hulah Lake on the Caney river, Copan Lake on the Little Caney River, Skiatook and Birch Lakes on Hominy and Birch Creeks, respectively, Keystone Lake on the Arkansas River, Fort Gibson Lake on the Grand River, Eufaula Lake on the Canadian River, and Tenkiller Lake on the Illinois River. Downstream related projects are W.D. Mayo L&D on the Arkansas River and Wister Lake on the Poteau River.

3-05. Modification to regulations. The regulation of Robert S. Kerr L&D and Reservoir 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. The principal regulating problem for Robert S. Kerr L&D and Reservoir is being certain that the regulation during periods of high flow is appropriately coordinated with the hydropower marketing agency. Inspections and periodic maintenance also result in a need for effective coordination. Lock personnel are on duty at the project 24 hours a day.

IV - WATERSHED CHARACTERISTICS

4-01. General characteristics. The Arkansas River rises in the Rocky Mountains about 90 miles upstream of Pueblo, Colorado at an elevation of approximately 11,500 feet, NGVD, and flows in an easterly direction through the rolling Kansas prairies, then through much of Oklahoma and Arkansas to its confluence with the Mississippi River. The total length of the Arkansas River is about 1460 miles. The elevation of the confluence is approximately 106 feet. The fall of the River ranges from 110 feet per mile at the source to about 0.9 feet per mile at Robert S. Kerr to approximately 0.4 feet per mile at the mouth. Channel capacity below the project is approximately 135,000 cfs. The river basin between Hutchinson, Kansas and the Kansas-Oklahoma state line varies in width from 600 to 2500 feet with banks about 5 feet high. Between the Kansas-Oklahoma state line and Robert S. Kerr, the width is 600-3000 feet with banks from 10 to 20 feet. Below the Grand River, the banks are 20 to 40 feet high. The area of the Arkansas River basin is 160,645 square miles, of which 147,756 square miles are above Robert S. Kerr. Major tributaries of the Arkansas River are the Grand and the Verdigris Rivers, which enter the main stream at navigation miles 394.0 and 395.0, respectively. The Grand River has a drainage area of 12,520 square miles and the Verdigris River has a drainage area of 8,303 square miles. Other major tributaries include the Canadian and Illinois Rivers, which enter the main stream at navigation miles 356 and 360.9, respectively (numbers may vary slightly from Plate 4-1 due to updated river charts). The Canadian River has a drainage area of 47,705 square miles and the Illinois River has a drainage area of 1,660 square miles. Stream profiles of the Arkansas River are shown on Plate 4-1. The plate also shows 50-year flood profiles and a 1943 flood high waterline. Plate 4-2 shows the Standard Project Flood profiles for natural conditions and with 50-year sediment deposits.

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. Robert S. Kerr L&D is located in the Arkansas Valley section of Ouachita Physiographic Province, an area between the Ouachita Mountains to the south and the Ozark Uplift to the north. The maximum relief in the area is about 375 feet. Bedrock consists of sedimentary strata of lower Pennsylvanian age. Overburden throughout most of the floodplain averages about 30 feet thick. Under the Arkansas River the overburden is less than 10 feet in thickness.

4-04. Sediment. The Arkansas River at Robert S. Kerr Dam site carries a large sediment load. Existing projects reduced the sediment inflow so that an estimated 11,000,000 tons of bed material entered the reservoir in the third year after project completion. The distribution of sediment within the reservoir affects flooding within the reaches of the reservoir by its effect on backwater and net reservoir capacity. Dredging is required periodically to maintain a navigable channel throughout the reservoir.

The most recent resurvey was performed in the fall of 1976, yielding a loss of capacity at elevation 461.2 equal to 4827 acre-feet, or 0.9 percent. The average annual loss was therefore 0.09 percent per year, since the original survey was October 1966.

4-05. Climate. The Robert S. Kerr area has a moist, humid climate. Masses of warm, moist air from the Gulf of Mexico alternate with cooler moist air from the West Coast or with colder dry air from the Arctic Circle. The changes are often quite rapid and occasionally violent. Precipitation increases markedly during spring when local storms are most frequent. Periods of hot, dry weather in summer are caused by extended periods of clear skies and persistent winds from the south and west. Average annual precipitation is approximately 44 inches. Climatic characteristics for the area are shown in the following tabulation.

a. Temperature.

Mean annual (Sallisaw, OK)	61 degrees F
Maximum recorded (Sallisaw, OK, 1936)	115 degrees F
Minimum recorded (Sallisaw 1930)	-19 degrees F

b. Precipitation. (Basin average)(1)

Average annual (Jan 1930 - Dec 1991)	43.5 inches
Maximum annual (1973)	67.4 inches
Minimum annual (1978)	18.5 inches
Percent occurring during growing season. (Apr-Sep)	58.4 percent

c. Snowfall. (Sallisaw, OK)

Maximum (1975)	24.3 inches
Minimum (several years)	0 inches
Mean annual (1917-1995)	5.6 inches

(1) The basin average monthly and annual rainfall and runoff data are shown in table 4-1.

TABLE 4-1
AVERAGE MONTHLY AND ANNUAL RAINFALL AND RUNOFF ABOVE ROBERT S. KERR L&D

Month	Average Rainfall[1] (inches)	Percent of Average Annual Rainfall	Average Runoff (acre-feet)	Average Runoff (inches)[2]	Percent of Average Annual Runoff
January	2.20	5.1	1,267,100	.16	5.3
February	2.59	5.9	1,373,300	.17	5.6
March	3.53	8.1	2,441,700	.31	10.3
April	4.54	10.4	2,863,900	.36	12.0
May	5.71	13.1	3,498,600	.44	14.6
June	4.51	10.4	3,101,600	.39	13.0
July	3.24	7.4	2,102,000	.27	9.0
August	3.10	7.1	1,036,400	.13	4.3
September	4.35	10.0	1,200,100	.15	5.0
October	3.73	8.6	1,398,500	.18	6.0
November	3.36	7.7	1,622,800	.22	7.3
December	2.67	6.2	1,785,500	.23	7.6
Total	43.53	100.0	23,691,500	3.01	100.0

(1) Period of record - January 1930 through December 1996.

(2) Runoff from drainage area of 147,756 square miles. Period of record - January 1943 through December 1996.

d. Evaporation. The estimated pan evaporation at Robert S. Kerr L&D and Reservoir is shown in Table 4-2.

TABLE 4-2
ESTIMATED MONTHLY PAN EVAPORATION
ROBERT S. KERR L&D AND RESERVOIR (1980-1996)

Month	Evaporation (inches) (1)
January	2.41
February	2.57
March	4.61
April	6.16
May	6.71
June	8.28
July	10.13
August	9.00
September	6.31
October	4.77
November	3.36
December	2.72
Total	67.03

(1) National Weather Service Class "A" Pan.

e. Wind. The prevailing wind is from a southerly direction, with the greatest wind movements occurring in the spring months. Wind velocity data indicate the highest wind speed that can reasonably be expected at the dam site is 59 miles per hour and the highest wind speed for a one hour duration is 43 miles per hour.

4-06. Storms and floods. Most major storms in the Robert S. Kerr L&D and Reservoir drainage basin have occurred in April through June and September through November. However, major storms can occur at any time. The storms that cause precipitation on the basin are of three general types; (1) thunderstorms, (2) frontal storms, and (3) remnants of hurricanes. The largest flood in the 54 years of record was produced by a frontal storm. The April 14-29, 1990 storm produced an average of 10.68 inches of rainfall over the Robert S. Kerr basin. The time of year and antecedent soil moisture condition are also major factors that determine the amount of runoff from a given storm. Major storms in the basin are listed in Table 4-3. Major floods at three major upstream gage sites are presented in Table 4-4.

TABLE 4-3
MAJOR STORMS
OCTOBER 1970 TO NOVEMBER 1996
ROBERT S. KERR BASIN

Inclusive Dates	Average Basin Rainfall (inches)	Inclusive Dates	Average Basin Rainfall (inches)
22-23 Sep 1970	3.70	13-21 Feb 1989	4.02
25-28 Oct 1970	7.90	13-24 May 1989	5.01
22-24 Jul 1971	3.80	11-14 Jun 1989	3.84
8-9 Dec 1971	5.70	9-15 Sep 1989	5.69
21-22 Oct 1972	3.30	17-20 Jan 1990	4.75
28 Oct-2 Nov 1972	4.90	10-16 Feb 1990	4.27
1-6 Jun 1973	3.80	14-29 Apr 1990	10.68
22-26 Nov 1973	8.10	1-9 May 1990	7.26
6-9 Jun 1974	4.40	17-22 Sep 1990	4.04
8-14 Aug 1974	3.60	15-21 Sep 1991	3.27
30 Aug-3 Sep 1974	7.90	24 Oct-10 Nov 1991	9.21
17-21 Jun 1980	5.49	13-17 Dec 1992	4.49
28 Jul-4 Aug 1981	4.95	9-13 May 1993	3.83
10-18 Oct 1981	7.39	13-18 Sep 1993	4.37
30-31 Jan 1982	3.38	12-18 Nov 1993	3.60
12-15 May 1982	3.80	3-6 Nov 1994	5.82
11-15 May 1983	3.07	6-9 May 1995	3.39
12-28 Oct 1984	7.22	30 May-6 Jun 1995	3.50
18-24 Feb 1985	3.22	22-23 Apr 1996	3.86
29-31 Mar 1985	3.48	8-13 Jul 1996	3.90
18-20 Nov 1985	4.08	24 Nov-1 Dec 1996	4.32
27-Sep-4 Oct 1986	4.47		

4-07. Runoff characteristics. The watershed of the Arkansas River above Robert S. Kerr L&D includes three drainage basins, the Arkansas, Canadian, and Illinois Rivers. Average annual runoff varies from about one inch at the western limit of the normally contributing area to about 15 inches at the eastern limit in northwest Arkansas.

The primary sources of inflow to Robert S. Kerr L&D are the releases from Webbers Falls L&D, and from Eufaula and Tenkiller Lakes. The travel times from Webbers, Eufaula, and Tenkiller dams are 4, 12, and 6 hours respectively. Many runoff events include significant local runoff below the upstream flood storage projects.

Storm studies show that 1 to 2 inches of rainfall generally are needed to satisfy initial losses before significant runoff begins. Pertinent data for upstream gaging stations in the system are shown in Table 4-5. The estimated monthly and annual flows at Robert S. Kerr L&D, modified by the current upstream projects, are shown on Table 4-6. The modified inflow frequency volumes (by month) are shown in Table 4-7. A flow duration curve is shown on Plate 4-3.

TABLE 4-4

MAJOR FLOODS OF RECORD AT UPSTREAM GAGE SITES ROBERT S. KERR LOCK AND DAM

Canadian River near Whitefield			Illinois River near Gore			Arkansas River near Webbers Falls*	
Date	Discharge (c.f.s.)	Stage (ft.)	Date	Discharge (c.f.s.)	Stage (ft.)	Date	Discharge (c.f.s.)
5/6/41	94600	17.75	5/11/43	110000	24.50	3/19/73	139200
10/31/41	220000	21.40	4/15/45	118000	25.38	4/3/73	142400
5/10/43	281000	25.50	5/11/50	180000	29.60	10/14/73	131800
4/16/45	255000	21.80	5/24/90	15600	17.96	6/9/74	146000
12/10/46	151000	18.07				11/10/74	185800
6/25/48	260000	17.70				3/29/84	132000
5/19/49	210000	18.70				3/4/85	136000
5/11/50	256000	20.00				11/26/85	136000
5/2/54	165000	18.71				10/6/86	352200
5/18/57	176000	18.25				4/6/88	142200
5/19/60	180000	17.86				5/10/93	198700
5/3/90	241000	25.32				6/7/93	134000
5/21/93	55000	15.45				4/15/94	138500
						5/8/95	131000
						6/13/95	259000
						6/30/95	145000

* Stage at Webbers Falls depends on run-of-river operation.

TABLE 4-5
PERTINENT DATA FOR STREAM GAGING STATIONS

Station	Stream	River Miles Above Mouth	Gage Datum (ft.NGVD)	Flood Stage (ft.)	BankFull Capacity (c.f.s.)	Maximum Flood of Record		
						Date	Discharge (c.f.s.)	Stage (ft.)
Whitefield, OK	Canadian River	18.8	473.16	17.5	76,800	5/10/43	281,000	25.50
Gore, OK	Illinois River	8.5	468.00	17.0	12,200	5/11/50	180,000	29.60
Webbers Falls, OK	Arkansas River	366.6	N/A	N/A	135,000	10/6/86	352,200	Reg'd*

Station	Stream	2nd Largest Flood of Record			3rd Largest Flood of Record			Period of Record
		Date	Discharge (c.f.s.)	Stage (ft.)	Date	Discharge (c.f.s.)	Stage (ft.)	
Whitefield, OK	Canadian River	5/3/90	241,000	25.32	4/16/45	255,000	21.80	Jul `38-Sep `96
Gore, OK	Illinois River	4/15/45	118,000	25.38	5/11/43	110,000	24.50	Apr `39-Sep `96
Webbers Falls,OK	Arkansas River	6/13/95	259,000	Reg'd*	11/10/74	185,800	Reg'd*	Oct `70-Sep `96

* Elevation of Webbers Falls Pool; this could be above or below normal, depending on local conditions.

TABLE 4-7
INFLOW VOLUME FREQUENCY
(1940-1995)

Return Period, Yrs	Monthly Inflow in Thousands of Acre-Feet											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	970	980	1500	1900	2600	2200	1700	900	950	1200	1400	1300
5	1850	2100	3700	4400	5300	4800	3200	1700	1800	1900	2100	2000
10	2900	3400	6300	6800	7800	7300	4400	2300	2400	3300	3800	3600
20	4200	5000	9700	9900	10800	10500	5800	2900	3100	5300	5500	5400
50	6400	7900	16200	16400	17000	16700	8000	3900	4700	7500	7900	7700

4-08. Water quality. Designated beneficial uses for the water in Robert S. Kerr Reservoir are public and private water supply, warm water aquatic community, irrigation, hydropower, municipal and industrial process and cooling, primary body contact, navigation, aesthetics. Designated beneficial uses for surface waters are found in Chapter 45 of Oklahoma Water Quality Standards published by the Oklahoma Water Resources Board. Project purposes are navigation, hydroelectric power, and recreation.

Limited water quality data is available for the reservoir. Temperature-dissolved oxygen vertical profiles suggest that the reservoir does not strongly thermally stratify during the summer, even though temperature and dissolved oxygen decrease with depth. Dissolved oxygen concentrations near the reservoir bottom did not reach concentrations below approximately 4 milligrams/liter (mg/l), so dissolved oxygen content of lower waters were sufficient to sustain aquatic life. The water in the reservoir is relatively high in mineral content as indicated by a mean conductivity of about 600 microSiemens/Centimeter. Chloride concentrations ranged from 104 to 120 mg/l and sulfates from 45 to 53 mg/l. Total phosphorus concentrations are high with a mean of 0.144 mg/l, which would indicate the reservoir is hyper-eutrophic. Secchi disk readings, a measure of water transparency, indicated the lake is fairly turbid.

4-09. Channel and floodway characteristics. The regulating discharge on the Arkansas River from Robert S. Kerr L&D to Van Buren, Arkansas is 135,000 cfs. Flows of this magnitude occur less than 10 percent of the time, resulting in a very reliable navigation system. The channel has a nine foot minimum depth, and is dredged and otherwise maintained to ensure navigability. The control point for the Tulsa District portion of the basin is at Van Buren, Arkansas, and the rating curve for this gage is adjusted periodically to reflect the current condition of the channel.

A major tributary below Robert S. Kerr Dam is the Poteau River. Rating curves for the Whitefield and Gore, Oklahoma gages are kept current for estimating the local flows below the lake projects. Discharge rating curves for these gages are included as plates 4-4 through 4-5. Travel time from Robert S. Kerr to Van Buren, Arkansas is approximately 6 hours. A discharge rating curve for Van Buren is included as Plate 4-6. A summary sketch of travel times is shown on Plate 4-7.

4-10. Upstream structures. Operational structures in the Arkansas River basin upstream of Robert S. Kerr L&D are Cheney, El Dorado, Kaw, Great Salt Plains, Heyburn, and Keystone Lakes in the Arkansas basin; Toronto, Fall River, Elk City, Skiatook, Birch, Oologah, Big Hill, Hulah, and Copan Lakes, Newt Graham L&D and Chouteau L&D in the Verdigris basin; and Marion, Council Grove, John Redmond, Pensacola, Markham Ferry, and Fort Gibson Lakes in the Grand basin. Between Webbers Falls L&D and Robert S. Kerr are Meredith, Thunderbird, Optima, Fort Supply, Canton, Arcadia, and Eufaula Lakes on the Canadian River and Tenkiller Lake on the Illinois River. The operating agency for most of the listed structures is the Corps of Engineers. Exceptions to this are Cheney lake, owned by the Bureau of Reclamation and operated by the city of Wichita, Kansas; Pensacola and Markham Ferry lakes, owned and operated by the Grand River Dam Authority; and Meredith and Thunderbird lakes, owned and operated by the Bureau of Reclamation.

4-11. Downstream structures. Structures downstream of Robert S. Kerr L&D are W.D. Mayo Lock and Dam and Barling L&D at Van Buren. Wister Lake on the Poteau River contributes to flow in the Arkansas River below W.D. Mayo L&D. A small lake on Lee Creek occasionally contributes to the local inflow at Van Buren. The regulating agency for these structures is the Corps of Engineers.

4-12. Economic data.

a. Population. The 1990 population of major communities within counties that are adjacent to the Arkansas River above and below Robert S. Kerr are shown in Table 4-1. Table 4-1 also shows the projected population for these counties and cities for years 2000, 2010, and 2020. An upward trend in population growth is expected over the next two decades for all the counties, except Haskell county.

TABLE 4-8
POPULATION BY COUNTY AND MAJOR CITIES

County/*City*	1990 Population	2000 Population	2010 Population	2020 Population
Oklahoma				
Muskogee	68,078	74,475	79,715	83,465
Muskogee	*37,708*	*39,570*	*41,925*	*43,090*
Haskell	10,940	11,030	10,915	10,430
Stigler	*2,574*	*2,570*	*2,540*	*2,420*
Le Flore	43,270	47,040	49,925	51,250
Poteau	*7,210*	*7,650*	*8,040*	*8,200*
Sequoyah	33,828	36,860	38,925	39,735
Sallisaw	*7,122*	*7,650*	*8,050*	*8,165*
Arkansas				
Sebastian	99,590	111,417	123,644	137,207
Ft. Smith	*72,798*	*81,446*	*90,381*	*100,296*
Crawford	42,493	52,583	64,498	79,113
Van Buren	*14,979*	*18,537*	*22,734*	*27,886*

Source: "Population Projections for Oklahoma, 1990-2020," Oklahoma Department of Commerce, April 1993. Arkansas, Series B-Projection Series, Arkansas Population by County, 1990-2010, extrapolated to year 2020.

b. Industry. Though the counties are mainly agricultural, some manufacturing occurs in the major cities in the basin. In 1987, Muskogee county had about 350 million dollars of value added by manufacturing, and LeFlore county had about 26 million dollars in value added by manufacturing. The other counties did not report this information. In LeFlore county, farming and ranching predominate, but manufacturing includes refrigerator parts, instrument panels, crackers, and cattle feed. Local industries in Haskell county include meat packing, milling and trucking. In Muskogee county, 82 manufacturing industries existed in 1987. These are related to the oil and gas industry and small manufacturing located in industrial parks. Ft. Smith, Arkansas is a major manufacturing center. In 1987 there were about 203 manufacturing establishments, 278 wholesale establishments, and 1,153 retail trade establishments. Sebastian county, in which Ft. Smith is the principle city, had 227 manufacturing establishments with a total value added by manufacturers of $1.4 billion. Crawford county, in which Van Buren is located, had 50 manufacturing establishments with a total value added by manufacturers of $14.8 million. Forty-two wholesale trade establishments and 407 retail trade establishments are found in the county.

c. Agriculture. The soil, climate, and topography of the Arkansas River floodplain is suitable for diversified farming. While upland areas are used principally for livestock grazing and hay production, crops, such as wheat, soybeans, alfalfa, truck gardening (e.g. spinach), and other crops are grown in the bottom land. Table 4-9 shows the annual value of crops in the area.

TABLE 4-9
ANNUAL PRODUCTION AND VALUE OF CROPS
BELOW ROBERT S. KERR

1996 Current Normalized Prices

Crops	Robert S. Kerr to Vicinity Of Fort Smith	
	Acres	**Value**
Alfalfa	6,780	$ 2,033,000
Soybeans	23,810	3,167,000
Truck Garden	2,600	3,125,000
Wheat	26,130	2,500,000
Other(corn, etc)	1,530	232,000
Total	60,850	$11,057,000

d. Flood Damages. The "Arkansas River Feasibility Report," dated March 1990, describes the average annual flood damages to crops and structures under the existing operating plan. Below Robert S. Kerr L&D in the Sallisaw reach, at 1997 price levels, these values are $742,000 for crops and $209,000 for structures. In addition, about $6,000 in average annual damages to structures, at 1997 price levels, occur in the Sallisaw reach. Structural loss and area curves from Robert S. Kerr Dam to Fort Smith are included in Plate 4-8. No flood control benefits can be attributed to Robert S. Kerr L&D, since flood control is not a project purpose.

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological stations.

a. Facilities. The Water Control Section, Hydrology and Hydraulics Branch, Tulsa District Office, the National Weather Service (NWS), and the U.S. Geological Survey (USGS) cooperate to collect data and maintain a reliable communication network. All pertinent reporting observation stations are shown on Plate 5-1. The Arkansas River at the Van Buren, Arkansas gage is the control point for regulation. Important stream gages used to forecast inflows into Robert S. Kerr L&D are Whitefield on the Canadian River and Gore on the Illinois River, and numerous gages in the Arkansas Basin upstream of Webbers Falls.

At Robert S. Kerr L&D, a tipping bucket rain gage is located near the control shack next to the lock entrance. Pool elevation bubbler readings are recorded hourly by lock personnel and are provided by a gage upstream of the lock. Tailwater readings are provided by a bubbler gage located near the downstream end of the lock. Both gages are read continuously in the lock control room. A staff gage for pool elevation readings is located on the south wall of the upstream lock entrance. A staff gage for tailwater readings is located on the south training wall of the lock. A float gage is also provided for lock water level elevations.

b. Reporting. The reporting procedure for precipitation and stream gaging stations is on a cooperative basis with NWS. Hydrometeorological data collected by project personnel at Robert S. Kerr L&D is submitted to the Water Control Section, Hydrology and Hydraulics Branch, Tulsa District (telephone (918) 669-7095 or VHF-FM radio, call signal WUI-3). Detailed instructions on reporting criteria are presented in paragraph 5-07 of this section and paragraph 2 of Exhibit B, Standing Instructions to Lockmaster.

c. Maintenance. Maintenance and repair of stream gages are responsibilities of the administering agency. Historical recording and maintenance of data are resonsibilities of the United States Geological Survey (USGS). Both the Corps of Engineers and the USGS have streamgaging equipment in the Arkansas River Basin. The Hydrology/Hydraulics Section, Hydrology and 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's) which record data hourly and transmit the data every four hours or when the threshold value is exceeded. The data is transmitted via GOES satellite to a downlink and computer facility owned and operated by the National Oceanic and Atmospheric Administration (NOAA) near Washington, D.C. The data is transferred to the Tulsa District water control computer system by using the DOMSAT downlink located at the Tulsa District Office or by using telephone modems. When received, the river stage is converted to flow and lake elevation is converted to storage. All the data is then stored in a data base in the Corps' water control computer system for access when needed. DCP's also report rain data in the same way. In addition to DCP data, observer rainfall and MESONET data is collected and stored in the computer system for use in forecasting. (MESONET is an Oklahoma statewide network of scientific data recording stations.) Observers phone the NWS office in this region and the NWS then encodes the data into a Standard Hydrologic Exchange Format (SHEF). This data is then transferred to the water control computer system using telephone modems and a dedicated phone line to the Tulsa National Weather Service River Forecast Center. Once the data is received, it is decoded and handled in a manner similar to the DCP data. Informative display of all data is possible through the use of several versatile computer programs developed for use on the water control computer system. Table 5-1 contains a list of automated stream gage and rainfall stations.

5-02. Water quality stations.

a. Facilities. The water quality station for the Arkansas River basin upstream from Robert S. Kerr L&D is listed in Table 5-2. Water quality samples are taken occasionally from the lake.

b. 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, biological, and sediment characteristics of the stream water. The Corps of Engineers is sent copies of the published data entitled "Water Resources Data Oklahoma, Volume 1." Water quality samples taken by Corps of Engineers personnel are reported directly to the Tulsa District Office. Environmental Branch, Planning Division, is the Tulsa District recipient of the data.

c. Maintenance. Maintenance of the gage is the responsibility of the USGS. The Corps of Engineers shares in the expense. The Hydrology/ Hydraulics Section, Hydrology and Hydraulics Branch, Tulsa District, is responsible for any gaging equipment owned by the Corps of Engineers.

TABLE 5-2
PERTINENT REPORTING WATER QUALITY STATIONS

Station	Stream	Station ID number	Type	Period of Record	Frequency of Sample Analysis	Operating Agency
Tulsa, OK	Arkansas River	07164500	Specific conductance	October 1977	Daily	USGS

5-03. Sediment stations.

a. Facilities. The gages at Salt Fork near Alva, Arkansas River near Ponca City, Tulsa, and Haskell, Caney River near Ramona, Verdigris near Claremore, Bird Creek near Sperry, Neosho River near Commerce in Oklahoma, Arkansas river near Arkansas City, Cottonwood River near Plymouth, Elk River near Elk City, Grand River near Americus, Walnut river near Winfield, and Whitewater River near Towanda in Kansas are used for sediment measurement. These stations are operated by the USGS. The Corps of Engineers maintains 51 sediment ranges within the lake. The ranges below Robert S. Kerr L&D are the sediment ranges for W.D. Mayo L&D. These ranges are surveyed periodically (by assigned personnel from the Hydrology/Hydraulic Section) for the purpose of computing sediment deposition and new Reservoir area/capacity data. Sediment ranges are shown on Plate 2-4.

b. Reporting. Sediment data for gages within the Arkansas River basin are available from the USGS. The Corps of Engineers maintains records of the periodic re-surveys of the sediment ranges at Robert S. Kerr Reservoir.

c. Maintenance. Maintenance of the sediment and degradation range monuments is the responsibility of the Hydrology/Hydraulics Section, Hydrology and Hydraulics Branch, Tulsa District, Corps of Engineers.

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

a. Stages and discharges. The stages received from streamgaging stations and the corresponding discharges are maintained in the Water Control Data System computer.

b. Precipitation. The precipitation data received from the NWS and DCP's are maintained in the Water Control Data System computer.

c. Water quality data. Environmental Analysis Branch and Operations Division, Tulsa District take water quality samples in the lake at random times as needed. Water quality data at selected stream gages is recorded by the USGS and received at the Tulsa District Office in the form of an annual report entitled "Water Resources Data Oklahoma."

d. Radar and satellite reports. Current computer-enhanced satellite images, weather charts, and national radar summaries are accessed when needed and received into the water control computer from a private vendor. Also, a computer-enhanced image of the real-time radar scope image depicting cloud coverage and relative intensity is available from the National Weather Service and is routinely received from Oklahoma City. Computer images of rainfall data (NEXRAD) are also available and are compared with ground data. NWS locations in and near the Tulsa District with this capability, in addition to Oklahoma City, are Kansas City and Monett, Missouri; Garden City and Wichita, Kansas; and Amarillo, Texas. Hard copies of any of this data are available by use of color printers located in the Water Control Section.

5-05. Communication network. Wire facilities at Robert S. Kerr L&D and Reservoir are local and long distance telephone service. Radio communication is by VHF-FM fixed station (call signal WUI-324) capable of reaching local mobile stations, the Tulsa district, and other stations on the local, north, and south loops of the District via repeater relay. Maintenance of the telephone lines is the responsibility of the company leasing the line to the Government. The District radio technicians make periodic inspections of the project's fixed equipment and makes repairs as conditions warrant. To alert the public of impending gate changes a warning siren which is activated before each tainter gate change is located on the downstream side of the spillway. The siren is blown for several minutes before changes in discharge occur. A second siren is located near the downstream end of the lock. This siren is blown for three minutes before evacuating the lock chamber. A third siren can be activated from the powerhouse control room in the event of a change in power discharge.

5-06. Communication with project.

a. Regulating office with the lock. Instructions for the storage and release of water from the lake will be communicated by the Water Control Section to the responsible project operating personnel at the lock for the implementation of the provisions set forth in Section IX of this manual. This communication will normally be made by long distance telephone but on occasion could be made by VHF-FM radio. The reports by the lock personnel, described in paragraph 5-07 and Exhibit B of this manual, will be communicated directly to the Water Control Section. Should communication between the project and the district office be disrupted, the Project Engineer or his representative, on his own initiative, will direct regulation of the lake in accordance with the emergency rules of regulation as required in Section VII and Exhibit B of this manual. A chart, "Organization of Flood Control Regulation, Robert S. Kerr Lock and Dam No. 15," is shown on Plate 5-2.

b. Between project office and others. Communication between project personnel and other Federal, State, and local agencies will be sufficient to effect the coordination described in Section IX of this manual.

5-07. Project reporting instruction. Daily lake data from Robert S. Kerr L&D and Reservoir (see Plate 5-3) will be submitted to the Water Control Section, Hydrology and Hydraulics Branch, Tulsa District Office (FAX 918-669-7536, telephone 918-669-7095 or VHF-FM radio, call signal WUI-3 during normal working hours). The Water Control Section office is manned from 7:00 a.m. to 4:30 p.m. daily and occasionally is manned for various hours on weekends and holidays. Data for nonworking days shall be read from the gage data logger and submitted the following workday. Should unusual conditions arise during nonworking hours, one of the persons listed on Page iii should be contacted. The following data should be included in the daily report:

a. As of 8 a.m. Pool elevations at 8 a.m.of the current day, and 12 noon, 4 p.m., and 12 midnight of the previous day; whether tainter gates are open, and the total number of gate feet open; outflow stage at 8 a.m., and precipitation in inches for the preceding 24 hours (7a.m. to 7a.m.).

b. Each gate operation. Date and time of gate operation, total number of gate feet open before and after gate operation, lake elevation, and tailwater elevation. Confirmation of gate changes shall normally be made when the daily report is made at 8 a.m. More frequent updates may occasionally be requested by the Water Control Section. Complaints about pool elevations or releases, operating machinery failure and out-of-service times for maintenance shall be reported to the Water Control Section as they occur.

c. Power releases. Hourly total releases (midnight to midnight), 8 a.m. instantaneous power discharge, 8 a.m. spillway discharge, 24-hour average (midnight to midnight) power releases, 24-hour average spillway releases, time of use of each generator, and the 24-hour net power generation will be reported daily.

d. During flood period. In addition to subparagraphs a and b above, additional reports may be required by Water Control Section.

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

(1) At 8 a.m. all precipitation that has occurred during the preceding 24 hours, 7 a.m. to 7 a.m. as shown on Plate 5-3 (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 iii. In the event no one on the emergency list is available, a report should be made to the National Weather Service, Tulsa, Oklahoma, telephone 1-800-722-2778.

5-08. Warnings. The Project Manager and the project personnel who are authorized to make gate changes will maintain a list in current status of residents and/or property which might be endangered or inconvenienced by in-channel releases and will give them notification of impending releases. This notification will be made by telephone or oral warning by corps employees. If it is necessary to make damaging releases, notification to resident and/or property owners will be made by whatever means are available by project personnel. Notification will also be made in accordance with the Tulsa District supplements to ER 500-1-1. This would include media such as radio, television, telephone, citizens band radio, use of law enforcement and civil defense agencies and their communication system, National Guard and reserve units, supplemented by oral warning by corps employees. Dam safety studies have been made for the Robert S. Kerr Dam 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. These flooded area maps are part of the Operations and Maintenance Manual Volume III. In every case when a gate change is made, a siren is blown to give warning to people immediately downstream. When power releases are initiated, a horn is blown to give warning to people immediately downstream.

5-09. Frequency of gate changes. During flood periods, gate changes may be directed by the Water Control Section at any time. When significant amounts of floodwaters have entered the pool, gate changes can be expected several times per day. When the pool level is at or above the top of the power pool, gate changes may occur every hour. Only under the most unusual circumstances will gate changes be ordered more frequently than one every hour. Frequency of gate changes during low flow operation will be less frequent than during flood operations. For total outflows less than available power capacity, the spillway gates will remain closed.

VI - HYDROLOGIC FORECASTS

6-01. General. Hydrologic forecasts are necessary in predicting streamflow above and below Robert S. Kerr L&D and Reservoir to determine if and when releases should be made.

a. Role of Corps of Engineers. Hydrologic forecasts are made by the Forecasting Section, Tulsa District, for use in the regulation of lakes for flood control and other authorized purposes and for the benefit of Corps of Engineers' construction projects and flood-fighting activities. The District furnishes current information on lake levels, streamflow, discharges, and any other available information on observed conditions. General news releases are made by the Public Affairs Office which is kept fully informed of the hydrologic situation as appropriate. Further discussion of the role of the Corps of Engineers in hydrologic forecasts in presented in Section V of the Water Control Master Manual for the Arkansas River Basin.

b. Role of other agencies. The NWS is the official agency making flood forecast information available to the public. This information is disseminated by the Weather Wire Circuit (by commercial vendors) to subscribing government agencies and the various news media. 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.
(3) Quantitative precipitation forecasts are made daily for first six hour, second six hour, day one 24-hour, and day two 24-hour rainfall totals.
(4) Three-day river stage forecasts, when required.
(5) Rainfall required to produce bankfull stages (occasionally).
(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 occurred on the basin above Robert S. Kerr L&D. Personnel in the Forecasting Section have developed a flood forecasting model which is useful for estimating inflow to Robert S. Kerr L&D and Reservoir. This model was calibrated to historical flood events. Forecasting model sub-area delineations are presented in Plate 6-1. To utilize this model the following data is required:

1. Rainfall for stations listed in Table 5-1.
2. Robert S. Kerr Reservoir pool elevation for time of forecast.
3. Flood hydrographs for gages listed in Table 4-5.
4. Projected releases from Webbers Falls, Eufaula, and Tenkiller Lakes.

b. Methods. Inflow forecasts and forecasts of flow for the uncontrolled areas below the dam are made using the Corps Hydrologic Engineering Center (HEC) computer program HEC-1. Downstream of Robert S. Kerr L&D, flows are predicted using the Lower Arkansas forecast model as well as the Wister model. Precipitation data is received from the NWS and the DCP's by the water control computer. Average precipitation for various project basins above Robert S. Kerr L&D is calculated by means of a Tulsa District computer program called RAIN. The RAIN program takes the DCP data and plots isohyetal maps of 24-hour rainfall. The RAIN program also computes the basin and sub-basin average rainfalls for input into the HEC-1 forecasting model. The HEC-1 program uses the hourly DCP and MESONET rainfalls to distribute the sub-basin average rainfalls. Beginning loss rates are chosen

based upon historical storm reproductions. Rainfall excess is computed by subtracting the applicable losses from the incremental rainfall amounts. Snyder's coefficients are used to develop unit hydrographs or 2 hour unit hydrographs are input directly for each sub-area. Flood hydrographs are computed by applying the rainfall excess to the unit hydrographs. Loss rates are adjusted and the HEC-1 model rerun until the computed and observed hydrographs converge. Calibrated loss rates are applied to ungaged sub-areas and flood hydrographs are combined and routed, along with reservoir releases from upstream projects, to compute an inflow hydrograph. Using projected inflows to Robert S. Kerr L&D, the inflow hydrograph is routed through the lake to determine elevations. Flood releases are generally equal to inflow to maintain the Robert S. Kerr pool between elevations 458.0 and 460.00. A small buffer zone is provided above 460.00 for flexibility in flood operations. Sample input and output using one inch of runoff are presented in Plates 6-2 and 6-3, respectively. A sample calculation of inflow is presented in Plate 6-4.

6-03. Conservation purpose forecasts.

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

b. Methods. Forecasts for conservation purposes during the nonflood periods would rely largely on statistical interpretation of historical data. The flow duration curve (Plate 4-3), and the peak inflow probability curve (Plate 8-4), would be considered in conjunction with NWS forecasts in making conservation forecasts during nonflood periods.

6-04. Long-range forecasts.

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

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

VII - WATER CONTROL PLAN

7-01. General objectives. The primary objectives of the Robert S. Kerr L&D project are navigation, hydropower production, and recreation. Robert S. Kerr L&D will be operated as a unit in a multiple-purpose system providing benefits on the Arkansas River. Releases from Robert S. Kerr L&D will be made in accordance with the predicted volume of inflow into the pool.

7-02. Major constraints. The major constraints on the operation of the Arkansas River system include the channel capacity below each dam and the stage of the Arkansas river at Van Buren, Arkansas. The non-damaging flood release on the Arkansas River below Robert S. Kerr L&D is currently estimated to be about 135,000 cfs. This release should not be exceeded unless inflow forecasts show that uncontrolled flow will require releases which temporarily exceed this amount. Flood stage at the Van Buren gage is 22 feet. This corresponds to a flow currently estimated to be 135,000 cfs. The Van Buren gage is the primary control for system flood releases. Releases will be made so that, when combined with discharges from downstream lakes and intervening area runoff, the target flows at all locations specified by the Arkansas River Basin Water Control Master Manual will not be exceeded. The tainter gates are capable of discharging 755,000 cfs at the top of power pool, elevation 460.0 feet, NGVD. The invert elevation of the penstocks is 396.0 feet, NGVD, which is the lowest elevation at which water can be released from the dam.

7-03. Overall plan for water control.

a. General. Robert S. Kerr L&D is regulated as a unit in a multipurpose system for the benefit of water resources in the Arkansas River Basin. Development of 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. Robert S. Kerr L&D will be regulated as a run of the river facility in the total Arkansas River system for control of floods on the Arkansas River to Van Buren, Arkansas. When the flood waters are being accumulated in the system, each lake shall be regulated to retain equivalent flood control capabilities, as much as possible. Priority for releases, as shown on curves "A","B", and "C", Plate 7-54 of the Arkansas River Basin Water Control Master Manual, will be given to the lake with the least amount of flood storage available, depending on predicted inflows into the lake and conditions downstream. Section 7 of the Arkansas River Basin Water Control Master Manual provides detailed information on the Arkansas River System operation, necessary to determine the allowable flood releases from lakes upstream of Robert S. Kerr L&D. In addition, Robert S. Kerr L&D will be regulated for navigation and hydropower.

7-04. Standing instructions to Lockmaster. During flood periods the project will be regulated in accordance with the normal regulations for flood operations as directed in subparagraph 7-05.a. and Exhibit B (paragraph II-1) of this manual. Instructions necessary for the discharge of floodwater will be issued by the Water Control Section, Tulsa District Office. In the event communication with the Tulsa District Office is disrupted, the lake regulation will become the responsibility of the Lockmaster and will be regulated in accordance with subparagraph 7-05.b. and Exhibit B (paragraphs II-2,3) of this manual. In addition, the Lockmaster will immediately make every effort to reestablish communications with the Tulsa District Office. The Lockmaster will make daily observations of the pool level data and report those observations as directed in paragraph 5-07 and repeated in Exhibit B (paragraph I-2). Should an emergency situation occur, in which communication is not lost, such as inoperable gates, a drowning accident, excessive trash in draft tubes, a broken buoy line, or power outage, the Water Control Section will be notified immediately.

7-05. Regulation procedures.

a. Normal Operating Procedures. The navigation pool at Robert S. Kerr L&D will be maintained to provide a navigable channel from Webbers Falls L&D through Robert S. Kerr L&D. Pondage for hydroelectric power between elevations 458.0 and 460.0 is also provided. The normal operation for flood releases from Robert S.

Kerr L&D is conducted by the Water Control Section. The following regulations will normally govern releases from the reservoir:

1. When the navigation pool level is below elevation 458.0 all inflow will be stored except that necessary for lockages and maintenance of navigation below the dam, if possible, until elevation 458.0 is reached.

2. When the navigation pool level is between elevations 458.0 and 460.0, required releases will be made by lockage and the power turbines until the navigation pool level reaches elevation 460.0. See paragraph 7-11, for hydropower operation.

3. When the navigation pool level is at or near 460.0 and the inflow exceeds that necessary for lockage and power requirements, the spillway gates will be operated to maintain the pool level at or near elevation 460.0 by releasing inflow until all gates are fully open.

4. When the navigation pool level exceeds elevation 460.0 and reaches a maximum elevation and begins falling, the maximum spillway gate openings will be held until the pool level nears elevation 460.0; after which time the navigation pool level will be maintained at or near elevation 460.0 by releasing inflow.

5. All spillway gates shall be operated in increments of one foot with no more than one foot difference in the opening of any gate. In every case the top of gate elevation will be maintained above the reservoir pool level by an amount usually equal to at least one foot.

b. Emergency regulation procedures. Should communications with the Tulsa District Office be disrupted, the project engineer or his representative will direct regulation of the reservoir in accordance with the following rules of regulation until communication is restored. In addition, the project engineer or his representative will immediately make every effort to reestablish communication with the Tulsa District Office and, if necessary, send information to the Tulsa District Office by any available means. If an emergency condition is experienced the following regulations shall be followed:

1. Read current pool level and maintain current release one hour. The pool elevation should be carefully read from the pool gages (average hourly readings if pool level is fluctuating) to obtain the changes in pool elevation and, based on judgment, allowance should be made for any changes that wind action might have on the gage readings.

2. At the end of each hour period thereafter, read the pool level elevation.

3. Compare current pool level reading with the previous reading and adjust releases in accordance with Plate 7-1, Required Discharge Changes for Stationary, Rising, or Falling Pools. However, if the current discharge is less than 50,000 cfs, the change in releases will be limited to 10,000 cfs per hour and if the current discharge is more than 50,000 cfs, the change in releases will be limited to 0.2 times the current release per hour.

4. If discharge requirements exceed the spillway gate capacity, all gates will be held fully open until the reservoir pool level reaches a peak and recedes to elevation 460.0, at which time releases will be adjusted in accordance with Plate 7-1. Non-damaging channel capacity is 135,000 cfs which is the primary constraint to flood control operation. Adjustment of flows is usually held to 10,000 cfs per gate change, to avoid adverse effects on pool stability. The operation of Robert S. Kerr L&D is coordinated with the other elements of the Arkansas River System, to maximize system benefits.

5. The Lockmaster may temporarily deviate from the current release rates in the event an immediate short-term departure is deemed necesssary 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 Water Control Section and shall include justification for the action. Continuance of the deviation will require the approval of the Water Control Section.

7-06. Recreation. No storage or releases are designated for recreation at Robert S. Kerr L&D. Recreation features at the project include camping, picnicking, swimming, boating, and fishing. The location of public facilities is shown on Plate 2-6 of this manual.

7-07. Water quality. Water quality is not an authorized project purpose, therefore the project has no storage allocated for this purpose.

7-08. Fish and wildlife. Fish and wildlife is not included as an authorized project purpose; therefore, no storage or releases are specifically provided in the project. Management of the fish and wildlife resources is under the direction of the Oklahoma Department of Wildlife Conservation.

7-09. Water supply. Currently no storage is provided for water supply at Robert S. Kerr project.

7-10. Water rights.

a. General. The Oklahoma Water Resources Board (OWRB) has issued water rights on the Arkansas River below Robert S. Kerr L&D. The water rights applicants and authorized amounts are presented in Table 7-1. The OWRB should be contacted for updated water rights summaries.

b. Regulation procedure for water rights. No special procedures exist for operation of Robert S. Kerr L&D for water rights.

TABLE 7-1

ACTIVE WATER RIGHTS HOLDERS

Applicants Name	Authorized Amount (Acre-feet)
Sequoyah Water Distribution Authority	309
Paul Stottsberry	93
Othel Gamble	3420
T-P Farms	320
Othel Gamble, Jr.	288
Pecan Ridge Company	600
Preston Kelly	60
Max Kelly	320
Don Bedford	610
Robert Young III	
	TOTAL . . .6,020

7-11. Hydroelectric power. Robert S. Kerr L&D contains 84,700 acre-feet of power storage between elevations 458.0 and 460.0 feet, NGVD. The powerhouse contains 4-27,500 kW hydroelectric generators with a full power discharge of about 33,000 cfs. The turbines are used in conjunction with the spillway for flood releases. Flood releases of 33,000 cfs or less are made through the turbines, if operable. The Water Control Section will notify Southwestern Power Administration (SWPA) of the daily outflow required through turbines for flood releases. The release of water from the power pondage (elevation 458.0 to 460.0 feet NGVD) will be for the production of hydroelectric power and will be determined by SWPA. A turbine performance curve is included as Plate 7-5, and a turbine discharge vs net head curve is included as Plate 7-6.

Two feet of power pondage is provided, with 84,700 acre-feet of storage between elevations 458.0 and 460.0. This will provide sufficient pondage for about 30 hours of full generation, with limited inflow. Operating heads range from a maximum of about 48 feet to a minimum of 16 feet, below which excessive cavitation would occur. Power discharges vary from a minimum of about 7,800 cfs per turbine up to a maximum of 63,000 cfs with all units operating at 15 percent overload. Care is exercised in the generation of power to avoid sudden large changes in discharge, which could cause turbulent currents dangerous to navigation.

7-12. Navigation. Navigation is a project purpose; storage for navigation is provided below elevation 458.0. Flows used for lockage come from inflow or hydropower storage. Robert S. Kerr L&D will be regulated as a run of river facility 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 reservoir is discussed in Chapter 7 of the Arkansas River Basin Water Control Master Manual.

The river is navigable more than 90 percent of the time, which results in a very reliable system. Flows in excess of 100,000 cfs are required to effectively eliminate tow boat traffic on the Arkansas River. Low flow restrictions have yet to be experienced, and are expected only during periods of extreme drought. Further discussion of these low flow restrictions is included in the Drought Contingency Plan published for the Navigation System.

7-13. Sediment. There are no regulation procedures for sediment, however, Robert S. Kerr Reservoir does provide sediment storage for the benefit of the McClellan-Kerr Arkansas River Navigation System. An area-capacity table based on the latest (1976) sediment resurvey is included as Table 7-2.

7-14. Drought Contingency Plans. A Drought Contingency Plan for the navigation system was published in September 1992, in accordance with ER 1110-2-240, ER 1110-2-1941, and ETL 1110-2-335. The plan was published as Appendix DCP-6 to the Water Control Master Manual, Arkansas River Basin, and contains instructions for necessary coordination and operations during a drought. Copies of the plan are kept at the Robert S. Kerr project office and Tulsa District office.

7-15. Deviation from normal regulation. The District Engineer is occasionally requested to deviate from normal regulating procedures at the projects. Prior approval is obtained from the Southwestern Division (SWD) for the subsequent action except as noted in subparagraph a. below. These deviations normally are in the following categories:

a. Emergencies. Emergency deviations require immediate action with no time in which to seek approval from SWD. These emergencies include drowning, accidents, operating facility failure, and pollution. SWD will be informed as soon as possible and a written confirmation describing the deviation will be furnished as soon as possible.

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 such as utility stream crossings, bridge work, and major construction contracts, account for the major portion of unplanned deviations. Also, deviations are sometimes necessary for maintenance and inspection. Requests for changes of release rates are generally for a few hours to a few days. Each request is analyzed on its own merits. Consideration is given to upstream watershed conditions, potential flood threat, conditions of the lake, and possible alternative measures. In an effort to maintain good public relations, the requests are usually granted, provided there are no adverse effects on the overall regulation of the project (or projects) for optimum benefits to the authorized and useful purposes. Approval for minor deviations will normally be obtained from SWD by telephone. A written confirmation showing the deviation and conditions will be furnished to CESWD-ETE-P (Form SWD 898).

c. Planned deviations. Other instances include anticipated or planned deviation. Each condition will 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, E-mail, or facsimile to Southwestern Division along with Tulsa District recommendations for review or approval.

7-16. Rate of release change. Gradual increases and decreases in releases will be made when possible in order to minimize erosion, bank sloughing, undercutting, and danger to human and animal life. Spillway releases should be increased and decreased in increments no greater than 10,000 cfs. Situations may arise which will not allow an orderly increase and/or decrease in releases. A change of greater than 10,000 cfs produces adverse effects on pool stability.

7-17. Operational curves. The Spillway Rating Curve is shown on Plate 7-2. Tailwater Rating Curves are shown on plate 7-3. The Evaporation Curves are shown on Plate 7-4. Expected Turbine Performance is shown on Plate 7-5. Elevation versus Area and Capacity Data are compiled in Table 7-2. Turbine Discharge vs. Net Head is shown on Plate 7-6. The Lock and Dam Spillway Rating Table for Robert S. Kerr project is given on Plate 7-7. Rating curves used by the Water 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 flood control regulations on the spillway design flood, one half the spillway design flood, and a portion of the June 1995 flood are presented below. These examples were selected to show the effects of the regulations on a variety of possible conditions. These floods have been modified by the existing and authorized system of flood control projects.

8-02. Flood Control.

a. Spillway design flood. Plate 8-1 shows the spillway design flood routed through the reservoir. Normal regulations were used for the first 13-1/4 days at which time emergency regulations were assumed until the pool level receded to elevation 460.0. Maximum pool level reached was elevation 479.49 with a maximum discharge of 1,542,000 cfs.

b. One-half Spillway design flood. Plate 8-2 shows this flood routed through the reservoir using normal regulations for the first 13-1/4 days and emergency regulations until the pool level receded to elevation 460.0. The maximum pool level reached was elevation 461.12 with a maximum discharge of 799,000 cfs.

c. Flood of June 1995. This flood had a total inflow volume of 8,742,000 acre-feet over a 22-day period. The peak inflow was 278,000 cfs, the peak pool was 460.60 feet, NGVD. Plate 8-3 shows the actual operation of this flood.

8-03. Recreation. Recreation features at the project include camping, picnicking, swimming, boating, and fishing. Recreational areas are not affected by the minor pool changes that occur at the project.

8-04. Water quality. No specific operation exists for water quality. Designated beneficial uses for the water in Robert S. Kerr Reservoir are warm water aquatic community, irrigation, hydropower, municipal and industrial process and cooling, primary body contact, navigation, and aesthetics. Designated beneficial uses for surface waters are found in Chapter 45 of Oklahoma's Water Quality Standards published by the Oklahoma Water Resources Board. Project purposes are navigation, hydroelectric power and recreation.

Limited water quality data are available for the reservoir. Temperature-dissolved oxygen vertical profiles suggest that the reservoir does not strongly thermally stratify during the summer, even though temperature and dissolved oxygen decrease with depth. Dissolved oxygen concentrations near the reservoir bottom did not reach concentrations below approximately 4 milligrams/liter (mg/l), so dissolved oxygen content of lower waters were sufficient to sustain life. The water in the reservoir is relatively high in mineral content as indicated by a mean conductivity of about 600 microSiemen/centimeter. Chloride concentrations ranged from 104 to 120 mg/l and sulfates from 45 to 53 mg/l. Total phosphorus concentrations are high with a mean of 0.144 mg/l, which would indicate the reservoir is hyper-eutrophic. Secchi disk readings, a measure of water transparency, indicated the lake is fairly turbid.

8-05. Fish and wildlife. Periodically, the Oklahoma Department of Wildlife Conservation requests a manipulation of the Robert S. Kerr pool level to enhance fish spawning and waterfowl habitat. The request is only general in nature and does not significantly affect the hydropower operation.

8-06. Water supply. Water supply is not a project purpose for Robert S. Kerr L&D.

8-07. Hydroelectric power. During normal operations, releases will be made primarily through the turbines to maintain the pool between elevations 458.0 and 460.0 feet, NGVD. The power storage from elevation 458.0 to 460.0 feet, NGVD, is allocated to hydroelectric power generation. During flood operations, discharges will be made through the hydroelectric turbines as long as possible.

8-08. Navigation. The coordination of releases from Robert S. Kerr L&D 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. The controlled recession will enable navigation to continue while shoals are removed from the navigation channel. Another benefit from Robert S. Kerr Reservoir is sediment storage that will reduce the incidence of shoaling in the navigation system.

8-09. Drought Contingency Plan. The Drought Contingency Plan has carefully addressed the problems encountered during a drought. It provides a base for a plan structured according to the severity of the drought. This will enable the Water Control Section to more effectively coordinate with the public and District elements during such emergencies.

8-10. Flood Emergency Action Plans. The Flood Emergency Plan is outlined in the Operations and Maintenance Manual, Volume II, for Robert S. Kerr L&D. 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.

8-11. Frequencies.

a. Peak inflow probability. Linear regression techniques were used to develop a regression equation correlating peak discharges to mean daily flows for the Arkansas River near Sallisaw during the period of record 1940 to 1995. This regression equation was used to compute peak discharges from mean daily flows obtained from SUPER (a period of record routing SWD computer model) run A96X01 for the period 1940 to 1995. The June 1995 peak discharge of 289,200 was used for the year 1995. Using these peak discharges, a peak inflow probability curve for Robert S. Kerr was generated. This probability curve was developed in accordance with Bulletin 17B, Guidelines for Determining Flood Flow Frequency, September 1981 with SWD requirements as stated in DF dated August 22, 1979. The peak flow probability curve is presented in Plate 8-4.

b. Pool elevation duration and frequency curves. Since the operation of Robert S. Kerr is run-of-river, the computation of these curves is unnecessary.

c. Key control points. The key control point below Robert S. Kerr L&D is the Van Buren gage on the Arkansas River. The stage-discharge curve for this gage is shown on Plate 4-6. Flood stage at the Van Buren gage is 22 feet.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and organizations.

a. Corps of Engineers. Robert S. Kerr L&D is owned by the U.S. Government. The Tulsa district of the Corps of Engineers is the operating agency for the Lock and Dam. The Lockmaster, Robert S. Kerr L&D, operating through the Project Engineer at the Robert S. Kerr Area Office and the Operations Division, Tulsa District, has the responsibility for project operations concerning discharge releases. The Project Manager, Robert S. Kerr L&D, operating through the Operations Division, Tulsa District, has the responsibility for project operations dealing with lands and recreation. Project reporting instructions are presented in Section V, and project operating instructions are presented in Section VII of this manual.

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

(a) Regulation of lakes and dissemination of 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 hydrometeorological 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, and provide the background for improving facilities and methods.

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

(d) Prepare reports on lake regulations.
1) Recurring reports.
2) Water control manuals.
3) Postflood reports.

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

(a) Evaluation of current hydrologic, hydraulic, and meteorologic data.

(b) Presentation of storm and flood analysis to the District Engineer 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 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 (RICC).

The duties of the project operating personnel under flood conditions are set forth in Section 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 nonflood periods, instructions for the routine regulation of the lake are accomplished by personnel of the Water 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 Water Control Section. The area and magnitude of the flood will determine the number of people engaged in each particular 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 and Construction Division with instruction to provide warning if unusual conditions occur. Responsible personnel are on duty at the Tulsa District Office 24 hours a day whenever basin and/or project conditions warrant and during flood emergencies. Responsible personnel will be on duty or on call at the project at all times.

(5) Role of Lockmaster. The Lockmaster will regulate the lake according to instructions issued by personnel of the Water Control Section. The instructions follow the "Normal Regulations of Flood Control," included in Section VII and paragraph II-1 of Exhibit B. If the Lockmaster 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, which is also included in Section VII and paragraph II-2 of Exhibit B in this manual.

b. Other Federal agencies. The National Weather Service and the U.S. Geological Survey (USGS) cooperate together with the Water Control Section, Hydrology and Hydraulics Branch, Tulsa District Office, to accumulate rainfall and streamflow data. Southwestern Power Administration (SWPA) cooperates with the Corps of Engineers to market hydropower produced by the project.

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

d. Private organizations. Presently, there are no private organizations which have regulatory responsibilities at Robert S. Kerr L&D.

9-02. Interagency coordination. Cooperative arrangements with other Federal agencies, state agencies, and local interests are discussed in Section X of the Water Control Master Manual, Arkansas River Basin, Tulsa and Little Rock Districts, dated July 1980. Excerpts of interest to the regulation of Robert S. Kerr L&D are presented below.

a. Local press and Corps bulletins. The Corps of Engineers and the NWS cooperate in forecasting river stages and streamflows. The NWS is officially responsible for issuing flood warnings to the public. The Corps will provide the local press with NWS river stage and flood forecasts, which may be supplemented with observed river stages, observed and forecasted lake conditions, and other information on observed conditions, and technical advice to enable local interests to obtain optimum flood protection and to perform rescue and relief functions.

b. National Weather Service. The Tulsa District Office and the Tulsa River Forecast Center, NW9S, exchange hydrometeorologic 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 Section 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 obtain the desired stream discharge measurements.

d. Southwestern Power Administration. Close coordination is maintained between the Tulsa District and SWPA. The District Office provides SWPA with daily inflow forecasts to Robert S. Kerr L&D. SWPA provides the District with daily power generation schedule forecasts. SWPA plans and holds monthly coordination meetings with representatives of the Southwestern Division and the various Districts with hydropower projects in this region. Current issues relating to hydropower operations are discussed and power allocations for each project for the coming month are established.

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

9-03. Interagency agreements. The Memorandum of Understanding between the Southwestern Power Administration and the Corps of Engineers dated July 23, 1980, outlines the coordination that will occur with regard to the operation of the Tulsa District hydropower facilities.

9-04. Commissions, river authority, compacts, and committees. Arkansas River Basin compacts have been established between the states of Arkansas and Oklahoma, and Kansas and Oklahoma. The major purposes of these compacts are:

a. To promote interstate comity between Arkansas and Oklahoma, and 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 Arkansas and Oklahoma, and Kansas and Oklahoma in the total development and management of the water resources of the Arkansas River Basin.

9-05. Reports.

a. Daily reports. This report is prepared in accordance with TDR 1130-2-12 by the Water 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, streamgaging, construction of flood control projects affected by releases from reservoirs, answering public inquiries, and preparing public releases. The report includes a summary of hydrologic conditions as of 8 a.m. of that day and lake data for the previous and present days. The report is completed and dispatched from the Hydrology and Hydraulics Branch daily.

b. Monthly lake reports. The Water Control Section, in accordance with paragraph 6-04 of EM 1110-2-3600 and paragraph 12(d) of ER 1110-2-240, prepares the monthly lake regulation tabulation. These reports are a record of lake regulation for all flood control, navigation, or multiple-purpose storage lakes that are under supervision of, or of direct interest to, the District Office. Supplemental information on the regulation of the lakes, such as explanation of deviations from approved schedules, is added as a note on the tabulation 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.

c. Flood situation reports. The Water Control Section submits data to the Readiness and Security Branch for situation reports during floods in accordance with ER 500-1-1 and OM 500-1-6. 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 cfs, percent of flood control storage used to date and 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 and OM 500-1-6, as soon as practicable after a flood causing major damage. The report describes flood emergency operation by the Corps of Engineers and others. Included in summary form are: available hydrologic information, damage estimate, and other engineering data considered to be essential for flood control and flood plain studies or in the review of possible claims against the United States. The report is prepared by the District Office Emergency Management personnel, using information compiled and prepared by the Water Control Section. The report should be completed within approximately 90 days after most emergency activities are complete, including a statement of final costs.

e. Annual report. This report is prepared by the Water 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. Included is information on flood and low flow regulation, rainfall, maximum and minimum lake levels and river stages experienced, flood reductions, navigation and power production. The report also presents the activities and accomplishments of the Water Control Section 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
SUMMARY OF REPORTS

Name of Report	When Reported	Form Number	Regulation
Daily Report	Daily, except Saturday, Sunday, & holidays	SWT Forms 56 & 57	TDR 1130-2-12
Monthly Lake Report	Monthly	- - - - - - - -	EC 1110-2-240 & EC 1110-2-3600
Flood Situation Report	During floods	- - - - - - - -	OM 500-1-6 ER 500-1-6
Post-Flood Report	Following a flood causing major damage	- - - - - - - -	OM 500-1-6 ER 500-1-6
Annual Report	Annually	- - - - - - - -	ER 1110-2-240

TABLES

TABLE 4-6
ESTIMATED MONTHLY AND ANNUAL FLOWS IN ACRE FEET
ROBERT S. KERR L&D AND RESERVOIR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1940	291882	249640	200265	528040	785443	656807	961174	759064	1011868	310143	429560	914567	7098452
1941	1668958	1894485	650416	3251901	3478661	4240859	1858709	964433	1522711	6931436	8194433	3860806	38517807
1942	1344918	1258028	1205280	4878625	6376387	3907696	3152408	1441884	2173091	1914048	2497210	1533193	31682768
1943	2523882	748863	849513	1375974	10132480	8038115	3234801	634875	177798	441604	199101	408462	28765288
1944	509240	794590	3485302	5108192	6050810	2692919	1443360	760417	701494	1983344	456992	1922594	25909255
1945	950352	1134069	5818818	8430902	8430073	5832595	3493971	1417843	1252562	5650588	1038526	422051	43872349
1946	2259669	2039103	1830117	1133792	2891762	1587154	1299909	501185	221355	405142	1132661	2889548	18191398
1947	965355	335611	905405	4522790	6507110	5208694	2072993	800980	272945	215514	184284	237096	22028778
1948	249148	436582	2715538	1239233	1436473	2571173	7405013	4852478	1290486	245704	359226	337321	23138357
1949	1755041	5520563	3797105	2255028	5338661	7117884	2720396	1168326	894942	728259	398142	485260	32179607
1950	1709294	1709490	932275	665018	4508886	2674770	3810325	6811781	4154897	1552254	231174	399423	29159388
1951	321765	1769026	2231139	990803	3521641	4672264	8649092	3712437	2984139	1967849	2224324	1539281	34563759
1952	970028	1179864	2847614	2841144	1560555	888397	529531	545272	155782	75937	83663	72186	11749973
1953	118979	107687	422235	1728952	1772134	381778	859966	692904	260985	349004	256225	222831	7173679
1954	232731	136399	104652	96873	2212078	433785	531806	427277	126744	387679	148463	170936	5009423
1955	343531	438855	776773	426942	1353158	1677064	1103579	525043	170003	1170171	319002	297354	8601475
1956	177453	103422	98257	106274	336153	336198	355890	412459	133349	83008	95683	83500	2321647
1957	81717	202433	430905	4009150	7728254	10552048	8837613	2132451	895359	512807	793131	511700	36687565
1958	612171	640455	3405368	3685395	2399000	1476059	4360516	2471556	1400430	400715	297640	333570	21462874
1959	429983	430302	1241742	1171993	2202783	1235782	2744192	2116957	877805	8524887	3399471	1354572	25730478
1960	2080310	2091279	2429191	2580992	4658977	2721064	1936736	1659489	953375	576262	969739	1080276	23737689
1961	542136	663447	1519789	2652932	7668918	4377362	3197724	2097342	4048066	3285098	3996000	3030539	37079354
1962	1404807	1784521	1614357	1697474	783168	1948939	1381134	1005076	1207636	1552254	697686	777142	15854195
1963	680053	395092	737605	646750	454578	584926	793928	623484	449494	198789	157805	140438	5862942
1964	180036	119988	105451	888099	980666	1171636	736007	683558	381659	292681	1271841	1128912	7940535
1965	693150	501279	831128	3499735	1157935	2254909	1795182	638303	1318016	955025	223914	394197	14262783
1966	411537	790294	643591	1086426	1317679	555590	584993	600918	321620	90633	75213	97027	6575522
1967	163434	140120	121991	735888	708708	997884	2332102	1210078	730592	834940	965514	819999	9761248
1968	1073082	1891854	2694940	2713864	2173156	1792800	1447603	1123563	450565	480833	1587511	2357681	19787452
1969	2198674	2681558	3077331	3374896	4267178	3634988	2427592	959760	881441	1744834	638241	652445	26518938
1970	737175	396258	1195872	3430532	4166481	1973097	1106223	496266	661686	2355590	1343663	337382	18200207
1971	1194397	1548266	1185358	476152	727644	1529316	1219361	526088	876912	1135430	910413	3061099	14390435
1972	1517514	386539	261568	772780	1077140	254678	987552	505674	422003	565501	3547160	1816405	12114515

TABLE 4-6, CONT'D
ESTIMATED MONTHLY AND ANNUAL FLOWS IN ACRE FEET
ROBERT S. KERR L&D AND RESERVOIR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1973	3136728	3643240	7250065	8445719	8266946	4523028	1538912	946233	1095174	4375027	3439696	6043124	52703891
1974	2733923	1848389	5765692	2124357	2756428	5416006	1234733	824426	1761560	1550410	7804264	3350090	37170278
1975	1875310	4149517	4775926	3350856	3226377	4278406	1945160	992041	431762	187353	202969	732379	26148057
1976	362900	232038	917211	2121858	2463009	1070241	3112502	948754	172502	142036	90565	148984	11782601
1977	222155	236755	694687	721369	1650327	2399266	2152804	1208354	1443570	957239	1914724	437546	14038796
1978	350910	1003613	2894959	2985560	3087784	2083359	999665	481878	144833	69604	102942	122422	14327529
1979	411721	423138	1966312	1970360	1921365	2806096	1676398	1088761	349408	219511	1385673	967876	15186618
1980	414857	617082	990504	2826089	1995396	1725382	926987	522829	182618	87743	93421	90387	10473294
1981	193071	112019	150645	148950	434348	874532	1104809	769333	380767	1057833	2273415	698561	8199282
1982	782737	2446191	1908883	393798	4574739	7115444	2716276	948323	259021	164725	195055	1121534	22626727
1983	949676	2520666	1784801	5110274	6073315	2441692	1740222	469150	146202	1032623	1186334	646542	24101497
1984	584194	585445	4334138	6891530	2917279	1810830	654536	492639	133765	525658	1066195	2952635	22948843
1985	4588881	2779969	8672273	5162935	4164878	4468820	1599477	1109790	1110526	3621866	5581844	5016650	47877709
1986	1227170	1047265	1010549	3232740	3512725	2119597	1486832	759126	956529	10747418	6892423	2982764	35975136
1987	1866702	4093480	8358993	2841739	1891912	4165646	2074407	1039817	512212	500817	938559	3866340	32150623
1988	5086992	1571982	4825362	7407491	1433829	331914	741540	493192	429620	188644	452529	410061	23373157
1989	625390	2216489	2309044	1455352	1623457	4526301	1750613	1370866	2986988	950229	519114	477943	20811788
1990	870480	2009613	6951604	6984476	8331201	6844046	1480867	575831	423848	300244	270149	589851	35832210
1991	1757746	626793	486059	1068873	1550533	1453745	529716	470749	194638	552282	1443987	2920846	13055966
1992	1941471	1012134	1036927	1311769	1493780	4486608	3505900	3477923	1767808	471425	3408397	8133088	32057229
1993	6092745	4613641	4460925	4994420	9683805	8522181	4305546	2151328	2820020	2866613	1223583	1498854	53231663
1994	680729	1193272	3539964	4594909	5543661	1138255	886360	735884	347326	380239	3563881	2026570	24811049
1995	1567073	1010221	2691066	2924271	8317674	10392991	7531678	3126952	870843	488027	181309	490487	39592592
MAXIMUM	6092745	5520563	5818818	8445719	10132480	10552046	8837613	4852478	4154697	10747418	8194433	8133088	53231663
MINIMUM	81717	103422	98257	96873	336153	331914	355890	412459	133349	69604	75213	72186	2321647
AVERAGE	1227071	1330588	2288276	2715254	3501416	3124707	2232988	1251486	933270	1417063	1488476	1418095	22928690

TABLE 5-1

AUTOMATED RAINFALL AND STREAM GAGING STATIONS

STATION NAME	OPERATING AGENCY	TULSA ID	USGS ID	SHEF ID	DATA STORED
ARKANSAS RIVER NEAR PONCA CITY	USGS	KAWA	7148140	PCYO2	SFP,SD
SALT FORK NEAR ALVA	USGS	ALVA	7148400	AVAO2	SFP,SD
SALT FORK NEAR TONKAWA	USGS	TONK	7151000	TONO2	SFP
CHIKASKIA RIVER NEAR BLACKWELL	USGS	BLAC	7152000	BLKO2	SFP
ARKANSAS RIVER NEAR RALSTON	USGS	RALS	7152500	RLSO2	SFP
BLACKBEAR CREEK NEAR PAWNEE	USGS	PAWN	7153000	PAWO2	SFP
CIMARRON RIVER NEAR WAYNOKA	USGS	WAYN	7158000	WANO2	SFP
CIMARRON RIVER NEAR DOVER	USGS	DOVE	7159100	DOVO2	SFP
CIMARRON RIVER NEAR SEWARD	USGS	SEWA	7159750	SWDO2	SFP
CIMARRON RIVER NEAR GUTHRIE	USGS	GUTH	7160000	GTRO2	SFP
CIMARRON RIVER NEAR RIPLEY	USGS	RIPL	7161450	RIPO2	SFP
ARKANSAS RIVER AT TULSA	CORPS	TULA	7164500	TLSO2	SFP,WQ,SD
ARKANSAS RIVER NEAR HASKELL	USGS	HASK	7165570	HSKO2	SFP,SD
VERDIGRIS RIVER NEAR LENAPAH	USGS	LENA	7171000	LEPO2	SFP
CANEY RIVER NEAR BARTLESVILLE	USGS	BART	7174500	BVLO2	SFP
SAND CREEK NEAR OKESA	USGS	OKES	7174600	OKSO2	SFP
CANEY RIVER NEAR RAMONA	USGS	RAMO	7175500	RAMO2	SFP,SD
CANEY RIVER NEAR COLLINSVILLE	CORPS	COLL	7175550	CVLO2	S
VERDIGRIS RIVER NEAR CLAREMORE	USGS	CLAR	7176000	CLRO2	SFP,SD
BIRD CREEK NEAR AVANT	USGS	AVAN	7176500	AVTO2	SFP
BIRD CREEK NEAR SPERRY	USGS	SPER	7177500	SPEO2	SFP,SD
VERDIGRIS RIVER NEAR CATOOSA	CORPS	CATO	7178450	CATO2	S
NEOSHO RIVER AT COMMERCE	USGS	COMM	7185000	COMO2	SFP,SD
SPRING RIVER NEAR QUAPAW	USGS	QUAP	7188000	QUAO2	SFP
SPAVINAW CREEK NEAR SYCAMORE	USGS	SYCA	7191220	SYCO2	SFP
ELK RIVER NEAR TIFF CITY	USGS	TIFF	7189000	TIFM7	SFP
NEOSHO RIVER NEAR LANGLEY	GRDA	LANG	7190000	LNGO2	SFP
BIG CABIN CREEK NEAR BIG CABIN	GRDA	BCAB	7191000	BGCO2	SFP
ARKANSAS RIVER NEAR MUSKOGEE	CORPS	MUSK	7194500	MKGO2	S
ILLINOIS RIVER NEAR WATTS	USGS	WATT	7195500	WTTO2	SFP
FLINT CREEK NEAR KANSAS	USGS	KANS	7196000	KNSO2	SFP
ILLINOIS RIVER NEAR TAHLEQUAH	USGS	TAHL	7196500	TALO2	SFP,SD
BARON FORK RIVER AT ELDON	USGS	ELDN	7197000	ELDO2	SFP
ILLINOIS RIVER NEAR GORE	USGS	GORE	7198000	GORO2	SFP,WQ
CANADIAN RIVER NEAR WHITEFIELD	USGS	WHIT	7245000	WHTO2	SFP
CANADIAN RIVER AT CALVIN	USGS	CALV	7231500	CLVO2	SFP
CANADIAN RIVER AT PURCELL	USGS	PURC	7229200	PRCO2	SFP
LITTLE RIVER NEAR TECUMSEH	USGS	TECU	7230500	TCMO2	SFP
N. CANADIAN RVR NEAR SEILING	USGS	SEIL	7238000	SEIO2	SFP
N. CANADIAN RVR NEAR CANTON	USGS	CANN	7239000	CNOO2	SF
N. CANADIAN RVR AT WOODWARD	USGS	WOO2	7237500	WDGO2	SFP, WQ

NOTES:

S	STAGE	SD	SEDIMENT	STO	STORAGE
F	FLOW	WQ	WATER QUALITY		
P	PRECIPITATION	EL	ELEVATION		

TABLE 5-1 - (CONT'D)

AUTOMATED RAINFALL AND STREAM GAGING STATIONS

STATION NAME	OPERATING AGENCY	TULSA ID	USGS ID	SHEF ID	DATA STORED
N. CANADIAN RVR NEAR WATONGA	USGS	WATO	7239300	WATO2	SFP
N. CANADIAN RVR NEAR WETUMKA	USGS	WETU	7242000	WETO2	SFP
DEEP FORK NEAR WARWICK	USGS	WARW	7242380	WRWO2	SFP
DEEP FORK NEAR BEGGS	USGS	BEGG	7243500	BGSO2	SFP, SD
WOLF CREEK NEAR LIPSCOMB	USGS	LIPS	7235000	LCBT2	SFP

LAKE GAGES UPSTREAM OF ROBERT S. KERR L&D AND RESERVOIR

STATION NAME	OPERATING AGENCY	TULSA ID	USGS ID	SHEF ID	DATA STORED
ARKANSAS RIVER NEAR KAW LAKE	CORPS	KAWL	7148130	KAWO2	P,EL,STO
SALT FORK RIVER NEAR GREAT SALT PLAINS	CORPS	GSAL	7150000	GSPO2	P,EL,STO
ARKANSAS RIVER NEAR KEYSTONE	CORPS	KEYS	7164200	KEYO2	P,EL,STO
POLECAT CREEK NEAR HEYBURN	CORPS	HEYB	7165000	HEYO2	P,EL,STO
VERDIGRIS RIVER NEAR OOLOGAH	CORPS	OOLO	7171300	OOLO2	P,EL,STO
VERDIGRIS RIVER NEAR HULAH	CORPS	HULA	7172500	HEYO2	P,EL,STO
LITTLE CANEY RIVER NEAR COPAN	CORPS	COPA	7174300	COPO2	P,EL,STO
BIRCH CREEK NEAR BIRCH	CORPS	BIRC	7176400	BIRO2	P,EL,STO
HOMINY CREEK NEAR SKIATOOK	CORPS	SKIA	7177400	SKIO2	P,EL,STO
VERDIGRIS RIVER NEAR NEWT GRAHAM	CORPS	NEWT	7178600	NEWO2	P,EL,STO
VERDIGRIS RIVER NEAR CHOUTEAU	CORPS	CHOU	7179500	WAGO2	P,EL,STO
SPAVINAW CREEK NEAR SPAVINAW	TULSA	SPAV	7191000	SPAO2	P,EL,REL
GRAND RIVER NEAR PENSACOLA	GRDA	PENS	7191	PEN	P,EL,REL
GRAND RIVER NEAR HUDSON	GRDA	HUDS	7191[illegible]	HUD	P,EL,REL
GRAND RIVER NEAR FORT GIBSON	CORPS	FGIB	7191[illegible]	[illegible]	P,EL,REL
ARKANSAS RIVER NEAR WEBBERS FALLS	CORPS	WEBB	[illegible]	[illegible]	P,EL,REL
ILLINOIS RIVER NEAR TENKILLER	CORPS	TENK	[illegible]	[illegible]	P,EL,REL
CANADIAN RIVER NEAR EUFAULA	CORPS	EUFA	[illegible]	[illegible]	P,EL,STO
N. CANADIAN RIVER NEAR CANTON	CORPS	CANT	[illegible]	[illegible]	P,EL,STO
DEEP FORK RIVER NEAR ARCADIA	CORPS	ARCA	[illegible]	[illegible]	P,EL,STO
LAKE THUNDERBIRD NEAR NORMAN	BURC	THUN	[illegible]	[illegible]	P,EL,STO
FORT SUPPLY LAKE NEAR FT. SUPPLY	CORPS	FSUP	[illegible]	[illegible]	P,EL,STO
R.S.KERR L&D NEAR SALLISAW	CORPS	ROBE	[illegible]	[illegible]	P,EL,STO
LAKE MEREDITH NEAR SANFORD	BURC	MERE	[illegible]	[illegible]	P,EL,STO

NOTES:

S	STAGE	SD	SEDIMENT	STO	STORAGE
F	FLOW	WQ	WATER QUALITY		
P	PRECIPITATION	EL	ELEVATION		

TABLE 5-1 (CONT'D)

AUTOMATED RAINFALL GAGES USED IN THE ROBERT S. KERR FORECAST MODEL

STATION NAME	OPERATING AGENCY	TULSA ID	USGS ID	SHEF ID	DATA STORED
LAHOMA PRECIPITATION GAGE	CORPS	LAHO	36239806	LHMO2	P
HARDY PRECIPITATION GAGE	CORPS	HARD	36569648	HARO2	P
HALLET PRECIPITATION	CORPS	HALL	36139637	HLTO2	P
PERRY PRECIPITATION GAGE	CORPS	PERR	36179717	PERO2	P

STREAM GAGES UPSTREAM OF ROBERT S. KERR IN KANSAS

STATION NAME	OPERATING AGENCY	TULSA ID	USGS ID	SHEF ID	DATA STORED
ARKANSAS RIVER NEAR ARKANSAS CITY	USGS	AARK	7146500	ARCK1	SFP,SD
ARKANSAS RIVER NEAR DERBY	USGS	DERB	7144550	DRBK1	SFP
ARKANSAS RIVER NEAR GREAT BEND	USGS	GBEN	7141300	GTBK1	SFP
ARKANSAS RIVER NEAR HUTCHINSON	USGS	HUTC	7143330	HAUK1	SFP
BIG HILL CREEK NEAR CHERRYVALE	USGS	CHER	7170700	CHRK1	SFP
CANEY RIVER NEAR ELGIN	USGS	CEDA	7171600	CDVK1	SFP
CHIKASKIA RIVER NEAR CORBIN	USGS	ELGI	7172000	ELGK1	SFP
COTTONWOOD RIVER NEAR FLORENCE	USGS	CORB	7151500	CBNK1	SFP
CANEY RIVER NEAR CEDARVALE	USGS	FLOR	7180400	FLRK1	SFP
COTTONWOOD RIVER NEAR MARION LEVEE	USGS	MAR2	7180200	MARK1	SFP
COTTONWOOD RIVER BELOW MARION LAKE	USGS	MARC	7179795	MABK1	SFP
COTTONWOOD RIVER NEAR PLYMOUTH	USGS	PLYM	7182250	PLYK1	SFP,SD
ELK RIVER NEAR ELK FALLS	USGS	ELKF	7169800	ELFK1	SFP,SD
FALL RIVER NEAR FREDONIA	USGS	FRED	7169500	FRNK1	SFP
GRAND RIVER NEAR AMERICUS	USGS	AMER	7179730	AMCK1	SFP,SD
GRAND RIVER NEAR CHANUTE	USGS	CHAU	7183200	CNUK1	SFP
COUNCIL GROVE OUTFLOW NEAR COUNCIL GROVE	USGS	COUG	7179500	CGRK1	SFP
NEOSO RIVER NEAR DUNLAP	USGS	DUNL	7179710	DUNK1	SFP
NEOSO RIVER NEAR IOLA	USGS	IOLA	7183000	IOLK1	SFP
NEOSO RIVER NEAR PARSONS	USGS	PARS	7183500	PPFK1	SFP
CANEY RIVER NEAR SEDAN	USGS	SEDA	7173300	SDNK1	SFP
NINNESCAH RIVER NEAR PECK	USGS	PECK	7145500	PECK1	SFP
SLATE CREEK AT WELLINGTON	USGS	WELI	7145700	WELK1	SFP
SOUTH FORK NINNESCAH RIVER NEAR MURDOCK	USGS	MURD	7145200	MDRK1	SFP
NINNESCAH RIVER NEAR PRATT	USGS	PRAT	7144910	PTTK1	SFP
VERDIGRIS RIVER NEAR ALTOONA	USGS	ALTO	7166500	ATOK1	SFP
VERDIGRIS RIVER NEAR INDEPENDENCE	USGS	INDP	7170500	IDPK1	SFP
VERDIGRIS RIVER NEAR VIRGIL	USGS	VIRG	7165750	VGLK1	SFP
WALNUT RIVER NEAR WINFIELD	USGS	WINF	7147800	WFDK1	SFP,SD
WHITEWATER RIVER NEAR TOWANDA	USGS	TOWA	7147070	TOWK1	SFP,SD
LITTLE ARKANSAS RIVER NEAR VALLEY CENTER	USGS	VALC	7144200	VACK1	SFP

NOTES:

S	STAGE	SD	SEDIMENT	STO	STORAGE
F	FLOW	WQ	WATER QUALITY		
P	PRECIPITATION	EL	ELEVATION		

TABLE 5-1, CONT'D

LAKE GAGES UPSTREAM OF ROBERT S. KERR IN KANSAS

STATION NAME	OPERATING AGENCY	TULSA ID	USGS ID	SHEF ID	DATA STORED
BIG HILL CREEK NEAR BIG HILL	CORPS	BIGH	7170695	BIGK1	P,STO,EL
COTTONWOOD RIVER NEAR MARION	CORPS	MARI	7179794	MLBK1	P,STO,EL
ELK RIVER NEAR ELK CITY	CORPS	ELKC	7170050	ECLK1	P,STO,EL
FALL RIVER NEAR FALL RIVER	CORPS	FALL	7168000	FLLK1	P,STO,EL
GRAND RIVER NEAR COUNCIL GROVE	CORPS	COUN	7179400	CNGK1	P,STO,EL
GRAND RIVER NEAR JOHN REDMOND	CORPS	JOHN	7182450	JRLK1	P,STO,EL
VERDIGRIS RIVER NEAR TORONTO	CORPS	TORO	7165900	TRLK1	P,STO,EL

AUTOMATED RAINFALL GAGES UPSTREAM OF ROBERT S. KERR IN KANSAS

STATION NAME	OPERATING AGENCY	TULSA ID	USGS ID	SHEF ID	DATA STORED
CLIMAX	USGS	CLIM	7167500	CMXK1	P
ARLINGTON	USGS	ARLI	7144600	ARLK1	P
ATLANTA	USGS	ATLA	7147580	ATLK1	P
COTTONWOOD	USGS	COTT	7181990	CTWK1	P
DEXTER	USGS	DEXT	7148090	DEXK1	P
DIAMOND SPRINGS	USGS	DIAM	7181850	DIAK1	P
GRENOLA	USGS	GREN	7171590	GRNK1	P
HARPER	USGS	HARP	7151675	HRPK1	P
HAVANA	USGS	HAVA	7173550	HVAK1	P
INMAN	USGS	INMA	7143633	INMK1	P
MATFIELD	USGS	MATF	7182090	MTGK1	P
NEOSHO	USGS	NEOS	7182380	NEOK1	P
BEAUMONT	USGS	BEAU	7167451	BUMK1	P
CASSODAY	USGS	CASS	7146551	CSSK1	P
THRALL	USGS	THRA	7165829	THRK1	P
DURHAM	USGS	DURH	7179780	DURK1	P

NOTES:

S	STAGE	SD	SEDIMENT	STO	STORAGE
F	FLOW	WQ	WATER QUALITY		
P	PRECIPITATION	EL	ELEVATION		

TABLE 7-2
ROBERT S. KERR L&D 15
ELEVATION-AREA-CAPACITY TABLE

BASED ON 1976 RESURVEY
POOL ELEV (FT. NGVD)

AREA IN 1000'S OF ACRES

ELEV	0	1	2	3	4	5	6	7	8	9
400	.000	.000	.000	.000	.000	.000	.000	.000	.000	.010
410	.051	.099	.133	.202	.325	.446	.518	.609	.700	.747
420	.794	.900	1.029	1.177	1.495	1.630	1.714	1.781	1.863	1.981
430	2.103	2.337	2.667	2.970	3.315	3.779	4.354	4.990	5.689	6.285
440	6.868	7.214	7.663	8.730	10.051	11.300	13.301	15.522	18.135	20.682
450	22.968	24.944	26.996	29.149	31.670	34.251	36.169	38.319	40.757	42.408
460	43.796	46.445	49.107	52.048	54.355	56.479	58.889	60.924	62.310	63.539
470	64.535	71.265	73.915	76.103	78.679	80.780	83.051	84.477	86.305	88.735
480	90.861	103.868	108.203	110.784	112.185	113.317	114.488	115.547	116.464	117.420
490	118.421									

CAPACITY IN 1000'S OF ACRE-FEET

ELEV	0	1	2	3	4	5	6	7	8	9
400	.000	.000	.000	.000	.000	.000	.000	.000	.000	.005
410	.036	.111	.227	.394	.658	1.043	1.525	2.089	2.743	3.467
420	4.237	5.084	6.049	7.152	8.488	10.050	11.722	13.470	15.292	17.214
430	19.256	21.476	23.978	26.796	29.939	33.486	37.552	42.224	47.564	53.551
440	60.127	67.168	74.607	82.803	92.194	102.869	115.170	129.581	146.410	165.818
450	187.643	211.599	237.569	265.642	296.051	329.012	364.222	401.466	441.004	482.586
460	525.688	570.809	618.585	669.162	722.364	777.781	835.465	895.371	956.988	1019.913
470	1083.950	1151.850	1224.440	1299.449	1376.840	1456.569	1538.485	1622.249	1707.640	1795.160
480	1884.958	1982.322	2088.358	2197.851	2309.336	2422.087	2535.989	2651.007	2767.012	2883.954
490	3001.875									

TABLE 7-2 (Continued)
ROBERT S. KERR L&D 15
ELEVATION-AREA-CAPACITY TABLE

BASED ON 1976 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
400.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
401.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
402.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
403.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
404.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
405.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
406.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
407.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
408.0	.000	.000	.000	.001	.001	.001	.002	.003	.003	.004
	.000	.001	.002	.003	.004	.005	.006	.007	.008	.009
409.0	.005	.006	.008	.010	.012	.015	.018	.022	.026	.031
	.010	.014	.018	.022	.026	.031	.035	.039	.043	.047
410.0	.036	.041	.047	.053	.060	.067	.075	.083	.092	.101
	.051	.056	.061	.065	.070	.075	.080	.085	.090	.094
411.0	.111	.121	.131	.142	.153	.164	.176	.188	.201	.213
	.099	.102	.106	.109	.113	.116	.120	.123	.126	.130
412.0	.227	.240	.255	.270	.285	.302	.319	.337	.355	.374
	.133	.140	.147	.154	.161	.168	.175	.181	.188	.195
413.0	.394	.415	.437	.460	.485	.510	.537	.566	.595	.626
	.202	.214	.227	.239	.251	.264	.276	.288	.301	.313
414.0	.658	.691	.725	.761	.797	.835	.874	.915	.956	.999
	.325	.337	.349	.361	.373	.386	.398	.410	.422	.434
415.0	1.043	1.088	1.134	1.180	1.227	1.275	1.324	1.373	1.423	1.474
	.446	.453	.461	.468	.475	.482	.489	.497	.504	.511
416.0	1.525	1.577	1.631	1.685	1.740	1.795	1.852	1.910	1.969	2.028
	.518	.527	.536	.545	.554	.564	.573	.582	.591	.600
417.0	2.089	2.150	2.212	2.275	2.339	2.404	2.470	2.537	2.605	2.674
	.609	.618	.627	.636	.646	.655	.664	.673	.682	.691
418.0	2.743	2.813	2.884	2.955	3.027	3.099	3.172	3.245	3.318	3.392
	.700	.705	.710	.714	.719	.724	.728	.733	.738	.742
419.0	3.467	3.542	3.617	3.693	3.769	3.846	3.923	4.001	4.079	4.158
	.747	.752	.757	.761	.766	.771	.775	.780	.785	.789

TABLE 7-2 (Continued)
ROBERT S. KERR L&D 15
ELEVATION-AREA-CAPACITY TABLE

BASED ON 1976 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
420.0	4.237	4.317	4.398	4.480	4.563	4.647	4.733	4.819	4.906	4.995
	.794	.805	.815	.826	.836	.847	.858	.868	.879	.890
421.0	5.084	5.175	5.267	5.360	5.454	5.550	5.647	5.746	5.845	5.946
	.900	.913	.926	.939	.952	.965	.978	.990	1.003	1.016
422.0	6.049	6.152	6.257	6.364	6.472	6.582	6.693	6.805	6.919	7.035
	1.029	1.044	1.059	1.074	1.088	1.103	1.118	1.133	1.148	1.162
423.0	7.152	7.271	7.393	7.519	7.648	7.780	7.915	8.053	8.195	8.340
	1.177	1.209	1.241	1.273	1.304	1.336	1.368	1.400	1.432	1.463
424.0	8.488	8.638	8.789	8.942	9.096	9.252	9.409	9.567	9.727	9.888
	1.495	1.509	1.522	1.536	1.549	1.563	1.576	1.590	1.603	1.617
425.0	10.050	10.214	10.378	10.543	10.709	10.876	11.043	11.212	11.381	11.551
	1.630	1.638	1.647	1.655	1.664	1.672	1.681	1.689	1.697	1.706
426.0	11.722	11.894	12.066	12.239	12.413	12.587	12.763	12.938	13.115	13.292
	1.714	1.721	1.727	1.734	1.741	1.748	1.754	1.761	1.768	1.774
427.0	13.470	13.648	13.827	14.008	14.189	14.370	14.553	14.736	14.921	15.106
	1.781	1.789	1.798	1.806	1.814	1.822	1.830	1.839	1.847	1.855
428.0	15.292	15.478	15.667	15.856	16.046	16.238	16.431	16.625	16.820	17.016
	1.863	1.875	1.887	1.898	1.910	1.922	1.934	1.946	1.957	1.969
429.0	17.214	17.412	17.612	17.813	18.016	18.219	18.424	18.630	18.837	19.046
	1.981	1.993	2.006	2.018	2.030	2.042	2.054	2.066	2.079	2.091
430.0	19.256	19.467	19.681	19.897	20.116	20.336	20.560	20.785	21.013	21.243
	2.103	2.126	2.150	2.173	2.197	2.220	2.243	2.267	2.290	2.314
431.0	21.476	21.711	21.950	22.192	22.437	22.685	22.937	23.192	23.451	23.713
	2.337	2.370	2.403	2.436	2.469	2.502	2.535	2.568	2.601	2.634
432.0	23.978	24.246	24.517	24.791	25.069	25.349	25.632	25.919	26.208	26.501
	2.667	2.697	2.728	2.758	2.788	2.819	2.849	2.879	2.910	2.940
433.0	26.796	27.095	27.397	27.703	28.012	28.324	28.640	28.960	29.283	29.609
	2.970	3.005	3.039	3.074	3.108	3.143	3.177	3.212	3.246	3.281
434.0	29.939	30.272	30.611	30.954	31.302	31.654	32.011	32.373	32.739	33.110
	3.315	3.362	3.408	3.454	3.501	3.547	3.593	3.640	3.686	3.733
435.0	33.486	33.866	34.253	34.645	35.043	35.447	35.856	36.272	36.693	37.120
	3.779	3.837	3.894	3.952	4.009	4.067	4.124	4.182	4.239	4.297
436.0	37.552	37.991	38.436	38.887	39.345	39.809	40.279	40.756	41.239	41.728
	4.354	4.418	4.481	4.545	4.609	4.672	4.736	4.799	4.863	4.926
437.0	42.224	42.727	43.236	43.753	44.276	44.806	45.344	45.888	46.440	46.998
	4.990	5.060	5.130	5.200	5.270	5.340	5.410	5.479	5.549	5.619
438.0	47.564	48.135	48.713	49.297	49.887	50.483	51.084	51.692	52.306	52.925
	5.689	5.749	5.808	5.868	5.927	5.987	6.047	6.106	6.166	6.226
439.0	53.551	54.182	54.819	55.462	56.111	56.766	57.427	58.093	58.765	59.443
	6.285	6.343	6.402	6.460	6.518	6.577	6.635	6.693	6.752	6.810

TABLE 7-2 (Continued)
ROBERT S. KERR L&D 15
ELEVATION-AREA-CAPACITY TABLE

BASED ON 1976 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
440.0	60.127	60.816	61.508	62.203	62.902	63.604	64.310	65.019	65.732	66.448
	6.868	6.903	6.937	6.972	7.006	7.041	7.076	7.110	7.145	7.180
441.0	67.168	67.892	68.620	69.353	70.090	70.831	71.577	72.328	73.083	73.843
	7.214	7.259	7.304	7.349	7.394	7.439	7.484	7.528	7.573	7.618
442.0	74.607	75.378	76.161	76.954	77.757	78.571	79.396	80.232	81.078	81.935
	7.663	7.770	7.877	7.983	8.090	8.197	8.303	8.410	8.517	8.623
443.0	82.803	83.683	84.576	85.482	86.401	87.333	88.279	89.238	90.210	91.195
	8.730	8.862	8.994	9.126	9.259	9.391	9.523	9.655	9.787	9.919
444.0	92.194	93.205	94.229	95.265	96.314	97.375	98.449	99.535	100.634	101.745
	10.051	10.176	10.301	10.426	10.551	10.676	10.800	10.925	11.050	11.175
445.0	102.869	104.009	105.169	106.349	107.549	108.769	110.009	111.269	112.549	113.850
	11.300	11.500	11.700	11.900	12.101	12.301	12.501	12.701	12.901	13.101
446.0	115.170	116.511	117.874	119.260	120.668	122.098	123.550	125.024	126.521	128.040
	13.301	13.523	13.745	13.967	14.189	14.412	14.634	14.856	15.078	15.300
447.0	129.581	131.146	132.738	134.355	135.999	137.669	139.365	141.087	142.835	144.609
	15.522	15.783	16.045	16.306	16.567	16.829	17.090	17.351	17.612	17.874
448.0	146.410	148.236	150.088	151.965	153.867	155.795	157.749	159.728	161.733	163.763
	18.135	18.390	18.645	18.899	19.154	19.409	19.663	19.918	20.173	20.427
449.0	165.818	167.898	170.000	172.126	174.274	176.445	178.639	180.856	183.095	185.358
	20.682	20.911	21.139	21.368	21.597	21.825	22.054	22.282	22.511	22.740
450.0	187.643	189.950	192.276	194.622	196.988	199.374	201.780	204.205	206.650	209.115
	22.968	23.166	23.363	23.561	23.758	23.956	24.154	24.351	24.549	24.747
451.0	211.599	214.104	216.629	219.175	221.741	224.328	226.935	229.563	232.211	234.880
	24.944	25.149	25.354	25.560	25.765	25.970	26.175	26.381	26.586	26.791
452.0	237.569	240.279	243.011	245.765	248.540	251.336	254.154	256.994	259.855	262.737
	26.996	27.211	27.427	27.642	27.857	28.073	28.288	28.503	28.719	28.934
453.0	265.642	268.569	271.522	274.500	277.503	280.531	283.585	286.664	289.768	292.897
	29.149	29.401	29.653	29.905	30.157	30.410	30.662	30.914	31.166	31.418
454.0	296.051	299.231	302.437	305.668	308.926	312.209	315.518	318.852	322.213	325.599
	31.670	31.928	32.186	32.444	32.702	32.961	33.219	33.477	33.735	33.993
455.0	329.012	332.446	335.900	339.373	342.865	346.377	349.907	353.457	357.026	360.614
	34.251	34.443	34.635	34.826	35.018	35.210	35.402	35.594	35.785	35.977
456.0	364.222	367.849	371.498	375.169	378.861	382.575	386.310	390.067	393.845	397.644
	36.169	36.384	36.599	36.814	37.029	37.244	37.459	37.674	37.889	38.104
457.0	401.466	405.310	409.178	413.071	416.988	420.930	424.896	428.886	432.901	436.940
	38.319	38.563	38.807	39.050	39.294	39.538	39.782	40.026	40.270	40.513
458.0	441.004	445.088	449.188	453.305	457.438	461.588	465.755	469.938	474.138	478.354
	40.757	40.922	41.087	41.252	41.417	41.583	41.748	41.913	42.078	42.243
459.0	482.586	486.834	491.095	495.371	499.660	503.964	508.281	512.612	516.957	521.315
	42.408	42.547	42.686	42.825	42.963	43.102	43.241	43.380	43.519	43.657

TABLE 7-2 (Continued)
ROBERT S. KERR L&D 15
ELEVATION-AREA-CAPACITY TABLE

BASED ON 1976 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
460.0	525.688	530.081	534.500	538.946	543.418	547.917	552.443	556.994	561.573	566.177
	43.796	44.061	44.326	44.591	44.856	45.121	45.386	45.650	45.915	46.180
461.0	570.809	575.466	580.151	584.862	589.600	594.364	599.155	603.972	608.816	613.687
	46.445	46.711	46.978	47.244	47.510	47.776	48.042	48.308	48.575	48.841
462.0	618.585	623.510	628.465	633.449	638.463	643.506	648.578	653.680	658.811	663.972
	49.107	49.401	49.695	49.989	50.284	50.578	50.872	51.166	51.460	51.754
463.0	669.162	674.378	679.618	684.880	690.166	695.474	700.806	706.161	711.539	716.940
	52.048	52.279	52.509	52.740	52.971	53.202	53.432	53.663	53.894	54.124
464.0	722.364	727.810	733.277	738.766	744.276	749.807	755.359	760.932	766.527	772.143
	54.355	54.568	54.780	54.992	55.205	55.417	55.630	55.842	56.054	56.267
465.0	777.781	783.441	789.125	794.833	800.565	806.321	812.102	817.906	823.735	829.588
	56.479	56.720	56.961	57.202	57.443	57.684	57.925	58.166	58.407	58.648
466.0	835.465	841.364	847.283	853.223	859.183	865.163	871.164	877.185	883.227	889.289
	58.889	59.093	59.296	59.500	59.703	59.907	60.110	60.314	60.517	60.721
467.0	895.371	901.470	907.584	913.711	919.852	926.006	932.175	938.357	944.554	950.764
	60.924	61.063	61.201	61.340	61.479	61.617	61.756	61.894	62.033	62.172
468.0	956.988	963.225	969.475	975.736	982.010	988.297	994.595	1000.906	1007.229	1013.565
	62.310	62.433	62.556	62.679	62.802	62.925	63.048	63.170	63.293	63.416
469.0	1019.913	1026.271	1032.640	1039.019	1045.408	1051.807	1058.215	1064.634	1071.063	1077.501
	63.539	63.639	63.738	63.838	63.938	64.037	64.137	64.236	64.336	64.436
470.0	1083.950	1090.437	1096.991	1103.613	1110.302	1117.058	1123.882	1130.773	1137.731	1144.757
	64.535	65.208	65.881	66.554	67.227	67.900	68.573	69.246	69.919	70.592
471.0	1151.850	1158.989	1166.156	1173.348	1180.568	1187.813	1195.086	1202.384	1209.710	1217.061
	71.265	71.530	71.795	72.060	72.325	72.590	72.855	73.120	73.385	73.650
472.0	1224.440	1231.842	1239.266	1246.713	1254.181	1261.671	1269.182	1276.716	1284.272	1291.849
	73.915	74.134	74.353	74.572	74.790	75.009	75.228	75.447	75.665	75.884
473.0	1299.449	1307.072	1314.721	1322.396	1330.096	1337.822	1345.574	1353.352	1361.155	1368.985
	76.103	76.361	76.618	76.876	77.133	77.391	77.649	77.906	78.164	78.422
474.0	1376.840	1384.718	1392.617	1400.538	1408.479	1416.442	1424.425	1432.430	1440.455	1448.502
	78.679	78.889	79.099	79.309	79.520	79.730	79.940	80.150	80.360	80.570
475.0	1456.569	1464.658	1472.771	1480.905	1489.063	1497.243	1505.446	1513.672	1521.920	1530.191
	80.780	81.007	81.234	81.461	81.688	81.916	82.143	82.370	82.597	82.824
476.0	1538.485	1546.797	1555.123	1563.464	1571.819	1580.188	1588.572	1596.970	1605.382	1613.808
	83.051	83.194	83.336	83.479	83.621	83.764	83.907	84.049	84.192	84.335
477.0	1622.249	1630.705	1639.181	1647.674	1656.186	1664.716	1673.264	1681.830	1690.415	1699.018
	84.477	84.660	84.843	85.025	85.208	85.391	85.574	85.757	85.939	86.122
478.0	1707.640	1716.282	1724.949	1733.641	1742.356	1751.096	1759.860	1768.648	1777.461	1786.298
	86.305	86.548	86.791	87.034	87.277	87.520	87.763	88.006	88.249	88.492
479.0	1795.160	1804.044	1812.949	1821.876	1830.824	1839.793	1848.783	1857.795	1866.828	1875.882
	88.735	88.948	89.160	89.373	89.586	89.798	90.011	90.223	90.436	90.648

TABLE 7-2 (Continued)
ROBERT S. KERR L&D 15
ELEVATION-AREA-CAPACITY TABLE

BASED ON 1976 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
480.0	1884.958	1894.109	1903.390	1912.801	1922.343	1932.014	1941.815	1951.747	1961.809	1972.000
	90.861	92.162	93.463	94.763	96.064	97.365	98.665	99.966	101.267	102.567
481.0	1982.322	1992.731	2003.182	2013.678	2024.216	2034.798	2045.423	2056.092	2066.804	2077.559
	103.868	104.302	104.735	105.169	105.602	106.036	106.469	106.903	107.336	107.770
482.0	2088.358	2099.191	2110.050	2120.935	2131.845	2142.781	2153.744	2164.732	2175.746	2186.786
	108.203	108.461	108.719	108.977	109.235	109.494	109.752	110.010	110.268	110.526
483.0	2197.851	2208.937	2220.036	2231.149	2242.277	2253.418	2264.573	2275.743	2286.927	2298.124
	110.784	110.924	111.064	111.204	111.344	111.485	111.625	111.765	111.905	112.045
484.0	2309.336	2320.560	2331.795	2343.042	2354.300	2365.570	2376.850	2388.142	2399.446	2410.760
	112.185	112.298	112.411	112.525	112.638	112.751	112.864	112.978	113.091	113.204
485.0	2422.087	2433.424	2444.773	2456.134	2467.507	2478.892	2490.288	2501.695	2513.115	2524.546
	113.317	113.434	113.551	113.668	113.785	113.903	114.020	114.137	114.254	114.371
486.0	2535.989	2547.443	2558.908	2570.383	2581.869	2593.365	2604.873	2616.390	2627.918	2639.457
	114.488	114.594	114.700	114.806	114.912	115.018	115.123	115.229	115.335	115.441
487.0	2651.007	2662.566	2674.134	2685.712	2697.299	2708.895	2720.500	2732.114	2743.738	2755.370
	115.547	115.639	115.730	115.822	115.914	116.006	116.097	116.189	116.281	116.372
488.0	2767.012	2778.663	2790.324	2801.994	2813.674	2825.364	2837.063	2848.771	2860.489	2872.217
	116.464	116.560	116.655	116.751	116.846	116.942	117.038	117.133	117.229	117.325
489.0	2883.954	2895.701	2907.458	2919.225	2931.002	2942.789	2954.586	2966.393	2978.210	2990.038
	117.420	117.520	117.620	117.720	117.821	117.921	118.021	118.121	118.221	118.321

EXHIBITS

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

ROBERT S. KERR LOCK AND DAM AND RESERVOIR

EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

ROBERT S. KERR LOCK AND DAM

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	a. Van Buren Gage	

1 - GENERAL INFORMATION
ROBERT S. KERR L&D

Other names for project	Lock and Dam No. 15
Location	Arkansas River at river mile 336.2, approximately 8 miles south of Sallisaw, Oklahoma.
Type of project	Lock and Dam and reservoir
Objectives of regulations	Multipurpose - Hydropower, navigation, recreation, and fish and wildlife.
Project owner	U.S. Government.
Operating agency	U.S. Corps of Engineers. 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. Working hours during flood emergency conditions are 24 hours a day. The powerhouse is normally manned 8 hours a day, 5 days a week.
Regulating agency	U.S. Army Corps of Engineers
Project cost	$94,578,000
Closure date	September 1970
Water Supply Contracts	No water supply contracts exist for Robert S. Kerr Reservoir.
Water Rights	Water rights in the amount of 6,020 acre-feet have been granted between Robert S. Kerr Dam and the Arkansas State line.
Other Interagency Agreements	Southwestern Power Administration is the marketing agency for hydropower produced at Robert S. Kerr L&D.
Special Project Features	None

2 - LAKE INFORMATION

ELEVATIONS, AREAS, AND STORAGES

Feature	Elevation (feet NGVD)	Lake Area(1) (acres)	Lake Capacity	
			Accumulative(1) (acre-feet)	Incremental (acre-feet)
Top of Dam	483.5			
Maximum Pool	479.5			
Top of Power Pool	460.0	43,796	525,700	84,700
Bottom of Power Pool	458.0	40,757	441,000	440,600
Inactive	413.0	200	400	400
Spillway Crest	417.0	610	2,100	
Power Storage	458.5-460.0		84,700	
Streambed at Dam	409.0			

(1) Based on 1976 sedimentation survey.
Total drainage area is 147,756 which includes 22,241 square miles normally classified as non-contributing.

MAJOR FLOODS PAST DAMSITE

Date	Peak Flow (cfs)	Volume (acre-feet)	Runoff(1) (inches)
Sep 30 - Oct 18, 1986	409,900	10,210,500	1.30
May 1 - May 18, 1990	354,000	6,956,600	0.88
May 4 - May 30, 1993	277,000	11,260,900	1.43
Jun 1 - Jun 30, 1995	276,000	10,325,400	1.31

(1) Runoff from drainage area of 147,756 square miles.

Real estate taking line for fee

The fee taking line for Robert S. Kerr L&D is a blocked perimeter to elevation 473.0 feet, NGVD and contains 330,112 acres.

Real estate flood easement

Flowage easements were acquired in the flat pool area above the fee taking line to elevation 473.0 feet, NGVD. In the upper reaches the flowage easement is to elevation 463.1 feet, NGVD, or the elevation of the envelope curve of backwater effects of the 50-year flood after 50 years of sedimentation, whichever is higher.

Pool elevation corresponding to discharge capability of maximum non-damaging flow rate	Non-damaging channel capacity immediately below Robert S. Kerr L&D is currently estimated to be 135,000 cfs. This flow rate can be discharged when the lake level is at elevation 432.5 and above.
Reservoir length at top of power pool	30.4 miles
Shoreline length at top of power pool	250 miles
Emergency drawdown	The minimum time required to empty from the top of power pool (elevation 460.0) to spillway crest (elevation 417.0) with a maximum release of 135,000 cfs is 3 days.

3 - HYDROLOGY

Drainage area	147,800 square miles
Spillway design flood (full pool)	
Maximum water surface elevation	479.49 feet, NGVD
Peak inflow	1,609,000 cfs
Volume	22,550,000 acre-feet, or 2.86 inches
Maximum outflow	1,542,000 cfs
Flood duration	19 days
One-half Spillway design flood (full pool)	
Maximum water surface elevation	461.12 feet, NGVD
Peak inflow	805,000 cfs
Volume	11,275,000 acre-feet, or 1.43 inches
Maximum outflow	799,000 cfs
Flood duration	19 days
Climate	Moderate
Storm types	Primarily thunderstorms
Flood seasons	Primary flood period March through June with a secondary flood period of September through November; however, floods have occurred in every month of the year.
Low flow season	Primarily August, December through February; however, low flow can occur at any time of the year.
Minimum daily flow	(No flow) several days
Minimum monthly flow	69,600 acre feet in October 1978.
Minimum annual flow and date	2,321,600 acre-feet in 1956.
Average annual flow	22,928,700 acre-feet (1940-1995).
Maximum annual flow and date	53,231,700 acre-feet in 1993.
Maximum monthly flow and date	10,747,400 acre-feet in October 1986.
Maximum daily	389,800 cfs October 6, 1986.
Maximum instantaneous flow and date	409,900 cfs on October 6, 1986
Name and location of key streamflow stations	
	Arkansas River at Webbers Falls
	Canadian River at Whitefield

	Illinois River at Gore
	Arkansas River at Van Buren, Ark
Type of hydrometerologic data	Pool elevations recorded at damsite, tailwater stage, rainfall, pan evaporation, and weather conditions.
Number of precipitation stations used in hydrologic forecasting of Robert S. Kerr L&D	141 DCP recording.
Number of sediment ranges	51
Number of degradation ranges	19 (Sediment ranges for W. D. Mayo L&D)

4 - DAM

Location	Arkansas River, navigation mile 336.2
Purpose	Hydroelectric power, navigation, recreation, and fish and wildlife.
Type	Non-overflow.
Type of fill	Rolled earthfill embankment.
Slope protection	Riprap upstream, grass covered downstream.
Height	75 feet above streambed.
Length	7,230 feet (including spillway & powerhouse.)
Top elevation	483.5 feet, NGVD.
Design flood	Spillway Design Flood developed in original project design.
Freeboard	4.0 feet above design flood peak.
Used for roadway	No
Elevation of streambed at dam	408.5 feet, NGVD

5 - SPILLWAY

Location	Across the original river channel near the right abutment.
Type	Gated concrete, gravity, ogee weir.
Crest elevation	417.0 feet, NGVD.
Net overflow length	900 feet.
Number and size of gates	Eighteen, 50' wide X 44' high.
Type of gates	Tainter, operated by individual electric motors.
Top of gate elevation	461.0 feet, NGVD, in closed position.
Induced surcharge	None.
Design head	62.5 feet.
Discharge capacity (Maximum pool elevation)	1,542,000 cfs at 479.5 feet NGVD
Bridge deck elevation	476.0 feet, NGVD
Type of energy dissipator	Stilling Basin
Time required to open and close all gates	Gates raise or lower separately or together at a rate of 1.0 foot per minute.
Type of emergency closure	Bulkheads are provided for tainter gates and penstocks.
Spillway activation	The tainter gates, except for periodic maintenance, are activated only during flood conditions. During normal conditions, discharges are released through the powerhouse.

6 - LOCK

Type	Ohio
Location	Approximate left bank of original river channel
Type of construction	Concrete gravity founded on rock
Size of chamber	110' x 600'
Length of center to center pintles	670 feet
Culvert size	13.0'h x 14.5'w
Normal lift	48 feet
Type and number of gates	Miter, 2 pairs
Type of operation	Hydraulic
Filling and emptying system	Side laterals
Type of discharge	Side outlet
Elevations in feet, NGVD	
Maximum locking stage (lower pool)	440.0
Normal lower pool	413.0
Minimum lower pool	411.0
Maximum lower pool for unwatering lock	428.0
Top of lock wall	470.0
Elevation of upper miter sill	442.0
Elevation of lower miter sill	396.0
Top of lower guide wall	442.4

7 - HYDROELECTRIC POWER FACILITIES

Location	Between spillway and right abutment.
Type	Integral type with axis turbines.
Installed capacity	110,000 kW
Number, type and capacity	Four, 27,500 kilowatt generators.
Power on-line date	October, July, September, and November 1971 (units 1, 2, 3, and 4, respectively).
Number and size of draft tubes	Four, 74' w x 36' h (inlet) and 74' w 30' h (outlet).
Turbine discharge Design head Top of power pool	 8,250 cfs for one unit 33,000 cfs with all four units (37,950 with 15% overload).
Average net head	45 (four units operating - according to latest determination)
Minimum flow required for prime power	4,650 cfs
Draw down	2.0 ft.
Minimum head	18.0 ft. (bottom of power pool - critical tailwater)
Critical hydroyear	1956
Dependable capacity (10% to 15% overload)	121,000 kW to 126,500 kW
Average annual energy	459,000,000 kWh - Design Studies 592,900,000 kWh - Actual (1972-1997)
Specific hydroelectric power storage	84,700 acre-feet
Critical Tailwater elevation	440.0 feet, NGVD

8 - CONTROL POINTS

a - VAN BUREN

Location	Near left bank on upstream side of U.S. Highway 64 bridge at Van Buren, Arkansas at navigation mile 300.4 on Arkansas River.
Purpose of gage	Provide stage and precipitation data and serve as a control point for flood releases from Robert S. Kerr L&D and other upstream projects.
Channel and flood plain description	The channel is well defined and fairly straight at the gage. The left bank is high, and the right bank is a combined levee and floodwall that protects properties on the right bank.
Drainage area	150,482 square miles, of which 22,241 square miles are non-contributing.
Target flow rate	Bankfull stage 22.0 feet, 135,000 cfs (current reading).
Time of crest travel	Robert S. Kerr Dam to Van Buren gage, 6 hours (approximate).
Monitoring provisions	Water surface elevation is recorded by a Sutron Data Collection Platform.
Zero of Gage	372.36 ft. NGVD
Channel usage	Navigation, water supply, fishing and fish spawning.

EXHIBIT B

STANDING INSTRUCTIONS TO

ROBERT S. KERR LOCK & DAM
& RESERVOIR

EXHIBIT B

STANDING INSTRUCTIONS TO LOCKMASTER
ROBERT S. KERR LOCK & DAM

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EXHIBIT B

STANDING INSTRUCTIONS TO LOCKMASTER ROBERT S. KERR L&D

I - GENERAL

1. Operation. During flood periods the project will be regulated in accordance with the normal regulations for flood operations as directed in subparagraph 7-05a and Exhibit B (paragraph II-1) of this manual. Instructions necessary for the storage and discharge of floodwater will be issued by the Water Control Section. In the event communication with the Tulsa District Office is disrupted, the lake regulation will become the responsibility of the Lockmaster and will be regulated in accordance with subparagraph 7-05b and Exhibit B (paragraphs II-2,3) of this manual. In addition, the Lockmaster will immediately make every effort to reestablish communications with the Tulsa District Office. The Lockmaster will make daily observations of the weather station and pool level data and report those observations as directed in paragraph 5-07 and repeated in Exhibit B (paragraph I-2). Should an emergency situation occur, in which communication is not lost, such as inoperable gates, a drowning accident, excessive trash in gates, a broken buoy line, or power outage, the Water Control Section will be notified immediately.

2. Data reporting instructions. Daily lake data from Robert S. Kerr L&D (see Plate 5-3) will be submitted to the Water Control Section, Hydrology-Hydraulics Branch, Tulsa District Office (FAX 918-669-7536, telephone 918-669-7095 or VHF-FM radio, call signal WUI-3). The Water 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 submitted the following workday. 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 8 a.m., and 12 noon, 4 p.m., and 12 midnight of the previous day; whether tainter gates are open, with the total number of gate feet open; outflow stage at 8 a.m.; precipitation in inches for the preceding 24 hours (7 a.m. to 7 a.m.).

b. Each gate operation. Date and time of gate operation, total number of gate feet open before and after gate operation, and lake elevation. Confirmation of gate changes shall normally be made during submittal of the first morning report following the change. More frequent updates may occasionally be requested by the Water Control Section. Complaints about pool elevations or releases, operating machinery failure and out-of-service times for maintenance shall be reported to the Water Control Section as they occur.

c. Power releases. Hourly power releases (midnight to midnight), 8 a.m. instantaneous power discharge, 8 a.m. spillway discharge, 24-hour average (midnight to midnight) power releases, 24-hour average spillway release, and the 24-hour net power generation will be reported daily.

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

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

(1) At 8 a.m. all precipitation that has occurred during the preceding 24 hours, 7 a.m. to 7 a.m. as shown on Plate 5-3 (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. In the event no one on the emergency list is available, a report should be made to the National Weather Service, Tulsa, Oklahoma, telephone 1-800-722-2778.

3. 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 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 indications 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 Water Control Section, Hydrology-Hydraulics Branch.

4. Warnings. The Project Manager and the project personnel who are authorized to make gate changes will maintain a list in current status of residents and/or property which might be endangered or inconvenienced by in-channel releases and will give them notification of impending releases. This notification will be made by telephone or oral warning by Corps employees. If it is necessary to make damaging releases, notification to resident and/or property owners will be made by whatever means are available by project personnel. Notification will also be made in accordance with the Tulsa District supplements to ER 500-1-1. This would include media such as radio, television, telephone, citizens band radio, use of law enforcement and civil defense agencies and their communication system, National Guard and reserve units, supplemented by oral warning by Corps employees. Dam safety studies have been made for the Robert S. Kerr Dam 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. In every case when a gate change is made, a siren is blown to give warning to people immediately downstream. When power releases are initiated, a horn is blown automatically to give warning to people immediately downstream.

5. Frequency of gate changes. During flood periods, gate changes may be directed by the Water Control Section at any time. When the floodwaters have significantly risen into the pool, gate changes can be expected several times per day. When the pool level is at or above the top of power pool, gate changes may occur every hour. Frequency of gate changes during low flow operation will be less frequent than during flood operations. For total releases less than available power capacity, the spillway gates will remain closed.

II - REGULATION PROCEDURES

1. Normal regulation procedures. The navigation pool at Robert S. Kerr Lock and Dam will be maintained to provide a navigable channel from Webbers Falls Lock and Dam through Robert S. Kerr Lock and Dam. Pondage for hydroelectric power between elevations 458.0 and 460.0 is also provided. The following regulations will normally govern releases from the reservoir:

a. The navigation pool level will be maintained at or above elevation 458.0 at all times.

b. When the navigation pool level is between elevations 458.0 and 460.0 required releases will be made by lockage and the power turbines until the navigation pool level reaches elevation 460.0. See paragraph 7-11 for hydropower operation.

c. When the navigation pool level is at or near 460.0 and the inflow exceeds that necessary for lockage and power requirements, the spillway gates will be operated to maintain the pool level at or near elevation 460.0 by releasing inflow until all gates are fully open.

d. When the navigation pool level exceeds elevation 460.0 and reaches a maximum elevation and begins falling, the maximum spillway gate openings will be held until the pool level nears elevation 460.0; after which time the navigation pool level will be maintained at or near elevation 460.0 by releasing inflow.

e. All spillway gates shall be operated in increments of one foot with no more than one foot difference in the opening of any gate. In every case the top of gate elevation will be maintained above the reservoir pool level by an amount usually equal to at least one foot.

2. Emergency regulation procedures. Should communications with the Tulsa District Office be disrupted, the project engineer or his representative will direct regulation of the reservoir in accordance with the following rules of regulation until communication is restored. In addition, the project engineer or his representative will immediately make every effort to reestablish communication with the Tulsa District Office and, if necessary, send information to the Tulsa District Office by any available means. If an emergency condition is experienced the following regulations shall be followed:

a. Read current pool level and maintain current release one hour. The pool elevation should be carefully read from the pool gages (average hourly readings if pool level is fluctuating) to obtain the changes in pool elevation and, based on judgment, allowance should be made for any changes that wind action might have on the gage readings.

b. At the end of each one hour period thereafter, read the pool level elevation.

c. Compare current pool level reading with the previous reading and adjust releases in accordance with Plate 7-1. However, if the current discharge is less than 50,000 cfs, the change in releases will be limited to 10,000 cfs per hour and if the current discharge is more than 50,000 cfs, the change in releases will be limited to 0.2 times the current release per hour.

d. If discharge requirements exceed the spillway gate capacity, all gates will be held fully open until the reservoir pool level reaches a peak and recedes to elevation 460.0, at which time releases will be adjusted in accordance with Plate 7-1.

3. During emergency events. The Lockmaster 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 Water Control Section and shall include justification for the action. Continuance of the deviation will require the approval of the Water Control Section.

AREAS OF RESPONSIBILITY	
1	MARION
2	FALL RIVER
3	OOLOGAH
4	CANTON
5	KEYSTONE
6	FORT GIBSON
7	CHLORIDE CONTROL
8	EUFAULA
9	ROBERT S. KERR
10	WAURIKA
11	TEXOMA
12	HUGO

SEE REVERSE FOR MANAGERS AND COUNTIES

Ⓐ TULSA AREA LEVEES

TULSA/WEST TULSA
MINGO CREEK
JOE CREEK
FLAT ROCK/VALLEY VIEW CRKS
CHERRY/RED FORK CREEKS
HAIKEY CREEK

LEGEND

- USACE PROJECTS
- OPERATED FOR FLOOD CONTROL
- ▲ LOCAL PROTECTION PROJECTS
- MCCLELLAN-KERR ARKANSAS RIVER NAVIGATION SYSTEM
- LOCK

U.S. ARMY
CORPS OF ENGINEERS

Tulsa District

AREA MANAGER
RESPONSIBILITY
LIMITS

MAY 1998

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1-1

CORPS OF ENGINEERS

U.S. ARMY

WEBBERS FALLS DAM SITE

MILITARY RESERVATION

TENKILLER FERRY RESERVOIR

ROBERT S. KERR L. & D. NO. 15

VICINITY MAP

SCALE OF MILES

LEGEND

- U.S. highway
- State highway
- Concrete, brick, or asphalt road
- Low type bituminous or gravel road
- Graded and drained road
- Stream mile above mouth
- Reservoir area, pool El. 460.0

ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

LOCATION AND VICINITY MAPS

U. S. ARMY ENGINEER DISTRICT, TULSA, CORPS OF ENGINEERS 1998

DRAWN J.W.C.
CHECKED S.E.J.

2-1

CORPS OF ENGINEERS

(b) (7)(F)

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER WATERSHED
LOCK AND DAM NO. 15
ROBERT S. KERR

GENERAL PLAN AND SECTIONS

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998

DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

2-2

(b) (7)(F)

ARKANSAS RIVER WATERSHED ARKANSAS RIVER. OKLAHOMA

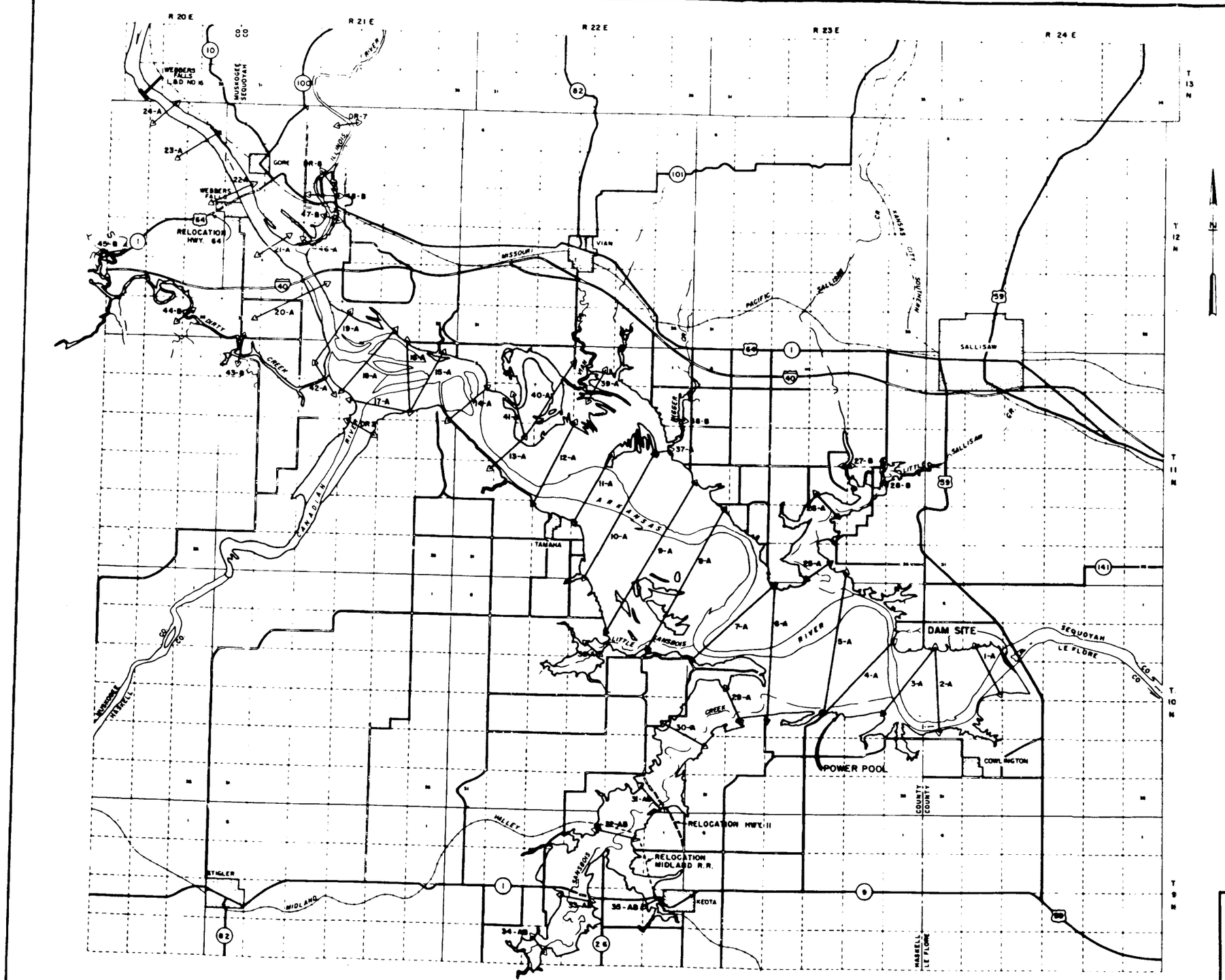
ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

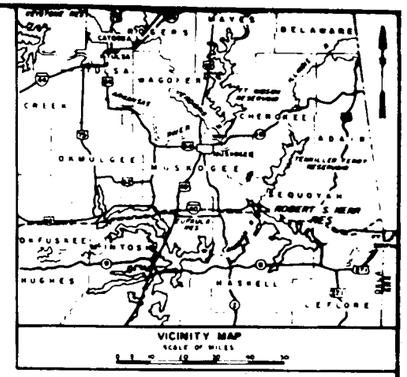
GENERAL LOCK PLAN

DEPARTMENT OF THE ARMY. TULSA DISTRICT CORPS OF ENGINEERS 1998

DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

2-3





LEGEND

- FEDERAL HIGHWAYS
- STATE HIGHWAYS
- INTERSTATE HIGHWAYS (PROPOSED)
- EXISTING RAILROADS
- POWER POOL EL. 480
- COUNTY ROADS
- PROPOSED RELOCATION OF HIGHWAY
- PROPOSED RELOCATION OF RAILROAD

SCALE OF MILES

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

SEDIMENT RANGES

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1956
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

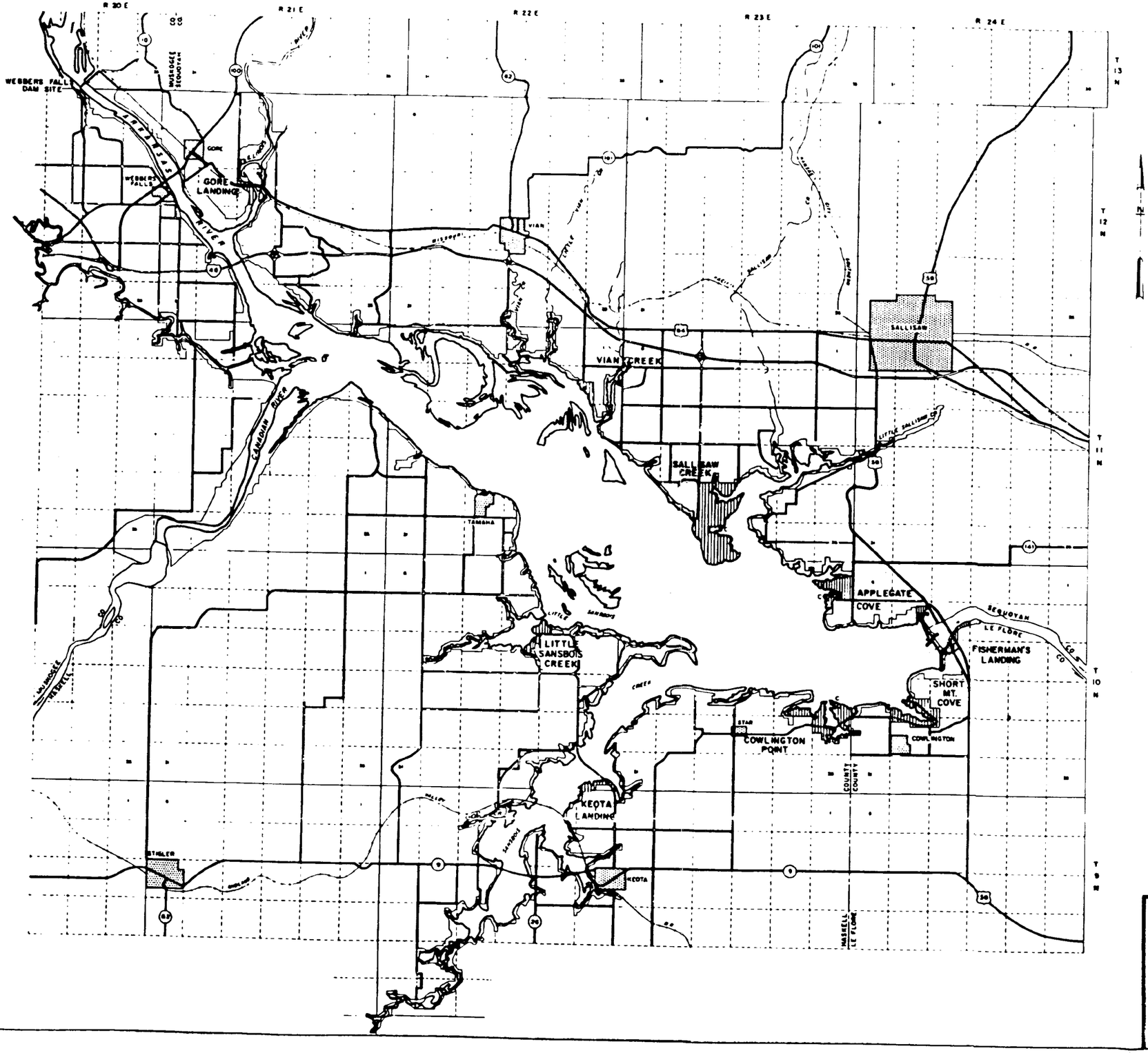
(b) (7)(F)

ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

TYPICAL SECTION THROUGH POWERHOUSE

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

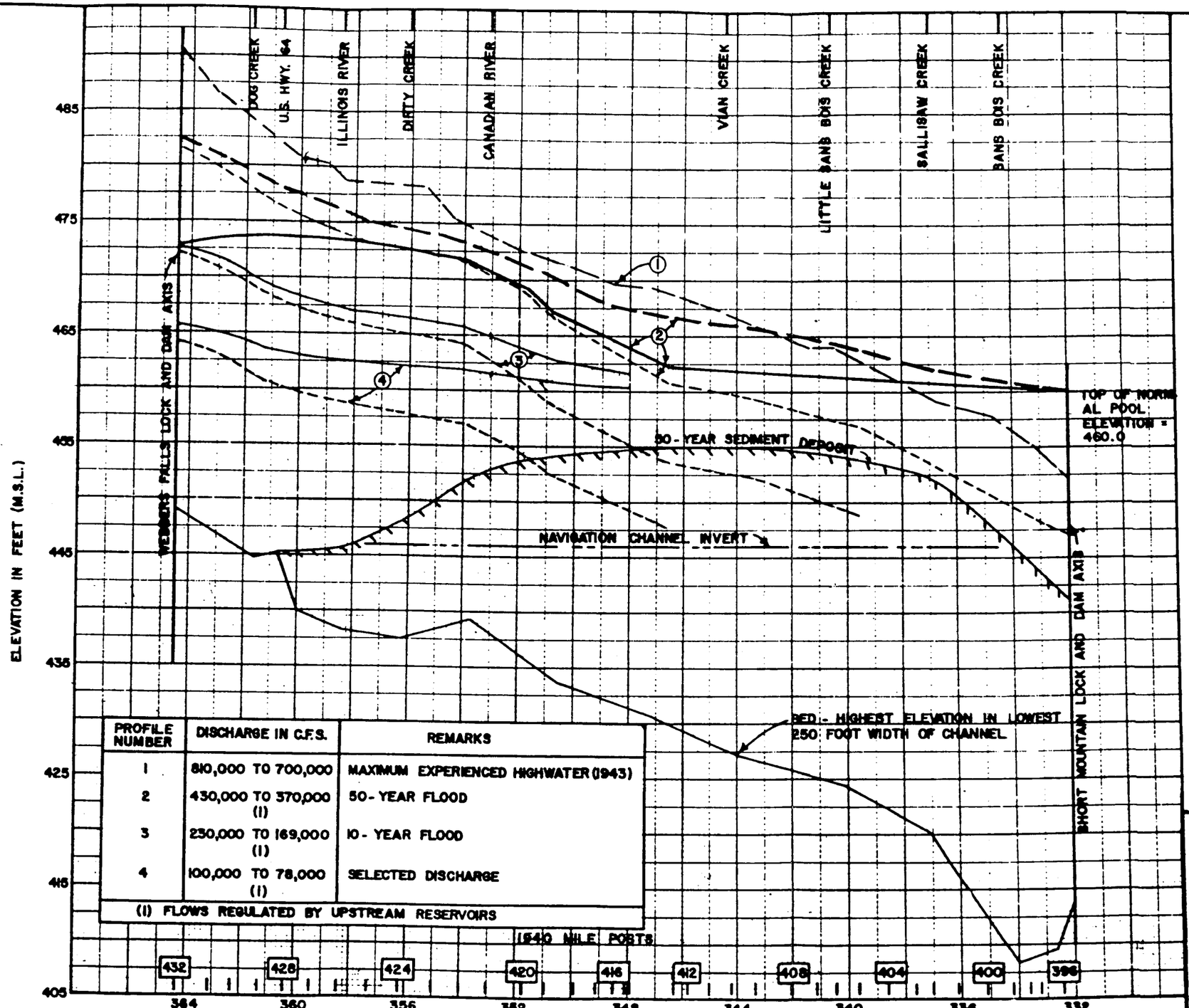
ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

PUBLIC USE AREAS

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998
DRAWN BY: J.B.C.
CHECKED BY: S.E.J.

CORPS OF ENGINEERS

U.S. ARMY



PROFILE NUMBER	DISCHARGE IN C.F.S.	REMARKS
1	810,000 TO 700,000	MAXIMUM EXPERIENCED HIGHWATER (1943)
2	430,000 TO 370,000 (1)	50-YEAR FLOOD
3	230,000 TO 169,000 (1)	10-YEAR FLOOD
4	100,000 TO 78,000 (1)	SELECTED DISCHARGE

(1) FLOWS REGULATED BY UPSTREAM RESERVOIRS

LEGEND

- ENVELOPE CURVE OF BACKWATER EFFECTS 50-YEAR FLOOD. NO SEDIMENT DEPOSITS
- ENVELOPE CURVE OF BACKWATER EFFECTS 50-YEAR FLOOD 50-YEAR SEDIMENT DEPOSITS.
- NATURAL PROFILES
- PROFILES WITH DAM IN PLACE NO SEDIMENT DEPOSITS
- MAXIMUM FLOOD OF RECORD

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

50 YEAR FLOOD PROFILE

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
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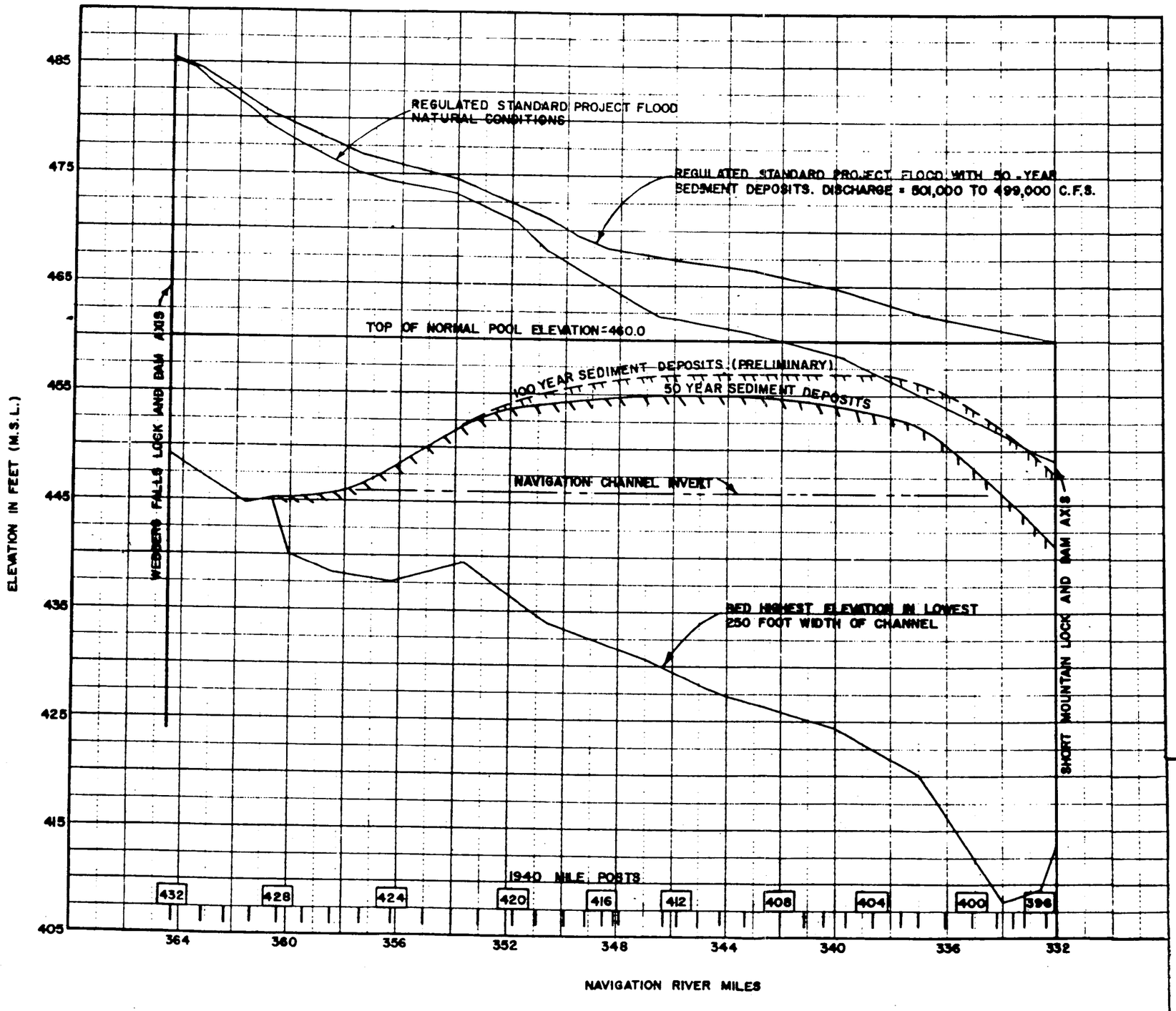
4-1

CORPS OF ENGINEERS

U.S. ARMY

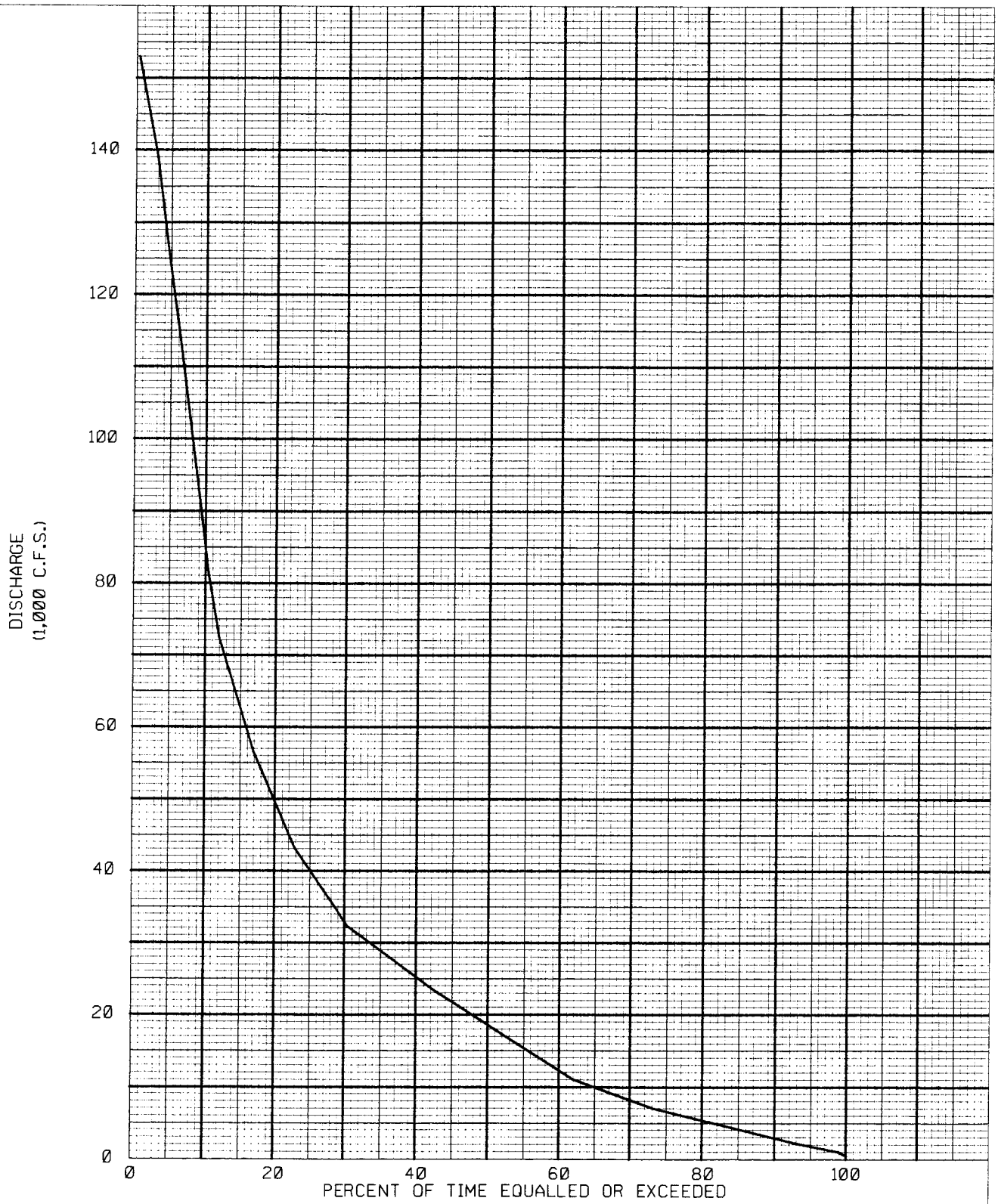


ARKANSAS RIVER WATERSHED ARKANSAS RIVER. OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

STANDARD PROJECT FLOOD PROFILE

DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

FLOW DURATION CURVE

NOTE:

1. APPROACHES ZERO AT 200,000 C.F.S.
2. BASED ON PERIOD OF RECORD
   JAN. 1940 THRU DEC. 1995

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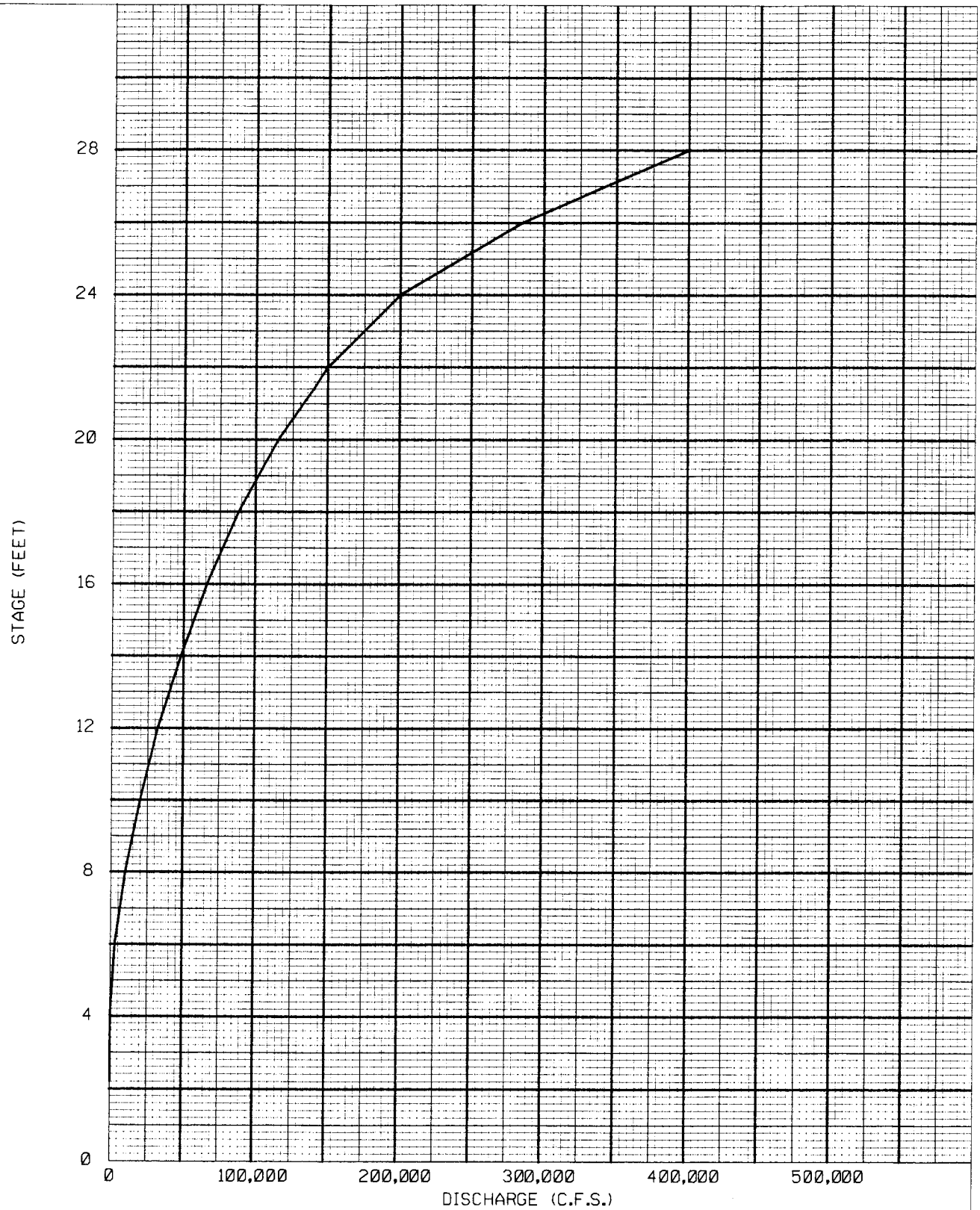


ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

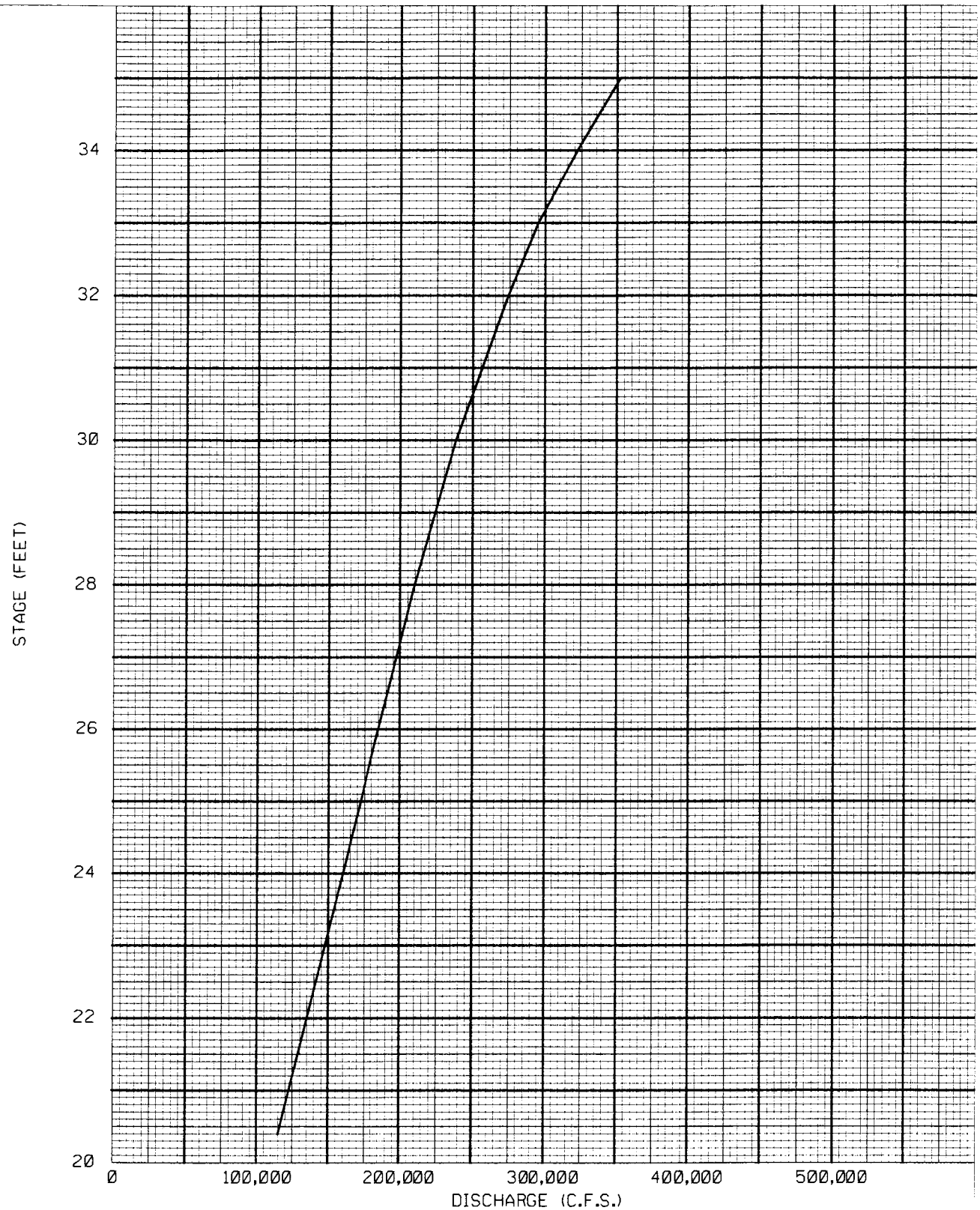
DISCHARGE RATING CURVE

WHITEFIELD, OKLAHOMA

DATUM = 473.16 FT.

RATING NO. 29, OCTOBER 1, 1991

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

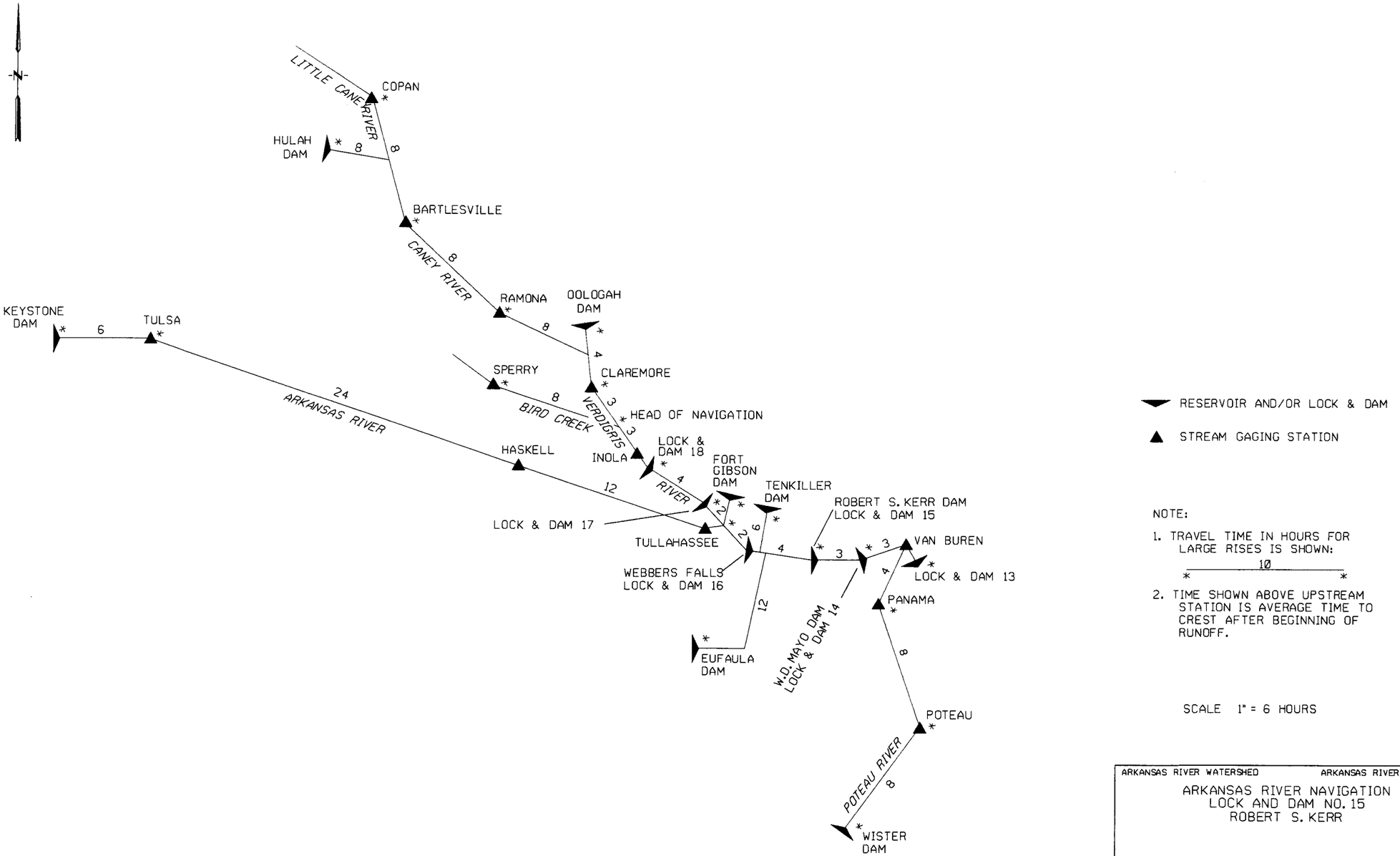
ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

DISCHARGE RATING CURVE

VAN BUREN, ARKANSAS

DATUM = 372.36 FT.

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



NOTE:

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

   10

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

SCALE 1" = 6 HOURS

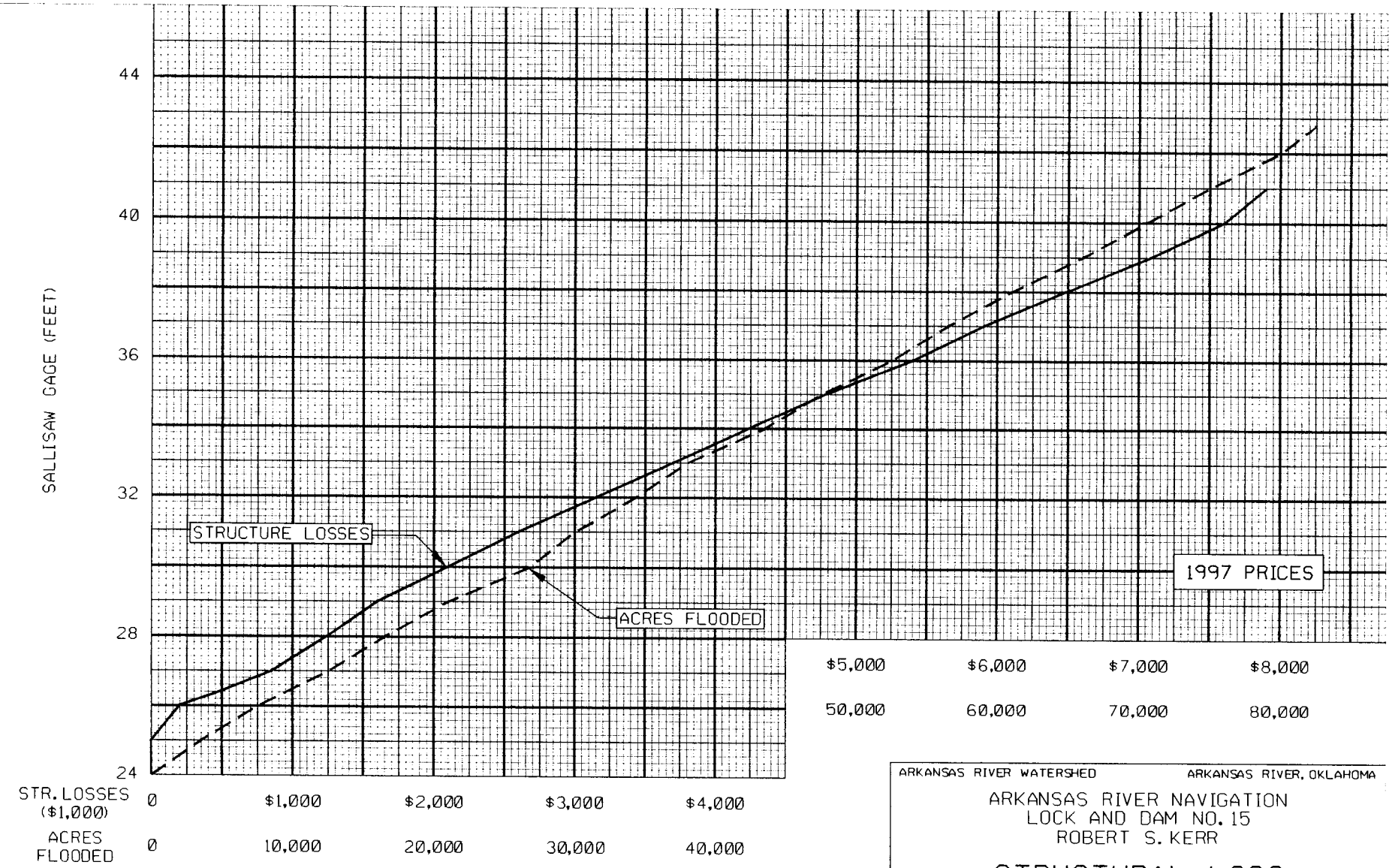
ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

CREST TRAVEL TIME

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

4-7



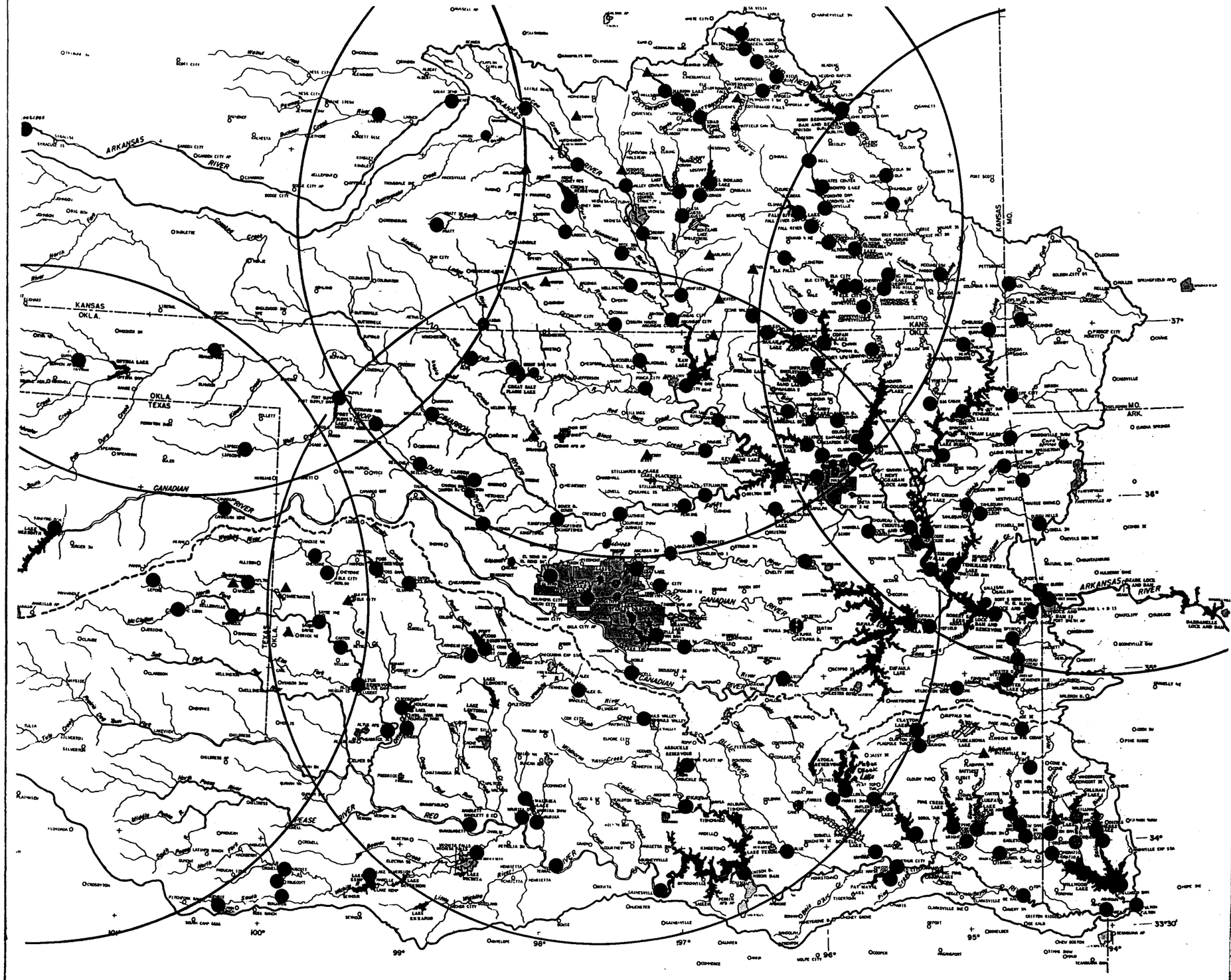
ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

STRUCTURAL LOSS AND AREA CURVES

ROBERT S. KERR DAM
TO FORT SMITH

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



LEGEND

RESERVOIR IN OPERATION

RESERVOIR UNDER CONSTRUCTION

RESERVOIR AUTHORIZED

O PRECIPITATION STATION

▲ STREAM GAGING STATION +

LEGEND:

● GAGE HAS STAGE AND RAINFALL

● GAGE HAS STAGE ONLY

▲ GAGE HAS RAINFALL ONLY

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

RAINFALL AND STREAM GAGING STATIONS

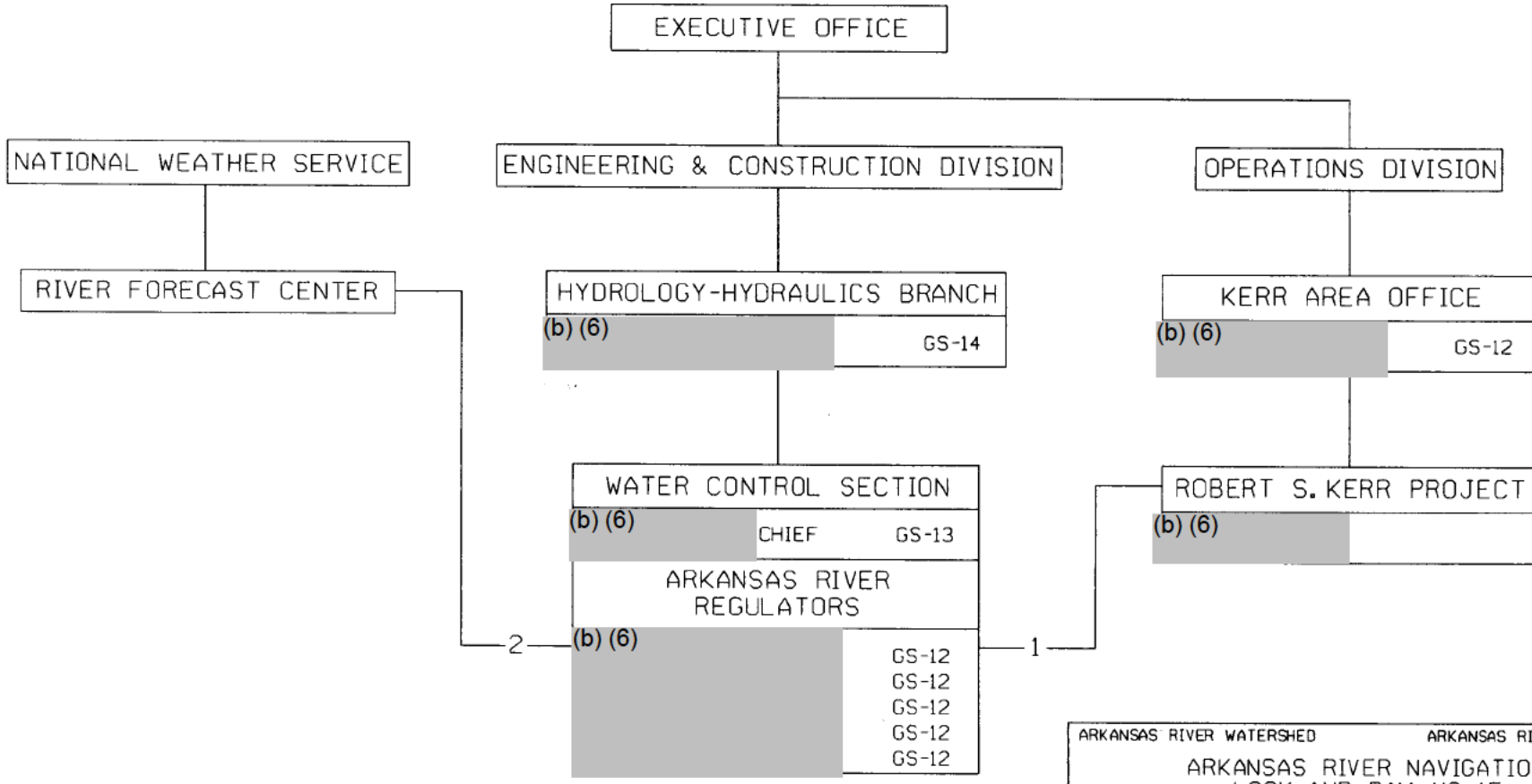
DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998

DRAWN BY: J.W.C.

CHECKED BY: S.E.J.

5-1

ORGANIZATION OF FLOOD CONTROL REGULATION
ROBERT S. KERR LOCK AND DAM NO. 15
TULSA DISTRICT
(June 1998)



1. DIRECT COMMUNICATIONS ARE MAINTAINED BETWEEN THE LAKES AND THE WATER 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

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

ORGANIZATIONAL CHART

OF FLOOD CONTROL REGULATION
ROBERT S. KERR LOCK AND DAM

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

ROBERT S. KERR

Project Name

LAKE DATA

Computed By: JWC Date: June XX Checked By: Date: JULY 1998 Book No.

Date	Time	Pool Elevation	Tailwater Elevation	△ Storage (1) (2) (1000's A.F.)	△ Storage (3) c.f.s.	Gates Operating No. & Type	Gates Operating Opening	Discharge in c.f.s. Instantaneous (4) Flood Control	Instantaneous Power	Instantaneous Total	Average (5) Flood Control	Average Power	Average (6) Evap.	Average Total	(7) Inflow
6-17	2400	459.90				7	GF	11700	36800	48500					
6-18	0800	459.95	416.07	8/+2.0	8/3025			11700	36800	48500	11700	36800	104	48604	51629
				0 R.F.									0.19"		
	1200	459.97		4/+0.8	4/2420						4/11700	36800	71	48571	50991
	1600	460.01						11700	36800	48500					
	1700	460.03				11	GF	18300	37700	56000					
	2000	460.08		4/+2.8	4/8470	14	GF	23300	37700	61000	4/16650	4/37475	4/54	4/54179	4/62649
	2400	460.06		24/+6.4	24/3225			23300	37700	61000	24/14458	24/36996	24/323	24/51777	24/55002
6-19	0800					14	GF	23300	38500	61800					
				0 R.F.											
				(1) (2)	(3)			(4)			(5)		(6)		(7)

(1) Reservoir capacity table.
(2) Subtract storage at beginning of period from storage at end of periods. If pool is rising, change in storage is (+), if falling negative (-).
(3) Change in storage (a.f.) x12 = change in storage in c.f.s. / No. of hours in period.
(4) From discharge rating curves.
(5) Average discharge rating curves.
(6) Pan evaporation applied to evaporation curves.
(7) Inflow = change in storage (c.f.s.) + average discharge + evaporation.

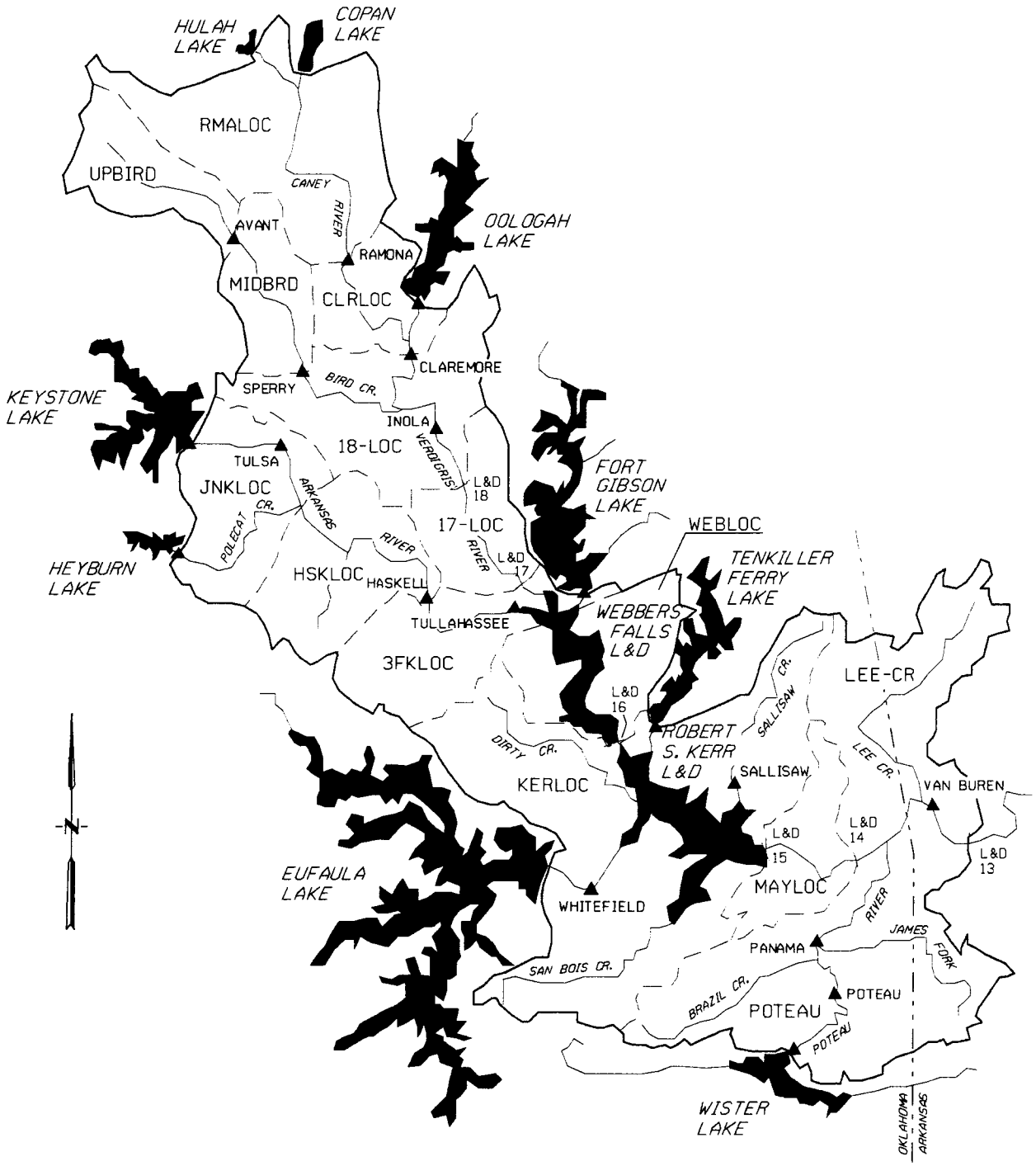
NOTE: During flood periods evaporation is usually neglected in preliminary inflow calculations. Number of hours for the inflow period is indicated by 4/

SWD Form 156
25 Nov. 52
6/98 electronic format by SWT

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

LAKE DATA

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

FORECASTING REACHES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

```
ID      VAN BUREN FORECAST MODEL
ID      UNIT HYDROGRAPHS COOK MAY,83
ID      MODIFIED FOR DSS GOODWIN,JAN91
ID      MODIFIED FOR PUHLS ROUTING GOODWIN FEB,91
ID      MESONET PRECIP APPLICATION ADJUSTED TO "CUM" 2/14/94  DAYLOR
ID
ID      RS.2 CHANGED TO "FLOW"                  DAYLOR
ID      PLOT MACROS IN DSPLAY REVISED            "
ID      RS.1 VALUES REVISED FOR 2-HOUR MODEL     "
ID
ID      MACRO'S CLEANUP                                  11/26/96  DAYLOR
ID      JNKLOC & NSKLOC SEPARATED IN RAIN PROGRAM          "       "
ID      ADDITIONAL PLOT MACRO'S ADDED                      "       "
ID      FLOW-RES OUT OBS ADDED TO EXTR AND PLOT MACROS     "       "
ID      ADDITIONAL PRECIP GAGES FROM LRD ADDED           12/ 9/96    "
ID
ID
ID       ADDITIONAL MACRO'S ADDED 7 JAN '97 FOR WEBB, ROBE, VANB (BARL) LOCALS
ID       FOR DETERMINATION OF LOCALS WITHOUT ANY OUTFLOWS FROM RELEASE MACRO
ID             IR WEBBLOC - UNCONTROLLED AREA RUNOFF ABOVE WEBB
ID             IR ROBELOC - UNCONTROLLED AREA RUNOFF FROM WEBB TO ROBE
ID             IR VANBLOC - UNCONTROLLED AREA RUNOFF FROM ROBE TO BARL
ID
ID       DSS "A=" ELIMINATED JAN 97 DAYLOR
ID       EXTRACT PRECIP & DCPPCP REVISED MAR97 DAYLOR
ID
ID   ************** 1 INCH RUNOFF IN 2 HOURS ************************
ID
ID
*FREE
IT   120 01APR97    0000     100
IO     3
VSJNKLOC  NSKLOC  RMALOC  CLRLOC  UPBIRD  MIDBRD  18-LOC  17-LOC  3FKLOC  WEBLOC
VV  5.11    5.11    5.11    5.11    5.11    5.11    5.11    5.11    5.11    5.11
VSKERLOC  MAYLOC  LEE-CR  POTEAU
VV  5.11    5.11    5.11    5.11
VSJNKLOC  NSKLOC  NASKEL  RMALOC  CLRLOC  CLRMOR  UPBIRD  MIDBRD  SPERRY  CATOOS
VV  2.11    2.11    2.11    2.11    2.11    2.11    2.11    2.11    2.11    2.11
VS18-LOC   18-IN  17-LOC   17-IN  3FKLOC  3FORKS  WEBLOC  WEB-IN  KERLOC  KERRIN
VV  2.11    2.11    2.11    2.11    2.11    2.11    2.11    2.11    2.11    2.11
VSMAYLOC  MAYOIN  MAYOUT  LEE-CR  POTEAU    VANB
VV  2.11    2.11    2.11    2.11    2.11    2.11
* ***********************************************************
KKKEYSTN        KEYSTONE RELEASES
BA     1
ZR=QI    B=KEYS C=FLOW-RES OUT F=EST
* ***************************************************************
KK JENK1  ROUTE ARKANSAS RIVER FROM KEYSTONE DAM TO JENKS (POLECAT CK CONFL)
RS     6    FLOW      -1
SV     0   34349   56849   71998   86741  121910  206651  334702  438161  538154
SQ     0   40000   90000  130000  170000  250000  400000  600000  800000 1000000
* ***********************************************************
KKHEYBRN        HEYBURN RELEASES
BA     1
ZR=QI    B=HEYB C=FLOW-RES OUT F=EST
* ***********************************************************
KK JENK2  ROUTE POLECAT CREEK FROM HEYBURN DAM TO ARKANSAS RIVER NEAR JENKS
RS     9    FLOW      -1
SV     0    5365    9264   13391   17546   22239   33378   44268   56368   69967
SV 96587  121889  140715  177014  214114
SQ     0    2000    4000    6000    8000   10000   15000   20000   25000   30000
```

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

SAMPLE INPUT HEC-1 MODEL

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

TABLE 3 STATION				JNKLOC	HSKLOC	NASKEL	RNALOC	CLRLOC	CLRMOR	UPBIRD	MIDBRD	SPERRY	CATOOS
				FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW
PER	DAY	MON	HRMN										
1	1	APR	0000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	1	APR	0200	438.45	359.75	359.83	188.73	309.36	309.37	289.37	207.17	207.17	8.45
3	1	APR	0400	1606.51	1324.00	1325.16	712.94	1139.22	1139.25	1048.82	753.60	753.60	66.56
4	1	APR	0600	3182.25	2637.45	2646.00	1468.58	2271.07	2271.33	2049.18	1479.06	1479.06	256.24
5	1	APR	0800	4926.65	4107.24	4147.67	2369.83	3539.48	3541.07	3127.81	2268.11	2268.11	659.82
6	1	APR	1000	6740.60	5651.64	5790.92	3378.54	4829.98	4837.29	4221.65	3074.87	3074.89	1311.09
7	1	APR	1200	8513.35	7222.67	7597.96	4470.40	5899.09	5925.16	5291.02	3875.27	3875.38	2182.43
8	1	APR	1400	9955.18	8659.88	9490.63	5596.24	6565.39	6641.05	6184.30	4655.72	4656.16	3194.38
9	1	APR	1600	10857.98	9739.77	11307.89	6633.98	6813.06	6997.64	6744.19	5341.16	5342.69	4235.45
10	1	APR	1800	11241.75	10397.48	12997.93	7495.06	6528.31	6916.91	6968.32	5822.14	5826.84	5193.69
11	1	APR	2000	11108.10	10656.66	14537.00	8169.35	5772.12	6494.01	6887.62	6076.12	6089.27	5991.11
12	1	APR	2200	10296.42	10510.39	15818.74	8642.86	4929.60	6136.05	6493.36	6131.23	6165.31	6621.07
13	2	APR	0000	8888.18	9829.53	16581.11	8882.65	4210.06	6055.04	5658.41	6003.36	6086.81	7182.68
14	2	APR	0200	7427.15	8635.73	16701.03	8777.93	3595.54	6215.08	4583.07	5690.30	5865.97	8088.77
15	2	APR	0400	6206.29	7356.46	16470.18	8398.13	3070.73	6565.43	3648.54	5122.80	5564.87	9065.20
16	2	APR	0600	5186.10	6266.69	16055.08	7970.39	2622.51	7045.14	2904.56	4305.69	5268.67	9882.65
17	2	APR	0800	4333.62	5338.36	15363.12	7564.44	2239.72	7588.17	2312.29	3483.53	5504.68	10621.12
18	2	APR	1000	3621.26	4547.55	14365.19	7179.17	1912.81	8128.57	1840.79	2818.48	5848.21	11314.15
19	2	APR	1200	3026.01	3873.89	13101.60	6813.51	1633.61	8605.51	1465.44	2280.41	6173.09	11975.71
20	2	APR	1400	2528.59	3300.02	11668.34	6466.48	1395.16	8967.93	1166.62	1845.05	6424.92	12580.66
21	2	APR	1600	2112.95	2811.17	10184.10	6137.13	1191.52	9179.51	928.73	1492.81	6564.99	13158.09
22	2	APR	1800	1765.62	2394.73	8753.97	5824.55	1017.60	9223.70	739.36	1207.82	6576.08	13678.98
23	2	APR	2000	1475.39	2039.98	7447.61	5527.89	869.07	9106.77	677.30	977.23	6464.98	14108.31
24	2	APR	2200	1232.87	1737.78	6296.97	5246.34	742.21	8855.71	651.00	790.67	6207.84	14422.57
25	3	APR	0000	1108.76	1480.35	5306.22	4979.13	672.48	8548.67	625.72	639.72	5798.95	14611.08
26	3	APR	0200	1076.23	1261.06	4464.17	4725.53	652.75	8222.37	601.42	599.01	5329.40	14677.46
27	3	APR	0400	1044.66	1074.25	3754.09	4484.85	633.60	7863.49	578.07	581.43	4777.50	14635.98
28	3	APR	0600	1014.01	1036.06	3280.83	4256.43	615.01	7496.68	555.62	564.38	4196.64	14502.24
29	3	APR	0800	984.26	1005.67	2895.36	4039.64	596.97	7136.04	534.04	547.82	3631.34	14287.16
30	3	APR	1000	955.38	976.16	2585.50	3833.89	579.46	6788.31	513.31	531.75	3113.54	13997.28
31	3	APR	1200	927.35	947.52	2345.87	3638.62	562.46	6456.02	493.37	516.15	2662.97	13636.18
32	3	APR	1400	900.15	919.72	2167.63	3453.79	545.95	6139.62	474.22	501.00	2289.08	13204.23
33	3	APR	1600	873.74	892.74	2037.87	3277.41	529.94	5838.79	455.80	486.30	1993.06	12696.65
34	3	APR	1800	848.10	866.55	1942.04	3110.48	514.39	5552.87	438.10	472.04	1769.75	12104.60
35	3	APR	2000	823.22	841.13	1867.35	3018.60	499.30	5281.16	421.09	458.19	1609.43	11416.22
36	3	APR	2200	799.07	816.45	1804.65	2930.04	484.65	5022.97	404.74	444.75	1499.79	10583.53
37	4	APR	0000	775.63	792.50	1748.47	2844.08	470.43	4777.67	389.02	431.70	1427.97	9756.99
38	4	APR	0200	752.87	769.25	1695.94	2760.64	456.63	4544.83	373.92	419.03	1381.74	8987.86
39	4	APR	0400	730.78	746.68	1645.75	2679.64	443.23	4324.52	359.40	406.74	1330.95	8288.77
40	4	APR	0600	709.34	724.77	1597.32	2601.03	430.23	4117.59	345.44	394.81	1277.15	7660.65
41	4	APR	0800	688.53	703.51	1550.41	2524.72	417.61	3925.85	332.03	383.22	1221.98	7103.22
42	4	APR	1000	668.33	682.87	1504.91	2450.65	405.36	3751.42	319.13	371.98	1166.91	6613.52
43	4	APR	1200	648.72	662.83	1460.76	2378.75	393.46	3595.70	306.74	361.07	1113.19	6186.57
44	4	APR	1400	629.69	643.39	1417.90	2308.96	381.92	3458.30	294.83	350.47	1061.72	5816.12
45	4	APR	1600	611.22	624.51	1376.30	2241.22	370.71	3336.85	283.38	340.19	1013.05	5495.29
46	4	APR	1800	593.29	606.19	1335.92	2175.47	359.84	3227.79	272.38	330.21	967.48	5217.00
47	4	APR	2000	575.88	588.41	1296.73	2111.64	349.28	3127.56	261.80	320.52	925.05	4974.26
48	4	APR	2200	558.98	571.14	1258.68	2049.69	339.03	3033.35	251.64	311.12	885.62	4760.47
49	5	APR	0000	542.59	554.39	1221.76	1989.56	329.09	2943.39	241.86	301.99	848.98	4569.90
50	5	APR	0200	526.67	538.12	1185.91	1931.19	319.43	2856.69	232.47	293.13	814.85	4398.11
		MAX		11241.75	10656.66	16701.03	8882.65	6813.06	9223.70	6968.32	6131.23	6576.08	14677.46
		MIN		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
		AVE		1605.32	1645.12	3241.40	2621.88	936.34	3512.99	912.01	945.71	1848.26	5301.19

TABLE 4 STATION				18 LOC	18 IN	17 LOC	17 IN	SFKLOC	SFORKS	WERLOC	WER IN	KERLOC	KERRIN
				FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW
PER	DAY	MON	HRMN										
1	1	APR	0000	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	1	APR	0200	941.24	941.29	1784.84	1708.62	462.93	2172.98	21000.00	23172.98	64600.00	64852.54
3	1	APR	0400	3390.64	3391.34	5891.47	5924.11	1696.20	7634.21	7000.00	14634.21	40000.00	41763.07
4	1	APR	0600	6573.57	6577.96	10733.09	10873.08	3359.91	14298.87	4500.00	18798.87	22000.00	27553.60
5	1	APR	0800	9954.93	9973.03	14007.65	14413.44	5201.69	19822.62	3000.00	22822.62	15000.00	25774.29
6	1	APR	1000	13336.61	13392.52	14283.99	15195.74	7116.90	22809.77	2093.76	24903.52	10000.00	25306.25
7	1	APR	1200	16359.35	16498.61	11294.47	13011.93	8988.61	22982.89	2032.33	25015.21	7000.00	25461.91
8	1	APR	1400	18404.67	18698.43	7276.75	10122.12	10510.93	22322.52	1972.70	24295.03	6321.09	27267.26
9	1	APR	1600	19242.68	19785.80	4564.71	8836.09	11464.14	22922.57	1914.83	24837.40	6135.64	29074.43
10	1	APR	1800	19004.61	19907.01	2863.45	8786.91	11869.32	24423.14	1858.65	26281.79	5955.63	30082.83
11	1	APR	2000	17637.61	19010.51	1796.24	9487.80	11728.21	26307.32	1804.12	28111.45	5780.91	30475.70
12	1	APR	2200	14827.89	16768.56	1409.36	10851.73	13871.22	28272.94	1751.19	30024.13	5611.30	30858.57
13	2	APR	0000	11536.33	14116.19	1368.02	12401.67	9384.36	29872.98	1699.81	31572.79	5446.68	31661.24
14	2	APR	0200	8927.92	12190.69	1327.88	13665.01	7841.77	31142.76	1649.94	32792.70	5286.88	32903.36
15	2	APR	0400	6909.28	10881.69	1288.92	14558.58	6552.75	32230.44	1601.54	33831.98	5131.77	34351.88
16	2	APR	0600	5347.06	10052.05	1251.11	15061.72	5475.62	32989.83	1554.55	34544.38	4981.22	35735.13
17	2	APR	0800	4138.06	9598.01	1214.40	15208.69	4575.54	33346.37	1508.94	34855.31	4835.08	36959.93
18	2	APR	1000	3202.43	9436.49	1178.77	15068.40	3823.42	33289.40	1464.67	34754.07	4693.22	37901.16
19	2	APR	1200	2478.35	9490.36	1144.19	14724.36	3194.93	32852.29	1421.70	34274.00	4555.53	38540.04
20	2	APR	1400	1923.63	9713.26	1110.62	14259.66	2669.75	32089.61	1379.99	33469.60	4421.88	38836.61
21	2	APR	1600	1867.19	10422.85	1078.04	13749.06	2230.90	31062.96	1339.51	32402.46	4292.15	38765.78
22	2	APR	1800	1812.41	11114.74	1046.41	13257.02	1864.19	29837.90	1300.21	31138.11	4166.23	38333.27
23	2	APR	2000	1759.24	11782.36	1015.71	12834.99	1557.76	28482.82	1262.06	29744.88	4044.00	37573.05
24	2	APR	2200	1707.62	12419.00	985.91	12517.08	1301.70	27064.93	1225.04	28289.97	3925.35	36536.87
25	3	APR	0000	1657.53	13016.68	956.99	12319.58	1170.66	25729.63	1189.09	26918.73	3810.19	35286.66
26	3	APR	0200	1608.90	13564.85	928.91	12244.23	1136.31	24510.38	1154.21	25664.59	3698.41	33891.89
27	3	APR	0400	1561.69	14053.17	901.66	12282.41	1102.98	23361.57	1120.35	24481.92	3589.90	32430.93
28	3	APR	0600	1515.88	14470.98	875.20	12418.92	1070.62	22319.83	1087.48	23407.31	3484.58	30978.03
29	3	APR	0800	1471.40	14809.70	849.53	12634.85	1039.21	21409.06	1055.57	22464.63	3382.35	29586.90
30	3	APR	1000	1428.24	15063.56	824.60	12909.74	1008.72	20641.94	1024.60	21666.54	3283.12	28286.18
31	3	APR	1200	1386.33	15229.56	800.41	13223.04	979.12	20020.11	994.54	21014.66	3186.80	27092.37
32	3	APR	1400	1345.66	15307.23	776.93	13555.11	950.40	19534.38	965.37	20499.74	3093.30	26020.61
33	3	APR	1600	1306.18	15297.69	754.14	13887.89	922.51	19167.12	937.04	20104.16	3002.55	25083.40
34	3	APR	1800	1267.86	15202.85	732.01	14205.33	895.45	18895.93	909.55	19805.48	2914.46	24285.83
35	3	APR	2000	1230.66	15024.48	710.53	14493.60	869.18	18696.70	882.87	19579.56	2828.95	23623.75
36	3	APR	2200	1194.56	14763.20	689.69	14741.10	843.68	18545.58	856.97	19402.55	2745.96	23084.86
37	4	APR	0000	1159.51	14418.29	669.45	14938.36	818.93	18420.08	831.82	19251.90	2665.40	22650.90
38	4	APR	0200	1125.49	13990.38	649.81	15077.81	794.90	18299.61	807.42	19107.03	2587.20	22300.28
39	4	APR	0400	1092.47	13485.36	630.75	15153.50	771.58	18165.91	783.73	18949.64	2511.29	22010.24
40	4	APR	0600	1060.42	12915.68	612.24	15160.97	748.94	18003.47	760.74	18764.21	2437.62	21758.46
41	4	APR	0800	1029.31	12298.46	594.28	15097.25	726.97	17799.87	738.42	18538.29	2366.10	21523.99
42	4	APR	1000	999.11	11652.74	576.85	14961.10	705.64	17546.17	716.76	18262.93	2296.68	21288.03
43	4	APR	1200	969.80	10997.20	559.92	14753.23	684.94	17237.09	695.73	17932.82	2229.30	21036.23
44	4	APR	1400	941.35	10348.44	543.50	14476.50	664.85	16870.98	675.32	17546.30	2163.90	20749.27
45	4	APR	1600	913.73	9720.13	527.55	14135.92	645.34	16449.60	655.50	17105.10	2100.42	20423.04
46	4	APR	1800	886.92	9122.66	512.07	13738.45	626.41	15977.61	636.27	16613.88	2038.79	20048.87
47	4	APR	2000	860.90	8563.15	497.05	13292.66	608.03	15462.01	617.60	16079.61	1978.98	19623.57
48	4	APR	2200	835.65	8045.81	482.47	12808.19	590.19	14911.38	599.49	15510.86	1920.92	19147.25
49	5	APR	0000	811.13	7572.29	468.31	12295.28	572.88	14335.23	581.90	14917.13	1864.56	18623.02
50	5	APR	0200	787.33	7142.26	454.57	11764.16	556.07	13743.35	564.83	14308.18	1809.86	18056.38
		MAX		19242.68	19907.01	14283.99	15208.69	11869.32	33346.37	21000.00	34855.31	64600.00	64852.54
		MIN		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
		AVE		2419.03	7647.34	1190.62	8708.33	1694.94	13627.06	1076.50	14653.55	3605.65	18171.54

TABLE 5 STATION				MAYLOC	MAYOIM	MAYOUI	LEE CR	POTEAU	VANB
				FLOW	FLOW	FLOW	FLOW	FLOW	FLOW
PER	DAY	MON	HRMN						
1	1	APR	0000	.00	.00	.00	.00	.00	.00
2	1	APR	0200	3708.70	3713.60	711.86	538.49	480.03	1061.87
3	1	APR	0400	12816.96	12866.78	4274.89	1973.05	1777.44	4168.62
4	1	APR	0600	21175.10	21420.07	11626.34	3908.30	3568.35	9357.24
5	1	APR	0800	22356.58	23142.61	19219.26	6050.70	5602.40	16917.99
6	1	APR	1000	16802.63	18681.41	22008.48	8278.51	7770.89	26399.73
7	1	APR	1200	10635.19	14258.35	19382.63	10455.72	10008.99	35804.19
8	1	APR	1400	6731.53	12685.73	15285.33	12226.51	12276.46	42612.91
9	1	APR	1600	4260.71	12935.88	13087.86	13335.29	14436.67	45831.63
10	1	APR	1800	2696.81	14236.31	13036.42	13806.61	16213.35	46606.84
11	1	APR	2000	2200.38	16527.50	14258.90	13642.47	17468.63	45874.88
12	1	APR	2200	2135.83	19023.06	16300.41	12645.60	18233.21	45037.02
13	2	APR	0000	2073.17	21218.75	18699.30	10916.06	18525.25	44156.60
14	2	APR	0200	2012.34	23101.43	20946.71	9121.69	18336.03	43618.61
15	2	APR	0400	1953.30	24696.54	22867.25	7622.28	17587.84	43305.69
16	2	APR	0600	1896.00	26048.89	24497.96	6369.34	16044.00	42557.93
17	2	APR	0800	1840.37	27210.57	25883.89	5322.35	14085.68	41684.74
18	2	APR	1000	1786.38	28234.14	27075.04	4447.47	12315.37	40554.66
19	2	APR	1200	1733.97	29168.66	28118.16	3716.40	10767.55	39762.39
20	2	APR	1400	1683.10	30055.02	29067.75	3105.50	9414.27	39084.15
21	2	APR	1600	1633.72	30924.83	29963.62	2595.03	8231.07	38518.11
22	2	APR	1800	1585.79	31796.02	30837.47	2168.46	7196.58	38071.25
23	2	APR	2000	1539.26	32672.94	31708.67	1812.01	6292.10	37751.79
24	2	APR	2200	1494.10	33546.76	32583.12	1514.15	5501.30	37564.43
25	3	APR	0000	1450.27	34397.45	33453.68	1361.73	4809.89	37603.57
26	3	APR	0200	1407.72	35196.96	34302.00	1321.78	4205.37	37833.49
27	3	APR	0400	1366.42	35912.67	35101.42	1283.00	3676.83	38129.63
28	3	APR	0600	1326.33	36511.35	35820.40	1245.36	3214.72	38469.20
29	3	APR	0800	1287.42	36962.61	36426.31	1208.82	2810.69	38822.06
30	3	APR	1000	1249.65	37261.97	36888.93	1173.36	2457.44	39153.55
31	3	APR	1200	1212.99	37333.07	37183.49	1138.93	2148.59	39427.72
32	3	APR	1400	1177.40	37228.99	37292.97	1105.52	1878.55	39610.50
33	3	APR	1600	1142.86	36932.49	37209.51	1073.09	1804.09	39834.23
34	3	APR	1800	1109.33	36455.41	36934.76	1041.60	1751.16	39906.89
35	3	APR	2000	1076.78	35817.22	36479.35	1011.04	1699.78	39798.53
36	3	APR	2200	1045.19	35043.18	35861.70	981.38	1649.91	39507.79
37	4	APR	0000	1014.53	34162.23	35106.12	952.59	1601.51	39041.88
38	4	APR	0200	984.76	33205.04	34240.88	924.64	1554.52	38415.61
39	4	APR	0400	955.87	32202.15	33296.21	897.52	1508.92	37650.01
40	4	APR	0600	927.83	31182.32	32302.40	871.18	1464.65	36770.56
41	4	APR	0800	900.61	30171.31	31288.21	845.63	1421.68	35805.32
42	4	APR	1000	874.19	29190.97	30279.58	820.82	1379.97	34783.14
43	4	APR	1200	848.54	28258.51	29298.65	796.73	1339.48	33732.08
44	4	APR	1400	823.64	27386.27	28363.08	773.36	1300.18	32677.96
45	4	APR	1600	799.48	26581.76	27485.70	750.67	1262.04	31643.38
46	4	APR	1800	776.02	25847.87	26674.60	728.65	1225.01	30646.93
47	4	APR	2000	753.26	25183.38	25933.18	707.27	1189.07	29702.73
48	4	APR	2200	731.16	24583.59	25260.78	686.52	1154.19	28820.31
49	5	APR	0000	709.71	24041.05	24653.15	666.38	1120.33	28004.76
50	5	APR	0200	688.89	23546.31	24103.25	646.83	1087.46	27256.98
		MAX		22356.58	37333.07	37292.97	13806.61	18525.25	46406.84
		MIN		.00	.00	00	.00	.00	.00
		AVE		1710.42	19434.39	19382.45	1971.58	3307.06	24565.60

ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

SAMPLE SUMMARY OUTPUT FROM HEC-1 MODEL

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998

DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

ROBERT S. KERR

Project Name

DISCHARGE AND INFLOW COMPUTATION

Computed By: JWC Date: June XX Checked By: Date: JULY 1998 Book No.

Date	Time	Pool Elevation	Tailwater Elevation	Storage (1) (2) (1000's A.F.)	Storage (3) c.f.s.	Gates Operating No. & Type	Gates Operating Opening	Discharge in c.f.s. Instantaneous (4) Flood Control	Power	Total	Average (5) Flood Control	Power	(6) Evap.	Total	(7) Inflow
6-17	2400	459.90				7	GF	11700	36800	48500					
6-18	0800	459.95	416.07	8/+2.0	8/3025			11700	36800	48500	11700	36800	104	48604	51629
	1200	459.97		4/+0.8	4/2420						4/11700	36800	71	48571	50991
	1600	460.01						11700	36800	48500					
	1700	460.03				11	GF	18300	37700	56000					
	2000	460.08		4/+2.8	4/8470	14	GF	23300	37700	61000	4/16650	4/37475	4/54	4/54179	4/62649
	2400	460.06		24/+6.4	24/3225			23300	37700	61000	24/14458	24/36996	24/323	24/51777	24/55002
6-19	0800					14	GF	23300	38500	61800					
				(1) (2)	(3)			(4)			(5)		(6)		(7)

(1) Reservoir capacity table.
(2) Subtract storage at beginning of period from storage at end of periods. If pool is rising, change in storage is (+), if falling negative (-).
(3) Change in storage (a.f.) x12 = change in storage in c.f.s. No. of hours in period.
(4) From discharge rating curves.
(5) Average discharge rating curves.
(6) Pan evaporation applied to evaporation curves.
(7) Inflow = change in storage (c.f.s.) + average discharge + evaporation.

NOTE: During flood periods evaporation is usually neglected in preliminary inflow calculations. Number of hours for the inflow period is indicated by 4/

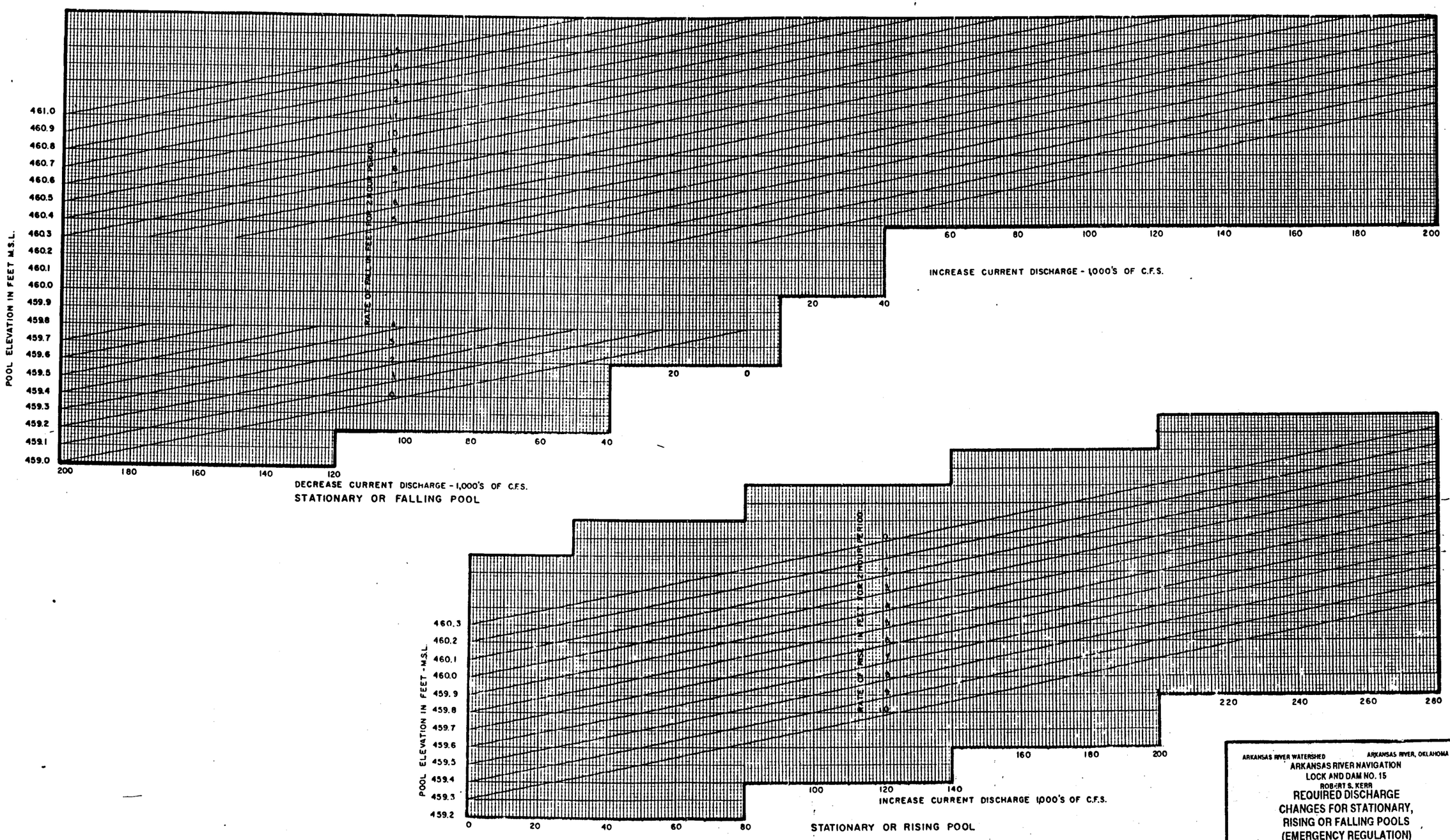
SWD Form 156A
25 Nov. 52
6/98 electronic format by SWT

ARKANSAS RIVER WATERSHED ARKANSAS RIVER, OKLAHOMA
ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

INFLOW COMPUTATION EXAMPLE
ROBERT S. KERR

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998

DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



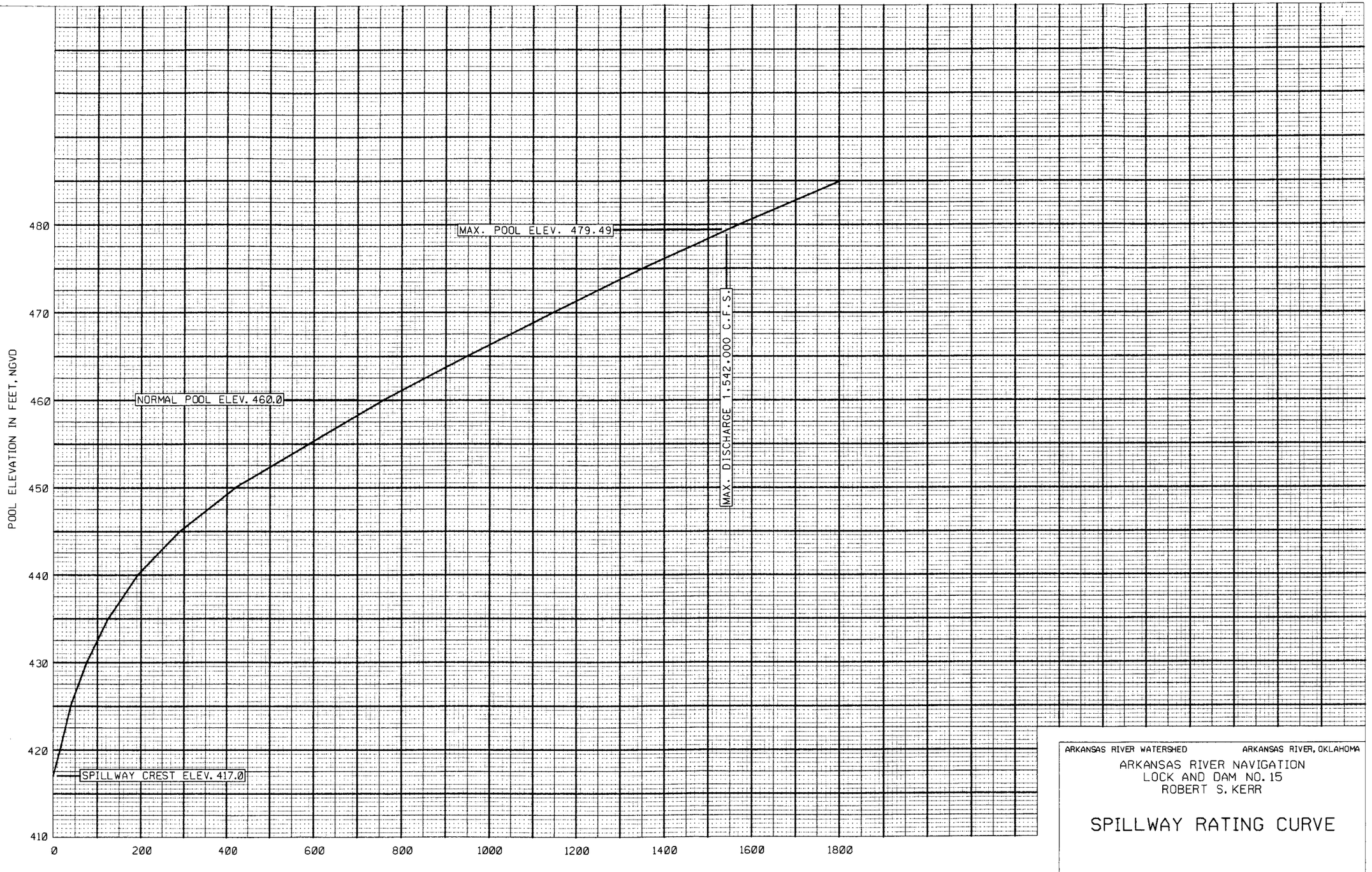
ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

REQUIRED DISCHARGE CHANGES FOR STATIONARY, RISING OR FALLING POOLS (EMERGENCY REGULATION)

DEPARTMENT OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: C.E.W.

7-1

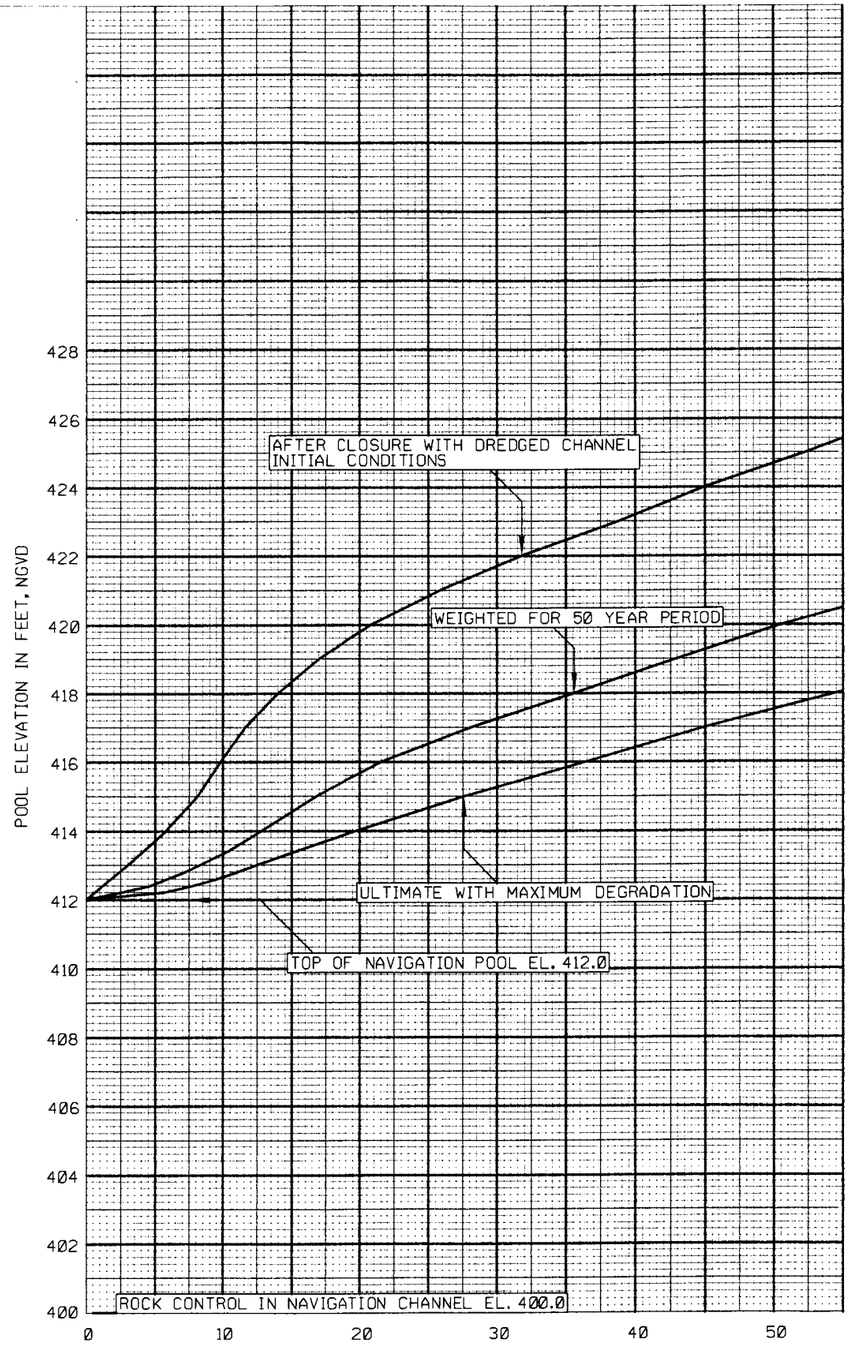


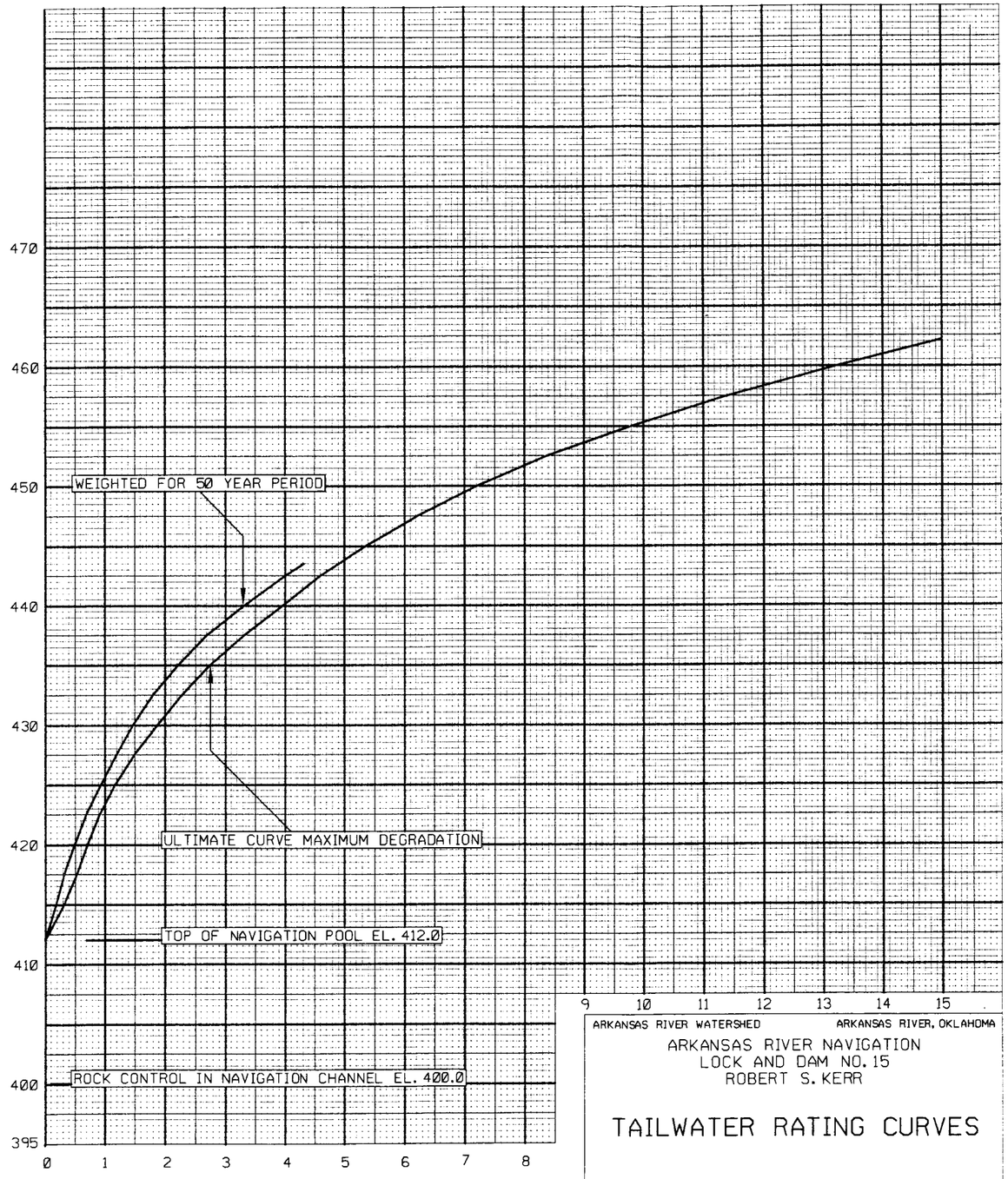
ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

SPILLWAY RATING CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



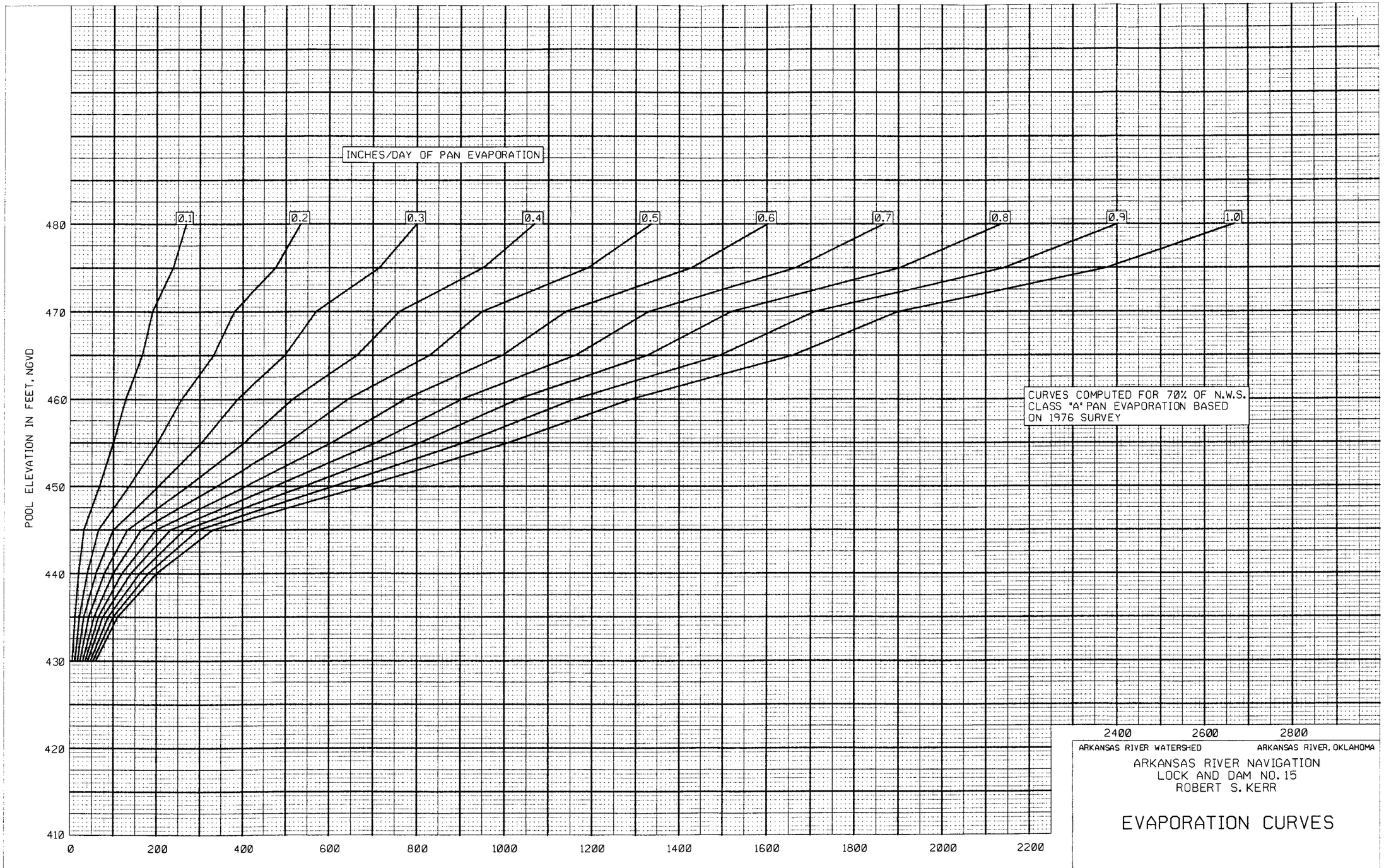


ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

TAILWATER RATING CURVES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

EVAPORATION CURVES

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
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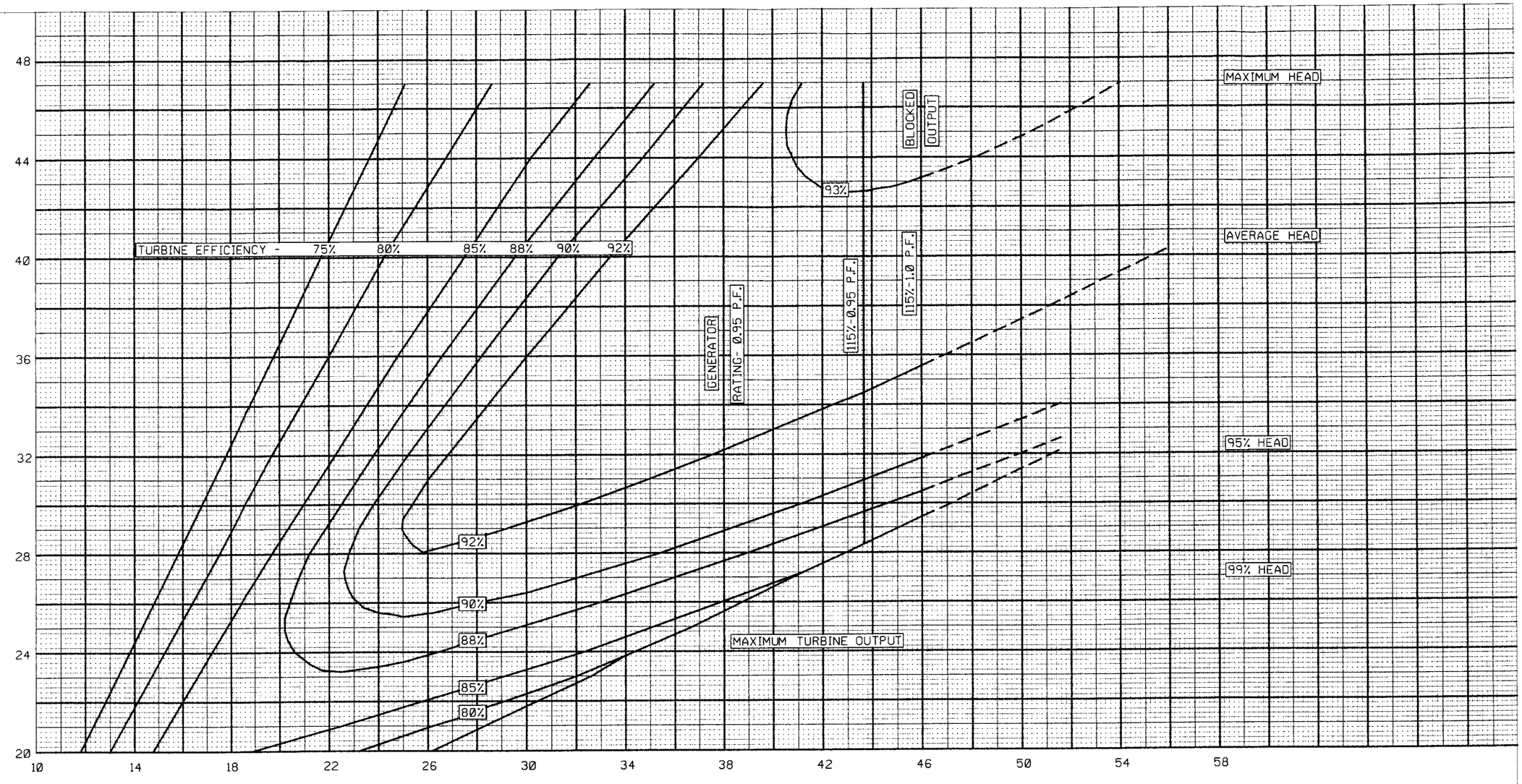

NOTES:

1. DATA FROM ALLIS-CHALMERS MODEL TEST NO. 3176
2. OUTPUT HORSEPOWER IS FOR ONE TURBINE

ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
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EXPECTED TURBINE PERFORMANCE

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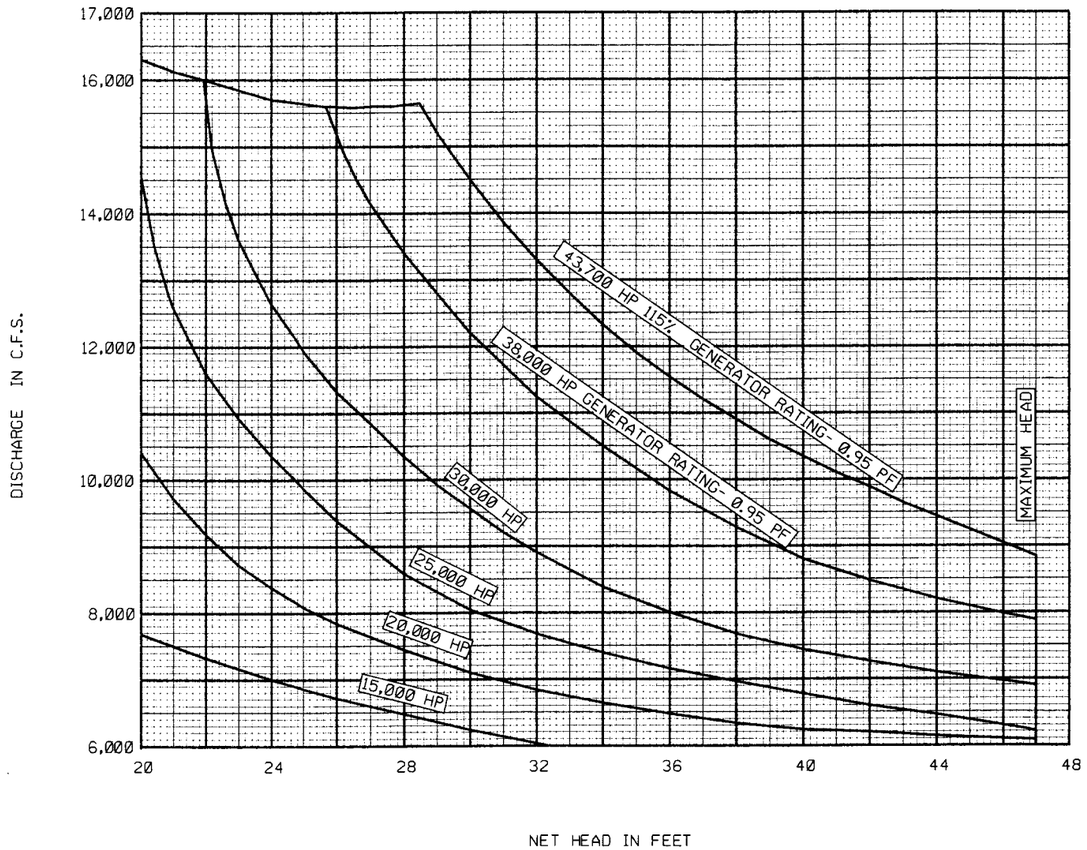
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



NOTES:

1. DATA FROM ALLIS-CHALMERS MODEL TEST NO. 3176.
2. DISCHARGE IS FOR ONE UNIT.

ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

TURBINE DISCHARGE VS. NET HEAD

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DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

ROBERT S. KERR RESERVOIR
LOCK AND DAM NO. 15
SPILLWAY RATING TABLE
UNIFORM AND PARTIAL GATE OPENINGS

Number of Gates	GATE OPENING IN FEET																									
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	DISCHARGE IN 1,000'S OF C.F.S.																									
18	0	0	36	68	95	120	144	166	188	210	230	251	271	291	310	330	349	368	387	406	425	444	460	476	492	508	524
17	1	2	38	70	96	121	145	167	189	211	231	252	272	292	311	331	350	369	388	407	426	445	461	477	493	509	525
16	2	4	40	71	98	123	146	168	190	212	232	253	273	293	312	332	351	370	389	408	427	446	462	478	494	510	526
15	3	6	42	73	99	124	148	170	192	213	234	254	274	294	313	333	352	371	390	409	428	447	463	479	495	511	527
14	4	8	44	74	100	125	149	171	193	214	235	255	275	295	314	334	353	372	391	410	429	448	464	480	495	511	528
13	5	10	45	76	102	127	150	172	194	216	236	257	277	296	316	335	354	373	392	411	430	448	464	480	496	512	529
12	6	12	47	77	103	128	151	173	195	217	237	258	278	297	317	336	355	374	393	412	432	449	465	481	497	513	530
11	7	14	49	79	105	129	152	175	197	218	238	259	279	298	318	337	356	375	394	414	433	450	466	482	498	514	531
10	8	16	51	80	106	131	154	176	198	219	239	260	280	299	319	338	357	376	395	415	434	451	467	483	499	515	532
9	9	18	53	82	107	132	155	177	199	220	241	261	281	301	320	339	358	377	397	416	435	452	468	484	500	516	533
8	10	20	55	83	109	133	156	178	200	221	242	262	282	302	321	340	359	379	398	417	436	453	469	485	501	517	534
7	11	22	57	85	110	135	157	179	201	222	243	263	283	303	322	342	361	380	399	418	437	454	470	486	502	518	535
6	12	24	58	86	112	136	159	181	203	223	244	264	284	304	323	343	362	381	400	419	438	455	471	487	503	519	536
5	13	26	60	88	113	137	160	182	204	224	245	265	285	305	324	344	363	382	401	420	439	456	472	487	503	519	537
4	14	28	62	89	114	139	161	183	205	226	246	267	286	306	326	345	364	383	402	421	440	456	472	488	504	520	538
3	15	30	63	91	116	140	162	184	206	227	248	268	288	307	327	346	365	384	403	422	441	457	473	489	505	521	539
2	16	32	65	92	117	141	164	186	208	228	249	269	289	308	328	347	366	385	404	423	442	458	474	490	506	522	540
1	17	34	67	93	119	143	165	187	209	229	250	270	290	309	329	348	367	386	405	424	443	459	475	491	507	523	541

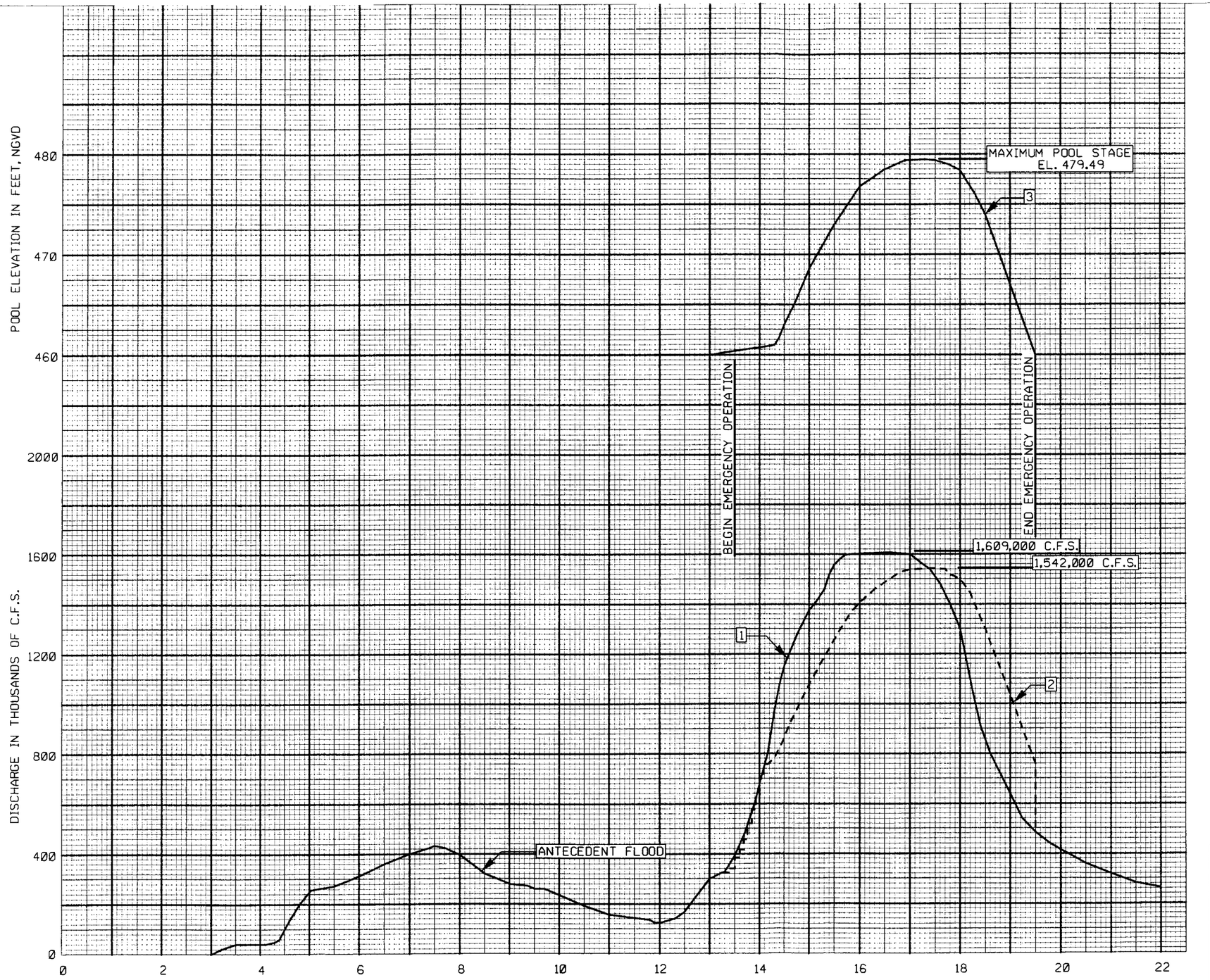
NOTES:
1. Discharge figures are based on combination of all eighteen gates as shown in Table.
2. Maximum discharge at top of power pondage is 759,000 c.f.s.
3. All spillway gates shall be operated in increments of 1 foot with no more than 1 foot difference in the opening of any gate. In every case, the top of gate elevation will be maintained 1 foot or more above the reservoir pool level.

ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

LOCK AND DAM
SPILLWAY RATING TABLE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



NOTE:
EMERGENCY OPERATION
1 INFLOW HYDROGRAPH
2 OUTFLOW HYDROGRAPH
3 POOL STAGE

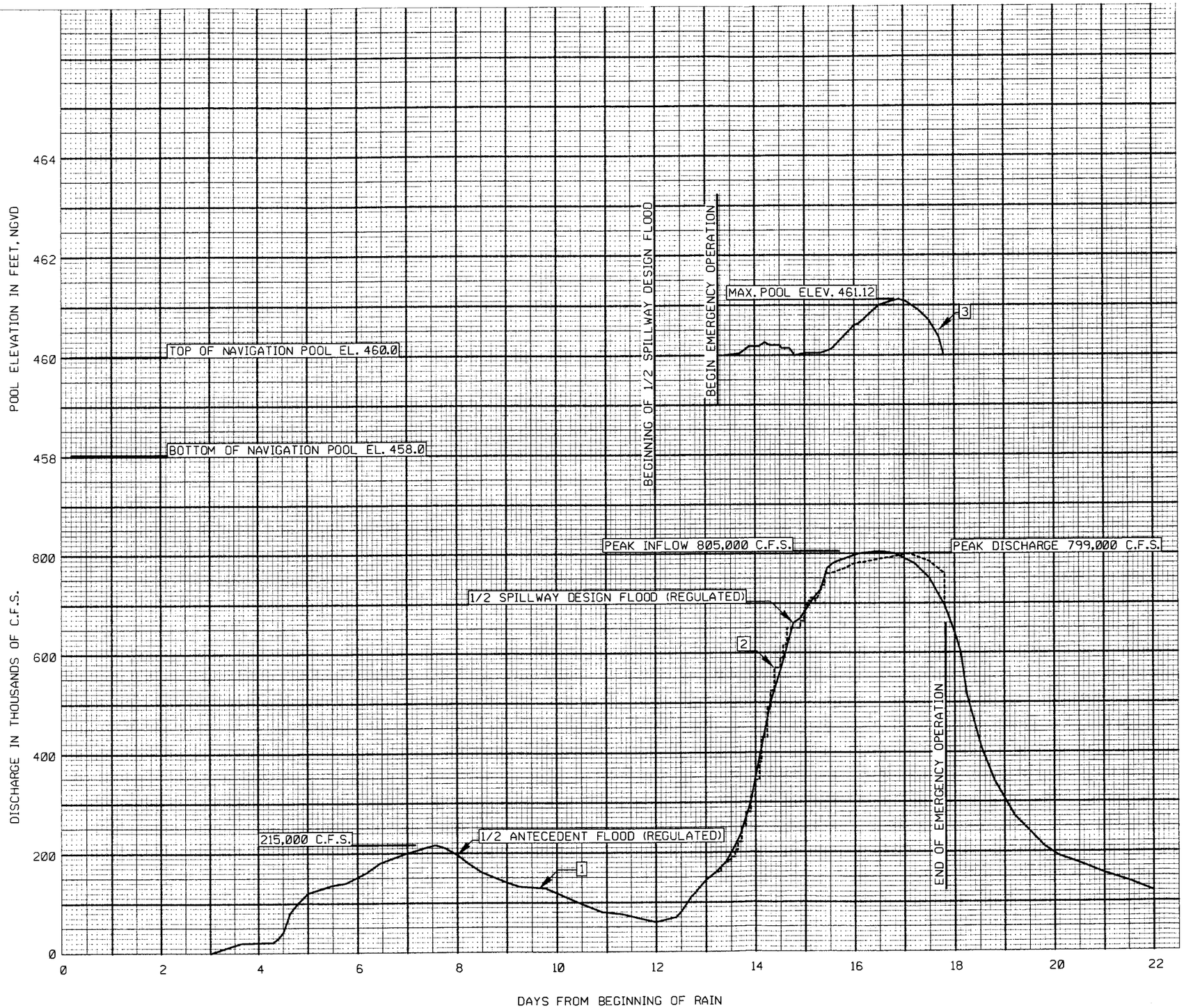
ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

SPILLWAY DESIGN FLOOD OPERATIONAL HYDROGRAPHS

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.

8-1



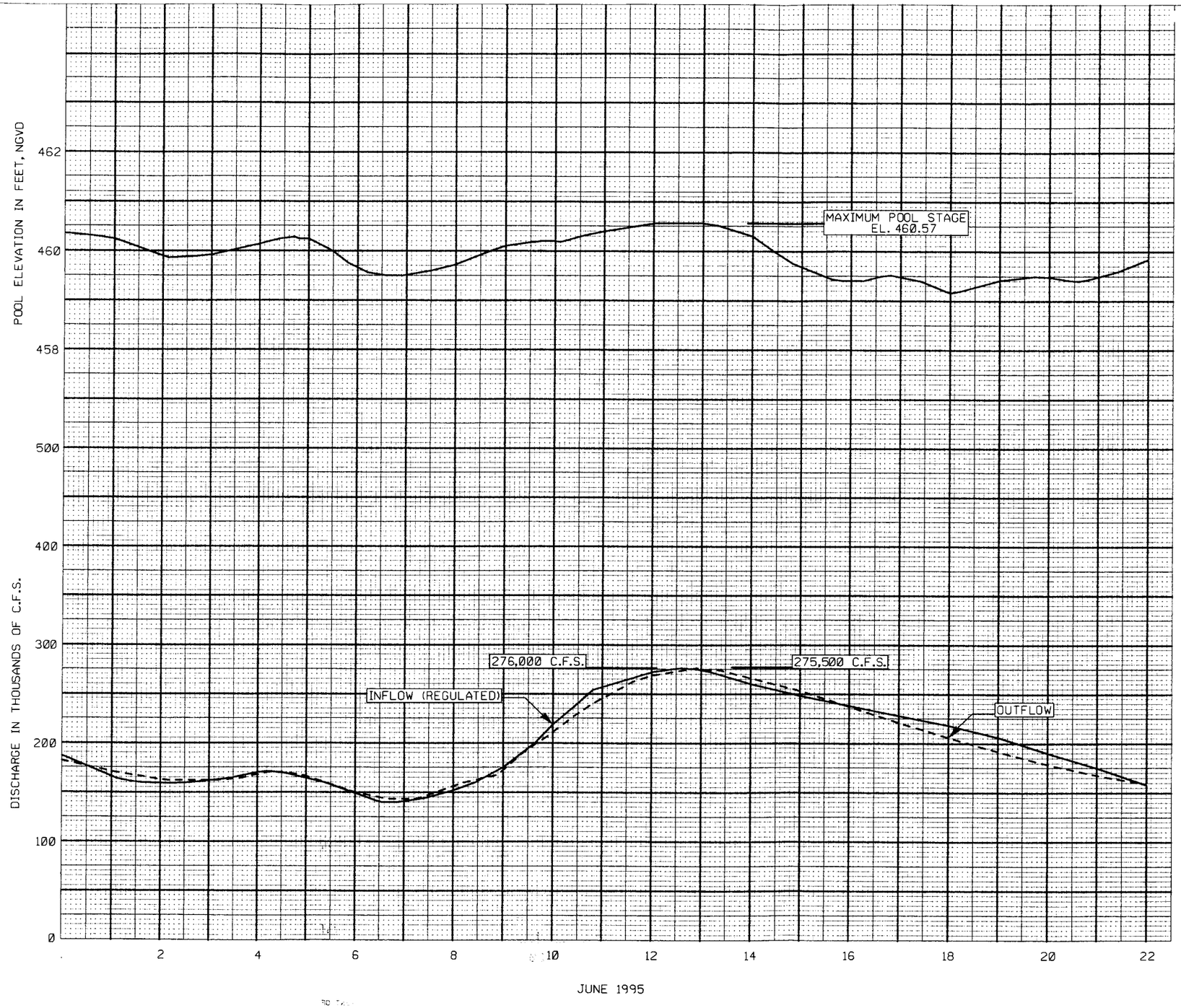
NOTE:
EMERGENCY OPERATION
1 INFLOW HYDROGRAPH
2 OUTFLOW HYDROGRAPH
3 POOL STAGE

ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

OPERATIONAL HYDROGRAPHS
1/2 SPILLWAY DESIGN FLOOD

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

ACTUAL HYDROGRAPHS
JUNE 1995 FLOOD

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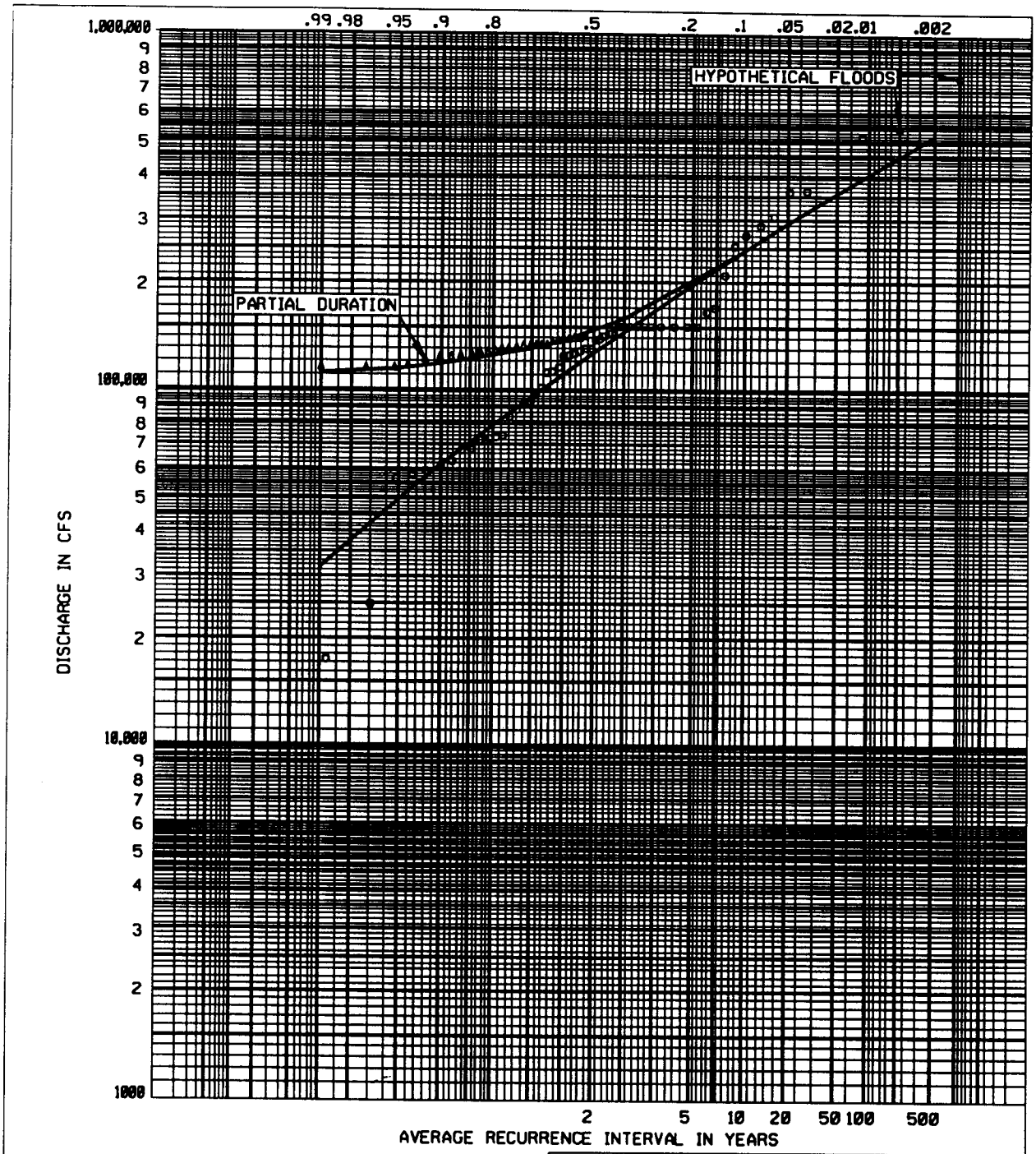
DRAWN BY: J.W.C.
CHECKED BY: S.E.J.



NOTES

1. BASED ON ANNUAL PEAK DISCHARGES FOR THE PERIOD OF RECORD 1940 THROUGH 1995 AT THE SALLISAW GAGE.
2. PEAK FLOWS FROM SUPER RUN A96X01.

ARKANSAS RIVER WATERSHED — ARKANSAS RIVER, OKLAHOMA

ARKANSAS RIVER NAVIGATION
LOCK AND DAM NO. 15
ROBERT S. KERR

PEAK INFLOW PROBABILITY CURVE

DEPARTMENT OF THE ARMY, TULSA DISTRICT, CORPS OF ENGINEERS 1998
DRAWN BY: J.M.C.
CHECKED BY: S.E.J.