

**COUNCIL GROVE LAKE
NEOSHO RIVER, KANSAS
WATER CONTROL MANUAL**

APPENDIX O – PART I
TO
WATER CONTROL MASTER MANUAL
ARKANSAS RIVER BASIN

**PREVIOUS EDITION – MARCH 1995
REVISED EDITION – MARCH 2011**

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

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. All elevations referred to in this manual, unless noted otherwise, are in feet, NGVD29 (National Geodetic Vertical Datum 1929).

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 Management Section, Tulsa District Office at (918) 669-7085. If the above office cannot be contacted, assistance can be achieved by contacting, in the order listed, one of persons shown below. Section VII of this Manual contains detailed instructions for emergency regulations. All project personnel associated with regulation of the project must be thoroughly familiar with the procedure outlined in this section.

EMERGENCY

PERSONNEL

ROSTER

<u>TITLE AND NAME</u>	<u>RESIDENCE TELEPHONE</u>
Coordinator (b) (6)	(b) (6)
Backup Coordinator (b) (6)	(b) (6)
Chief, Water Control Section (b) (6)	(b) (6) (b) (6)
Chief, Hydrology-Hydraulics Branch (b) (6)	(b) (6) (b) (6)



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TABLE OF CONTENTS

Section Title	Page
I - INTRODUCTION	1-1
1-01. AUTHORIZATION	1-1
1-02. PURPOSE AND SCOPE.....	1-1
1-03. RELATED MANUALS.....	1-1
1-04. PROJECT OWNER.....	1-1
1-05. OPERATING AGENCY.....	1-1
1-06. REGULATING AGENCIES.....	1-2
II - DESCRIPTION OF PROJECT.....	2-1
2-01. LOCATION	2-1
2-02. PURPOSE.....	2-1
2-03. PHYSICAL COMPONENTS	2-1
<i>a. Embankment</i>	<i>2-1</i>
<i>b. Spillway</i>	<i>2-1</i>
<i>c. Outlet Works.....</i>	<i>2-1</i>
<i>d. Water Supply.....</i>	<i>2-1</i>
<i>e. Sediment and Degradation Ranges.....</i>	<i>2-1</i>
2-04. RELATED CONTROL FACILITIES	2-2
2-05. REAL ESTATE ACQUISITION	2-2
2-06. PUBLIC FACILITIES.....	2-2
III - HISTORY OF PROJECT	3-1
3-01. AUTHORIZATION.....	3-1
3-02. PLANNING AND DESIGN.....	3-1
<i>a. House Document No. 308.....</i>	<i>3-1</i>
<i>b. House Document No. 442.....</i>	<i>3-1</i>
<i>c. Design Memoranda</i>	<i>3-1</i>
3-03. CONSTRUCTION.....	3-1
3-04. RELATED PROJECTS.....	3-1
3-05. MODIFICATION TO REGULATION	3-2
3-06. PRINCIPLE REGULATION PROBLEMS	3-2
IV - WATERSHED CHARACTERISTICS.....	4-1
4-01. GENERAL CHARACTERISTICS.....	4-1
4-02. TOPOGRAPHY.....	4-2
4-03. GEOLOGY & SOILS	4-2
4-04. SEDIMENTATION AND DEGRADATION RANGES.....	4-2
4-05. CLIMATE	4-2

<i>a. Temperature</i>	4-3
<i>b. Rainfall</i>	4-3
<i>c. Snowfall</i>	4-3
<i>d. Evaporation</i>	4-3
<i>e. Wind</i>	4-3
4-06. STORMS & FLOODS.....	4-5
4-07. RUNOFF CHARACTERISTICS.....	4-8
4-08. WATER QUALITY.....	4-9
4-09. CHANNEL AND FLOODWAY CHARACTERISTICS.....	4-9
4-10. UPSTREAM STRUCTURES.....	4-9
4-11. DOWNSTREAM STRUCTURES.....	4-9
4-12. ECONOMIC DATA.....	4-12
<i>a. Population</i>	4-12
<i>b. Industry</i>	4-12
<i>c. Agriculture</i>	4-12
<i>d. Flood Damages</i>	4-12
V - DATA COLLECTION AND COMMUNICATION NETWORKS.....	5-1
5-01. HYDROMETEOROLOGICAL STATIONS.....	5-1
<i>a. Facilities</i>	5-1
<i>b. Reporting</i>	5-1
<i>c. Maintenance</i>	5-2
5-02. WATER QUALITY STATIONS.....	5-2
<i>a. Facilities</i>	5-2
<i>b. Reporting</i>	5-2
<i>c. Maintenance</i>	5-2
5-03. SEDIMENT STATIONS.....	5-2
<i>a. Facilities</i>	5-2
<i>b. Reporting</i>	5-2
<i>c. Maintenance</i>	5-2
5-04. RECORDING HYDROLOGIC DATA.....	5-4
<i>a. Stages and Discharges</i>	5-4
<i>b. Precipitation</i>	5-4
<i>c. Water Quality Data</i>	5-4
5-05. COMMUNICATION NETWORK.....	5-4
5-06. COMMUNICATION WITH PROJECT.....	5-4
<i>a. Water Management Section with Project Office</i>	5-4
<i>b. Between Project Office and Others</i>	5-5
5-07. PROJECT REPORTING INSTRUCTIONS.....	5-5
5-08. WARNINGS.....	5-6
5-09. FREQUENCY OF GATE CHANGES.....	5-6
VI - HYDROLOGIC FORECASTS.....	6-1
6-01. GENERAL.....	6-1
<i>a. Role of Corps of Engineers</i>	6-1
<i>b. Role of Other Agencies</i>	6-1
6-02. FLOOD CONDITIONS FORECASTS.....	6-2
<i>a. Requirements</i>	6-2
<i>b. Methods</i>	6-2
6-03. CONSERVATION PURPOSE FORECASTS.....	6-3
<i>a. Requirements</i>	6-3
<i>b. Methods</i>	6-3
6-04. LONG-RANGE FORECASTS.....	6-3

<i>a. Requirements</i>	6-3
<i>b. Methods</i>	6-3
6-05. DROUGHT FORECASTS.	6-3
VII - WATER CONTROL PLAN	7-1
7-01. GENERAL OBJECTIVES.	7-1
7-02. MAJOR CONSTRAINTS.....	7-1
7-03. OVERALL PLAN FOR WATER CONTROL.	7-1
<i>a. General</i>	7-1
<i>b. System Regulation</i>	7-1
7-04. STANDING INSTRUCTIONS TO LAKE MANAGER.	7-1
7-05. FLOOD CONTROL.	7-2
<i>a. Normal Flood Control Regulations</i>	7-2
<i>b. Emergency Flood Control Regulations</i>	7-4
<i>c. Constraints</i>	7-5
<i>d. Operational Curves</i>	7-6
7-06. RECREATION.	7-6
7-07. WATER QUALITY.....	7-6
7-08. FISH AND WILDLIFE	7-6
7-09. WATER SUPPLY.....	7-6
<i>a. General</i>	7-6
<i>b. Regulation Procedure for Water Supply</i>	7-7
<i>c. Accounting Procedure for Water Supply</i>	7-7
7-10. WATER RIGHTS.....	7-8
<i>a. General</i>	7-8
<i>b. Regulation Procedure for Water Rights</i>	7-8
7-11. HYDROELECTRIC POWER.....	7-8
7-12. NAVIGATION.	7-8
7-13. SEDIMENTATION.	7-8
7-14 DROUGHT CONTINGENCY PLANS.....	7-8
7-15. FLOOD EMERGENCY ACTION PLANS.....	7-8
7-16. DEVIATION FROM NORMAL FLOOD CONTROL REGULATION.....	7-8
<i>a. Emergencies</i>	7-8
<i>b. Unplanned Minor Deviations</i>	7-9
<i>c. Unplanned Major Deviations</i>	7-9
<i>d. Planned Deviations</i>	7-9
7-17. RATE OF RELEASE CHANGE	7-10
VIII - EFFECT OF WATER CONTROL PLAN	8-1
8-01. GENERAL	8-1
8-02. FLOOD CONTROL.....	8-1
<i>a. Probable Maximum Flood</i>	8-1
<i>b. Spillway Design Flood</i>	8-1
<i>c. Standard Project Flood</i>	8-1
<i>d. Flood of June-July 1951</i>	8-1
<i>e. Flood of July 1993</i>	8-2
8-03. RECREATION.	8-2
8-04. WATER QUALITY.....	8-2
8-05. FISH AND WILDLIFE.	8-2
8-06. WATER SUPPLY.	8-2
8-07. HYDROELECTRIC POWER.....	8-2
8-08. NAVIGATION.	8-2
8-09. DROUGHT CONTINGENCY PLANS.....	8-3

8-10. FLOOD EMERGENCY ACTION PLANS.....	8-3
8-11. FREQUENCIES	8-3
<i>a. Peak Inflow Probability</i>	8-3
<i>b. Pool Elevation Duration and Probability</i>	8-3
<i>c. Key Control Points</i>	8-3
8-12. OTHER STUDIES	8-3
<i>a. Improvements in Forecasting</i>	8-3
<i>b. Channel and Floodway Improvement</i>	8-3
IX - WATER CONTROL MANAGEMENT.....	9-1
9-01. RESPONSIBILITIES AND ORGANIZATIONS.	9-1
<i>a. Corps of Engineers</i>	9-1
<i>b. Other Federal Agencies</i>	9-3
<i>c. State Agencies</i>	9-3
<i>d. Private Organizations</i>	9-3
9-02. INTERAGENCY COORDINATION.	9-3
<i>a. Local Press and Corps Bulletins</i>	9-3
<i>b. National Weather Service</i>	9-4
<i>c. U.S. Geological Survey</i>	9-4
<i>d. Power Marketing Agency</i>	9-4
<i>e. Other Federal, State, or Local Agencies</i>	9-4
9-03. INTERAGENCY AGREEMENTS.....	9-4
9-04. COMMISSIONS, RIVER AUTHORITIES, COMPACTS, AND COMMITTEES	9-4
9-05. REPORTS	9-5
<i>a. Daily Reports</i>	9-5
<i>b. Monthly Lake Reports</i>	9-5
<i>c. Flood Situation Reports</i>	9-5
<i>d. Post Flood Reports</i>	9-5
<i>e. Annual Reports</i>	9-6
<i>f. Summary of Reports</i>	9-6

TABLES

TABLE	NO.	TITLE OR DESCRIPTION	PAGE
TABLE	1-1	PERTINENT REPORTS AND DESIGN MEMORANDA	1-2
TABLE	3-1	RESUME OF CONSTRUCTION ACTIVITIES	3-2
TABLE	4-1	AVG MONTHLY AND ANNUAL RAINFALL AND RUNOFF	4-4
TABLE	4-2	ESTIMATED MONTHLY PAN EVAPORATION	4-5
TABLE	4-3	MAJOR STORMS JANUARY 1922 THROUGH	4-6
TABLE	4-4	TOP TWENTY ANNUAL PEAK STAGES AND CORRESPONDING DISCHARGES AT GAGES	4-8
TABLE	4-5	PERTINENT DATA FOR STREAM GAGING STATIONS	4-10
TABLE	4-6	COUNCIL GROVE DAM SITE MONTHLY INFLOWS	T4-6-1
TABLE	4-7	INFLOW VOLUME-FREQUENCY	4-11
TABLE	4-8	POPULATION OF COUNTIES AND CITIES DOWNSTREAM OF COUNCIL GROVE DAM	4-12
TABLE	4-8A	2002 ECONOMIC CENSUS FOR EMPORIA, KS.	4-13
TABLE	4-8B	2002 ECONOMIC CENSUS FOR MORRIS COUNTY, KS.	4-14
TABLE	4-8C	2002 ECONOMIC CENSUS FOR LYONS COUNTY, KS	4-15
TABLE	4-9	ANNUAL VALUE OF CROPS BELOW COUNCIL GROVE	4-16
TABLE	4-10	AVERAGE ANNUAL FLOOD DAMAGES PREVENTED	4-16
TABLE	4-11	TOP FIVE FLOOD EVENTS DOWNSTREAM OF COUNCIL GROVE DAM	4-17
TABLE	5-1	AUTOMATED GAGES	5-3
TABLE	7-1	REGULATING STATIONS	7-3
TABLE	7-2	EMERGENCY FLOOD CONTROL REGULATION	7-4
TABLE	7-3	ELEVATION-AREA-CAPACITY DATA	T7-3-1
TABLE	7-4	MONTHLY AND ANNUAL LOW FLOW RELEASES	7-7
TABLE	7-5	WATER RIGHTS BELOW COUNCIL GROVE LAKE TO JOHN REDMOND RESERVOIR	T7-5-1
TABLE	7-6	RELEASE RATE CHANGES	7-10
TABLE	9-1	TABULATION OF REPORTS	9-6

EXHIBITS

EXHIBIT A – SUPPLEMENTARY PERTINENT DATA

EXHIBIT B – STANDING INSTRUCTIONS TO LAKE MANAGER

EXHIBIT C – MEMORANDUM OF UNDERSTANDING

PLATES

PLATE 1-1	TULSA DISTRICT PROJECTS
PLATE 2-1	PROJECT LOCATION AND VICINITY MAP
PLATE 2-2	GENERAL PLAN AND SECTIONS
PLATE 2-3	SEDIMENTATION AND DEGRADATION RANGES
PLATE 2-4	PUBLIC USE SITES
PLATE 4-1	GRAND (NEOSHO) RIVER PROFILE
PLATE 4-2	COTTONWOOD RIVER AND CEDAR CREEK PROFILES
PLATE 4-3	FLOW DURATION CURVE
PLATE 4-4	PEAK INFLOW PROBABILITY CURVE
PLATE 4-5	DISCHARGE RATING CURVE - NEOSHO RIVER AT COUNCIL GROVE
PLATE 4-6	DISCHARGE RATING CURVE - NEOSHO RIVER AT AMERICUS
PLATE 4-7	TIME OF CREST TRAVEL
PLATE 4-8	STRUCTURAL LOSS AND AREA CURVES –DAM SITE TO MOUTH OF COTTONWOOD RIVER
PLATE 4-9	STRUCTURAL LOSS AND AREA CURVES – MOUTH OF COTTONWOOD RIVER TO UPPER LIMITS OF JOHN REDMOND RESERVOIR
PLATE 5-1	STREAM GAGE AND RAINFALL STATIONS
PLATE 5-2	ORGANIZATION FOR FLOOD CONTROL REGULATION
PLATE 5-3	SAMPLE LAKE DATA FOR COUNCIL GROVE LAKE
PLATE 6-1	FORECAST REACHES
PLATE 6-2	UNIT HYDROGRAPH FOR AREA ABOVE COUNCIL GROVE DAM
PLATE 6-3	UNIT HYDROGRAPH FOR AREA BELOW COUNCIL GROVE DAM AND ABOVE DUNLAP GAGE
PLATE 6-4	UNIT HYDROGRAPH FOR AREA BELOW DUNLAP GAGE AND ABOVE AMERICUS GAGE
PLATE 7-1	SAMPLE INFLOW COMPUTATION
PLATE 7-2	SPILLWAY AND CONDUIT RATING CURVES
PLATE 7-3	CONDUIT RATING CURVE - PARTIAL AND FULL GATE OPENINGS (ONE GATE)
PLATE 7-4	CONDUIT RATING CURVE - PARTIAL AND FULL GATE OPENINGS (TWO GATES)
PLATE 7-5	LOW FLOW RATING CURVE – 24” LOW FLOW PIPE
PLATE 7-6	TAILWATER RATING CURVE
PLATE 7-7	EVAPORATION CURVES
PLATE 7-8	ELEVATION - AREA – CAPACITY CURVES
PLATE 8-1	OPERATIONAL HYDROGRAPHS – SPILLWAY DESIGN FLOOD
PLATE 8-2	OPERATIONAL HYDROGRAPHS – STANDARD PROJECT FLOOD
PLATE 8-3	OPERATIONAL HYDROGRAPHS – FLOOD OF JUNE – JULY 1951
PLATE 8-4	OPERATIONAL HYDROGRAPHS – FLOOD JULY 1993
PLATE 8-5	ACTUAL HYDROGRAPHS – FLOOD OF JULY 1993
PLATE 8-6	POOL ELEVATION PROBABILITY CURVE
PLATE 8-7	POOL ELEVATION DURATION CURVE
PLATE 8-8	POOL ELEVATION HYDROGRAPHS 1940 – 1950
PLATE 8-9	POOL ELEVATION HYDROGRAPHS 1951 – 1961
PLATE 8-10	POOL ELEVATION HYDROGRAPHS 1962 – 1972
PLATE 8-11	POOL ELEVATION HYDROGRAPHS 1973 – 1983
PLATE 8-12	POOL ELEVATION HYDROGRAPHS 1984 – 1994
PLATE 8-13	POOL ELEVATION HYDROGRAPHS 1995 – 2005
PLATE 8-14	POOL ELEVATION HYDROGRAPHS 2006 – 2010

PERTINENT DATA

LOCATION:

Council Grove Dam is located on the Neosho River at river mile 449.9, approximately 22 miles northwest of Emporia, Kansas in Morris County, Kansas.

DRAINAGE AREA:

246 square miles above the dam

DAM: Type: Random impervious earth fill embankment

Length: 6,500 feet (excluding spillway)

Max.height: 96 feet above streambed

Top width: 32 feet

Top Elev: 1321.0 feet, NGVD29

SPILLWAY:

Location: Right saddle

Crest elevation: 1306.0 feet

Length: 500 feet

Type: Emergency, Uncontrolled

Control: None

Hoists: None

POWER FEATURES: None

LAND ACQUISITION:

	Guide Contour	Area (acres)
Fee Simple Easement	Semi-blocked to 1284.0 1306.0 feet	5,975 3,221

OUTLET WORKS:

Type: 1 - 17' diameter conduit

Location: Near right abutment.

Invert Elevation: 1223.0 feet, NGVD

CONTROL: Two 7.5' x 17' tractor-type gates

LOW FLOW CONTROL:

Type: 24-inch diameter pipe

Location: Intake structure, right of conduit

Entrance Elev.: 1229.5 feet, NGVD

WATER SUPPLY OUTLET:

Type: 24-inch diameter pipe

Location: Intake structure, right of conduit

Entrance Elev.: 1235.0 feet, NGVD

Feature	Elevation (feet, NGVD29)	Area (acres) (1)	Accumulative (acre-feet) (1)	Incremental (acre-feet)	Runoff (inches)(2)	Outlet Works & Spillway Capacity (c.f.s.)
Top of dam	1321.0					
Maximum pool	1315.0	11,970	334,751	98,773	25.51	55,500
Spillway crest	1306.0	9,330	235,978	125,787	17.99	12,700
Top of flood control pool	1289.0	5,370	110,191	64,260	8.45	11,400
Top of conservation pool	1274.0	3,314	45,931	45,911	3.50	9,900
Top of inactive pool	1240.0	20	20	--	0.001	47
Flood Control Storage	1274.0 - 1289.0		64,260		4.90	
Conservation Storage	1240.0 - 1274.0		45,916		3.50	
Streambed	1220.0		-	-	-	

(1) Capacity based on 1994 re-survey.

(2) Drainage area above dam is 246 square miles

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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 and ER 1110-2-8156. The name Council Grove Reservoir was changed to Council Grove Lake by ER 1120-2-111, dated February 11, 1971, and TDR 1120-2-1, dated March 2, 1971.

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.

1-03. Related Manuals. This manual is Appendix O – Part I to the Arkansas River Basin Water Control Master Manual. Other manuals important to the regulation of Council Grove Lake are:

Appendix E, Part I	– Pensacola	August 1992
Appendix E, Part II	– Markham Ferry	August 1992
Appendix E, Part III	– Fort Gibson	July 1992
Appendix O, Part II	– Marion	April 1996
Appendix O, Part IV	– John Redmond	April 1996
Appendix DCP-3	– Drought Contingency Plan For Upper Neosho Projects	January 2004

The locations of existing and authorized projects in the Tulsa District are shown on Plate 1-1. Reports important to the regulation of Council Grove Lake are shown in Table 1-1. Supplementary Pertinent Data is given in Exhibit A of this manual.

1-04. Project Owner. Council Grove Lake is owned by the U.S. Government.

1-05. Operating Agency. The U.S. Army Corps of Engineers is the operating agency for Council Grove Lake. The Lake Manager, Council Grove Lake, operating through the South Central Kansas Resident Office and the Operations Division, Tulsa District, has the responsibility for project operations. The project will be manned 24 hours a day when the lake level is above elevation 1,286.0 feet, National Geodetic Vertical Datum of 1929 (NGVD). Below elevation 1,286.0 feet, the project will be manned during normal work hours each day. When the project is in a flood control regulation, operation personnel will closely monitor the project and the downstream river reaches. The project

is furnished a list of the Water Management Section personnel to contact when necessary. The Lake Manager will furnish the Water Management Section a list of project personnel, giving their office and home telephone numbers and addresses. The Lake Manager resides as close to the project as is considered prudent to carry out his or her official duties.

TABLE 1-1
PERTINENT REPORTS AND DESIGN MEMORANDA
FOR COUNCIL GROVE LAKE AND DAM

Report or Memorandum Title	Date
DM No. 1 Council Grove Lake Hydrology	Jan 1959
DM No. 2B Council Grove Lake Master Plan (Updated)	Aug 1975
DM No. 3 Council Grove Lake General Design	Jun 1959
DM No. 7 Council Grove Lake First Stage Embankment and Outlet Works Evacuation	Feb 1960
DM No. 12 Council Grove Lake Construction of Spillway and Outlet Works and Completion of Embankment	Aug 1960 Rev. Apr 1961
Operations & Maintenance Vol. I – Council Grove Lake, Grand (Neosho) River, KS, Operations and Maintenance Manual Volume I, First Revised Edition	Sep 1983
Council Grove Dam, Grand (Neosho) River, Kansas, Operation and Maintenance Manual, Volume II, Emergency Action Plan	April 2010
Drought Contingency Plan – Upper Neosho River, KS, Neosho River Basin, Drought Contingency Plan	Jan 2004

1-06. Regulating Agencies. The regulating agency for Council Grove Lake is the Corps of Engineers, with the lake’s regulation being the responsibility of the Water Management Section, Hydrology-Hydraulics Branch, Tulsa District. Presently, there are no other agencies involved in the functional responsibilities of Council Grove Lake.

II - DESCRIPTION OF PROJECT

2-01. Location. Council Grove Dam is located at river mile 449.9 on the Neosho River, about 2 miles northwest of the town of Council Grove in Morris County, Kansas. The project location is shown on Plate 2-1.

2-02. Purpose. Council Grove Lake is a multi-purpose project for flood control, water quality control, recreation, water supply, and fish & wildlife. Council Grove Lake, Marion Lake, and John Redmond Reservoir are integral units in a three-unit system. This system is a part of the multi-purpose plan for flood control, generation of hydroelectric power, navigation, and allied water uses on the Arkansas River and tributaries in Kansas, Arkansas, and Oklahoma.

2-03. Physical Components.

a. Embankment. The embankment is a rolled random and impervious earth fill structure with the crest at elevation 1321.0 feet, and a maximum height of 96 feet above the streambed. The embankment section has a crest length of 6,500 feet, exclusive of the spillway. The width of the embankment at crest is 32 feet. A 24-foot roadway is provided along the crest. The upstream slopes of the embankment are protected by 18 inches of dumped riprap on 9 inches of crushed rock backing material. The downstream slopes are seeded to grass. A general plan and a typical section of the embankment are shown on Plate 2-2.

b. Spillway. The limited service, emergency-type spillway is uncontrolled and is located in a saddle in the right abutment. The spillway is 500 feet wide with the crest is at elevation 1306.0 feet.

c. Outlet Works. The outlet works consist of a cut-and-cover conduit 17 feet in diameter, located in the valley on the right side of the river. The intake structure is provided with two 7.5-foot wide by 17-foot high tractor-type stop logs. The electric-motor gate hoists will lift the gates at a speed of one-half foot per minute. A 24-inch low flow control pipe bypasses the conduit gates on the right and is equipped with an electrically operated pivot valve for normal operation and a manually operated gate valve for emergency control. An emergency diesel-powered generating unit is located at the project. A section of the outlet works is shown on Plate 2-2.

d. Water Supply. A 24-inch gate valve controlled pipe, for water supply, is located on the right side of the conduit. This pipe ends in a manhole near the downstream toe of the embankment.

e. Sediment and Degradation Ranges. Seventeen (17) sediment ranges are located in and above the reservoir area with their ends marked by permanent monuments. The locations of the sediment ranges are shown on Plate 2-3. Five (5) degradation ranges are established below Council Grove Dam to provide information on

the downstream channel condition. Eleven (11) of the sediment ranges are located on the Neosho River, and six (6) are located on Munkers Creek. The degradation ranges for Council Grove Lake are also shown on Plate 2-3.

2-04. Related Control Facilities. A small lake that used to supply water to the City of Council Grove, Kansas, is located on Canning Creek. The lake covers 434 surface acres and has a spillway crest elevation of 1344.0 feet.

2-05. Real Estate Acquisition. The fee taking line for Council Grove Lake is a semi-blocked perimeter to elevation 1284.0 feet, which was the 5-year frequency pool elevation at the time the taking line was established. Flowage easements at Council Grove Lake were acquired to elevation 1306.0 feet, the crest of the emergency spillway. A total of 5,975 acres in fee and 3,221 acres in flowage easement were taken, respectively.

2-06. Public Facilities. Eight public use areas have been developed at Council Grove Lake. They are: (1) Canning Creek Cove, (2) Santa Fe Trail, (3) Marina Cove, (4) Neosho Park, (5) Kansa View, (6) Kit Carson Cove, (7) Richey Cove, and (8) Custer Park, as shown on Plate 2-4. Facilities provided at these areas consist of roads parking areas, boat ramps, camping and picnicking facilities, walkways, sanitation facilities, and potable water.

III - HISTORY OF PROJECT

3-01. Authorization. Four reservoirs in the Neosho River Basin, including Council Grove, Marion, Cedar Point, and Strawn, were authorized for flood control, water supply, water quality, recreation, and fish & wildlife by the Flood Control Act of 17 May 1950 (Public Law 516, 81st Congress, 2nd Session). Strawn Reservoir was later renamed John Redmond Reservoir, and Cedar Point Reservoir was later de-authorized.

3-02. Planning and Design.

a. House Document No. 308. A comprehensive report of possible plans of development of the Arkansas River and tributaries for flood control and other uses was published in 1936 as House Document No. 308, 74th Congress, 1st Session. The report was unfavorable for participation by the United States at that time in the control of floods on the Neosho River.

b. House Document No. 442. The report "Grand (Neosho) River and Tributaries, Oklahoma, Kansas, Missouri, and Arkansas," published as House Document No. 442, 80th Congress, 2nd Session, presented the results of studies for improvements on the Neosho River upstream from the Pensacola Reservoir for flood control and related beneficial water uses in the basin. A number of possible improvements were considered on the main stem of the Neosho River and tributaries which could be developed into a comprehensive plan to provide a high degree of flood control in the basin. The report recommended the construction of four reservoirs in Kansas consisting of Council Grove and Strawn on the main stream, Marion on the Cottonwood River, and Cedar Point on Cedar Creek. The four-reservoir system was authorized by Congress in the Flood Control Act of 17 May 1950. Cedar Point Reservoir was later de-authorized.

c. Design Memoranda. A series of design memoranda have been prepared in connection with planning and construction of Council Grove Lake. These reports cover the site selection, hydrology, and structural features of the plan, relocation of roads and utilities, and real estate for the project.

3-03. Construction. A resume of construction activities for Council Grove Lake is presented in Table 3-1.

3-04. Related Projects. Council Grove and Marion Lakes, and John Redmond Reservoir, are integral units in a three-unit system. This system is a part of the multiple-purpose plan for flood control, generation of hydro-electric power, navigation, and allied water uses on the Arkansas River and tributaries in Kansas, Arkansas, and Oklahoma.

TABLE 3-1

RESUME OF CONSTRUCTION ACTIVITIES

Activity	Date
Construction began	June 24, 1960
Date of diversion	August 6, 1963
Final storage began	October 9, 1964
Conservation pool filled	June 9, 1965

3-05. Modification to Regulation. The flood control and conservation regulations as contained in this Manual reflect the same constraint conditions as those contained in the previous Lake Regulation Manual for Council Grove Lake, dated April 1996. Also in 1996, a reallocation study was completed which transferred 8,000 acre-feet of water quality storage to water supply storage. This action did not affect flood pool or water quality regulations. The State of Kansas holds the contract for the entire water supply storage in Council Grove Lake. Table 7-3 lists the low flow releases for water quality. These low flow releases will be followed unless emergency releases are necessary for fish kills or pollution abatement, or similar circumstances.

3-06. Principle Regulation Problems. Council Grove Lake will be operated for optimal flood reductions on the Neosho River from the dam to the mouth of the Cottonwood River and in conjunction with Marion Lake from that point to the upper limits of John Redmond Reservoir. Council Grove Lake will also be operated for optimal flood control benefits as part of the Arkansas River System. Flood releases from each reservoir in the System will be made in accordance with predicted runoff from the uncontrolled area downstream and the predicted volume of inflow into the reservoir, each reservoir making its proportionate release in accordance with the predicted allowable release for the downstream control points. The proportionate release from each reservoir will be determined by the ability of each reservoir to evacuate the stored flood waters at channel capacity.

As the pool elevation rises in the flood control pool, the following physical constraints are encountered: at elevation 1275.0 feet, some campsite roads become inundated; at elevation 1276.0 feet, power to some campsites is cut-off; and at elevation 1299.5 feet, State Highway 177 becomes inundated.

Release rates of 3,000 c.f.s. or less can be made from Council Grove Lake without causing significant damage downstream of the dam.

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. The Grand (Neosho) River, known as the Neosho River above the mouth of Spring River (mile 131), is approximately 478 miles long and has its source in the Flint Hills region of east central Kansas. From its source, the stream flows in a southeasterly direction to the Kansas-Oklahoma State line near Commerce, Oklahoma. The watershed is roughly rectangular in shape, averaging about 18 miles wide and 60 miles long above John Redmond Dam, and 25 miles wide and 90 miles long between John Redmond Dam and the Kansas-Oklahoma State line. The Neosho River above the Kansas-Oklahoma State line is 314 miles long and drains an area of 6,220 square miles.

The Neosho River valley floor has a width of approximately 1 mile from the source to the vicinity of Emporia, Kansas (mile 398). At that point, the valley widens to about 3 or 4 miles, then decreases to about 2 miles at Burlington, Kansas (mile 339). From Burlington to the vicinity of the Kansas-Oklahoma State Line, the valley varies from 1 to 4 miles in width.

The valley slope is approximately 7.2 feet per mile in the reach from the source to the mouth of the Cottonwood River and 2.3 feet per mile from the mouth of the Cottonwood River to the Kansas-Oklahoma State line. The low water slope of the river averages about 1.3 feet per mile between the mouth of the Cottonwood River and the Kansas-Oklahoma State line.

The channel of the main stem is well defined and varies in width from 50 feet near its source, to about 200 feet at the Kansas-Oklahoma State line. The banks are generally stable, varying in height from 15 to 30 feet and usually support a growth of timber and brush along the low water line. The streambed is composed largely of gravel and boulders and is generally stable. A stream profile of the Grand (Neosho) River is shown on Plate 4-1.

The Cottonwood River, the principal tributary in Kansas, rises in east central Kansas near Marion and flows in a general easterly direction from its source to its confluence with the Neosho River at mile 382.8. The watershed is about 70 miles long, averaging about 26 miles in width and draining an area of approximately 1,908 square miles which is 70 percent of the total drainage area above the confluence of the Cottonwood and Neosho Rivers. A stream profile of the Cottonwood River is shown on Plate 4-2.

Cedar Creek is a tributary of the Cottonwood River and has its source in the south central portion of Chase County, Kansas. From its source, the stream flows westerly and northerly about 26 miles to join the Cottonwood River about 1-1/2 miles east of Cedar Point, Kansas. The watershed is fan shaped. The distance from mouth to source is about 15 miles long, is about 17 miles across, and comprises an area of approximately 141 square miles. The channel is crooked but well defined. The streambed is composed largely of shale and limestone. The valley floor varies in width

from less than one-fourth mile to about one-half mile. A profile of Cedar Creek is shown on Plate 4-2.

4-02. Topography. Topography of the Neosho River watershed varies from rolling to rough hill country. The extreme eastern portion of the watershed is located in the rugged area of the Boston Mountains of the Ozark uplift. The upper reaches of the basin are located in the Flint Hills region, which extends across Kansas from north to south. The valley slopes are gentle with woods and brush bordering the stream banks.

4-03. Geology & Soils. Council Grove Lake is located in the Flint Hills region of east central Kansas. The Flint Hills form the western boundary of the Prairie Plains physiographic province and represent the first step in the transition from the hilly Prairie Plains to the flatter and higher terrain of the Great Plains province of western Kansas. The overburden in the floodplain has an average depth of 23 feet and consists of an overlying clay with a thin basal layer of sands. Bedrock at the dam site consists of alternating limestone and shales, all in the Wolfcampian series of Permian rocks. The rock strata at the site are essentially horizontal.

4-04. Sedimentation and Degradation Ranges. A relatively large amount of sediment deposition occurs at Council Grove Lake because of the large amount of agriculture in the drainage basin and the absence of any upstream reservoirs. The measurement of sediment deposited in the lake is accomplished by periodic soundings along established range lines. The cross-sections of these ranges have been determined and their ends marked by permanent monuments with known vertical and horizontal positions. Sediment resurveys will be made by District personnel and coordinated with Division Office. The original sediment survey for Council Grove Lake was completed in May 1964. The most recent sediment survey was completed in 1994. The original design estimated the rate of sedimentation for Council Grove Lake to be approximately 206 acre-feet/year. The 1994 survey indicated a sedimentation rate of 224 acre-feet/year. In order to provide information on the stream profile downstream from the dam, degradation ranges were established across the flood plain below the dam. Council Grove Lake has five degradation ranges extending to approximately river mile 445.0. Sedimentation and degradation ranges for Council Grove Lake are shown on Plate 2-3.

4-05. Climate. The climate of the Neosho River watershed is characterized by moderate winters and comparatively long summers with relatively high temperatures. Summer rains generally occur as thunderstorms with very intense rainfall of short duration and limited areal coverage. Winter rains are generally of low intensity, but cover a large area and are of considerably longer duration. The Gulf of Mexico is the source of much of the precipitation which falls on the basin.

Climatic characteristics for the basin are described in the following subsections:

a. Temperature. - Topeka Gage for Period of Record (1887 - 2009)

Mean annual	53.6 degrees F
Maximum recorded (August 1936)	114 degrees F
Minimum recorded (December 1989)	-26 degrees F

b. Rainfall. - Basin Average Totals Based on Period of Record (1922 -2009)

Average annual	32.3 inches
Maximum annual (1951)	57.5 inches
Minimum annual (1978)	12.3 inches
Percent occurring during growing season (April through September)	72.2 percent

c. Snowfall. - Topeka Gage for Period of Record (1947 - 1992)

Maximum Monthly (February 1971)	22.4 inches
Minimum Monthly (several occasions)	0.00 inches
Mean Annual	20.8 inches

Runoff from snowfall is not excessive and has not been a factor of importance in contributing to floods. The average monthly and annual rainfall and runoff data are shown in Table 4-1. The locations of precipitation and stream gaging stations are shown on Plate 5-1.

d. Evaporation. Following the construction of the Council Grove project, evaporation data was collected from an evaporation pan on site. In 1996, the Tulsa District migrated from using an evaporation pan to using an empirical formula, which is based on meteorology data collected on site. The formula incorporates electronically collected data for solar radiation, wind speed, air temperature and relative humidity. The estimated monthly pan evaporation at Council Grove Lake is shown in Table 4-2.

e. Wind. The prevailing wind is from a southerly direction, with the greatest wind movements occurring in the spring months. A study of available wind velocity data indicated that for 1-minute and 1-hour durations, the highest wind velocities that can be expected are 70 and 50 miles per hour, respectively.

TABLE 4-1
 AVERAGE MONTHLY AND ANNUAL RAINFALL AND
 RUNOFF DATA
 NEOSHO RIVER BASIN ABOVE COUNCIL GROVE DAM

Month	Average rainfall (inches) ⁽¹⁾	Percent average annual rainfall	Average Runoff Council Grove Dam Site ⁽¹⁾⁽²⁾		Percent of average annual runoff
			(acre-feet)	(inches)	
January	0.82	2.5	2,710	0.21	2.8
February	0.87	2.7	4,550	0.35	4.7
March	2.03	6.3	8,390	0.64	8.7
April	3.07	9.5	12,020	0.92	12.5
May	4.60	14.1	16,230	1.24	16.8
June	4.84	15.0	15,860	1.21	16.5
July	3.59	11.1	11,530	0.88	12.0
August	3.58	11.1	5,320	0.41	5.5
September	3.67	11.4	6,510	0.50	6.8
October	2.54	7.9	5,520	0.42	5.7
November	1.58	4.9	4,590	0.35	4.7
December	1.12	3.5	3,190	0.24	3.3
Total	32.31	100.0	96,420	7.37	100.0

⁽¹⁾ Period of record is January 1922 through December 2009

⁽²⁾ Drainage area above Council Grove Dam = 246 square miles

TABLE 4-2

ESTIMATED MONTHLY PAN EVAPORATION

Month	Evaporation (inches) ⁽¹⁾	
	Normal	Drought Periods ⁽²⁾
January	1.70	3.30
February	2.13	1.85
March	3.78	3.30
April	5.22	5.83
May	6.12	7.25
June	7.21	9.98
July	8.47	15.12
August	7.36	10.79
September	5.34	7.34
October	3.67	5.20
November	2.57	3.90
December	1.97	2.63
Total Inches Per Year	55.54	76.49

(1) National Weather Service Class "A" Pan. Period of Record 1980 – 2009.

(2) Using January through December 1980 as an example drought period.

4-06. Storms & Floods. Most of the flood-producing storms over the watershed above Council Grove Dam have been from 3 to 5 days in duration and have occurred in the spring and the fall months. The winter months produce little precipitation. Maximum rainfall occurs in May and June, with a noticeable decrease in the average rainfall in July and August and an increase again in September. The maximum storm over the watershed above Council Grove Dam during the 88 year period of record was 10.23 inches of rain occurring from 9 July to 13 July, 1951. Storms with an average precipitation of 3 inches or more over the area above Council Grove Lake are shown in Table 4-3. Over the period of record, about 72.2 percent of the rainfall occurred during the months of April through September. The averages were computed from published precipitation records of rainfall recorded for the basin. These records do not necessarily record the center of intense storms. Antecedent precipitation, season of the year, and many other factors influence storm runoff so that floods have frequently followed periods of relatively small amounts of recorded rainfall. Conversely, some storms of greater amounts of recorded rainfall have caused only minor flooding. The top twenty annual peak flows at the Council Grove, Kansas and Americus, Kansas gages are shown in Table 4-4.

TABLE 4-3

MAJOR STORMS
APRIL 1922 THROUGH SEPTEMBER 2008
GRAND NEOSHO BASIN
UPSTREAM OF COUNCIL GROVE LAKE

Inclusive Dates	Average Basin Rainfall (inches)	Inclusive Dates	Average Basin Rainfall (inches)
3-8 April 1922	3.21	19-20 Oct 1941	4.80
10-12 July 1922	3.30	15-24 June 1942	6.66
11-13 Nov 1922	3.02	3-6 Sep 1942	4.70
14-23 May 1923	3.82	15-16 June 1943	3.81
5-11 June 1923	4.59	20-27 April 1944	6.31
2-5 July 1923	5.31	21-26 August 1944	5.27
4-6 August 1924	3.06	2-5 December 1944	4.04
6-11 Sep 1925	4.86	11-16 April 1945	4.82
21-26 Sep 1925	3.43	24-30 May 1945	4.07
12-15 Sep 1926	3.53	28-30 Sep 1945	3.92
30 Sep – 3 Oct 1926	4.35	19-20 June 1946	6.34
7-14 April 1927	3.35	1-7 September 1946	3.78
13-20 June 1927	4.32	21-25 April 1948	3.12
12-16 August 1927	5.54	20-29 June 1948	6.02
31 May – 5 Jun 1928	5.21	12-22 July 1948	9.19
11 July 1928	3.09	9-10 July 1950	3.61
14-17 Nov 1928	4.73	16-19 July 1950	3.99
11 May 1929	4.75	25-30 August 1950	3.49
29 May–3 Jun 1929	3.03	27 Apr-1 May 1951	4.27
9-11 July 1929	3.22	6-7 June 1951	3.34
4-10 May 1930	3.16	9-13 July 1951	10.23
21-24 Sep 1931	3.47	1-6 September 1951	5.24
10-18 Nov 1931	5.21	8-11 August 1952	3.07
19-20 June 1932	4.18	12-16 June 1954	4.26
4-5 July 1932	8.13	24-28 May 1955	3.45
20-24 August 1933	3.11	9-12 August 1956	3.40
1-3 June 1935	3.54	12-17 May 1957	4.65
26 Aug-2 Sep 1935	6.44	27-28 June 1957	3.10
17-21 Oct 1935	3.00	14-15 July 1959	4.09
22-24 May 1936	4.22	18-21 Sep 1959	3.17
12-16 Sep 1936	4.89	1-5 October 1959	3.33
4-10 Sep 1937	5.02	23-24 Sep 1960	3.62
2-6 May 1938	5.34	17-23 May 1961	6.07
9-11 June 1938	4.93	11-13 Sep 1961	4.37
15-16 August 1938	3.38	28 May-3 Jun 1962	5.59
19-26 Nov 1940	3.63	19-24 Sep 1962	4.78
29 May-1 Jun 1941	6.65	15-17 June 1963	3.07

TABLE 4-3 (continued)

Inclusive Dates	Average Basin Rainfall (inches)	Inclusive Dates	Average Basin Rainfall (inches)
11-15 June 1964	3.16	8-10 October 1985	4.74
15-19 Nov 1964	3.85	9-21 May 1986	3.94
4-14 June 1965	4.67	30 Jun-1 Jul 1986	3.12
26-28 June 1965	3.11	24-31 May 1987	3.34
18-21 Sep 1965	4.12	23-27 August 1987	3.23
10-12 April 1966	3.08	16-22 May 1989	3.23
31 Mar-2 Apr 1967	3.93	19-29 August 1989	5.71
7-12 June 1967	3.98	5-9 September 1989	3.79
15-24 June 1967	4.78	6-19 March 1990	3.07
1-4 Sep 1967	3.35	11-20 June 1990	3.45
17-21 Sep 1967	3.15	26 Jul-4 Aug 1990	3.32
4-8 October 1967	3.85	18-27 April 1991	3.21
7-19 October 1967	3.73	12-27 May 1991	3.69
15-16 October 1968	4.00	5-16 June 1991	3.06
25-26 April 1969	3.50	1-16 June 1992	5.84
21 Jun-1 Jul 1969	6.02	4-14 July 1992	3.03
20-23 May 1971	4.50	16-27 July 1992	5.48
6-12 June 1971	3.20	3-10 August 1992	3.06
22 July 1971	3.25	7-13 May 1993	4.75
26 Oct-2 Nov 1971	4.37	18-22 July 1993	7.61
10-19 July 1972	4.82	19-25 Sep 1993	4.30
1-10 March 1973	4.40	30 Jun-5 Jul 1994	3.38
18-25 July 1973	3.50	13-21 July 1994	4.84
21-28 Sep 1973	7.57	16-19 May 1995	3.55
10-11 October 1973	4.02	8-10 June 1995	3.06
8-14 May 1974	3.41	15-17 August 1995	6.62
5-11 June 1974	3.91	26-27 May 1996	3.16
24 Oct-4 Nov 1974	3.00	1 June 1996	5.01
16-28 April 1976	3.64	23-27 July 1998	4.57
19-21 May 1977	4.28	31 Oct-4 Nov 1998	5.76
17-22 June 1977	3.00	14-15 April 1999	3.06
12-19 May 1981	4.03	22-28 April 1999	3.62
11-15 June 1981	3.79	27-29 June 1999	3.38
27-30 June 1981	4.18	28 Aug-2 Sep 2003	5.75
12-17 May 1982	3.61	15-19 June 2004	5.63
25 May-4 Jun 1982	4.45	21-25 July 2004	3.33
1-12 April 1983	3.71	12-14 May 2005	4.24
21-30 April 1984	3.75	3-5 June 2005	3.30
6-13 June 1984	3.50	9-13 June 2005	3.75
4-11 June 1985	3.04	23-27 August 2005	5.52
13-22 August 1985	3.35	6-7 May 2007	3.83
21-30 Sep 1985	4.50	12-13 Sep 2008	3.63

TABLE 4-4

TOP TWENTY ANNUAL PEAK STAGES
AND CORRESPONDING DISCHARGES AT GAGES

Council Grove Gage			Americus Gage (2)		
DATE	STAGE (FT.)	DISCH. (C.F.S.)	DATE	STAGE (FT.)	DISCH. (C.F.S.)
1903	37.30	(1)	7/??/1951	31.80	(1)
7/11/1951	35.50	121,000	7/22/1993	27.84	17,400
10/20/1941	34.70	65,900	10/10/1985	27.43	17,000
7/5/1932	34.00	58,000	6/19/2004	27.68	15,600
5/11/1929	33.80	56,000	6/1/1996	27.40	15,500
6/11/1938	33.20	51,000	11/2/1998	27.38	15,400
5/22/1961	33.35	40,400	8/26/2005	26.98	13,400
11/16/1928	31.20	36,000	5/17/1995	26.78	13,000
5/3/1944	30.00	33,800	5/7/2007	26.85	12,900
7/20/1948	29.90	29,900	6/5/1985	26.80	12,700
8/13/1927	29.20	27,000	4/11/1997	26.41	11,600
6/16/1943	28.20	24,400	6/27/1969	28.30	10,900
6/7/1951	28.27	23,000	6/22/1967	28.17	10,700
4/16/1945	26.15	22,600	4/27/1969	27.91	10,400
9/4/1951	27.00	19,700	9/27/1973	27.76	10,200
12/4/1944	25.10	19,500	10/11/1973	27.74	10,200
5/1/1951	26.55	18,600	5/23/1971	27.70	10,100
4/22/1944	24.37	17,600	5/14/1974	27.58	9,940
5/2/1948	23.48	16,500	10/8/1967	27.52	9,870
6/19/1942	25.80	16,100	6/25/1977	27.31	9,590

Flood stage 14.00 feet

Flood stage 27.50 feet

Period of Record is
June 1938 – Aug 2010

Period of Record is
July 1963 – Aug 2010

- (1) Data is Unavailable
- (2) Medium and high-water flows prior to May 17, 1983 were measured from downstream side of county highway bridge 0.4 miles upstream from gage. DCP was installed on May 17, 1983.

4-07. Runoff Characteristics. The upper portion of the Neosho River drainage area lies in the Flint Hills, a region characterized by steep broken hills which are devoid of trees except along the streams. The thin, rather impervious soil cover and the steep slopes of the tributary streams are conducive to rapid concentration of runoff in the main stem and major tributaries. This part of the drainage area produces flash flood flows on the main stem, which are decreased by valley storage in passing through the central portion of the valley, unless augmented by heavy rainfall over that portion of the watershed. Long periods of very low flow have been observed on the main stem in Kansas, and at

infrequent intervals, short periods of zero flow have been recorded. On the Cottonwood River, the main tributary of the Neosho River above Iola, Kansas, drainage is well developed. Due to the comparatively large channel capacities in the upper reaches of the river, floods of large magnitude are relatively infrequent, high flows in Cottonwood Creek can contribute to heavy flows in the Neosho River. Stream gages pertinent to Council Grove Lake are Council Grove, and Americus, Kansas. Pertinent data for stream gaging stations used for regulation of Council Grove Lake is shown on Table 4-5. Estimated monthly and annual flows past Council Grove Dam are shown in Table 4-6 located in the Supplemental Tables Section. The inflow volume frequency by months is shown in Table 4-7. The flow duration curve is shown on Plate 4-3.

Peak inflows taken from monthly inflow computation records at the dam site for the period 1940 through 2008 were used to compute the maximum annual peak inflow probability. The inflow probability was derived in accordance with Bulletin 17B, "Guidelines for Determining Flood Flow Frequency," dated September 1981. The peak inflow probability curve is shown on Plate 4-4.

4-08. Water Quality. Water quality surveys have not been conducted for Council Grove Lake.

4-09. Channel and Floodway Characteristics. The regulating channel capacity for the Neosho River below Council Grove Dam is 3,000 c.f.s. Discharge rating curves for the Council Grove and Americus gages on the Neosho River are shown on Plates 4-5 and 4-6, respectively, and are valid for rough use only. Discharge rating curves used by the Water Management Section are adjusted for changing conditions and are maintained in a current status. Crest travel times are provided in Plate 4-7.

4-10. Upstream Structures. Council Grove Lake is the upstream-most structure on the Neosho River.

4-11. Downstream Structures. Structures on the Neosho River below Council Grove Lake include Marion Lake on the Cottonwood River; John Redmond, Pensacola, Markham-Ferry, and Fort Gibson Reservoirs, on the Grand (Neosho) River. These projects are operated as a system with Council Grove Lake in the multi-purpose plan for flood control, hydropower, navigation, and allied water uses on the Arkansas River and its tributaries. The US Army Corps of Engineers is responsible for regulating the flood waters of all the above projects.

TABLE 4-5
PERTINENT DATA
FOR STREAM GAGING STATIONS

STATION	STREAM	MILES ABOVE MOUTH	GAGE ZERO (ft.,NGVD)	FLOOD STAGE (ft.) ⁽¹⁾	Drainage Area (sq. mi.)	MAXIMUM FLOOD OF RECORD		
						DATE	STAGE (ft.)	DISCHARGE (c.f.s)
Council Grove, KS	Neosho River	448.0	1205.63	14.00	250	1903	37.30	(2)
Americus, KS	Neosho River	409.3	1106.99	27.50	622	July 1951	31.80	(2)

TABLE 4-5 (continued)
PERTINENT DATA
FOR STREAM GAGING STATIONS

STATION	STREAM	2 nd LARGEST FLOOD OF RECORD			3 rd LARGEST FLOOD OF RECORD			PERIOD OF RECORD
		DATE	STAGE (ft.)	DISCHARGE (c.f.s)	DATE	STAGE (ft.)	DISCHARGE (c.f.s)	(FLOW AND / OR STAGE)
Council Grove, KS	Neosho River	7-11-51	35.50	121,000	10-20-41	34.70	65,900	1938 -- Present
Americus, KS	Neosho River	7-22-93	27.84	17,400	10-10-85	27.43	17,000	1963 -- Present

- (1) Regulating Flood Stages
- (2) Not determined

TABLE 4-7

INFLOW VOLUME-FREQUENCY
(January 1922 – December 2009)

Frequency Of Occurrence (years)	Monthly Inflow in Hundreds of Acre-Feet											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2	10	18	30	63	86	94	31	19	20	13	12	11
5	38	65	126	192	239	260	138	75	86	60	52	40
10	67	123	226	319	395	413	291	141	189	147	117	79
25	85	208	356	547	661	681	528	314	350	436	313	214
50	115	573	687	1060	1112	1137	950	583	678	496	372	256
100	132	751	1004	1081	1210	1250	1044	800	930	700	673	388

4-12. Economic Data.

a. Population. The population of counties traversed by the Neosho River below Council Grove Dam and larger cities in the basin are shown in Table 4-8.

b. Industry. Health Care and Social Assistance and Retail Trade are the largest industries in the region, followed by Accommodation and Food Services. The primary manufacturing industries of the area are Food and Animal Slaughtering. The largest companies in the area are located in Emporia, Kansas and are involved in the food, corn, grain, and cattle industries. Tables 4-8A, 4-8B, and 4-8C display the major industries in the City of Emporia, Lyons and Morris counties along with corresponding data on number of establishments, sales, annual payroll, and employees.

c. Agriculture. Agriculture and livestock are the principal occupations in the Neosho River Basin. The principal crops grown in the Kansas portion of the basin are corn, wheat, soybeans, sorghums, oats, and hay. The principal livestock raised in east central Kansas is beef cattle. Native grasses used exclusively for grazing cattle cover most of this area. Production and annual value of the major crops in the flood plain below Council Grove Dam are shown in Table 4-9.

d. Flood Damages. The estimated average annual flood damages prevented by Council Grove Dam on the Neosho River are presented in Table 4-10 while the top five flood events, in terms of flood damages prevented, to pass through Council Grove Dam are presented in Table 4-11. Plate 4-8 shows the Structural Loss and Area curve for the area of the Council Grove dam site downstream to the mouth of the Cottonwood River. Plate 4-9 shows the Structural Loss and Area curve for the area of the mouth of the Cottonwood River downstream to the upper limits of John Redmond Reservoir.

TABLE 4-8

POPULATION OF COUNTIES AND CITIES
DOWNSTREAM OF COUNCIL GROVE DAM

County	Major Cities	U.S. Census Population			% Change (1990-2000)
		1990	2000	2008*	
Kansas					
Morris		6,198	6,104	6,037	-1.52%
	Council Grove	2,228	2,321	2,253	4.17%
Lyon		34,732	35,935	35,562	3.46%
	Emporia	25,512	26,760	26,662	4.89%
Coffey		8,404	8,865	8,409	5.49%
	Burlington	2,735	2,790	2,679	2.01%
1990 Census, 2000 Census, *2007 or 2008 Population Estimates http://factfinder.census.gov/					

TABLE 4-8A

2002 ECONOMIC CENSUS FOR EMPORIA, KS

NAICS Code	Industry Description	Number of Establishments	Sales, Shipments, Receipts, or Revenue (\$1,000's)	Annual Payroll (\$1,000's)	Number of Employees
31-33	Manufacturing	31	D	D	h
42	Wholesale trade	31	103,140	12,772	378
44-45	Retail trade	141	316,663	3,583	1,952
51	Information	13	N	3,367	123
53	Real estate & rental & leasing	32	11,497	2,210	122
54	Professional, scientific, & technical services	39	17,077	6,167	355
56	Administrative & support & waste management & remediation service	26	10,247	5,696	298
61	Educational services	5	D	D	a
62	Health care & social assistance	91	124,363	48,996	2,018
71	Arts, entertainment, & recreation	11	1,478	490	71
72	Accommodation & food services	89	43,633	11,727	1,634
81	Other services (except public administration)	88	D	D	e

Source: U.S. Bureau of the Census, 2002 Economic Census

* 2006 County Business Patterns

Key to table:

e = 250 to 499 employees

h = 2,500 to 4,999 employees

N Not available or not comparable

a = 0 to 19 employees

D = Withheld to avoid disclosing data for individual companies; data are included in higher level totals

TABLE 4-8B

2002 ECONOMIC CENSUS FOR MORRIS COUNTY, KANSAS

NAICS Code	Industry Description	Number of Establishments	Sales, Shipments, Receipts, or Revenue (\$1,000's)	Annual Payroll (\$1,000's)	Number of Employees
31-33	Manufacturing *	7	-	-	c
42	Wholesale trade	5	4,508	385	25
44-45	Retail trade	42	40,068	3,644	231
51	Information	6	N	487	38
53	Real estate & rental & leasing	2	D	D	a
54	Professional, scientific, & technical services	9	4,890	1,739	76
56	Administrative & support & waste management & remediation service	2	D	D	a
61	Educational services	1	D	D	a
62	Health care & social assistance	9	8,192	3,285	215
71	Arts, entertainment, & recreation	3	D	D	a
72	Accommodation & food services	12	3,661	1,278	167
81	Other services (except public administration)	15	1,754	407	39

Source: U.S. Bureau of the Census, 2002 Economic Census,

* 2006 County Business Patterns

Key to table:

- Zero or rounds to zero

a = 0 to 19 employees

c = 100 to 249 employees

D = Withheld to avoid disclosing data for individual companies; data are included in higher level totals

N = Not available or not comparable

TABLE 4-8C

2002 ECONOMIC CENSUS FOR LYONS COUNTY, KS

NAICS Code	Industry Description	Number of Establishments	Sales, Shipments, Receipts, or Revenue (\$1,000's)	Annual Payroll (\$1,000's)	Number of Employees
31-33	Manufacturing	39	D	D	i
42	Wholesale trade	39	D	D	e
44-45	Retail trade	158	337,970	34,943	2,062
51	Information	17	N	D	f
53	Real estate & rental & leasing	34	D	D	c
54	Professional, scientific, & technical services	42	D	D	e
56	Administrative & support & waste management & remediation service	34	D	D	e
61	Educational services	7	D	D	b
62	Health care & social assistance	106	D	D	g
71	Arts, entertainment, & recreation	13	D	D	b
72	Accommodation & food services	100	45,259	12,187	1,692
81	Other services (except public administration)	92	22,349	6,200	341

Source: U.S. Bureau of the Census, 2002 Economic Census

* 2006 County Business Patterns

Key to table:

D = Withheld to avoid disclosing data for individual companies; data are included in higher level totals

i = 5,000 to 9,999 employees

g = 1,000 to 2,499 employees

f = 500 to 999 employees

c = 100 to 249 employees

b = 20 to 99 employees

N = Not available or not comparable

e = 250 to 499 employees

TABLE 4-9

ANNUAL VALUE OF CROPS
BELOW COUNCIL GROVE DAM

NEOSHO RIVER						
	Marion dam site to mouth of Cottonwood River		Council Grove dam site to Kansas - Oklahoma State Line		Total	
Crops	Area (Acres)	Value (\$)	Area (Acres)	Value (\$)	Area (Acres)	Value (\$)
Corn	19,340	4,977,900	64,400	16,586,000	83,800	21,563,900
Sorghum	7,050	1,841,700	6,600	1,724,100	13,700	3,565,800
Soybeans	1,510	296,500	26,200	5,152,900	27,800	5,449,500
Wheat	15,050	2,058,200	39,900	5,454,000	54,900	7,512,200
Alfalfa	3,140	784,000	8,200	2,040,000	11,300	2,824,000
Oats	3,400	273,500	4,100	329,000	7,500	602,500
Prairie Hay	13,380	1,354,700	91,000	9,214,300	104,400	10,568,900
Total	62,870	11,586,500	240,400	40,500,300	303,300	52,086,800

TABLE 4-10

AVERAGE ANNUAL FLOOD DAMAGES PREVENTED

Average Annual Flood Damages Prevented by Council Grove Dam		
Years in Operation	Cumulative Damages (2008 \$ 1,000's)	Average Annual Damages (2008 \$1,000's)
43	159,100	3,700

TABLE 4-11

TOP FIVE FLOOD EVENTS
DOWNSTREAM OF COUNCIL GROVE DAM

Top Five Floods of Record		
Year	Damages (Year \$ 1,000's)	Damages (2008 \$1,000's)
1995	7,202	10,939
1997	8,421	12,012
1999	8,850	12,138
2005	11,905	13,286
1993	22,989	36,668

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological Stations.

a. Facilities. The Water Management Section, Hydrology-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 for the Neosho River basin are shown on Plate 5-1.

The precipitation stations important to Council Grove Lake are located near the gate tower at the dam and administration building and at Dunlap, Americus and Council Grove, Kansas. Stream flow gages important to the regulation of Council Grove Lake are Council Grove and Americus, Kansas on the Neosho River.

At Council Grove Lake, a tipping bucket rain gage is located on the gate tower near the southwest end of the embankment. Another tipping bucket rain gage along with a standard rain gage is located approximately 100 feet to the west of the Administration Building.

A remote indicator pool gage with a 24-hour continuous recorder is used to monitor pool elevation. A staff gage located on the upstream side of the dam is periodically checked to verify the recorder gage. A staff gage is also located on the downstream side of the dam. However, this gage is seldom checked. The Council Grove stream gage is used as the primary indicator of outflow and tailwater elevation.

b. Reporting. The reporting procedures for precipitation and stream gaging stations are on a cooperative basis with the NWS and the USGS. The reporting of data from pool elevation and stream gaging stations has been automated by using Data Collection Platforms (DCP's) which record data hourly and transmit the data hourly or when a threshold value is exceeded. The data is transmitted via Geostationary Operational Environmental Satellite (GOES) to a downlink and computer facility owned and operated by the National Oceanic and Atmospheric Administration (NOAA) near Washington, D.C. The data is then transmitted to a domestic satellite (DOMSAT) which in turn passes the data to the Tulsa District's Receive Only Terminal (DROT). The data from the NOAA computer facility may also be transferred via the Internet. When received, the river stage is converted to flow and lake elevation is converted to storage. All the data are then stored in a database on the Tulsa District Water Control Data System (WCDS) for access when needed. Data Collection Platforms also report rainfall data in the same way.

As well as DCP data, observer rainfall data is collected and stored in the computer system for use in forecasting. Observers telephone the NWS offices in this region and the NWS then encodes the data into a Standard Hydrologic Exchange Format (SHEF). This data is then transferred to the WCDS by electronic data

transmission from the Arkansas-Red Basin River Forecast Center. Once the data is received, it is decoded and handled similarly to the DCP data. Informative display of all data is possible by using several versatile computer programs developed for use on the WCDS. Table 5-1 contains a list of automated stream gage and rainfall stations. Detailed instructions on reporting criteria are presented in paragraph 2 of Exhibit B, Standing Instructions to Lake Manager.

c. Maintenance. Maintenance and repair of stream gages are the responsibility of the administering agency. Both the Corps of Engineers and the USGS have stream-gaging equipment in the Neosho River Basin. The Forecasting Section, Hydrology-Hydraulics Branch, Tulsa District, is charged with the responsibility for the equipment placed by the Corps of Engineers.

5-02. Water Quality Stations.

a. Facilities. No water quality stations currently exist at Council Grove Lake.

b. Reporting. Water quality samples taken by Corps of Engineers personnel will be reported directly to the Tulsa District Office.

c. Maintenance. No permanent facilities exist to maintain.

5-03. Sediment Stations.

a. Facilities. The seventeen (17) sedimentation ranges above Council Grove Lake and five (5) degradation ranges below Council Grove Dam are used for sedimentation measurements. These ranges are surveyed periodically for the purpose of computing sediment deposition, and new lake area and capacity data.

b. Reporting. Sediment surveys are made infrequently for Council Grove Lake. The most recent sediment survey was conducted in 1994.

c. Maintenance. Sedimentation and degradation ranges will be maintained by the Tulsa District Corps of Engineers.

TABLE 5-1
AUTOMATED GAGES

Station	Operating Agency	Tulsa ID	USGS ID	SHEF ID
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Automated Stream Gages

Cottonwood River

Marion, Kansas	USGS	MARC	07179795	MABK1
Plymouth, Kansas	USGS	PLYM	07182250	PLYK1

Neosho River

Council Grove, Kansas	USGS	COUG	07179500	CGRK1
Dunlap, Kansas	NWS	DUNL	07179710	DUNK1
Americus, Kansas	USGS	AMER	07179730	AMCK1

Automated Pool Gages

Council Grove Lake	COE	COUN	07179400	CAYO2
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Automated Rainfall Gages Used in the Council Grove Lake Forecast Model

Americus, Kansas	USGS	AMER	07179730	AMCK1
Council Grove, Kansas	USGS	COUG	07179500	CGRK1
Cottonwood, Kansas	NWS	COT1		COTK1
Diamond, Kansas	NWS	DIAM		DIAK1
Dunlap, Kansas	NWS	DUNL	07179710	DUNK1
Durham, Kansas	NWS	DURH		DURK1
Emporia, Kansas	NWS	EMPO		NBEK1
Manhattan, Kansas	NWS	MANH		MNTK1
Marion, Kansas	NWS	MAR2		MARK1
Marion Reservoir, Kansas	COE	MARI		MLBK1
Neosho Rapids, Kansas	NWS	NEOC		NEOK1
Parkerville, Kansas	NWS	PARK		PKVK1
Salina, Kansas	NWS	MEKS		MTRK1
Smokey Hills, Kansas	NWS	EPKS		ENTK1
Topeka, Kansas	NWS	TOPK		TOPK1
Topeka, Kansas	NWS	TPAK		TPAK1
Wamego, Kansas	NWS	WGKS		WMGK1

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

a. Stages and Discharges. The raw data that the water management computer retrieves from the central computer are stored as it is received. These raw data are then sorted by station and stored again. Several computer programs convert the raw data into stage/pool elevation data and the corresponding flow/storage values as determined from rating curves. These processed data are then stored in two databases. To prevent the databases from filling, they are periodically archived on tape for permanent storage. Stream flow measurements made by the USGS are reported to the Hydrology and Hydraulics Section. The measurements are entered into the database for storage.

b. Precipitation. Precipitation data from the DCP stations and the project are combined with NWS observer precipitation data that can then be used by computer programs for plotting distribution, determining basin rainfall, and forecasting runoff (see Chapter VI).

c. Water Quality Data. Water quality data has not been recorded with regularity for Council Grove Lake.

5-05. Communication Network. Wire facilities at the Council Grove Lake Office consist of local and long-distance telephone service. Radio Communication is by a VHF-FM fixed station (call signal WUI-301) capable of reaching local mobile stations, the Tulsa District Office, stations on the local loop of the District and other stations on the north and south loop of the District via repeater relay. Maintenance of the telephone lines is the responsibility of the company leasing the lines to the Government. The District radio technician makes quarterly inspections of the project's fixed equipment and makes repairs as conditions warrant. To alert the public of impending gate changes, warning horns are located on the conduit gate tower, on the downstream end of the conduit, and on the spillway. Control buttons for these devices are found on the gate control panels.

5-06. Communication with Project.

a. Water Management Section with Project Office. Instructions for the storage and release of water from the lake will be communicated by the Water Management Section to the responsible project operating personnel for the implementation of the provisions set forth in Chapter IX of this manual. This communication will normally be made by telephone but could on occasion be made by VHF-FM radio. The reports by the project office, described in paragraph 5-07 and Exhibit B of this manual, will be communicated directly to the Water Management Section. Should communication between the project and the District Office be disrupted, the Lake Manager will, on his or her own initiative, direct regulation of the lake according to emergency regulations as required in Chapter VII and Exhibit B of this manual. A chart, "Organization for Flood Control Regulation" is shown on Plate 5-2.

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

5-07. Project Reporting Instructions. Daily lake data from Council Grove Lake will be submitted to the Water Management Section, Hydrology-Hydraulics Branch, Tulsa District Office (telephone 918-669-7094 or VHF-FM radio, call signal WUI-3). The Water Management Section office is manned from 7:00 a.m. to 4:30 p.m. daily and various hours on weekends and holidays. Data for nonworking days shall be read from the recorder chart and submitted the following workday. Data will be submitted in accordance with the form shown on Plate 5-3. 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; number of gates open; amount of gate opening; outflow stage at 8 a.m.; precipitation in inches for the preceding 24 hours (7 a.m. to 7 a.m.); and wind velocity and direction (at 8 a.m.).
- b) Each Gate Operation. Date and time of gate operation, number of gates open and amount of gate opening before and after gate operation, lake elevation. Confirmation of gate changes shall be made immediately after completion of the change. Complaints about pool elevations or releases, operating machinery failure, and out-of-service times for maintenance shall be reported to the Water Management Section as they occur.
- c) During Flood Periods. In addition to subparagraphs a. and b. above, additional reports may be required by the Water Management Section.
- d) 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. (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 non-working hours, the report should be made to one of the persons listed on page i.

- (5) After office hours, rainfall reports should be made as indicated in subsection (4) above; however, if no contact with the Water Management Section personnel can be made, rainfall reports should be made to the National Weather Service, Tulsa, Oklahoma at telephone 1-800-722-2778.

5-08. Warnings. It is the responsibility of the Lake Manager to initiate a warning to the local threatened area emergency representatives and to the Lake Manager at Marion Lake if emergency situations develop. They have the responsibility to properly recognize emergency situations and to seek assistance from supervisory offices, if time permits. They must be knowledgeable of conditions that constitute an emergency such as a dam failure possibility. The downstream population should be notified as early as possible of a potential problem. Minimum notification procedures are as follows: A "General Alert" should be issued by the Lake Manager to the Kansas Civil Defense when life-threatening high releases from a dam failure or flooding are predicted to reach the downstream population at risk within 6 hours; An "Evacuation Warning" should be issued by the Lake Manager when analysis of the threatening event and reservoir response indicate that life-threatening floodwaters will reach the downstream population in 4 hours or less. The Council Grove Lake project personnel have compiled a list of downstream contacts for use in emergency situations.

5-09. Frequency of Gate Changes. During flood periods, gate changes may be directed by the Water Management Section at anytime. The initial transition to flood releases or vice versa may require gate changes every hour. When floodwater has significantly risen into the flood control pool, gate changes can be expected two or more times daily. Only under the most unusual circumstances will changes be ordered more frequently than once every three (3) hours. Frequency of gate changes during low flow operations Will generally be less than once a day.

VI - HYDROLOGIC FORECASTS

6-01. General. Hydrologic forecasts are necessary in predicting stream flow above and below Council Grove Lake 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 management activities. As distinguished from the National Weather Service (NWS) who furnishes weather and flood forecasts to the public, the District furnishes information on current and forecasted lake levels and lake releases, along with technical advice. The Water Management Section (lake levels recording), telephone number (918) 669-7521, is listed in the Tulsa telephone directory to provide the public a means of obtaining current lake information such as pool levels and discharges. General news releases are made by the Public Affairs Office which is kept fully informed of the hydrologic situation as appropriate. Further discussion of the role of the Corps of Engineers in hydrologic forecasts is presented in Section V of the Arkansas River Basin Water Control Master Manual

b. Role of Other Agencies. The National Weather Service, Oklahoma City, Oklahoma, is the official agency making flood forecast information available to the public. This information is distributed by NWS Automation of Field Operations and Services (AFOS) network to subscribing government agencies and 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 (four times daily).
- (3) Quantitative precipitation forecasts (four times daily – one 24-hour and one 48-hour quantitative precipitation forecast and two 6-hour quantitative precipitation forecasts).
- (4) Three-day river stage forecasts (when available).
- (5) Rainfall required to produce bank full stages (weekly).
- (6) Urgent priority messages such as severe weather warnings, watches, forecasts and statements, and instructions from Civil Defense during emergency conditions are transmitted immediately, regardless of scheduled traffic. Unscheduled traffic, including the following, is sent when appropriate.
 - (a) Damage reports.
 - (b) Road information and winter weather conditions.
 - (c) River and flood warning bulletins, forecasts, and statements.

- (d) Thirty-day forecast.
 - (e) Road information and winter weather conditions.
- (7) Percent chance of precipitation (twice daily).

6-02. Flood Conditions Forecasts.

a. Requirements. Flood condition forecasts are necessary whenever substantial rainfall has occurred on the basin above or below Council Grove Dam. Personnel in the Forecasting Section have developed a flood-forecasting model for Council Grove Lake. This model was calibrated to historical flood events. Basin subdivisions contained in the forecasting model are presented in Plate 6-1. To use this model the following data is required:

- (1) Rainfall for stations listed in Table 5-1.
- (2) Council Grove Lake pool elevation for time of forecast.
- (3) Flood hydrographs for stream gages listed in Table 5-1.
- (4) Releases from Council Grove Lake, including projected releases, from time of forecast until the end of the forecast period.

b. Methods. Inflow forecasts are made using a slightly modified HEC-1 computer program. Precipitation data is received from the NWS observers, the Data Collection Platforms (DCP) by the water control computer, and also the NWS Stage III digital radar. The average precipitation over the project basin is computed by a computer program called VIEWRAIN. The VIEWRAIN program takes the DCP data and plots isohyetal maps of 24-hour rainfall. The VIEWRAIN program also computes the basin and subbasin average rainfalls for input into the HEC-1 forecasting model. The HEC-1 program uses the hourly DCP rainfalls to distribute the subbasin 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. One-hour unit hydrographs are computed using Snyder's coefficients or are entered directly into the data file for each subarea. Flood hydrographs are computed by applying the rainfall excess to the unit hydrographs. Computed flood hydrographs are compared with observed flood hydrographs for gages listed in Table 5-1. Loss rates are adjusted and the HEC-1 model is rerun until the computed and observed hydrographs converge. Calibrated loss rates are applied to ungaged subareas and flood hydrographs are combined and routed to compute an inflow hydrograph. Using projected releases from Council Grove Lake, the inflow hydrograph is routed through the lake to determine elevations. Flood control releases are projected based upon conditions on the Neosho (Grand) River System and following procedures described in section V of the Arkansas River Basin Water Control Master Manual. Unit hydrographs are presented on Plates 6-2 through 6-4.

6-03. Conservation Purpose Forecasts.

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

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

6-04. Long-Range Forecasts.

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

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

6-05. Drought Forecasts. Droughts can be forecast when runoff is dependent upon snowmelt by measuring snow pack in the mountains. However, on projects where runoff is a result of a rainfall event, as in the Tulsa District, no techniques are available at this time to forecast droughts. Future pool draw downs can be forecast by estimating water supply usage and evaporation rates.

VII - WATER CONTROL PLAN

7-01. General Objectives. The primary purpose of Council Grove Lake is flood control. Council Grove Lake, along with Marion Lake and John Redmond Reservoir, are integral parts of a three-reservoir system used to control flooding in the upstream section of the Neosho River Basin. This three-reservoir system is a part of the multi-purpose plan for flood control, generation of hydro-electric power, navigation, and allied water uses on the Arkansas River and tributaries in Kansas, Arkansas, and Oklahoma. Flood releases from Council Grove Lake will be made in accordance with the predicted runoff from the uncontrolled area downstream of the dam, the allowable stage for the lake, and the proportion of available storage remaining in various lakes in the Arkansas River System.

7-02. Major Constraints. Since Council Grove Lake is operated as part of a three-reservoir system, and because of its role in the overall operation of lakes and reservoirs in the Neosho River Basin, releases from the lake have to be coordinated with expected runoff, available flood storage, and releases made at other lakes and reservoirs in the system. The non-damaging channel capacity below Council Grove Dam is 3,000 c.f.s. Because the spillway at Council Grove Lake is an uncontrolled type, discharge cannot be controlled when the pool elevation exceeds elevation 1306.0 feet.

7-03. Overall Plan for Water Control.

a. General. Council Grove Lake is regulated as a unit in a multipurpose system for the benefit of water resources in the Arkansas River Basin. Development of these 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. Council Grove Lake will be operated for optimal flood damage reductions on the Neosho River from the dam to the mouth of the Cottonwood River and in conjunction with Marion Lake from that point to the upper limits of John Redmond Reservoir. Council Grove Lake will also be operated for optimal flood control benefits as part of the Arkansas River System. When the floodwaters are being accumulated in the system, each lake shall be regulated to retain equivalent flood control capabilities, as much as possible, with priority for releases, as shown on curve "C" Plate 7-54 of the Arkansas River Basin Water Control Master Manual, given to the lake with the least amount of flood storage available and considering predicted inflow 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.

7-04. Standing Instructions to Lake Manager. During flood periods the lake will be regulated in accordance with the normal regulations for flood control operation as directed in subparagraph 7-05a and Exhibit B of this manual. Instructions for the storage and discharge of floodwater will be issued by the Water Management Section. In the event communication with the Tulsa District Office is disrupted, the lake

regulation will become the responsibility of the Lake Manager and will be regulated in accordance with subparagraph 7-05b and Exhibit B of this manual. In addition, the Lake Manager will immediately make every effort to reestablish communications with the Tulsa District Office. The Lake Manager 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. 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 Management Section will be notified immediately.

7-05. Flood Control.

a. Normal Flood Control Regulations. Council Grove Lake will be operated for optimal flood reductions on the Neosho River from the dam to the mouth of the Cottonwood River and in conjunction with Marion Lake from that point to the upper limits of John Redmond Reservoir. Releases will also be coordinated with the flood control operation of Marion, John Redmond, Pensacola, Markham Ferry, and Fort Gibson Reservoirs, to provide optimal flood control benefits on the Grand (Neosho) and Arkansas River Basins. The conduit outlet and stilling basin must be visually monitored very closely during all high releases and during high tailwater events. If unusual conditions occur (such as riprap displacement, surging, submerged outlet, or the hydraulic jump moving out of the stilling basin), notify Water Management and Dam Safety immediately.

(1) When the lake is at or below elevation 1274.0 feet, and flood estimates indicate that the volume of inflow will exceed the available conservation capacity, regulated releases, in general, may be made in amounts which, when combined with local inflow below the dam, shall not produce flows in excess of channel capacity on the Neosho River. In order to accomplish this purpose, flows shall not exceed a 14-foot stage (3,280 c.f.s) on the U.S. Geological Survey gage at the Council Grove, Kansas, or a 27.5-foot stage (15,550 c.f.s.) at the U.S. Geological Survey gage at Americus, Kansas. Regulating stations on the Neosho River below Council Grove Lake are presented in Table 7-1.

(2) When the lake level rises above elevation 1274.0 feet, regulated releases, in general, shall be made at the maximum rate permissible, but limited to the amount which, when combined with local inflow below the dam, will not produce flows on the Neosho River in excess of those specified in sub-paragraph (1) above, and in any event shall not exceed 3,000 c.f.s. at the dam except as stated in sub-paragraph (3) below. When the pool elevation is near elevation 1274.0 feet and flood estimates indicate that the pool elevation will exceed elevation 1274.0 feet by 2 feet or more, regulated releases shall be made at the maximum rate permissible, as stated above. However, when the pool elevation crests within 2 feet or recedes to within 2 feet above elevation 1274.0 feet, regulated releases may be made at less than the maximum rate permissible, as stated in sub-paragraph (1) above, provided that the reduced rate of release will alleviate

flooding of low water crossings and/or minimize bank caving downstream. Factors to be considered in determining the practicability of a reduced release rate are general climatic conditions, season of the year with respect to probability of floods, and status of crops on low lying farmland.

TABLE 7-1

REGULATING STATIONS

Station	Stream	Lake	Regulating Stage (Feet)	Regulating Discharge (c.f.s)
Council Grove	Neosho	Council Grove	14.0	3,280
Americus	Neosho	System	27.5	15,550
Burlington	Neosho	System	23.0	16,050
Iola	Neosho	System	15.0	22,770
Parsons	Neosho	System	19.0	16,830
Commerce	Neosho	System	15.0	20,940

(3) When the pool rises above elevation 1289.0 feet (top of the flood control pool), using Table 7-2 as a guide, releases shall be increased until the pool stops rising or until the pool approaches elevation 1294.0 feet (top of the surcharge pool), at which time releases shall be made equal to inflow insofar as possible. Inflows may be estimated using the method demonstrated on Plate 7-1. When the pool begins to recede, the maximum gate opening in effect at that time shall be maintained until the pool recedes to elevation 1289.0 feet, after which time releases through the conduit gates shall be made equal to the inflow or the maximum release permissible under sub-paragraph (2) above, whichever is greater.

When the predicted volume of runoff from the area above the dam exceeds the available flood control storage, the operation described in sub-paragraph (2) above may be modified, as needed, to obtain the maximum overall benefits under conditions existing in the reservoir area and in the downstream reaches of the river as directed by the District Engineer after coordination of the situation with the Southwestern Division Office.

In general, the release rate at Council Grove Lake will be at the maximum rate permissible, as defined in the above sub-paragraphs, unless limited by predicted downstream runoff, or flood storage utilized in all reservoirs of the system is about equal, in which case releases from Council Grove Dam will be at a rate such that all reservoirs in the system will be emptied at approximately the same

time. If flood storage in the Marion and John Redmond Lakes are at a much higher percentage than Council Grove flood storage, their releases will have a higher priority than Council Grove releases until such time that the flood storage of all the lakes are approximately equal.

b. Emergency Flood Control Regulations. Should communication with the Tulsa District Office be disrupted, the Lake Manager will, on his or her own initiative, direct operation of the lake in accordance with the following schedule shown in Table 7-2 until communication is restored. In addition, the Lake Manager will immediately make every effort to re-establish communication with the Tulsa District Office and, if necessary, send information to the Tulsa District Office by automobile, cell phone, or any other means available. The conduit outlet and stilling basin must be visually monitored very closely during all high releases and during high tailwater events. If unusual conditions occur (such as riprap displacement, surging, submerged outlet, or the hydraulic jump moving out of the stilling basin), close all conduit gates immediately and continue efforts to establish communications with the District Office.

TABLE 7-2

EMERGENCY FLOOD CONTROL REGULATION SCHEDULE
 COUNCIL GROVE LAKE
 NEOSHO RIVER, OKLAHOMA

Lake Stage	Pool Conditions	Regulation
1285.0 or below	Rising	No releases will be made through the flood control conduits after the 12-hour delay period.
1285.0 - 1289.0	Rising	Flood control conduit settings shall be maintained.
1289.0 or above	Rising	When the pool elevation is at or above elevation 1289.0, releases in effect shall be maintained until exceeded by the following requirements: Elevation 1289.0 - Increase releases to 2,000 c.f.s. Elevation 1290.0 - Increase releases to 4,000 c.f.s. Elevation 1291.0 - Increase releases to 6,000 c.f.s. Elevation 1292.0 - Increase releases to 8,000 c.f.s. Elevation 1293.0 - Increase releases to 10,000 c.f.s. Elevation 1294.0 - Gates fully open
1289.0 or above	Falling	The maximum flood control conduit gate settings attained shall be maintained until the pool recedes to elevation 1289.0 feet.

TABLE 7-2 (continued)

1289.0 - 1274.0	Falling	<p>If the maximum release rate is less than 3,000 c.f.s., this release or 1,500 c.f.s. (one-half channel capacity), whichever is larger, shall be maintained until the pool level nears elevation 1274.0 feet. If the maximum release rate exceeds 3,000 c.f.s., releases will be made equal to the previous 2-hour inflow or 3,000 c.f.s., whichever is greater.</p> <p>NOTE: Inflows made be estimated using the method demonstrated on Plate 7-1 Sample Inflow Computation</p>
Lake level within 2 feet of Elev. 1274.0	Falling	Releases shall be gradually reduced by amounts not to exceed 1,000 c.f.s. in 4 hours so that releases are equal to inflow by the time the pool recedes to Elev. 1274.0 feet.

NOTE: The conduit outlet and stilling basin must be visually monitored very closely during all high releases and during high tailwater events. If unusual conditions occur (such as riprap displacement, surging, submerged outlet, or the hydraulic jump moving out of the stilling basin), close all conduit gates immediately and continue efforts to establish communications with the District Office.

(1) When communication is disrupted and the pool elevation is below elevation 1289.0 feet (top of flood control pool), the Lake Manager shall delay 12 hours before making a change in releases, except that if the pool rises above elevation 1289.0 feet during the delay period, releases through the conduits shall be started immediately in accordance with Table 7-2.

(2) When the pool is rising, releases will be adjusted in accordance with Table 7-2.

(3) When the pool is falling, releases will be adjusted in accordance with Table 7-2.

c. Constraints. The regulation schedules provide that the channel capacity of 3,280 c.f.s. immediately below the dam is not to be exceeded insofar as practicable; however, the channel capacity in the vicinity of Council Grove, Kansas is 3,280 c.f.s.

and is 15,550 c.f.s. at Americus, Kansas. Floodwaters will be released as rapidly as practicable with consideration given to minimizing flooding of low-water crossings and low-lying farmland. The damage significance of the stages or discharges is shown on the stage-damage curves at the control points as presented on Plates 4-7 and 4-8.

d. Operational Curves. The spillway and conduit rating curves are shown on Plate 7-2. The conduit rating curves for partial and full gate openings (one gate only) are shown on Plate 7-3. The conduit rating curves for partial and full gate openings (for two gates) operation are shown on Plate 7-4. The low flow rating curves for the 24-inch low flow pipe are shown on Plate 7-5. The tailwater rating curve is shown in Plate 7-6. The evaporation curves are shown on Plate 7-7. Elevation versus area and capacity data are compiled in Table 7-3 located in the Supplemental Tables Section and are displayed in Plate 7-8.

7-06. Recreation. Recreation is included as an authorized project purpose; however, there is no storage or releases specifically designated for recreation purposes.

7-07. Water Quality. The State of Kansas has established Water Assurance Districts, authorized by the Kansas Office of Water Resources, to monitor flows and enforce the lawful withdrawal of water by contractual water customers on the Neosho and Verdigris Rivers. The Kansas Water Assurance Plan (KWAP) is a basin-wide approach to meeting the municipal, industrial, and environmental needs of communities associated with those basins outlined in the 1986 MOU between the Assistant Secretary of the Army (Civil Works) and the State of Kansas (see Exhibit B). Storage for water quality control was reduced from 17,500 acre feet to 9,500 acre feet with the 1996 Reallocation Report and Environmental Assessment. A minimum monthly and annual low flow release schedule is presented in Table 7-4. Also, emergency water quality releases will be made to respond to fish distress conditions as discussed in paragraph 7-08. There are no additional requirements for low flow releases.

7-08. Fish and Wildlife. Fish and wildlife is included as a project purpose pursuant to Public Law 85-624; however no storage or releases are specifically provided in the project. Low flow releases are occasionally made on an "as-needed" basis to relieve oxygen deficiency of fish trapped in stilling basins. Management of the fish and wildlife resources will be under the direction of the Kansas Department of Wildlife and Parks.

7-09. Water Supply.

a. General. The ultimate plan of development provides 45,931 acre-feet of conservation storage. This storage includes 32,400 acre-feet for water supply. The water supply storage at Council Grove Lake has been sold to the State of Kansas. The Cottonwood/Neosho River Basin Water Assurance District #3 has purchased approximately 6,200 acre-feet. The city of Council Grove has a contract for 150 Million Gallons per Year (MGY). The city of Emporia has a contract for 1,095 MGY.

TABLE 7-4
MONTHLY AND ANNUAL LOW FLOW RELEASES
COUNCIL GROVE LAKE

Month	Low Flow Releases (c.f.s)
January	4
February	4
March	4
April	4
May	5
June	7
July	8
August	8
September	6
October	4
November	4
December	4
Annual Average	5

b. Regulation Procedure for Water Supply. Withdrawals for municipal and industrial water supply are released through a 24-inch water supply pipe.

c. Accounting Procedure for Water Supply. Accounting procedures for conservation storage in multipurpose projects have been developed by the Tulsa District and approved by the Southwestern Division to account for the withdrawal of water from lakes by each water supply user. Losses are charged to each user in proportion to their average remaining storage. Inflows, after deductions for downstream water rights and vested rights, are credited to the storage account of the user in proportion to their contracted storage. Inflows occurring when the lake is above the conservation pool will be passed through the lake, and even though they may be satisfying an annual water right, they will not affect the conservation pool accounting procedure. When conservation storage falls to 75%, monthly accounting of water supply usage is initiated. Each user will periodically be notified of their remaining water supply storage, and when a user's storage is depleted, no withdrawals from storage will be made for that user. No accounting is necessary where all conservation storage is contracted for by one user or when the Corps is not the contracting agency.

7-10. Water Rights.

a. General. The Kansas Water Office has Water Marketing Contracts of 150 MGY with the City of Council Grove, 1,095 MGY with the City of Emporia, 109.865 MGY with the City of Iola, and 1.46 MGY with the White Memorial Camp. Water rights for the Neosho River are issued by the Kansas Department of Agriculture, Division of Water Resources. Water rights holders above John Redmond Reservoir on the Neosho River are presented in Table 7-5 in the Supplemental Tables Section.

b. Regulation Procedure for Water Rights. Releases from inflow to satisfy downstream water rights will be made at the request of the Kansas Water Office. The Kansas Water Office will inform the Water Management Section as to the amount and time distribution of the required release.

7-11. Hydroelectric Power. Operation of Council Grove Lake does not include hydroelectric power generation.

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

7-13. Sedimentation. There are no regulation procedures for sediment.

7-14 Drought Contingency Plans. The Drought Contingency Plan for the upper Neosho River basin, including Council Grove Lake, updated in January 2004, was prepared by the Water Management Section.

7-15. Flood Emergency Action Plans. A flood emergency action plan is outlined in the Council Grove Dam, Grand (Neosho) River, Kansas, Operation and Maintenance Manual, Volume II, Emergency Action Plan, dated April 2010. 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 appurtenant works.

7-16. Deviation from Normal Flood Control Regulation. Deviation from normal flood control regulation of the reservoir is occasionally necessary. Prior approval for a deviation is obtained from the Corps of Engineers Southwestern Division (SWD) except as noted in subparagraph 7-15.a, shown below. Deviation requests fall into the following categories:

a. Emergencies. The water control plan is subject to temporary modification by the Corps if found necessary in time of emergency. Request for and actions on such modifications may be made by the fastest means of communication available. Also, the Lake Manager may temporarily deviate from the water control plan in the event an

immediate short-term departure is deemed necessary for emergency reasons to avoid serious hazards. The Lake Manager may deviate from the water control plan whenever necessary to protect the safety of the dam. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing as soon as possible to the Water Management Section and shall include justification for the action. Continuation of the deviation will require the express approval of the Southwestern Division (SWD). A written confirmation showing the deviation and conditions will be furnished by the Water Management Section to SWD.

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

c. Unplanned Major Deviations. There are unplanned instances that create a temporary need for major deviations from the normal regulation plan and may be considered, but are not, emergencies. Flood control releases account for the major portion of these incidents and typical examples include project pre-releases or exceeding downstream channel capacity, incidents that have a short window of opportunity in an effort to minimize damages or optimize benefits. Requests for changes in release rates generally involve time periods ranging from a few hours to a few days. Each request is analyzed on its own merits. In evaluating the proposed deviation, consideration must be given to upstream watershed conditions, potential flood threat, and condition of the lake, and alternative measures that can be taken. Approval for these major deviations normally will be obtained from the Southwestern Division Office by telephone or email. Written confirmation explaining the deviation and its cause will be furnished to the Division water control manager.

d. Planned Deviations. Advance approval of the Southwestern Division water control manager is required prior to any deviation from the plan of regulation prescribed or approved by the Corps in the interest of flood control, except in emergency conditions provided for in subparagraph 7-15a. Each condition will be analyzed on its own merits. When conditions appear to warrant a prolonged deviation from the approved plan, the Water Management Section will investigate and evaluate the proposed deviation to insure that the overall integrity of the plan would not be unduly compromised. Approval of prolonged deviations will not be granted unless such investigation and evaluations

have been conducted to the extent deemed necessary by the Southwestern Division water control manager.

7-17. Rate of Release Change. The increase and decrease in releases from the lake shall be accomplished in a manner which minimizes damage to the reservoir area and downstream channel. Every reasonable precaution will be made to eliminate, if possible, bank sloughing, undercutting, excessive erosion, and danger to human and animal lives. Non-emergency releases should not exceed 500 c.f.s per gate change. Non-emergency gate changes should be at least two hours apart (see Table 7-6). Situations will arise which will not allow an orderly increase and/or decrease in releases. Examples of these situations are large flood releases, as described in paragraph 7-05, and drownings that occur downstream of the dam.

TABLE 7-6

RELEASE RATE CHANGES
INCREASING RELEASES TO CHANNEL CAPACITY ⁽¹⁾

<u>Current Release Range (c.f.s.)</u>	<u>Maximum Increase (c.f.s.)</u>	<u>Minimum Time Between Changes (hours)</u>
0 – 3,000	500	2

DECREASING RELEASES BELOW CHANNEL CAPACITY ⁽¹⁾

<u>Current Release Range (c.f.s.)</u>	<u>Maximum Increase (c.f.s.)</u>	<u>Minimum Time Between Changes (hours)</u>
3,000 - 0	500	3

⁽¹⁾ See paragraph 7-05.a.(3) for releases that will exceed channel capacity and also decrease in releases above channel capacity

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. The effects of the emergency flood control regulation schedules on the spillway design flood and standard project flood (one-half spillway design flood) and two examples of the normal and emergency regulations on floods of record for Council Grove Lake are presented in this Manual. The examples were selected to show the effects of the flood control regulation schedules on a variety of possible flood conditions.

8-02. Flood control.

a. Probable Maximum Flood. The Probable Maximum Flood (PMF) concept was not introduced until the late 1970's. Since Council Grove Dam was designed in the late 1950's, the PMF was not used for hydrologic design purposes.

b. Spillway Design Flood. The spillway design flood developed during the original project design was used as the maximum flood for evaluation of the effects of emergency operations. The flood was routed through Council Grove Lake on full and empty flood control pools using the emergency regulations outlined in Table 7-2. The spillway design flood has a total volume of 333,233 acre-feet (total storm runoff of 25.42 inches) with a peak inflow of 265,000 c.f.s. for the full pool routing and a volume of 299,700 acre-feet (total storm runoff of 22.86 inches) for the empty pool routing. The full pool regulation resulted in a maximum discharge of 55,000 c.f.s. for the full pool routing and 35,450 c.f.s. for the empty pool routing. The maximum pool elevation for the full pool routing was 1314.88 feet and was 1312.07 feet for the empty pool routing. The operational hydrographs resulting from the full and empty flood control pools routed by emergency regulations are shown on Plate 8-1.

c. Standard Project Flood. The standard project flood was considered to be one-half of the spillway design flood. This flood was also routed through Council Grove Lake on full and empty flood control pools using the emergency regulations outlined in Table 7-2. The resulting flood has a total volume of 241,381 acre-feet (total storm runoff of 18.41 inches) with a peak inflow of 142,000 c.f.s. for the full pool routing and a volume of 190,301 acre-feet (total storm runoff of 14.51 inches) for the empty pool routing. The full pool regulation resulted in a peak discharge of 13,558 c.f.s. at the peak pool elevation of 1306.28 feet and 12,480 c.f.s. at the peak elevation of 1300.59 feet for the empty pool routing. The operational hydrographs resulting from full and empty flood control pools routed by emergency regulations are shown on Plate 8-2.

d. Flood of June-July 1951. This flood was the maximum of record on the Neosho and Cottonwood Rivers above Pensacola Reservoir. The inflow hydrograph was routed through Council Grove Lake on an empty flood control pool utilizing the emergency regulations outlined in Table 7-2. The empty pool regulation resulted in a peak discharge of 12,360 c.f.s. and a maximum pool elevation of 1299.27 feet. The operational hydrograph resulting from routing the flood through Council Grove Lake under emergency regulations is shown on Plate 8-3.

e. Flood of July 1993. The July 1993 flood caused the most significant pool stages since the construction of Council Grove Lake and was the result of a cumulative basin rainfall of 7.61 inches. The precipitation from this flood was input into the HEC-1 model and routed through Council Grove Lake on full and empty flood control pools using the emergency regulations outlined in Table 7-2. The full pool regulation resulted in a peak discharge of 9,263 c.f.s. at the peak pool elevation of 1294.29 feet. The operational hydrographs resulting from routing the flood through Council Grove Lake under emergency regulations are shown on Plate 8-4. The actual operational hydrograph for the flood is shown on Plate 8-5.

8-03. Recreation. Recreation is an authorized project purpose; however, no storage or releases are specifically provided for recreational purposes. Eight (8) public use areas have been developed around the lake. The effects of increasing pool elevations include: at elevation 1275.0 feet, some campsite roads become inundated; at elevation 1276.0 feet, power to some campsites is cut-off; and at elevation 1299.5 feet, State Highway 177 becomes inundated.

8-04. Water Quality. Conservation storage includes 9,500 acre-feet for water quality control. Low flow releases are made in accordance with the established schedule as discussed in the next paragraph.

8-05. Fish and Wildlife. Fish and wildlife is an authorized project purpose; however, no storage or releases are specifically provided for fish and wildlife purposes. However, low flow releases are made according to the established schedule to relieve oxygen deficiency of fish downstream of the dam. Minor and planned deviations to the regulatory plan will be reviewed on a case-by-case basis as necessary to coordinate fish and wildlife resources which are under the direction of the Kansas Department of Wildlife and Parks. Waterfowl habitat has increased and the lake provides hunting opportunities for these species. There have been some losses of squirrel and deer habitat. However, because of the vast acreage of these habitat types in the general area, the minor loss does not have a significant effect on the hunting of these species in the area. The lake provides a greater diversification of fish and wildlife habitat and specific losses are replaced by wildlife management of the lake perimeter lands.

8-06. Water Supply. Conservation storage includes 32,400 acre-feet of water supply. The water supply storage of Council Grove Lake has been sold to the State of Kansas.

8-07. Hydroelectric Power. Hydroelectric power generation is not a project purpose of Council Grove Lake.

8-08. Navigation. Council Grove Lake is regulated for flood control in conjunction with the other reservoirs in the navigation system, to help provide a tapered recession of flows along the Arkansas River navigation channel. The coordinated regulation of the reservoir is discussed in Chapter 7 of the Arkansas River Basin Water Control Master

Manual.

8-09. Drought Contingency Plans. The Drought Contingency Plan has carefully addressed the problems encountered during a drought. It provides a base for implementing actions necessary for conservation of water supply and has been structured according to the severity of the drought. This will enable the Water Management Section to more effectively coordinate with the public and District elements during such emergencies.

8-10. Flood Emergency Action Plans. Preparation of these reports has focused attention upon the need for effective coordination during floods. Coordination strategy has been established between the Water Management Section and other District elements which deal with the media and local government. This has proven to yield positive results during the more recent flood events.

8-11. Frequencies.

a. Peak Inflow Probability. Peak inflows taken from hydrographs published in the previous manual (1922-1965), monthly computations (1966-1986), and computer storage (1987-2008) were used to compute the maximum annual peak inflow probability. The inflow probability was derived in accordance with Bulletin 17B, "Guidelines for Determining Flood Flow Frequency," dated September 1981. The peak inflow probability curve is shown on Plate 4-4.

b. Pool Elevation Duration and Probability. Pool level hydrographs for a synthetic period of record, preceding the construction of Council Grove Dam, extending from January 1940 through December 2008 have been analyzed for exceedance probabilities. Pool elevation probabilities are shown on Plate 8-6. The pool elevation duration curve is shown on Plate 8-7. Plates 8-8 through 8-14 show pool elevations from simulated and actual operational hydrographs for the period of record January 1940 through September 2010.

c. Key Control Points. Principal control points for Council Grove Lake are the Council Grove and Americus Gages (see plates 4-5 and 4-6). Forecasts of hydrographs at these points are made by procedures described in paragraph 6-02 of this Manual. Generally, releases less than 3,000 c.f.s. do not cause out-of-bank flooding.

8-12. Other Studies.

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

b. Channel and Floodway Improvement. There are currently no channelization projects in progress between Council Grove Lake and John Redmond Reservoir. Ground and aerial reconnaissance are made as required to determine if revised channel capacities and maximum discharge limits are warranted.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organizations.

a. Corps of Engineers. Council Grove Lake is a Corps of Engineers project, with the Tulsa District Corps prescribing and directing the flood control releases. Operation and Maintenance, as well as regulation of the conservation storage, will be the responsibility of the Corps. Project reporting instructions and an organization chart are presented in Chapter V, and project regulating instructions are presented in Chapter VII of this manual.

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

- (a) Routine regulation of lakes and distribution of routine data.
- (b) Investigations and refinement of regulation procedures.
 - 1). Analysis of past floods.
 - 2). Reconnaissance to determine channel capacities.
 - 3). Improvement of forecasting techniques.
 - 4). Plan and coordinate the hydrologic reporting network with the National Weather Service and the U.S. Geological Survey.
- (c) Train personnel in flood control duties.
 - 1). Make periodic visits to projects by Section personnel to familiarize themselves with regulation facilities, become acquainted with the operating personnel, discuss emergency regulation procedures with operating personnel, and provide the background for improving facilities and methods.
 - 2). Instruct personnel of the Hydrology-Hydraulics Branch in flood control procedures to supplement the Water Management Section during flood emergencies, when necessary.
- (d) Prepare reports on lake regulation.

- 1). Recurring reports.
- 2). Water control manuals.
- 3). Post flood reports.

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

- (a) Evaluation of current hydrologic, hydraulic, and meteorological data.
- (b) Performing or obtaining reservoir forecasts.
- (c) Presentation of storm and flood analysis to the District Commander and other interested District personnel.
- (d) When necessary, furnish personnel to help project operating personnel in flood regulations.
- (e) Regulation of lakes according to flood control regulation schedules.
- (f) Furnish information to higher authority.
 - 1). Provide initial reports to the Southwestern Division and the Office of the Chief of Engineers by telephone.
 - 2). Provide hydrologic data for situation reports.
- (g) Furnish information to the Reservoir Information Control Center. The duties of the Lake Manager under flood conditions are set forth in Chapter VII of this manual. The details of the overall procedures of the Tulsa District under emergency conditions are set forth in Tulsa District Supplement A, Natural Disaster Activities, to ER 500-1-1.

(3) Assignment of Personnel. During non-flood periods, the Water Management Section accomplishes the routine regulation of the lake. 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 Management Section during a major flood. The area and size of the flood will determine the number of people engaged in each activity.

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

(5) Role of Lake Manager. The Lake Manager will regulate the lake during flood periods according to instructions issued by personnel of the Water Management Section. The instructions follow the "Normal Regulations for Flood Control," included in Chapter VII. If the Lake Manager loses communication with the District Office, he or she will immediately attempt to reestablish communication with the District Office while following the instructions outlined in the Section "Emergency Regulations for Flood Control" included in Chapter VII and Exhibit B of this manual. The Lake Manager will make daily observations as directed in paragraph 5-07.

b. Other Federal Agencies. The NWS and the U.S. Geological Survey (USGS) cooperate with the Water Management Section, Hydrology-Hydraulics Branch, Tulsa District Office, to accumulate rainfall and stream flow data. The Environmental Protection Agency, together with the State of Kansas, establishes the standards for water quality releases.

c. State Agencies. Management of the fish and wildlife resources of the Council Grove project is the responsibility of the Kansas Department of Wildlife and Parks.

d. Private Organizations. Presently, there are no privately owned flood control protection facilities at Council Grove Lake whose regulation is coordinated with the Corps of Engineers.

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

a. Local Press and Corps Bulletins. The Corps of Engineers, the NWS, and USGS coordinate in forecasting flood stages, stream flow, and pool elevations. The NWS is officially responsible for issuing flood warnings to the public. This information will be supplemented by the Corps of Engineers bulletins on observed conditions and with technical advice to enable local interests, within the limits of their capabilities, to obtain optimal flood protection and to perform rescue and relief functions. The Corps of Engineers further assists in flood fighting, through the office of the Emergency Operations Manager, who furnishes sandbags and other necessary equipment based on equipment on hand and need. To facilitate the distribution of these data, a Reservoir Information Control Center (RICC) is in operation when conditions warrant.

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

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

d. Power Marketing Agency. Presently, hydropower is not a project purpose.

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

9-03. Interagency Agreements. A Memorandum of Understanding (MOU) between the State of Kansas and the US Department of the Army concerning the purchase of municipal and industrial water supply storage was signed in December 1985 and is presented as Exhibit C.

9-04. Commissions, River Authorities, Compacts, and Committees.

There are no commissions or a river authority on the Neosho River. 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.

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

9-05. Reports.

a. Daily Reports. In accordance with Tulsa District policy, this report is prepared following procedures outlined by the Water Management Section on a daily basis, except Saturday, Sunday, and holidays, to cover a period of 24-hours. The report provides data for use by personnel, whose work requires knowledge about the regulation of reservoirs, field investigations, stream gaging, and construction of flood control projects affected by releases from reservoirs, answering public inquiries, and preparing public releases. The report includes information on pool elevation, flood control storage, releases, inflow and rainfall. The report is completed and dispatched from the Hydrology-Hydraulics Branch by 10:00 a.m. daily under normal conditions.

b. Monthly Lake Reports. The Water Management Section prepares monthly reports in accordance with EM 1110-2-3600 and ER 1110-2-240. These reports are records for all flood control, navigation, and multiple-purpose storage lakes under supervision of or of direct interest to the Tulsa District Office. Supplemental information on the regulation of the reservoirs, such as explanation of deviations from approved schedules, is added as a note on the reports or as an attachment. These tabulations are promptly prepared each month and maintained in such form as to be readily available for transmittal to the Chief of Engineers or others, upon request. The monthly lake reports are also available on the Tulsa District Web Page from 1994 to the present at www.swt-wc.usace.army.mil.

c. Flood Situation Reports. The Water Management Section provides daily information 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 about the floods. Pertinent data specifically required for reservoirs are as follows: name of reservoir, reservoir stage, predicted maximum stage, rates of inflow and outflow in c.f.s., percent of flood control storage used to date and at predicted maximum stage, and any special information particularly pertinent to the flood situation.

d. Post Flood Reports. This report is prepared according to ER 500-1-1 and OM 500-1-6 when practicable after a flood that had caused major damages. The report describes flood emergency operations by the Corps of Engineers and others. Included in summary form are: available hydrologic information, damage estimates, and other engineering data as are considered essential for flood control and flood plain studies or in the review or possible claims against the United States for damages. The District Office Planning Division personnel, using information compiled and prepared by the

Water Management Section prepare the report. The report should be completed within approximately three months of the time of flooding, including a statement of final damages and associated costs.

e. Annual Reports. The Water Management Section prepares this report. The report contains a summation of the general conditions of the river basins and the individual projects in the District for the preceding fiscal year. The report also presents the activities and accomplishments of the Water Management Section for the past year. The report is forwarded to the SWD Water Management 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 the lakes in the Tulsa District.

TABLE 9-1
TABULATION OF REPORTS

Name of Report	When Required	Regulation Requiring Reporting
Daily Report	Daily, except Saturday, Sunday, and holidays	Tulsa District Policy
Monthly Lake Report	Monthly	ER 1110-2-3600 EM 1110-2-240
Flood Situation Report	During Floods	OM 500-1-6 ER 500-1-1
Post flood Report	Following a flood causing major damage	OM 500-1-6 ER 500-1-1
Annual Report	Annually	ER 1110-2-1400

**COUNCIL GROVE LAKE, NEOSHO RIVER, KANSAS
WATER CONTROL MANUAL**

**APPENDIX O – PART I
TO
WATER CONTROL MASTER MANUAL
ARKANSAS RIVER BASIN**

SUPPLEMENTAL TABLES

TABLE 4-6

COUNCIL GROVE DAM SITE MONTHLY INFLOWS
(DAY-SECOND-FEET)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1922	220	19,500	15,300	19,600	7,700	6,500	40,300	1,100	330	420	24,300	1,300	136,570
1923	880	650	930	930	9,800	45,100	26,100	1,400	3,100	4,800	1,300	1,600	96,590
1924	1,300	1,500	9,400	9,000	10,600	3,900	1,700	19,400	650	580	180	200	58,410
1925	600	680	1,000	2,100	970	12,300	1,300	310	14,600	320	270	270	34,720
1926	180	310	400	3,700	1,200	990	200	410	25,100	33,500	6,500	1,200	73,690
1927	430	1,200	9,800	36,600	18,100	36,600	20,300	50,800	7,600	3,700	1,100	1,500	187,730
1928	1,100	7,400	4,800	15,000	6,300	38,900	11,600	7,000	820	2,400	36,600	6,100	138,020
1929	5,600	5,500	4,900	9,600	60,700	18,800	34,700	17,700	870	1,800	2,300	1,700	164,170
1930	1,400	4,200	970	4,600	16,100	13,300	560	1,400	5,400	7,400	8,200	1,200	64,730
1931	720	550	1,000	2,200	1,700	14,800	5,700	6,800	27,800	160	38,600	3,700	103,730
1932	1,700	1,700	2,800	1,900	2,900	25,700	41,300	9,700	1,000	720	470	860	90,750
1933	810	550	4,600	16,900	5,600	410	16,500	8,400	16,300	190	60	170	70,490
1934	190	130	270	830	21,100	4,500	100	10	5,200	340	730	280	33,680
1935	270	230	260	230	32,800	7,700	1,500	12,600	11,300	7,300	1,100	850	76,140
1936	710	420	390	200	20,100	410	50	40	23,700	2,000	160	240	48,420
1937	2,400	10,400	1,700	1,400	2,800	3,000	2,100	7,100	16,700	130	130	260	48,120
1938	260	200	370	1,200	56,600	61,100	3,000	23,500	1,500	560	16,700	0	164,990
1939	0	0	270	400	8,800	960	30	0	0	0	0	0	10,460
1940	0	0	0	0	180	3,300	0	0	8,500	0	2,400	320	14,700
1941	8,000	2,000	2,200	2,000	1,700	38,100	740	210	370	79,700	11,300	2,500	148,820
1942	2,800	1,500	3,700	3,300	16,700	35,800	2,500	1,500	9,400	6,900	1,200	9,900	95,200
1943	5,000	5,500	2,000	1,600	4,600	53,600	8,200	810	230	320	190	290	82,340
1944	1,300	340	25,700	84,700	34,900	9,300	2,100	15,300	3,600	3,200	2,200	44,200	226,840
1945	2,600	4,300	7,900	55,300	17,300	15,900	18,700	12,400	13,600	4,000	1,200	930	154,130
1946	11,500	1,900	4,400	4,900	8,300	11,700	2,400	470	6,000	410	630	6,000	58,610
1947	1,700	810	21,300	14,700	6,400	25,400	1,200	260	30	20	0	30	71,850
1948	60	220	4,400	2,900	18,200	7,100	61,200	1,700	330	100	150	190	96,550
1949	24,700	32,200	1,900	9,200	24,000	7,500	1,200	370	100	380	100	150	101,800
1950	430	230	190	140	2,200	13,500	22,800	37,900	2,400	890	560	580	81,820
1951	440	500	1,300	13,000	51,500	51,500	175,700	6,000	58,600	4,300	5,600	2,200	370,640
1952	1,900	1,800	13,100	19,200	6,400	1,500	380	3,100	110	30	80	220	47,820
1953	260	220	1,200	440	1,100	220	180	30	10	10	20	30	3,720
1954	20	20	20	20	30	5,600	10	390	10	10	3	2	6,135
1955	2	440	40	5,800	8,000	4,000	4,300	30	2	240	0	0	22,854
1956	0	0	0	190	90	2	0	6,800	0	110	20	0	7,212
1957	0	0	400	6,100	25,000	12,600	2,600	60	2,800	5,800	5,400	1,400	62,160
1958	2,000	5,600	16,400	3,700	4,200	9,300	23,400	4,200	12,000	10,400	1,400	1,100	93,700
1959	1,600	2,900	2,500	4,000	20,800	5,700	29,300	1,500	1,200	13,500	1,500	1,300	85,800
1960	5,400	8,100	34,600	11,900	3,500	6,200	4,700	890	5,000	9,500	2,300	4,700	96,790
1961	1,600	8,400	15,100	20,200	69,700	15,300	2,900	760	11,600	15,200	13,300	2,900	176,960
1962	18,000	6,900	12,100	3,900	4,500	13,400	860	670	33,900	3,300	1,400	1,200	100,130
1963	890	820	6,500	1,500	780	3,100	530	20	200	660	130	140	15,270
1964	170	130	180	18,800	4,500	9,300	450	3,000	1,300	30	1,700	1,400	40,960
1965	1,500	5,400	14,100	4,300	2,500	37,600	5,200	1,900	33,900	1,900	890	5,600	114,790
1966	2,500	2,200	1,700	14,200	2,500	1,400	900	820	370	500	440	560	28,090
1967	760	580	550	2,900	1,100	47,400	2,300	730	11,200	28,300	3,600	2,500	101,920
1968	2,100	1,300	1,300	11,600	11,700	11,900	6,100	1,600	890	16,900	4,500	4,900	74,790
1969	2,800	9,600	12,000	37,400	13,000	38,000	42,000	1,700	1,500	2,200	1,300	3,200	164,700
1970	3,700	1,400	1,800	21,000	6,600	23,900	960	640	5,600	5,500	890	840	72,830

TABLE 4-6 (continued)

COUNCIL GROVE DAM SITE MONTHLY INFLOWS
(DAY-SECOND-FEET)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1971	2,100	7,700	5,200	2,300	21,000	23,600	33,500	2,700	770	1,600	10,200	2,800	113,470
1972	1,700	1,600	720	6,900	17,500	1,800	11,300	820	1,400	220	6,400	20,500	70,860
1973	22,200	27,700	77,600	21,900	23,100	2,600	9,800	2,800	54,300	56,900	540	21,300	320,740
1974	12,600	4,800	7,800	22,200	15,200	22,700	1,300	1,200	620	8,500	11,300	3,100	111,320
1975	410	9,000	7,100	20,200	4,100	27,600	1,900	1,700	350	60	1,200	1,300	74,920
1976	690	640	760	17,100	18,900	4,900	980	180	180	140	50	210	44,730
1977	490	420	900	1,600	30,100	48,000	6,000	3,200	5,800	3,800	8,000	2,000	110,310
1978	1,400	6,400	16,100	6,500	6,600	3,400	2,400	600	1,300	170	1,500	440	46,810
1979	1,100	7,800	34,100	7,900	4,600	2,600	17,900	2,200	410	2,000	1,300	560	82,470
1980	940	4,400	25,600	11,800	2,300	380	110	700	70	270	40	1,100	47,710
1981	220	550	910	570	4,200	28,100	11,200	6,300	2,700	1,100	22,100	4,000	81,950
1982	6,100	15,500	8,200	1,800	54,900	29,300	8,300	960	80	90	590	880	126,700
1983	1,300	5,900	10,000	51,100	40,300	18,500	2,300	490	480	580	7,700	1,300	139,950
1984	5,800	3,200	36,100	42,000	10,300	11,400	3,300	110	140	170	270	2,500	115,290
1985	1,400	19,800	15,400	7,000	19,300	31,500	1,600	12,400	32,300	50,800	10,200	9,600	211,300
1986	6,000	7,200	3,800	12,200	21,000	12,000	12,800	2,900	21,400	18,500	4,200	6,300	128,300
1987	5,100	12,900	35,000	16,300	8,900	6,800	3,000	3,900	950	1,100	2,600	6,500	103,050
1988	2,300	1,500	2,000	10,600	3,600	1,400	1,500	410	70	60	60	60	23,560
1989	410	210	1,300	320	590	480	90	5,900	8,400	430	250	550	18,930
1990	850	1,800	10,500	4,500	10,100	4,900	690	3,400	60	60	80	60	37,000
1991	9	140	990	14,500	8,300	3,900	280	0	0	0	520	210	28,849
1992	390	1,100	7,600	2,300	1,200	9,200	32,400	6,200	600	930	18,300	24,200	104,420
1993	7,700	8,500	18,500	27,800	99,200	7,400	109,900	9,500	7,400	1,600	1,800	2,200	301,500
1994	845	740	940	4,455	4,100	6,390	4,720	385	15	35	360	565	23,550
1995	295	355	9,220	13,040	64,980	27,300	22,400	7,020	340	25	275	505	145,755
1996	545	420	770	400	7,530	18,625	1,335	4,255	4,590	2,630	10,355	2,535	53,990
1997	1,430	10,845	2,820	16,230	5,110	1,530	2,605	1,390	1,005	4,740	1,635	8,750	58,090
1998	3,535	3,720	13,440	6,075	3,470	1,305	9,135	6,165	2,600	14,495	27,940	3,280	95,160
1999	3,285	3,820	2,620	38,275	26,210	8,950	950	775	525	85	520	629	86,644
2000	100	760	1,860	1,035	1,004	3,240	537	155	274	740	560	0	10,265
2001	640	8,830	5,710	3,195	2,140	11,095	1,180	870	465	330	280	300	35,035
2002	720	420	585	1,630	1,405	740	199	498	550	1,665	305	279	8,996
2003	44	630	1,225	6,720	2,945	1,420	235	4,200	631	90	55	300	18,495
2004	182	1,744	11,280	2,100	2,636	21,853	21,035	1,002	300	330	371	173	63,006
2005	2,395	3,865	1,875	5,050	14,289	27,230	5,535	32,425	3,250	670	525	620	97,729
2006	835	990	3,080	5,665	3,035	730	700	1,725	615	660	295	540	18,870
2007	705	2,180	8,595	5,575	29,309	3,370	780	322	316	744	190	4,605	56,691
2008	1,970	7,340	6,925	3,405	7,130	3,565	765	1,225	4,749	909	950	480	39,413
2009	620	398	1,398	11,620	1,136	4,020	4,255	1,494	3,651	3,125	2,620	1,860	36,197
MIN	0	0	0	0	30	2	0	0	0	0	0	0	3,720
MEAN	2,521	4,048	7,571	10,672	14,291	14,294	11,134	4,613	6,254	5,238	4,086	2,930	87,652
MAX	24,700	32,200	77,600	84,700	99,200	61,100	175,700	50,800	58,600	79,700	38,600	44,200	370,640

**TABLE 7-3
ELEVATION-AREA-CAPACITY DATA
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY**

AREA IN 1000'S OF AC

ELEV NGVD29	0	1	2	3	4	5	6	7	8	9
1230	.000	.000	.000	.000	.000	.000	.000	.000	.000	.010
1240	.020	.055	.091	.126	.162	.197	.232	.268	.303	.339
1250	.374	.487	.600	.713	.826	.939	1.051	1.164	1.277	1.390
1260	1.503	1.631	1.758	1.886	2.013	2.141	2.269	2.396	2.524	2.651
1270	2.779	2.913	3.047	3.180	3.314	3.431	3.547	3.664	3.781	3.897
1280	4.014	4.165	4.315	4.466	4.617	4.767	4.918	5.069	5.219	5.370
1290	5.585	5.800	6.015	6.231	6.446	6.661	6.876	6.974	7.073	7.171
1300	7.269	7.613	7.956	8.300	8.643	8.987	9.330	9.365	9.401	9.436
1310	9.471	.000	.000	.000	.000	.000	.000	.000	.000	.000

CAPACITY IN 1000'S OF ACRE-FEET

ELEV NGVD29	0	1	2	3	4	5	6	7	8	9
1230	.000	.000	.000	.000	.000	.000	.000	.000	.000	.005
1240	.020	.058	.131	.239	.383	.563	.777	1.027	1.313	1.634
1250	1.990	2.421	2.964	3.621	4.390	5.273	6.268	7.375	8.596	9.929
1260	11.376	12.943	14.637	16.459	18.409	20.486	22.691	25.023	27.483	30.071
1270	32.786	35.632	38.612	41.725	44.972	48.345	51.834	55.439	59.162	63.001
1280	66.956	71.046	75.286	79.676	84.218	88.910	93.752	98.746	103.890	109.184
1290	114.662	120.354	126.262	132.385	138.723	145.277	152.045	158.970	165.994	173.116
1300	180.336	187.777	195.561	203.689	212.161	220.976	230.134	239.482	248.865	258.283
1310	267.737	.000	.000	.000	.000	.000	.000	.000	.000	.000

T7-3-1

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1230.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1231.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1232.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1233.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1234.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1235.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1236.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1237.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1238.0	.000	.000	.000	.001	.001	.001	.002	.003	.003	.004
1239.0	.005	.006	.007	.009	.010	.011	.013	.015	.016	.018
1240.0	.020	.022	.025	.028	.031	.034	.038	.043	.047	.052
1241.0	.058	.063	.069	.076	.082	.090	.097	.105	.113	.122
1242.0	.131	.140	.149	.159	.170	.180	.192	.203	.215	.227
1243.0	.239	.252	.265	.279	.292	.307	.321	.336	.351	.367
1244.0	.383	.399	.416	.433	.451	.468	.487	.505	.524	.543
1245.0	.563	.582	.603	.623	.644	.665	.687	.709	.731	.754
1246.0	.777	.800	.824	.848	.873	.898	.923	.948	.974	1.000
1247.0	1.027	1.054	1.081	1.109	1.137	1.165	1.194	1.223	1.253	1.282
1248.0	1.313	1.343	1.374	1.405	1.437	1.469	1.501	1.534	1.567	1.600
1249.0	1.634	1.668	1.702	1.737	1.772	1.807	1.843	1.879	1.916	1.953
1250.0	1.990	2.028	2.067	2.107	2.149	2.191	2.235	2.280	2.325	2.372
1251.0	2.421	2.470	2.520	2.572	2.624	2.678	2.733	2.789	2.846	2.905
1252.0	2.964	3.025	3.086	3.149	3.213	3.278	3.344	3.412	3.480	3.550
1253.0	3.621	3.692	3.765	3.840	3.915	3.991	4.069	4.147	4.227	4.308
1254.0	4.390	4.473	4.558	4.643	4.730	4.817	4.906	4.996	5.087	5.179
1255.0	5.273	5.367	5.463	5.559	5.657	5.756	5.856	5.957	6.060	6.163
1256.0	6.268	6.373	6.480	6.588	6.697	6.807	6.919	7.031	7.145	7.259
1257.0	7.375	7.492	7.610	7.729	7.850	7.971	8.094	8.218	8.342	8.468
1258.0	8.596	8.724	8.853	8.984	9.115	9.248	9.382	9.517	9.653	9.791
1259.0	9.929	10.069	10.209	10.351	10.494	10.638	10.783	10.930	11.077	11.226

T7-3-2

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1260.0	11.376	11.527	11.679	11.832	11.987	12.143	12.300	12.459	12.619	12.780
1261.0	12.943	13.106	13.271	13.438	13.605	13.774	13.944	14.115	14.288	14.462
1262.0	14.637	14.814	14.991	15.170	15.351	15.532	15.715	15.899	16.084	16.271
1263.0	16.459	16.648	16.839	17.031	17.224	17.418	17.614	17.810	18.009	18.208
1264.0	18.409	18.611	18.814	19.018	19.224	19.431	19.639	19.849	20.060	20.272
1265.0	20.486	20.700	20.916	21.134	21.352	21.572	21.793	22.016	22.239	22.464
1266.0	22.691	22.918	23.147	23.377	23.608	23.841	24.075	24.310	24.546	24.784
1267.0	25.023	25.263	25.505	25.748	25.992	26.237	26.484	26.732	26.981	27.231
1268.0	27.483	27.736	27.990	28.246	28.503	28.761	29.020	29.281	29.543	29.806
1269.0	30.071	30.336	30.603	30.872	31.141	31.412	31.684	31.958	32.232	32.508
1270.0	32.786	33.064	33.344	33.625	33.908	34.192	34.477	34.764	35.052	35.341
1271.0	35.632	35.924	36.217	36.512	36.808	37.105	37.404	37.704	38.005	38.308
1272.0	38.612	38.917	39.224	39.532	39.841	40.152	40.464	40.777	41.092	41.408
1273.0	41.725	42.044	42.364	42.685	43.008	43.332	43.657	43.984	44.312	44.641
1274.0	44.972	45.304	45.637	45.972	46.307	46.644	46.982	47.321	47.661	48.002
1275.0	48.345	48.688	49.033	49.379	49.726	50.075	50.424	50.775	51.127	51.479
1276.0	51.834	52.189	52.545	52.903	53.262	53.622	53.983	54.345	54.709	55.073
1277.0	55.439	55.806	56.174	56.544	56.914	57.286	57.659	58.033	58.408	58.784
1278.0	59.162	59.540	59.920	60.301	60.683	61.067	61.451	61.837	62.224	62.611
1279.0	63.001	63.391	63.782	64.175	64.569	64.964	65.360	65.757	66.156	66.555
1280.0	66.956	67.358	67.762	68.167	68.574	68.982	69.392	69.803	70.216	70.630
1281.0	71.046	71.463	71.882	72.302	72.724	73.147	73.572	73.998	74.426	74.855
1282.0	75.286	75.718	76.152	76.587	77.024	77.462	77.902	78.343	78.786	79.230
1283.0	79.676	80.123	80.572	81.023	81.475	81.928	82.383	82.839	83.297	83.757
1284.0	84.218	84.680	85.144	85.609	86.076	86.545	87.015	87.486	87.959	88.434
1285.0	88.910	89.387	89.866	90.346	90.828	91.312	91.797	92.284	92.772	93.261
1286.0	93.752	94.245	94.739	95.234	95.731	96.230	96.730	97.232	97.735	98.239
1287.0	98.746	99.253	99.762	100.273	100.785	101.299	101.814	102.331	102.849	103.368
1288.0	103.890	104.412	104.936	105.462	105.989	106.518	107.048	107.580	108.113	108.648
1289.0	109.184	109.722	110.262	110.805	111.349	111.896	112.445	112.996	113.549	114.104

T7-3-3

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

BASED ON 1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1290.0	114.662	115.221	115.783	116.347	116.913	117.481	118.051	118.624	119.198	119.775
1291.0	120.354	120.935	121.518	122.104	122.691	123.281	123.873	124.467	125.063	125.661
1292.0	126.262	126.864	127.469	128.076	128.685	129.296	129.909	130.525	131.143	131.763
1293.0	132.385	133.009	133.635	134.264	134.894	135.527	136.162	136.799	137.438	138.080
1294.0	138.723	139.369	140.017	140.667	141.319	141.973	142.629	143.288	143.949	144.612
1295.0	145.277	145.944	146.613	147.285	147.958	148.634	149.312	149.992	150.674	151.359
1296.0	152.045	152.733	153.422	154.112	154.803	155.495	156.188	156.882	157.577	158.273
1297.0	158.970	159.668	160.367	161.067	161.768	162.469	163.172	163.876	164.581	165.287
1298.0	165.994	166.701	167.410	168.120	168.831	169.542	170.255	170.969	171.683	172.399
1299.0	173.116	173.833	174.552	175.271	175.992	176.713	177.436	178.159	178.884	179.609
1300.0	180.336	181.064	181.796	182.532	183.271	184.013	184.759	185.508	186.261	187.017
1301.0	187.777	188.540	189.306	190.076	190.849	191.626	192.406	193.190	193.977	194.767
1302.0	195.561	196.358	197.159	197.963	198.771	199.582	200.397	201.215	202.036	202.861
1303.0	203.689	204.521	205.356	206.195	207.037	207.882	208.731	209.583	210.439	211.298
1304.0	212.161	213.027	213.896	214.769	215.645	216.525	217.408	218.295	219.185	220.079
1305.0	220.976	221.876	222.780	223.687	224.598	225.512	226.430	227.351	228.275	229.203
1306.0	230.134	231.067	232.001	232.935	233.869	234.803	235.738	236.674	237.609	238.545
1307.0	239.482	240.418	241.355	242.293	243.230	244.169	245.107	246.046	246.985	247.925
1308.0	248.865	249.805	250.745	251.686	252.628	253.569	254.512	255.454	256.397	257.340
1309.0	258.283	259.227	260.171	261.115	262.060	263.005	263.951	264.897	265.843	266.790

T7-3-4

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1230.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1231.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1232.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1233.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1234.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1235.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1236.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1237.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
1238.0	.000	.000	.000	.001	.001	.001	.002	.003	.003	.004
	.000	.001	.002	.003	.004	.005	.006	.007	.008	.009
1239.0	.005	.006	.007	.009	.010	.011	.013	.015	.016	.018
	.010	.011	.012	.013	.014	.015	.016	.017	.018	.019

T7-3-5

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1240.0	.020	.022	.025	.028	.031	.034	.038	.043	.047	.052
	.020	.024	.027	.031	.034	.038	.041	.045	.048	.052
1241.0	.058	.063	.069	.076	.082	.090	.097	.105	.113	.122
	.055	.059	.062	.066	.069	.073	.077	.080	.084	.088
1242.0	.131	.140	.149	.159	.170	.180	.192	.203	.215	.227
	.091	.095	.098	.102	.105	.109	.112	.116	.119	.123
1243.0	.239	.252	.265	.279	.292	.307	.321	.336	.351	.367
	.126	.130	.133	.137	.140	.144	.148	.151	.155	.159
1244.0	.383	.399	.416	.433	.451	.468	.487	.505	.524	.543
	.162	.166	.169	.173	.176	.180	.183	.187	.190	.194
1245.0	.563	.582	.603	.623	.644	.665	.687	.709	.731	.754
	.197	.201	.204	.208	.211	.215	.218	.222	.225	.229
1246.0	.777	.800	.824	.848	.873	.898	.923	.948	.974	1.000
	.232	.236	.239	.243	.247	.250	.254	.257	.261	.264
1247.0	1.027	1.054	1.081	1.109	1.137	1.165	1.194	1.223	1.253	1.282
	.268	.272	.275	.279	.282	.286	.289	.293	.296	.300
1248.0	1.313	1.343	1.374	1.405	1.437	1.469	1.501	1.534	1.567	1.600
	.303	.307	.310	.314	.317	.321	.325	.328	.332	.336
1249.0	1.634	1.668	1.702	1.737	1.772	1.807	1.843	1.879	1.916	1.953
	.339	.343	.346	.350	.353	.357	.360	.364	.367	.371

T7-3-6

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1250.0	1.990	2.028	2.067	2.107	2.149	2.191	2.235	2.280	2.325	2.372
	.374	.385	.397	.408	.419	.431	.442	.453	.465	.476
1251.0	2.421	2.470	2.520	2.572	2.624	2.678	2.733	2.789	2.846	2.905
	.487	.498	.510	.521	.532	.544	.555	.566	.577	.589
1252.0	2.964	3.025	3.086	3.149	3.213	3.278	3.344	3.412	3.480	3.550
	.600	.611	.623	.634	.645	.657	.668	.679	.691	.702
1253.0	3.621	3.692	3.765	3.840	3.915	3.991	4.069	4.147	4.227	4.308
	.713	.724	.736	.747	.758	.770	.781	.792	.803	.815
1254.0	4.390	4.473	4.558	4.643	4.730	4.817	4.906	4.996	5.087	5.179
	.826	.837	.849	.860	.871	.883	.894	.905	.917	.928
1255.0	5.273	5.367	5.463	5.559	5.657	5.756	5.856	5.957	6.060	6.163
	.939	.950	.961	.973	.984	.995	1.006	1.018	1.029	1.040
1256.0	6.268	6.373	6.480	6.588	6.697	6.807	6.919	7.031	7.145	7.259
	1.051	1.062	1.074	1.085	1.096	1.108	1.119	1.130	1.141	1.153
1257.0	7.375	7.492	7.610	7.729	7.850	7.971	8.094	8.218	8.342	8.468
	1.164	1.175	1.187	1.198	1.209	1.221	1.232	1.243	1.255	1.266
1258.0	8.596	8.724	8.853	8.984	9.115	9.248	9.382	9.517	9.653	9.791
	1.277	1.288	1.300	1.311	1.322	1.334	1.345	1.356	1.368	1.379
1259.0	9.929	10.069	10.209	10.351	10.494	10.638	10.783	10.930	11.077	11.226
	1.390	1.401	1.413	1.424	1.435	1.447	1.458	1.469	1.480	1.492

T7-3-7

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1260.0	11.376	11.527	11.679	11.832	11.987	12.143	12.300	12.459	12.619	12.780
	1.503	1.516	1.529	1.541	1.554	1.567	1.580	1.593	1.605	1.618
1261.0	12.943	13.106	13.271	13.438	13.605	13.774	13.944	14.115	14.288	14.462
	1.631	1.644	1.656	1.669	1.682	1.695	1.707	1.720	1.733	1.745
1262.0	14.637	14.814	14.991	15.170	15.351	15.532	15.715	15.899	16.084	16.271
	1.758	1.771	1.784	1.796	1.809	1.822	1.835	1.848	1.860	1.873
1263.0	16.459	16.648	16.839	17.031	17.224	17.418	17.614	17.810	18.009	18.208
	1.886	1.899	1.911	1.924	1.937	1.950	1.962	1.975	1.988	2.000
1264.0	18.409	18.611	18.814	19.018	19.224	19.431	19.639	19.849	20.060	20.272
	2.013	2.026	2.039	2.052	2.064	2.077	2.090	2.103	2.115	2.128
1265.0	20.486	20.700	20.916	21.134	21.352	21.572	21.793	22.016	22.239	22.464
	2.141	2.154	2.167	2.180	2.192	2.205	2.218	2.231	2.243	2.256
1266.0	22.691	22.918	23.147	23.377	23.608	23.841	24.075	24.310	24.546	24.784
	2.269	2.282	2.295	2.307	2.320	2.333	2.345	2.358	2.371	2.383
1267.0	25.023	25.263	25.505	25.748	25.992	26.237	26.484	26.732	26.981	27.231
	2.396	2.409	2.422	2.434	2.447	2.460	2.473	2.486	2.499	2.511
1268.0	27.483	27.736	27.990	28.246	28.503	28.761	29.020	29.281	29.543	29.806
	2.524	2.537	2.549	2.562	2.575	2.588	2.600	2.613	2.626	2.638
1269.0	30.071	30.336	30.603	30.872	31.141	31.412	31.684	31.958	32.232	32.508
	2.651	2.664	2.677	2.690	2.702	2.715	2.728	2.741	2.753	2.766

T7-3-8

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1270.0	32.786	33.064	33.344	33.625	33.908	34.192	34.477	34.764	35.052	35.341
	2.779	2.793	2.806	2.819	2.833	2.846	2.859	2.873	2.886	2.900
1271.0	35.632	35.924	36.217	36.512	36.808	37.105	37.404	37.704	38.005	38.308
	2.913	2.927	2.940	2.953	2.967	2.980	2.993	3.007	3.020	3.034
1272.0	38.612	38.917	39.224	39.532	39.841	40.152	40.464	40.777	41.092	41.408
	3.047	3.060	3.074	3.087	3.100	3.114	3.127	3.140	3.154	3.167
1273.0	41.725	42.044	42.364	42.685	43.008	43.332	43.657	43.984	44.312	44.641
	3.180	3.194	3.207	3.220	3.234	3.247	3.260	3.274	3.287	3.301
1274.0	44.972	45.304	45.637	45.972	46.307	46.644	46.982	47.321	47.661	48.002
	3.314	3.326	3.338	3.349	3.361	3.373	3.384	3.396	3.408	3.419
1275.0	48.345	48.688	49.033	49.379	49.726	50.075	50.424	50.775	51.127	51.479
	3.431	3.443	3.454	3.466	3.477	3.489	3.501	3.512	3.524	3.536
1276.0	51.834	52.189	52.545	52.903	53.262	53.622	53.983	54.345	54.709	55.073
	3.547	3.559	3.570	3.582	3.594	3.606	3.617	3.629	3.641	3.652
1277.0	55.439	55.806	56.174	56.544	56.914	57.286	57.659	58.033	58.408	58.784
	3.664	3.676	3.688	3.699	3.711	3.723	3.734	3.746	3.758	3.769
1278.0	59.162	59.540	59.920	60.301	60.683	61.067	61.451	61.837	62.224	62.611
	3.781	3.793	3.804	3.816	3.828	3.839	3.851	3.862	3.874	3.885
1279.0	63.001	63.391	63.782	64.175	64.569	64.964	65.360	65.757	66.156	66.555
	3.897	3.909	3.921	3.932	3.944	3.956	3.967	3.979	3.991	4.002

T7-3-9

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1280.0	66.956	67.358	67.762	68.167	68.574	68.982	69.392	69.803	70.216	70.630
	4.014	4.029	4.044	4.059	4.075	4.090	4.105	4.120	4.135	4.150
1281.0	71.046	71.463	71.882	72.302	72.724	73.147	73.572	73.998	74.426	74.855
	4.165	4.180	4.195	4.210	4.225	4.240	4.255	4.270	4.285	4.300
1282.0	75.286	75.718	76.152	76.587	77.024	77.462	77.902	78.343	78.786	79.230
	4.315	4.330	4.345	4.360	4.376	4.391	4.406	4.421	4.436	4.451
1283.0	79.676	80.123	80.572	81.023	81.475	81.928	82.383	82.839	83.297	83.757
	4.466	4.481	4.496	4.511	4.527	4.542	4.557	4.572	4.587	4.602
1284.0	84.218	84.680	85.144	85.609	86.076	86.545	87.015	87.486	87.959	88.434
	4.617	4.632	4.647	4.662	4.677	4.692	4.707	4.722	4.737	4.752
1285.0	88.910	89.387	89.866	90.346	90.828	91.312	91.797	92.284	92.772	93.261
	4.767	4.782	4.797	4.812	4.827	4.843	4.858	4.873	4.888	4.903
1286.0	93.752	94.245	94.739	95.234	95.731	96.230	96.730	97.232	97.735	98.239
	4.918	4.933	4.948	4.963	4.978	4.994	5.009	5.024	5.039	5.054
1287.0	98.746	99.253	99.762	100.273	100.785	101.299	101.814	102.331	102.849	103.368
	5.069	5.084	5.099	5.114	5.129	5.144	5.159	5.174	5.189	5.204
1288.0	103.890	104.412	104.936	105.462	105.989	106.518	107.048	107.580	108.113	108.648
	5.219	5.234	5.249	5.264	5.280	5.295	5.310	5.325	5.340	5.355
1289.0	109.184	109.722	110.262	110.805	111.349	111.896	112.445	112.996	113.549	114.104
	5.370	5.392	5.413	5.435	5.456	5.478	5.499	5.521	5.542	5.564

T7-3-10

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1290.0	114.662	115.221	115.783	116.347	116.913	117.481	118.051	118.624	119.198	119.775
	5.585	5.607	5.628	5.650	5.671	5.693	5.714	5.736	5.757	5.779
1291.0	120.354	120.935	121.518	122.104	122.691	123.281	123.873	124.467	125.063	125.661
	5.800	5.822	5.843	5.865	5.886	5.908	5.929	5.951	5.972	5.994
1292.0	126.262	126.864	127.469	128.076	128.685	129.296	129.909	130.525	131.143	131.763
	6.015	6.037	6.058	6.080	6.102	6.123	6.145	6.166	6.188	6.209
1293.0	132.385	133.009	133.635	134.264	134.894	135.527	136.162	136.799	137.438	138.080
	6.231	6.253	6.274	6.296	6.317	6.339	6.360	6.382	6.403	6.425
1294.0	138.723	139.369	140.017	140.667	141.319	141.973	142.629	143.288	143.949	144.612
	6.446	6.468	6.489	6.511	6.532	6.554	6.575	6.597	6.618	6.640
1295.0	145.277	145.944	146.613	147.285	147.958	148.634	149.312	149.992	150.674	151.359
	6.661	6.683	6.704	6.726	6.747	6.769	6.790	6.812	6.833	6.855
1296.0	152.045	152.733	153.422	154.112	154.803	155.495	156.188	156.882	157.577	158.273
	6.876	6.886	6.896	6.905	6.915	6.925	6.935	6.945	6.955	6.964
1297.0	158.970	159.668	160.367	161.067	161.768	162.469	163.172	163.876	164.581	165.287
	6.974	6.984	6.994	7.004	7.014	7.024	7.034	7.043	7.053	7.063
1298.0	165.994	166.701	167.410	168.120	168.831	169.542	170.255	170.969	171.683	172.399
	7.073	7.083	7.093	7.102	7.112	7.122	7.132	7.142	7.152	7.161
1299.0	173.116	173.833	174.552	175.271	175.992	176.713	177.436	178.159	178.884	179.609
	7.171	7.181	7.191	7.201	7.210	7.220	7.230	7.240	7.249	7.259

T7-3-11

TABLE 7-3 (continued)
COUNCIL GROVE LAKE, KANSAS
1994 RESURVEY

POOL ELEV [FT. NGVD29]	CAPACITY [1000'S OF ACRE-FEET] AREA [1000'S OF ACRES]									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1300.0	180.336	181.064	181.796	182.532	183.271	184.013	184.759	185.508	186.261	187.017
	7.269	7.304	7.338	7.372	7.407	7.441	7.476	7.510	7.544	7.579
1301.0	187.777	188.540	189.306	190.076	190.849	191.626	192.406	193.190	193.977	194.767
	7.613	7.647	7.682	7.716	7.750	7.785	7.819	7.853	7.887	7.922
1302.0	195.561	196.358	197.159	197.963	198.771	199.582	200.397	201.215	202.036	202.861
	7.956	7.990	8.025	8.059	8.094	8.128	8.163	8.197	8.231	8.266
1303.0	203.689	204.521	205.356	206.195	207.037	207.882	208.731	209.583	210.439	211.298
	8.300	8.334	8.369	8.403	8.437	8.472	8.506	8.540	8.575	8.609
1304.0	212.161	213.027	213.896	214.769	215.645	216.525	217.408	218.295	219.185	220.079
	8.643	8.677	8.712	8.746	8.781	8.815	8.849	8.884	8.918	8.953
1305.0	220.976	221.876	222.780	223.687	224.598	225.512	226.430	227.351	228.275	229.203
	8.987	9.021	9.056	9.090	9.124	9.159	9.193	9.227	9.262	9.296
1306.0	230.134	231.067	232.001	232.935	233.869	234.803	235.738	236.674	237.609	238.545
	9.330	9.334	9.337	9.341	9.344	9.348	9.351	9.355	9.358	9.362
1307.0	239.482	240.418	241.355	242.293	243.230	244.169	245.107	246.046	246.985	247.925
	9.365	9.369	9.372	9.376	9.380	9.383	9.387	9.390	9.394	9.398
1308.0	248.865	249.805	250.745	251.686	252.628	253.569	254.512	255.454	256.397	257.340
	9.401	9.405	9.408	9.412	9.415	9.419	9.422	9.426	9.429	9.433
1309.0	258.283	259.227	260.171	261.115	262.060	263.005	263.951	264.897	265.843	266.790
	9.436	9.440	9.443	9.447	9.450	9.454	9.457	9.461	9.464	9.468

T7-3-12

TABLE 7-5

WATER RIGHTS BELOW COUNCIL GROVE LAKE
TO JOHN REDMOND RESERVOIR

Row	FILE_NO	USE	Q4	Q3	Q2	Q1	FEET NORTH	FEET WEST	SEC	TWP	RNG	COUNTY	AC-FT	DATE FILED	DATE APPR	LAST NAME	FIRST NAME
1	1653 00	IRR		CW	SW	SW			11	17	9E	MORRIS	110	23-Jul-53	10-Nov-53	(b) (6)	
2	1898 00	IRR		NW	SE	NE			23	17	9E	MORRIS	35	10-Oct-53	18-Jan-54		
3	1898 00	IRR		NW	SE	NE			23	17	9E	MORRIS	35	10-Oct-53	18-Jan-54		
4	1898 00	IRR		NW	SE	NE			23	17	9E	MORRIS	35	10-Oct-53	18-Jan-54		
5	1898 00	IRR		SE	SE	NE	2750	450	23	17	9E	MORRIS	35	10-Oct-53	18-Jan-54		
6	1898 00	IRR		SE	SE	NE	2750	450	23	17	9E	MORRIS	35	10-Oct-53	18-Jan-54		
7	1898 00	IRR		SE	SE	NE	2750	450	23	17	9E	MORRIS	35	10-Oct-53	18-Jan-54		
8	1898 00	IRR		SW	NW	NE	4050	2500	23	17	9E	MORRIS	35	10-Oct-53	18-Jan-54		
9	1898 00	IRR		SW	NW	NE	4050	2500	23	17	9E	MORRIS	35	10-Oct-53	18-Jan-54		
10	1898 00	IRR		SW	NW	NE	4050	2500	23	17	9E	MORRIS	35	10-Oct-53	18-Jan-54		
11	2006 00	IRR		NW	SE	SE			14	19	12E	LYON	11	23-Nov-53	21-Dec-53		
12	2841 00	IRR		SE	NW	NE			23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
13	2841 00	IRR		SE	NW	NE			23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
14	2841 00	IRR		SE	NW	NE			23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
15	2841 00	IRR		SE	SE	NE	2750	450	23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
16	2841 00	IRR		SE	SE	NE	2750	450	23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
17	2841 00	IRR		SE	SE	NE	2750	450	23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
18	2841 00	IRR		SW	NW	NE	4050	2500	23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		

T7-5-1

TABLE 7-5 (continued)

Row	FILE_NO	USE	Q4	Q3	Q2	Q1	FEET NORTH	FEET WEST	SEC	TWP	RNG	COUNTY	AC-FT	DATE FILED	DATE APPR	LAST NAME	FIRST NAME
19	2841 00	IRR		SW	NW	NE	4050	2500	23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54	(b) (6)	
20	2841 00	IRR		SW	NW	NE	4050	2500	23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
21	2841 00	IRR		SW	NW	NE			23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
22	2841 00	IRR		SW	NW	NE			23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
23	2841 00	IRR		SW	NW	NE			23	17	9E	MORRIS	25	7-Aug-54	4-Nov-54		
24	2841 00	STK		SW	NW	NE	4050	2500	23	17	9E	MORRIS	0	7-Aug-54	4-Nov-54		
25	2841 00	STK		SW	NW	NE	4050	2500	23	17	9E	MORRIS	0	7-Aug-54	4-Nov-54		
26	2841 00	STK		SW	NW	NE	4050	2500	23	17	9E	MORRIS	0	7-Aug-54	4-Nov-54		
27	4859 00	IRR		CW	SW	SW			11	17	9E	MORRIS	46	9-Dec-55	23-Dec-55		
28	6241 00	MUN		CS	SE	SW			11	16	8E	MORRIS	39.4	26-Oct-56	24-Oct-60	COUN GROVE	CITY OF
29	6777 00	IRR		NC	E2	SW	1250	3500	11	16	8E	MORRIS	20	25-Jan-57	12-Apr-57	(b) (6)	
30	6777 00	IRR		NC	E2	SW	1250	3500	11	16	8E	MORRIS	20	25-Jan-57	12-Apr-57	WHITE REVC TR	HENRY A
31	6777 00	IRR		NW	NE	SW	2580	3500	11	16	8E	MORRIS	20	25-Jan-57	12-Apr-57	(b) (6)	
32	6777 00	IRR		NW	NE	SW	2580	3500	11	16	8E	MORRIS	20	25-Jan-57	12-Apr-57	WHITE REVC TR	HENRY A
33	6777 00	IRR			E2	NE			10	16	8E	MORRIS	20	25-Jan-57	12-Apr-57	(b) (6)	
34	6777 00	IRR			E2	NE			10	16	8E	MORRIS	20	25-Jan-57	12-Apr-57	WHITE REVC TR	HENRY A
35	7020 00	IRR		NW	SE	NW			24	19	12E	LYON	46	4-Mar-57	17-May-57	(b) (6)	
36	7020 00	IRR		SE	NE	SW			24	19	12E	LYON	46	4-Mar-57	17-May-57		

T7-5-2

TABLE 7-5 (continued)

Row	FILE_NO	USE	Q4	Q3	Q2	Q1	FEET NORTH	FEET WEST	SEC	TWP	RNG	COUNTY	AC-FT	DATE FILED	DATE APPR	LAST NAME	FIRST NAME
37	7020 00	IRR		SE	SE	NW			24	19	12E	LYON	46	4-Mar-57	17-May-57	(b) (6)	
38	8420 00	MUN	NC	E2	SE	SE	660	420	32	18	11E	LYON	3077.88	27-Jun-60	14-Nov-60	EMPORIA	CITY OF
39	10046 00	IRR		NW	NE	SW	2100	3800	4	17	9E	MORRIS	217	20-May-64	14-Sep-64	(b) (6)	
40	10046 00	IRR		SW	NE	SW	1900	3500	4	17	9E	MORRIS	217	20-May-64	14-Sep-64	(b) (6)	
41	10046 00	IRR		SW	SW	NW	3050	5200	4	17	9E	MORRIS	217	20-May-64	14-Sep-64	(b) (6)	
42	17601 00	REC		SE	NE	SW	1700	3100	19	20	14E	COFFEY	205	16-Nov-70	29-Jun-72	US DEPT OF INTERIOR	
43																	
44	17606 00	REC		NE	NW	NW	5279	4250	29	20	14E	COFFEY	19	16-Nov-70	29-Jun-72	US DEPT OF INTERIOR	
45	17606 00	REC		SW	SE	SE			20	20	14E	COFFEY	19	16-Nov-70	29-Jun-72	US DEPT OF INTERIOR	
46	17609 00	REC		SE	NW	NW	4290	4540	28	20	14E	COFFEY	172	16-Nov-70	29-Jun-72	US DEPT OF INTERIOR	
47	28248 00	IRR		SE	NE	SW			14	17	9E	MORRIS	28	29-Dec-76	30-Jun-77	(b) (6)	
48	28248 00	IRR		SE	NE	SW			14	17	9E	MORRIS	28	29-Dec-76	30-Jun-77	(b) (6)	
49	28248 00	IRR		SE	NE	SW			14	17	9E	MORRIS	28	29-Dec-76	30-Jun-77	(b) (6)	
50	28248 00	IRR		SE	SE	NE	2750	450	23	17	9E	MORRIS	28	29-Dec-76	30-Jun-77	(b) (6)	
51	28248 00	IRR		SE	SE	NE	2750	450	23	17	9E	MORRIS	28	29-Dec-76	30-Jun-77	(b) (6)	
52	28248 00	IRR		SE	SE	NE	2750	450	23	17	9E	MORRIS	28	29-Dec-76	30-Jun-77	(b) (6)	

T7-5-3

TABLE 7-5 (continued)

Row	FILE_NO	USE	Q4	Q3	Q2	Q1	FEET NORTH	FEET WEST	SEC	TWP	RNG	COUNTY	AC-FT	DATE FILED	DATE APPR	LAST NAME	FIRST NAME
53	28248 00	IRR		SE	SW	SW			14	17	9E	MORRIS	28	29-Dec-76	30-Jun-77	(b) (6)	
54	28248 00	IRR		SE	SW	SW			14	17	9E	MORRIS	28	29-Dec-76	30-Jun-77		
55	28248 00	IRR		SE	SW	SW			14	17	9E	MORRIS	28	29-Dec-76	30-Jun-77		
56	28248 00	IRR		SW	NW	NE	4050	2500	23	17	9E	MORRIS	28	29-Dec-76	30-Jun-77		
57	28248 00	IRR		SW	NW	NE	4050	2500	23	17	9E	MORRIS	28	29-Dec-76	30-Jun-77		
58	28248 00	IRR		SW	NW	NE	4050	2500	23	17	9E	MORRIS	28	29-Dec-76	30-Jun-77		
59	28248 00	IRR		SW	NW	SW			14	17	9E	MORRIS	28	29-Dec-76	30-Jun-77		
60	28248 00	IRR		SW	NW	SW			14	17	9E	MORRIS	28	29-Dec-76	30-Jun-77		
61	28248 00	IRR		SW	NW	SW			14	17	9E	MORRIS	28	29-Dec-76	30-Jun-77		
62	30173 00	MUN		NC	NW	SW	1850	4600	14	20	13E	COFFEY	12.3	25-Jul-77	4-Apr-78	HARTFORD	CITY OF
63	33174 00	MUN	NC	E2	SE	SE	660	420	32	18	11E	LYON	3216.19	8-Jun-79	7-Nov-83	EMPORIA	CITY OF
64	35564 00	IRR		NW	NE	SW	2100	3800	4	17	9E	MORRIS	27	5-Aug-81	5-May-83	(b) (6)	
65	35564 00	IRR		SW	NE	SW	1900	3500	4	17	9E	MORRIS	27	5-Aug-81	5-May-83		
66	35564 00	IRR		SW	SW	NW	3050	5200	4	17	9E	MORRIS	27	5-Aug-81	5-May-83		
67	35564 00	MUN		SW	NE	SW	1900	3500	4	17	9E	MORRIS	0	5-Aug-81	5-May-83		
68	35564 00	MUN		SW	SW	NW	3050	5200	4	17	9E	MORRIS	0	5-Aug-81	5-May-83		
69	38274 00	REC		NC	NW	NW	4680	4680	29	20	14E	COFFEY	80	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	

T7-5-4

TABLE 7-5 (continued)

Row	FILE_NO	USE	Q4	Q3	Q2	Q1	FEET NORTH	FEET WEST	SEC	TWP	RNG	COUNTY	AC-FT	DATE FILED	DATE APPR	LAST NAME	FIRST NAME
70	38274 00	REC		NE	SE	NW	3850	3100	29	20	14E	COFFEY	80	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
71	38274 00	REC		SW	SE	NE	3000	1230	29	20	14E	COFFEY	80	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
72	38275 00	REC		SE	NW	SW	1800	4350	19	20	14E	COFFEY	330	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
73	38275 00	REC		SW	SW	NW	2730	4830	29	20	14E	COFFEY	330	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
74	38275 00	REC					4680	4680	29	20	14E	COFFEY	330	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
75	38276 00	REC		SE	NW	NE	4200	1500	28	20	14E	COFFEY	200	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
76	38276 00	REC		SW	NW	NE	4500	2100	28	20	14E	COFFEY	200	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
78	38276 00	REC		SW	SW	NE	2700	10	28	20	14E	COFFEY	200	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
79	38276 00	REC		SW	SW	NE	2700	600	28	20	14E	COFFEY	200	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
80	38277 00	REC		NE	SE	SW	1200	2700	13	20	13E	COFFEY	100	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	

T7-5-5

TABLE 7-5 (continued)

Row	FILE_NO	USE	Q4	Q3	Q2	Q1	FEET NORTH	FEET WEST	SEC	TWP	RNG	COUNTY	AC-FT	DATE FILED	DATE APPR	LAST NAME	FIRST NAME
81	38278 00	REC		SW	SE	NW	2800	3840	10	20	13E	LYON	206	21-Jul-86	10-Nov-87	US DEPT OF INTERIOR	
82	38278 00	REC					3700	1600	4	20	13E	LYON	206	21-Jul-86	10-Nov-87	US DEPT OF INTERIOR	
83	38280 00	REC		NW	SE	SW	800	3900	14	20	13E	COFFEY	73	21-Jul-86	10-Nov-87	US DEPT OF INTERIOR	
84	38281 00	REC		NE	SE	SW	1300	2650	34	20	14E	COFFEY	0	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
85	38282 00	REC		SW	SW	SE	500	2000	14	20	13E	COFFEY	77	21-Jul-86	6-Oct-87	US DEPT OF INTERIOR	
86	38284 00	REC		NW	SE	SW	750	3900	13	20	13E	COFFEY	0	21-Jul-86	10-Nov-87	US DEPT OF INTERIOR	
87	38948 00	MUN		NC	NW	SW	1850	4600	14	20	13E	COFFEY	0	29-Jul-88	21-Mar-91	HARTFORD	CITY OF
88	39115 00	REC		NC	S2	S2	500	2600	9	20	13E	LYON	270	5-Dec-88	22-Sep-89	US DEPT OF INTERIOR	
89	39475 00	MUN		NC	NW	SW	1850	4600	14	20	13E	COFFEY	0	1-Jun-89	21-Mar-91	HARTFORD	CITY OF
90	39580 00	REC		NE	SW	SE	700	1750	18	20	14E	COFFEY	125	14-Aug-89	30-Sep-92	US DEPT OF INTERIOR	
91	39581 00	REC		NE	NE	SW	2300	3250	4	20	13E	LYON	0	14-Aug-89	30-Sep-92	US DEPT OF INTERIOR	
92	39582 00	REC		SE	NE	SW	1650	2750	11	20	13E	COFFEY	0	14-Aug-89	30-Sep-92	US DEPT OF INTERIOR	

T7-5-6

TABLE 7-5 (continued)

Row	FILE_NO	USE	Q4	Q3	Q2	Q1	FEET NORTH	FEET WEST	SEC	TWP	RNG	COUNTY	AC-FT	DATE FILED	DATE APPR	LAST NAME	FIRST NAME
93	43589 00	REC		NE	NW	NE	5279	1700	31	19	13E	LYON	0	9-Nov-98	28-Dec-98	US DEPT OF INTERIOR	
94	43589 00	REC		NE	SW	NE	3500	1450	36	20	14E	COFFEY	0	9-Nov-98	28-Dec-98	US DEPT OF INTERIOR	
95	45852 00	REC		NW	NW	SW	2112	5068	31	19	13E	LYON	0	13-Feb-04	19-Jul-04	NRCS	
96	46249 A	REC		NE	NW	NE	5279	1700	31	19	13E	LYON	308.4	5-Jul-05	24-Aug-05	US DEPT OF INTERIOR	
97	46249 A	REC		NE	SW	NE	3500	1450	36	20	14E	COFFEY	308.4	5-Jul-05	24-Aug-05	US DEPT OF INTERIOR	
98	20099054 00	IND		SE	NW	SE	1475	1845	4	20	13E	LYON	11.999	26-Jun-09	6-Aug-09	PNHNDLE ESTRN PIPLN CO	
99	LY 1 00	MUN		NE	NW	SE	2150	1800	24	18	10E	LYON	2630.04	28-Jun-45	19-Oct-54	EMPORIA	CITY OF
100	LY 1 00	MUN		NE	SE	SE	900	350	32	18	11E	LYON	2630.04	28-Jun-45	19-Oct-54	EMPORIA	CITY OF
101	LY 1 00	MUN		NE	SW	SE	1050	1500	33	17	10E	LYON	2630.04	28-Jun-45	19-Oct-54	EMPORIA	CITY OF
102	LY 1 00	MUN		NW	SE	SE	905	830	33	17	9E	MORRIS	2630.04	28-Jun-45	19-Oct-54	EMPORIA	CITY OF
103	LY 1 00	MUN				N2			4	18	10E	LYON	2630.04	28-Jun-45	19-Oct-54	EMPORIA	CITY OF

T7-5-7

EXHIBIT A
SUPPLEMENTARY PERTINENT DATA
COUNCIL GROVE LAKE

EXHIBIT A
SUPPLEMENTARY PERTINENT DATA
COUNCIL GROVE LAKE

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
1	General Information	A-1
2	Lake Information	A-2
3	Hydrology	A-4
4	Embankment	A-5
5	Spillway	A-6
6	Outlet Facilities	A-7
7	Low Flow Control Pipe	A-8
8	Water Supply	A-8
9	Control Points / River Reaches	A-8
<u>Table</u>	<u>Title</u>	<u>Page</u>
A-1	Elevations, Areas, and Storages	A-2
A-2	Major Floods Past Council Grove Dam site	A-2

EXHIBIT A
SUPPLEMENTARY PERTINENT DATA
COUNCIL GROVE LAKE

1 - GENERAL INFORMATION

Other names for project	Formerly referred to Council Grove Reservoir
Location	Morris County, Kansas on Neosho River at mile 449.9
Type of Project	Dam and Lake
Objectives of Regulation	Multipurpose – Flood control, water supply, recreation, and water quality
Project Owner	US Government
Operating Agency	US Army Corps of Engineers. The normal working hours of operation for weekdays are 7:45 a.m. to 4:30 p.m. Working hours for weekends, holidays and nights vary. Working hours under flood emergency conditions are 24 hours.
Regulating Agency	US Army Corps of Engineers.
Water Supply Contracts	Administered by the Kansas Water Office
Water Rights Project	Administered by the Kansas Water Office
Cost	\$11,810,000
Closure Date	October 9, 1964

2 - LAKE INFORMATION

**TABLE A-1
ELEVATIONS, AREAS, AND STORAGES**

Feature	Elevation (feet, NGVD)	Lake area (acres)	Storage	
			Accumulative (acre-feet)(1)	Runoff (inches) (2)
Top of dam	1321.0	-	-	-
Maximum pool	1315.0	11,970	334,751	25.51
Spillway Crest	1306.0	9,330	235,978	17.99
Top of flood control pool	1289.0	5,370	110,191	8.45
Top of conservation pool	1274.0	3,314	45,931	3.50
Top of inactive pool	1240.0	20	20	0.001
Flood control storage	1274.0 - 1289.0	-	64,260	4.90
Conservation storage	1240.0 - 1274.0	-	45,916	3.50
Streambed at Dam	1220.0	-	-	-

(1) Based on 1994 sedimentation survey

(2) From a 246 square mile drainage area above the dam site. One inch of runoff = 13,120 acre-feet.

**TABLE A-2
MAJOR FLOODS PAST COUNCIL GROVE LAKE DAMSITE**

Date	Peak Inflow (c.f.s.)	Volume (acre-feet)	Runoff (inches)
19 October - 2 November 1941	65,900	79,700	6.07
9 April - 5 May 1944	33,800	112,100	8.54
15 - 25 July 1948	29,900	57,800	4.41
22 June - 18 July 1951	121,000	184,200	14.04
17 June - 12 July 1977	13,840	48,000	3.66
25 May - 4 June 1982	5,500	38,400	2.93
1-12 April 1983	14,400	44,800	3.41
20 September - 16 October 1985	21,800	50,800	3.87
2-17 May 1993	17,500	99,200	7.56
17 - 23 July 1993	14,600	109,900	7.61

2 - LAKE INFORMATION (continued)

Real estate taking for land fee title	The fee taking line for Council Grove Lake is a semi-blocked perimeter to elevation 1284.0, which was the 5-year frequency pool elevation at the time the taking was established.
Real estate taking for Easement	Flowage easements of Council Grove Lake were acquired to elevation 1306.0, the crest of the emergency spillway.
Range of clearing	Elevation 1274.0 in most areas. Northern portions of the lake were left uncleared.
Pool elevation corresponding to discharge capability of maximum non-damaging flow rate downstream	Non-damaging channel capacity below Council Grove Dam is estimated at 3,000 c.f.s. This flow rate can be discharged with adequate inflow at any elevation above minimum pool, elevation 1,240.0.
Reservoir length at top of conservation pool	8 miles
Reservoir length at top of flood pool	10 miles
Safety aspects, possibly requiring warning	As the pool elevation rises in the flood control pool: at elevation 1275.0, some campsite roads become inundated; at elevation 1276.0, power to some campsites is cut-off; at elevation 1299.5, State Highway 177 becomes inundated
Emergency drawdown	The minimum time to empty from top of conservation pool (elevation 1,274.0) to top of minimum pool (elevation 1,240.0) is approximately 3.5 days.

3 - HYDROLOGY

Drainage area	246 square miles
Probable Maximum Flood	Not Applicable
<u>Spillway Design Flood (Full Pool)</u>	
Maximum water surface elev.	1314.88 feet, NGVD29
Peak inflow (into full pool)	265,000 c.f.s.
Total storm runoff	25.42 inches
Volume (into full pool)	333,323 acre-feet
Maximum outflow	55,000 c.f.s.
Duration of flood	3.5 days
<u>Standard Project Flood (Full Pool)</u>	
Maximum water surface elev.	1306.28 feet, NGVD29
Peak inflow (into full pool)	142,000 c.f.s.
Total storm runoff	18.41 inches
Volume (into full pool)	241,381 acre-feet
Maximum outflow	13,558 c.f.s.
Duration of flood	3.0 days
Climate	Moderate
One inch of runoff	13,120 acre-feet
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	August, December through February; however, low flow can occur at any time of the year.
Minimum daily flow and date of occurrence	0 flow (acre-feet) on several different occasions.
Minimum monthly flow and date	0 flow (acre-feet) on several different occasions.
Minimum annual flow and year	3,720 acre-feet in 1953 (Period of record is 1922 – 2009)

3 - HYDROLOGY (continued)

Average annual flow	87,652 acre-feet (1922-2009)
Maximum annual flow and year	370,640 acre-feet in 1951 (1922-2009)
Maximum monthly flow and date	175,700 acre-feet, July 1951 (1922-2009)
Maximum daily flow (D.S.F.) and date	34,000 (D.S.F.) 11 Jul 1951
Maximum instantaneous flow (c.f.s.) and date	121,000 (c.f.s.) 11 July 1951
Name and location of key stream flow stations	Council Grove, Kansas, Neosho River (river mile 448); Americus, Kansas, Neosho River (river mile 409.3).
Type of hydrometeorological data recorded at dam site	Pool elevations, tailwater stage, rainfall, pan evaporation, wind speed and direction, lake water condition, weather conditions.
Number of precipitation stations used in hydrologic forecasting inflow	Twenty (20)
Number of sediment ranges	Seventeen (17)
Number of degradation ranges	Five (5)

4 - EMBANKMENT

Location	Neosho River, river mile 449.9.
Purpose	Flood Control, Water Supply, Recreation, and Water Quality, and Fish & Wildlife
Type	Earth fill
Type of fill	Random and impervious

4 - EMBANKMENT (continued)

Slope Protection	Riprap on upstream face; grassed on downstream face.
Height	96 feet above streambed
Length	6,500 feet (excluding spillway)
Top Elevation	1321.0 feet, NGVD
Design Flood	Spillway Design Flood developed in original project design
Freeboard	6.0 feet above maximum pool
Used for Roadway	A 24-foot wide roadway is provided along the crest
Elevation of stream bed	Approximately 1225.0 feet, NGVD

5 - SPILLWAY

Location	Right saddle
Type	Emergency, uncontrolled
Crest Elevation	1306.0 feet, NGVD
Net overflow length	500 feet
Discharge capacity at Maximum Pool	55,500 c.f.s.
Type of energy dissipater	None
Type of Emergency Closure	None
Spillway Activation	Uncontrolled

6 - OUTLET FACILITIES

Location	Near right abutment
Number and Size of Gates	Two 7.5' x 17' tractor type service gates with emergency gates; 24-inch low flow control pipe with pivot valve and gate valve
Type of Service Gates	Gate uncontrolled conduit
Conduit Diameter	17.0 feet
Entrance invert elevation	1223.0 feet, NGVD
Exit invert elevation	1220.0 feet, NGVD
Discharge at pertinent elevation	<u>Spillway</u> Maximum pool Elev.(1315.0) 55,500 c.f.s <u>Outlet Works</u> Top of conservation pool (1274.0) 6,050 c.f.s. Bottom of conservation pool (1240.0) 2,100 c.f.s.
Minimum pool elevation when inoperative	1240.0 feet, NGVD
Minimum time required to open / close service gates	Tractor type service gates open at a rate of 0.5 feet per minute
Type of emergency closure	Emergency gates and stop logs lowered by emergency gate hoist
Type of energy dissipater	Stilling basin with baffle blocks

7 - LOW FLOW CONTROL PIPE

Location	Intake structure, right of conduit
Type of Outlet and Size	Open 24-inch diameter
Type of Gate	24-inch gate valve for closure; butterfly valve for regulation
Entrance Elevation	1229.5 feet, NGVD

8 - WATER SUPPLY

Location	Intake structure, right of conduit
Type of Outlet and Size	Open 24-inch diameter
Type of Gate Entrance	24-inch gate valve
Entrance Elevation	1235.0 feet, NGVD

9 - CONTROL POINTS/RIVER REACHES

a. COUNCIL GROVE, KS

Location	River mile 448.0. On the center pier of the highway bridge near the city water plant in the north part of Council Grove, Kansas. 1.7 miles downstream of Council Grove Dam on the Neosho River
Purpose of Gage	Provide stage and precipitation data and serve as a control point for flood releases from Council Grove Lake.

9 - CONTROL POINTS/RIVER REACHES (continued)

Channel and Floodplain Description	The channel is well defined and fairly straight in the vicinity of the gage. The flood plain is narrow with urban development on both sides of the channel.
Drainage Area	250 square miles
Target Flow Rate	3,000 c.f.s. maximum
Time of Crest Travel	0 hours
Monitoring Provisions	Data Collection Platform (DCP)
Zero of Gage	1205.63 feet, NGVD
Channel Usage	Water supply, fishing, and navigation control

b. AMERICUS, KS

Location	River mile 409.3. Near the right bank of the Neosho River, 0.1 miles below Ruggles Dam and 2.0 miles south of Americus, Kansas
Purpose of gage	Provide stage and precipitation data and serve as a control point for flood releases from Council Grove Lake.
Channel and Floodplain Description	The channel is well defined and fairly straight in the vicinity of the gage. The flood plain is relatively narrow with cultivated crops and some rural development
Drainage Area	622 square miles

9 - CONTROL POINTS/RIVER REACHES (continued)

Target Flow Rate	16,000 c.f.s.
Time of Crest Travel	20 hours
Monitoring Provisions	Data Collection Platform (DCP)
Zero of Gage	1106.99 feet, NGVD
Channel Usage	Water supply, fishing, and navigation control.

EXHIBIT B
STANDING INSTRUCTIONS TO LAKE MANAGER
COUNCIL GROVE LAKE

EXHIBIT B
 STANDING INSTRUCTIONS TO LAKE MANAGER
 COUNCIL GROVE LAKE

TABLE OF CONTENTS

<u>Paragraph and Title</u>	<u>Page</u>
I - GENERAL.....	B-1
1. Operation.....	B-1
2. Data Reporting Instructions.....	B-1
3. Reporting Unusual Events.....	B-2
4. Warnings.....	B-2
5. Frequency of Gate Changes.....	B-3
II - REGULATION PROCEDURES.....	B-4
1. Regulating River Stages and Discharges.....	B-4
2. During Emergency Events.....	B-6

TABLE INDEX

<u>Table</u>	<u>Title</u>	<u>Page</u>
B-1	Emergency Flood Control Regulation Schedule	B-7

EXHIBIT B
STANDING INSTRUCTIONS TO LAKE MANAGER
COUNCIL GROVE LAKE

I - GENERAL

1. Operation. The lake will be regulated in accordance with the normal regulations for flood control as directed in Section VII of this Manual or Paragraph II-1.a. of this Exhibit. Instructions for the storage and discharge of floodwater will be issued by the Water Management Section. In the event communications with the Tulsa District Office are disrupted, the lake will be regulated in accordance with the schedule of emergency regulations for flood control (see Section VII of this Manual or paragraph II-1.b. of this Exhibit). In addition, the Lake Manager will immediately make every effort to re-establish communications with the Tulsa District Office.

2. Project Reporting Instructions. Daily lake data from Council Grove Lake will be submitted to the Water Management Section, Hydrology-Hydraulics Branch, Tulsa District Office (telephone 918-669-7094 or VHF-FM radio, call signal WUI-3). The Water Management Section office is manned from 7:00 a.m. to 4:30 p.m. daily and various hours on weekends and holidays. Data for nonworking days shall be read from the recorder chart and submitted the following workday. Data will be submitted in accordance with the form shown on Plate 5-3. 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; number of gates open; amount of gate opening; outflow stage at 8 a.m.; precipitation in inches for the preceding 24 hours (7 a.m. to 7 a.m.); and wind velocity and direction (at 8 a.m.).
- b) Each Gate Operation. Date and time of gate operation, number of gates open and amount of gate opening before and after gate operation, lake elevation. Confirmation of gate changes shall be made immediately after completion of the change. Complaints about pool elevations or releases, operating machinery failure, and out-of-service times for maintenance shall be reported to the Water Management Section as they occur.
- c) During Flood Periods. In addition to subparagraphs a. and b. above, additional reports may be required by the Water Management Section.
- d) 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. (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 non-working hours, the report should be made to one of the persons listed on page i.
- (5) After office hours, rainfall reports should be made as indicated in subsection (4) above; however, if no contact with the Water Management Section personnel can be made, rainfall reports should be made to the National Weather Service, Tulsa, Oklahoma at 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 Management Section, Hydrology-Hydraulics Branch.

4. Warnings. It is the responsibility of the Lake Manager and project personnel authorized to make gate changes to maintain a list in current status of residents and/or property which might be endangered or inconvenienced by large and/or prolonged releases. If damaging releases are expected to occur, notification will be made by telephone, or oral warning by Corps employees. Notification will be made in accordance with the Tulsa District supplements to ER 500-1-1. This would include 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. Studies have been made to determine the possible downstream flood conditions that could exist in the event of a maximum spillway release or failure of the dam at maximum pool. Approximate water surface profiles and flooded area maps giving the results of these studies are kept in the Council Grove Lake Operation and Maintenance Manual, Volume II, Emergency Action Plan. In every case, when a gate change is made a horn is blown to give warning to people immediately downstream of Council Grove Dam.

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

II - REGULATION PROCEDURES

1. Regulating River Stages and Discharges. The regulation schedules provide that the channel capacity of 3,000 c.f.s. is not to be exceeded insofar as practicable. Floodwaters will be released as rapidly as practicable with consideration given to minimizing flooding of low-water crossing and low-lying farmland. Factors considered in the determination of releases are: maximum inflow into the lake during a rise, general climatic conditions, season of the year with respect to the probability of floods, status of crops in low-lying farmlands, and maximum non-damaging stages or discharges

a) Normal Regulation of Flood Control Operations. Council Grove Lake will be operated for optimal flood reductions on the Neosho River from the dam to the mouth of the Cottonwood River and in conjunction with Marion Lake from that point to the upper limits of John Redmond Reservoir. Releases will also be coordinated with the flood control operation of Marion, John Redmond, Pensacola, Markham Ferry, and Fort Gibson Reservoirs, to provide optimal flood control benefits on the Grand (Neosho) and Arkansas River Basins. The conduit outlet and stilling basin must be visually monitored very closely during all high releases and during high tailwater events. If unusual conditions occur (such as riprap displacement, surging, submerged outlet, or the hydraulic jump moving out of the stilling basin), notify Water Management and Dam Safety immediately.

(1) When the lake is at or below Elev. 1274.0 feet, and flood estimates indicate that the volume of inflow will exceed the available conservation capacity, regulated releases, in general, may be made in amounts which, when combined with local inflow below the dam, shall not produce flows in excess of channel capacity on the Neosho River. In order to accomplish this purpose, flows shall not exceed a 14-foot stage (3,280 c.f.s.) on the U.S. Geological Survey gage at the Council Grove, Kansas, a 26-foot stage (5,860 c.f.s.) at the U.S. Geological Survey gage at Dunlap, Kansas, or a 27.5-foot stage (15,550 c.f.s.) at the U.S. Geological Survey gage at Americus, Kansas. Regulating stations on the Neosho River below Council Grove Lake are presented in Table 7-1.

(2) When the lake level rises above Elev. 1274.0 feet, regulated releases, in general, shall be made at the maximum rate permissible, but limited to the amount which, when combined with local inflow below the dam, will not produce flows on the Neosho River in excess of those specified in sub-paragraph (1) above, and in any event shall not exceed 3,000 c.f.s. at the dam except as stated in sub-paragraph (3) below. When the pool elevation is near Elev. 1274.0 feet and flood estimates indicate that the pool elevation will exceed Elev. 1274.0 feet by 2 feet or more, regulated releases shall be made at the maximum rate permissible, as stated above. However, when the pool elevation crests within 2 feet or recedes

to within 2 feet above Elev. 1274.0 feet, regulated releases may be made at less than the maximum rate permissible, as stated in sub-paragraph (1) above, provided that the reduced rate of release will alleviate flooding of low water crossings and/or minimize bank caving downstream. Factors to be considered in determining the practicability of reduced rate are general climatic conditions, season of the year with respect to probability of floods, and status of crops on low lying farmland.

- (3) When the pool rises above Elev. 1289.0 feet (top of the flood control pool), using Table 7-2 as a guide, releases shall be increased until the pool stops rising or until the pool approaches Elev. 1294.0 feet (top of the surcharge pool), at which time releases shall be made equal to inflow insofar as possible. When the pool begins to recede, the maximum gate opening in effect at that time shall be maintained until the pool recedes to Elev. 1289.0 feet, after which time releases through the conduit gates shall be made equal to the inflow or the maximum release permissible under sub-paragraph (2) above, whichever is greater.
 - (4) When the predicted volume of runoff from the area above the dam exceeds the available flood control storage, the operation described in sub-paragraph (2) above may be modified, as needed, to obtain the maximum overall benefits under conditions existing in the lake area and in the downstream reaches of the river as directed by the District Engineer after coordination of the situation with the Southwestern Division Office.
 - (5) In general, the release rate at Council Grove Lake will be at the maximum rate permissible, as defined in the above sub-paragraphs, unless limited by predicted peak natural inflows if less than channel capacity downstream, or flood storage utilized in all lakes of the system is about equal, in which case releases from Council Grove Dam will be at a rate such that all lakes in the system will be emptied at approximately the same time.
- b) Emergency flood control regulations. Should communication with the Tulsa District Office be disrupted, the Lake Manager will, on his or her own initiative, direct operation of the lake in accordance with the following schedule shown in Table 7-2 until communication is restored. In addition, the Lake Manager will immediately make every effort to re-establish communication with the Tulsa District Office and, if necessary, send information to the Tulsa District Office by automobile, cell phone, or any other means available. The conduit outlet and stilling basin must be visually monitored very closely during all high releases and during high tailwater events. If unusual conditions occur (such as riprap displacement, surging, submerged outlet, or the hydraulic jump moving out of the stilling basin), close all conduit gates immediately and continue efforts to establish communications with the District Office.

- (1) When communication is disrupted and the pool elevation is below Elev. 1289.0 feet (top of flood control pool), the Lake Manager shall delay 12 hours before making a change in releases, except that if the pool rises above Elev. 1289.0 feet during the delay period, releases through the conduits shall be started immediately in accordance with Table B-1.
- (2) When the pool is rising, releases will be adjusted in accordance with Table B-1.
- (3) When the pool is falling, releases will be adjusted in accordance with Table B-1.

2. During Emergency Events. The Lake Manager may temporarily deviate from the current release rates in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of 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 Management Section and shall include justification for the action. Continuation of the deviation will require the express approval of the Water Management Section and the SWD Office.

TABLE B-1
EMERGENCY FLOOD CONTROL REGULATION SCHEDULE
COUNCIL GROVE LAKE, NEOSHO RIVER, KANSAS

Lake Stage	Pool Conditions	Regulation
1285.0 or below	Rising	No change in releases will be made through the flood control conduits until after the 12-hour delay period.
1285.0 - 1289.0	Rising	Flood control conduit settings shall be maintained.
1289.0 or above	Rising	When the pool elevation is at or above elevation 1289.0 feet, releases in effect shall be maintained until exceeded by the following requirements: Elevation 1289.0 - Increase releases to 2,000 c.f.s. Elevation 1290.0 - Increase releases to 4,000 c.f.s. Elevation 1291.0 - Increase releases to 6,000 c.f.s. Elevation 1292.0 - Increase releases to 8,000 c.f.s. Elevation 1293.0 - Increase releases to 10,000 c.f.s. Elevation 1294.0 - Gates fully open
1289.0 or above	Falling	The maximum flood control conduit gate settings attained shall be maintained until the pool recedes to elevation 1289.0 feet.
1289.0 - 1274.0	Falling	If the maximum release rate is less than 3,000 c.f.s., this release or 1,500 c.f.s. (one-half channel capacity), whichever is larger, shall be maintained until the pool level nears Elev. 1274.0. If the maximum release rate exceeds 3,000 c.f.s., releases will be made equal to the previous 2-hour inflow or 3,000 c.f.s., whichever is greater.
Lake level within 2 feet of Elev. 1274.0	Falling	Releases shall be gradually reduced by amounts not to exceed 1,000 c.f.s. in 4 hours so that releases are equal to inflow by the time the pool recedes to elevation 1274.0 feet.

NOTE: The conduit outlet and stilling basin must be visually monitored very closely during all high releases and during high tailwater events. If unusual conditions occur (such as riprap displacement, surging, submerged outlet, or the hydraulic jump moving

out of the stilling basin), close all conduit gates immediately and continue efforts to establish communications with the District Office.

(1) When communication is disrupted and the pool elevation is below elevation 1289.0 feet (top of flood control pool), the Lake Manager shall delay 12 hours before making a change in releases, except that if the pool rises above elevation 1289.0 feet during the delay period, releases through the conduits shall be started immediately in accordance with Table 7-2.

(2) When the pool is rising, releases will be adjusted in accordance with Table 7-2.

(3) When the pool is falling, releases will be adjusted in accordance with Table 7-2.

EXHIBIT C

MEMORANDUM OF UNDERSTANDING

BETWEEN THE STATE OF KANSAS

AND

THE U. S. DEPARTMENT OF THE ARMY

CONCERNING THE PURCHASE OF MUNICIPAL

AND INDUSTRIAL WATER SUPPLY STORAGE

EXHIBIT C

MEMORANDUM OF UNDERSTANDING
BETWEEN THE STATE OF KANSAS
AND
THE U. S. DEPARTMENT OF THE ARMY
CONCERNING THE PURCHASE OF MUNICIPAL
AND INDUSTRIAL WATER SUPPLY STORAGE

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
1.	Purpose	C-1
2.	Background	C-1
3.	Overview of Initiative	C-2
4.	Procedures	C-4
5.	Conditions	C-7

EXHIBIT C

MEMORANDUM OF UNDERSTANDING
BETWEEN THE STATE OF KANSAS
AND
THE U. S. DEPARTMENT OF THE ARMY
CONCERNING THE PURCHASE OF MUNICIPAL
AND INDUSTRIAL WATER SUPPLY STORAGE

1. Purpose. The purpose of this Memorandum of Understanding (MOU) is to establish a cooperative partnership between the State of Kansas and the Department of the Army to achieve the greatest possible level of benefits from reservoirs operated by the Corps of Engineers in the Kansas, Neosho, Marais de Cygnes, and Verdigris River Basins in Kansas.

2. Background. Since 1948, seventeen reservoirs have been constructed in Kansas by the United States Army Corps of Engineers. The purposes of these reservoirs include flood control, water supply, water quality, navigation, and other purposes. Water users below Federal reservoirs have enjoyed significant water supply benefits during periods of low flow due to water quality releases.

The rules for operating these reservoirs for flood control are well established. The following problems concerning low flow conditions in Kansas have been identified:

- a. Water quality releases are not protected by the State.
- b. The State has not obtained reservation rights to store inflows into Federal water quality storage.
- c. The State has established minimum flow standards (for water quality, fisheries purposes, etc.) on several streams below Federal reservoirs. The State has

not yet coordinated the program to maintain these flows with Federal reservoir operating plans.

d. The State water marketing program, utilizing water supply storage in Federal reservoirs, was designed to provide a dependable water supply. However, some entities have purchased this storage only as "insurance" for use during sporadic low flow conditions. Water supply releases made to these entities during low flow conditions are difficult to protect and much of the water is lost in transit. Maintenance of a regulated flow to meet both water supply and minimum flow standards would be far more efficient to administer.

e. Water quality standards and storage to meet these standards were developed prior to enactment of Public Law 92-500. This Act shifted the burden from the assimilative capacity of the rivers to the point of discharge. Operations of the projects have not been modified to reflect current water quality standards. Because of this, certain amounts of storage may not be used currently for the highest and best uses.

3. Overview of Initiative. The Federal/State partnership established in this MOU is designed to take advantage of a unique opportunity to solve the problems listed in paragraph 2, above, while simultaneously increasing the economic benefits to be derived from the system of Corps reservoirs in Kansas, increasing the level of dependable water supplies to meet the needs of municipalities and industries in Kansas, and increasing the level of recovery of past Federal investments in water resources development.

In order to achieve these objectives, the Department of the Army, in conjunction with the state, intends to conduct storage reallocation studies on nine reservoirs to determine if storage can be reallocated from water quality or other conservation purposes to water supply. It is anticipated that such reallocations can be achieved without serious affects on the purposes for which the projects were authorized and constructed for two reasons: (1) significant progress has been made in

recent years to improve the quality of point-source discharges into these river systems, and (2) significant technological advances have been made in recent years in the area of computer-based river system simulations. It is expected that the reduction of dilution requirements and system-wide operation of multiple reservoir river systems will increase the effectiveness of available storage. This may allow significant quantities of storage to be reallocated to water supply.

(1) For its part, the State of Kansas intends to purchase such reallocated storage/ which will be used to provide an increased level of dependability to downstream water users within the state. Such purchases will be financed partially from revenues generated from the State's proposed Water Assurance Program, which will be introduced into the State legislature in 1986. Under the Assurance Program, water users in each of the four river basins would be authorized to form an Assurance District. The Assurance District will provide municipal and industrial water supplies to users under low flow conditions in return for payment associated with the cost of the storage space and the operation and maintenance expenses of such space incurred by the State.

(2) In addition, the State intends to pursue legislation, if deemed necessary, providing for the protection of water quality releases, with the objective of preventing water from being withdrawn for other purposes from releases made for water quality.

(3) Because of the unique nature of this opportunity, the Department of the Army will provide to the State a right of first refusal option on all storage to be reallocated. The purchase price of such storage will be considered as if it were authorized originally as municipal and industrial water supply storage.

(4) This procedure, which is responsive to the provisions of the 1958 Water Supply Act, represents a variation of standard procedures governing calculation of cost recovery requirements. This variation would be mutually beneficial to both State and Federal interests since this MOU represents the most effective way to maximize economic benefits, levels of water supply dependability, and Federal cost recovery.

The State of Kansas is the only entity that has the capability of providing comprehensive solutions to the water resources problems in the Kansas, Neosho, Marais des Cygnes, and Verdigris River Basins in Kansas, in conjunction with the Department of the Army.

(5) The expected sequence of events related to actual reallocation of storage and modified operation of the reservoirs is as follows:

- a. Reallocation studies will establish the new storage requirements for water quality and other purposes.
- b. Storage that is no longer required for water quality or other conservation purposes will become available for water supply.
- c. The Corps and State of Kansas will jointly establish a date for implementing new operating procedures for water quality at each reservoir. Project operations will follow the new procedures as of that date.
- d. The storage identified for water supply will be made available to the State of Kansas during the period of and under terms of this MOU.

4. Procedures.

a. The Kansas Water Office intends to:

- (1) Propose to the State legislature in 1986 a Water Assurance Program designed to accomplish the objectives summarized in paragraph 3, above.
- (2) Place into an escrow account, by July 1, 1986, an amount of four million dollars (\$4,000,000.00), which will be used toward purchases of storage made as a result of this MOU.

- (3) Pay the cost of each increment of water supply storage as purchased and as described in paragraphs 4b(2) and (3) below.
- (4) Obtain State legislation, if necessary, authorizing water quality reservation rights to the State and protection of water quality inflows and releases prior to the purchase of any storage under this MOU.
- (5) Cooperate and work with the Army Corps of Engineers toward timely completion of the required reallocation studies.
- (6) Participate equally in the costs of each reallocation study through in-kind or cash contributions up to a maximum of \$40,000.00 per reservoir. Costs to be shared in this manner are limited to significant additional costs incurred by the Army Corp of Engineers in conducting reallocation studies pursuant to this MOU.

b. The Department of the Army intends to:

- (1) Conduct reallocation studies on the reservoirs listed below to determine whether storage may be reallocated to water supply, the amount thereof that may be reallocated to water supply, and to adhere to the indicated schedule by the respective Corps Districts to the extent possible:

(a) Kansas City District, Corps of Engineers

Tuttle Creek	(by September 1986)
Pomona	(by September 1986)
Melvern	(by September 1986)

(b) Tulsa District, Corps of Engineers

John Redmond	(by July 1987)
Marion	(by December 1987)
Council Grove	(by December 1987)
Elk City	(by July 1988)
Toronto	(by July 1988)
Fall River	(by July 1988)

(2) Allow the State of Kansas to have a right of first refusal for the purchase of all storage that may be reallocated to water supply storage pursuant to this MOU. This purchase option shall be in effect for a period of 10 years from the effective date of this MOU. During this period, the State may purchase one or a multiple of storage increments of not less than 10 percent which may be available for reallocation in each reservoir. To reduce administrative burdens, no more than three contracts shall be allowed for each project under this MOU. Should another party offer a purchase contract to the Department of the Army for all or a portion of such storage during this period, the State shall have 60 days to exercise its option under this paragraph or lose the option for that particular quantity of storage.

(3) Calculate the purchase price for storage that may be reallocated to water supply storage pursuant to this MOU as if it were authorized originally as municipal and industrial water supply storage. Under this procedure, a 10-year interest free period, as provided in the 1958 Water Supply Act, would be allowed. Thereafter, interest would be compounded annually at the project water supply interest rate. The State shall pay the cost of each increment of storage at the time of purchase. The State would be responsible for 100 percent of the actual operation and maintenance, major replacement, and major rehabilitation costs allocated to storage placed under contract.

- (4) As part of the reallocation studies, perform studies required for NEPA compliance.
- (5) Diligently pursue Congressional approvals of storage reallocations, if deemed necessary.

5. Conditions

- a. This MOU shall be effective for a period of 10 years from July 1, 1986, which is the effective date of the MOU.
- b. This MOU is predicated upon the pursuit of solutions on a comprehensive basis. Should the initiative not move forward on a basin-wide basis due to failure of the State to create the Water Assurance Program, or to enact the legislation, if deemed necessary, as described in paragraph 4(a)(4), above, or should no Water Assurance Districts be formed within the effective period of this MOU become null and void.
- c. Final approval of reallocation studies for each reservoir and sale of water supply storage for each reservoir, Kansas Water Office obtaining reservation rights for water quality storage remaining after reallocations.
- d. This MOU may be modified or terminated by mutual consent of the signatories of the MOU or their designees or successors. All such changes shall be documented by written MOU.

Signed

Robert K. Dawson
Assistant Secretary of the Army
(Civil Works)
December 11, 1985

Signed

Joseph F. Harkins
Director
Kansas Water Office
December 11, 1985

Witnessed by:

Signed

Robert Dole
United States Senate
December 11, 1985

PLATES AND DRAWINGS

COUNCIL GROVE LAKE



US ARMY CORPS OF ENGINEERS
TULSA DISTRICT

U.S. Representative
KANSAS

- 1 Jerry Moran (R)
- 2 Lynn Jenkins (R)
- 4 Todd Tiahirt (R)

U.S. Senator
Sam Brownback (R)
Pat Roberts (R)

OKLAHOMA

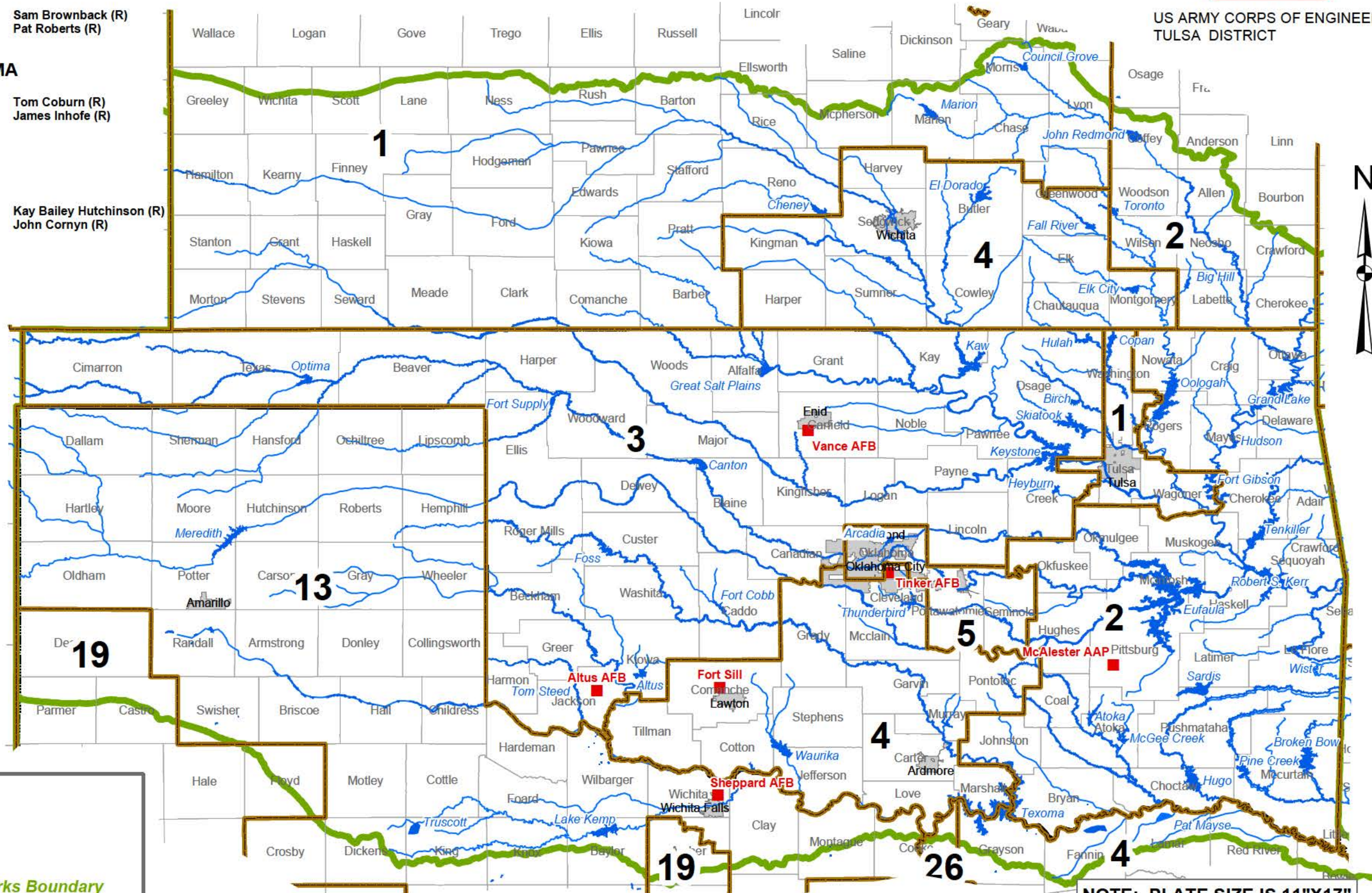
- 1 John Sullivan (R)
- 2 Dan Boren (D)
- 3 Frank Lucas (R)
- 4 Tom Cole (R)
- 5 James Lankford (R)

Tom Coburn (R)
James Inhofe (R)

TEXAS

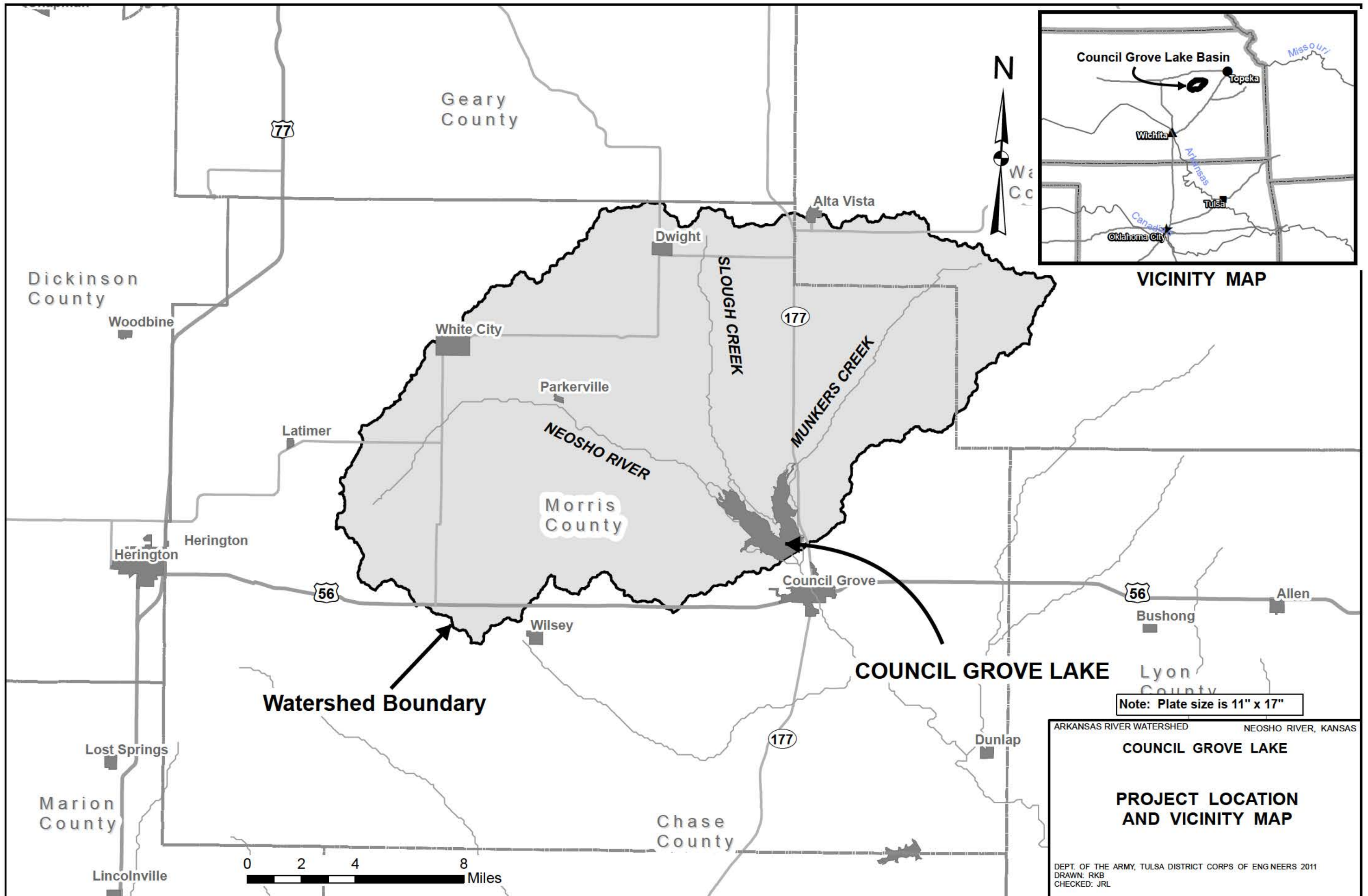
- 4 Ralph M. Hall (R)
- 13 Mac Thornberry (R)
- 19 Randy Neugebauer (R)
- 26 Michael C. Burgess (R)

Kay Bailey Hutchinson (R)
John Cornyn (R)



- Lakes
- Military Installations
- Tulsa District Civil Works Boundary
- 111th Congressional Boundaries

NOTE: PLATE SIZE IS 11"X17"



Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

PROJECT LOCATION AND VICINITY MAP

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL

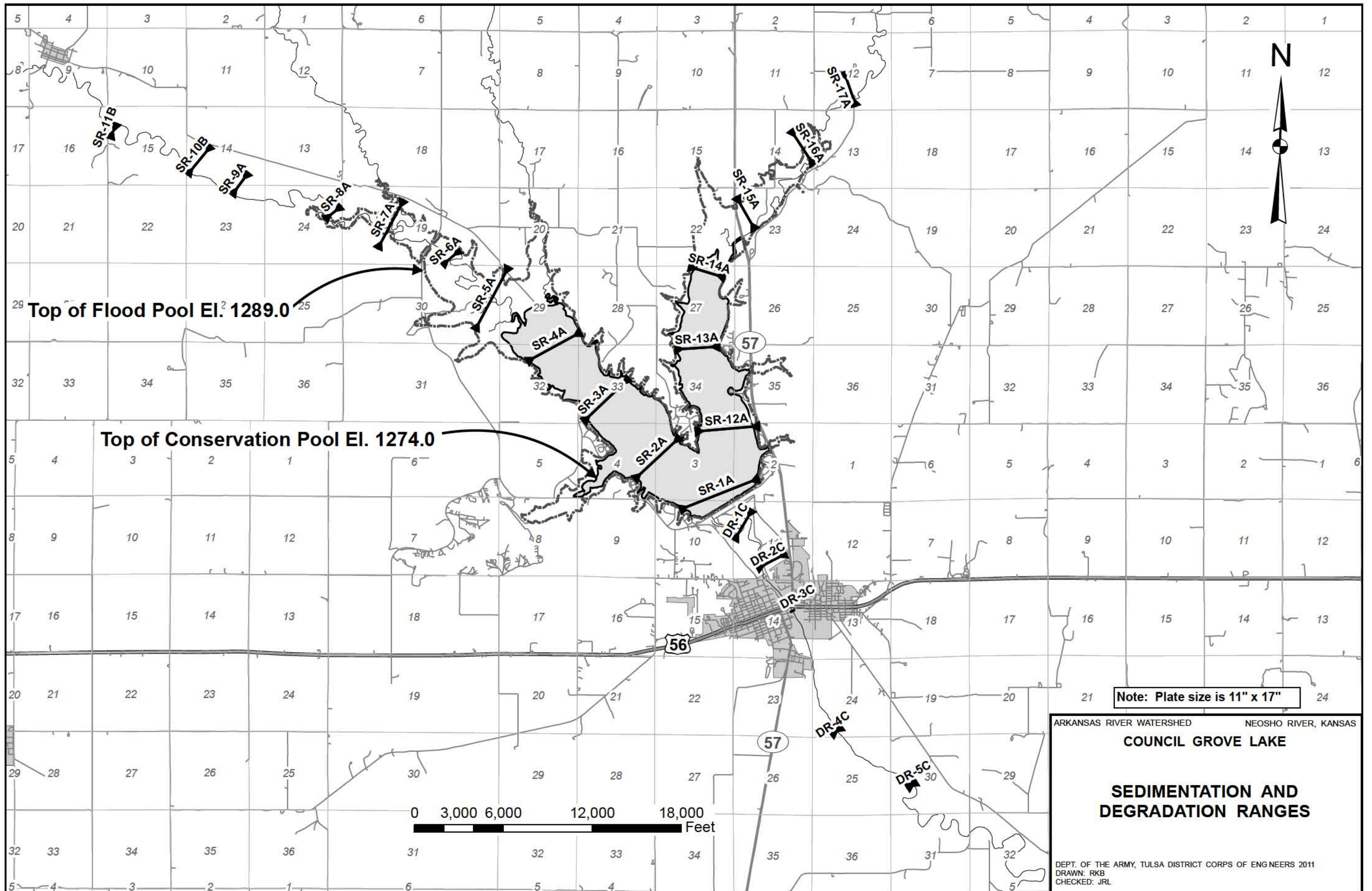
(b) (7)(F)

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

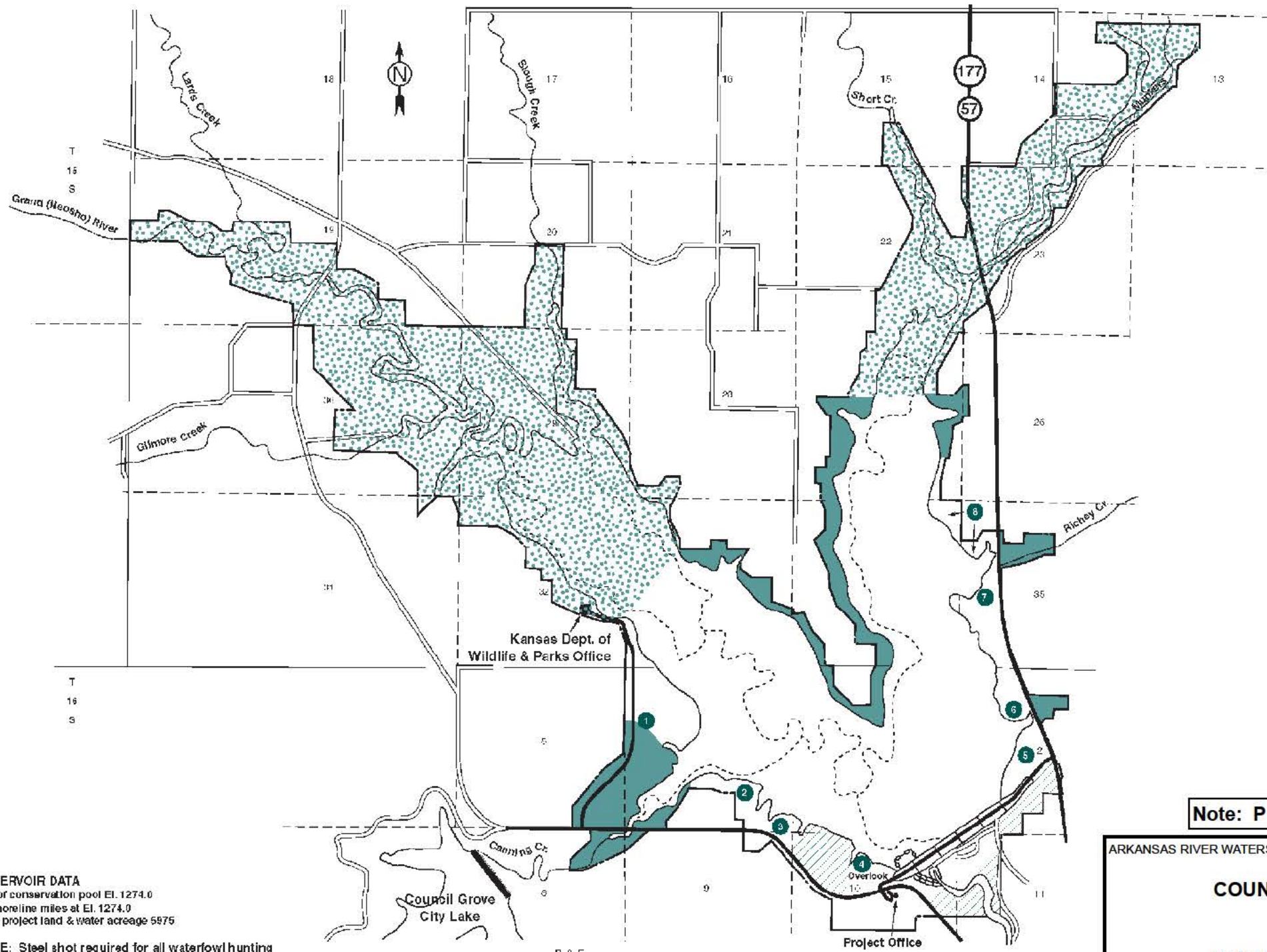
**GENERAL PLAN
AND SECTIONS**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



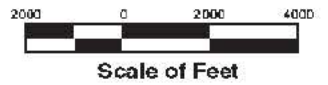
COUNCIL GROVE LAKE

PUBLIC HUNTING AREA



- PUBLIC USE AREAS**
- 1 Canning Creek Cove
 - 2 Santa Fe Trail
 - 3 Marina Cove
 - 4 Neosho Park
 - 5 Kansa View
 - 6 Kit Carson Cove
 - 7 Richey Cove
 - 8 Custer Park

- LEGEND**
- Paved Road
 - Improved Road
 - - - - - Dirt Road
 - - - - - Project Boundary
 - Corps Areas Open For Hunting
 - ▨ State Areas Open For Hunting
 - ▨ Archery, Shotgun, & Primitive Firearms Only



RESERVOIR DATA
 Top of conservation pool El. 1274.0
 40 shoreline miles at El. 1274.0
 Total project land & water acreage 5875

NOTE: Steel shot required for all waterfowl hunting

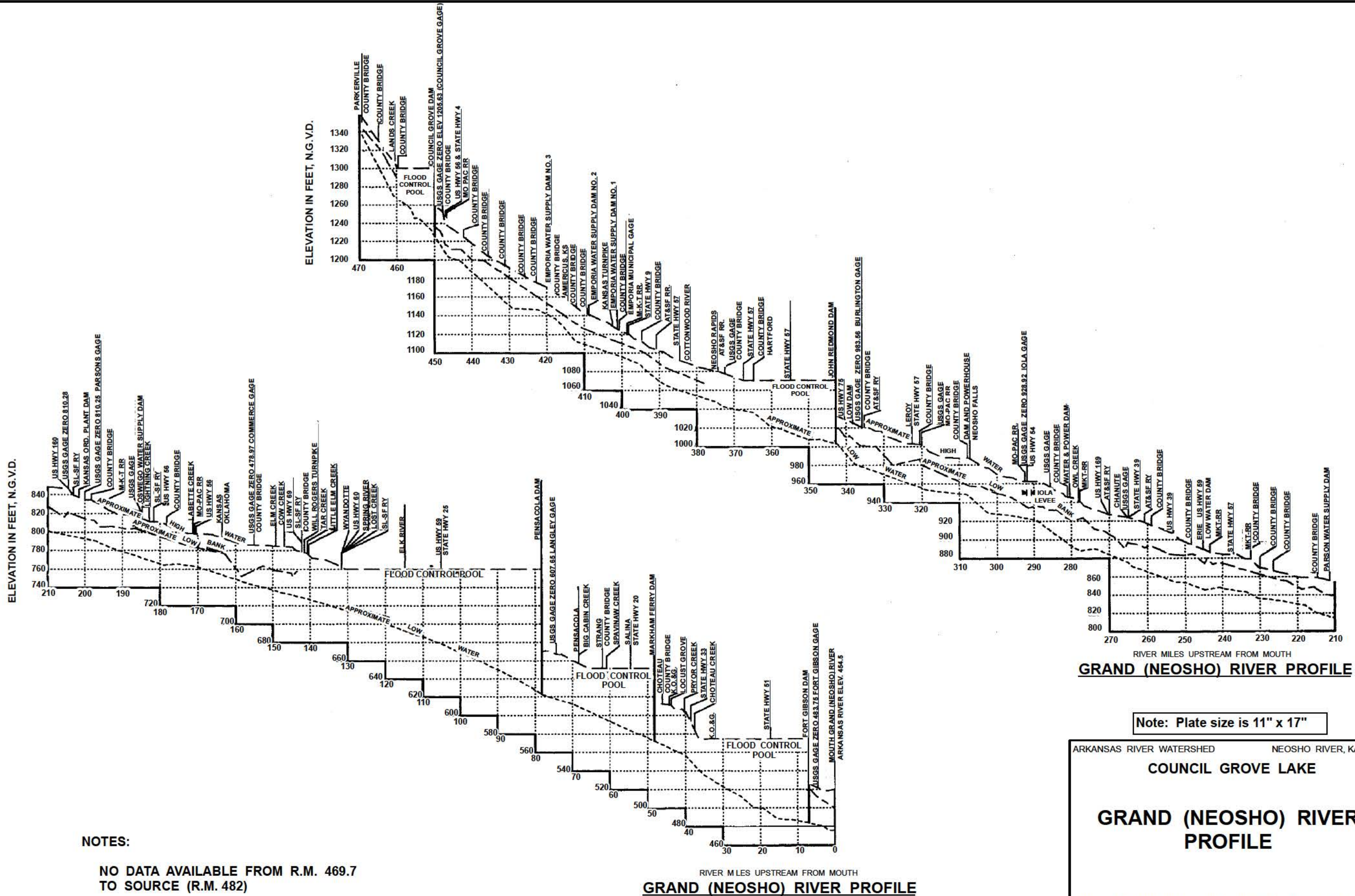
Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

PUBLIC USE SITES

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



NOTES:

NO DATA AVAILABLE FROM R.M. 469.7 TO SOURCE (R.M. 482)

Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

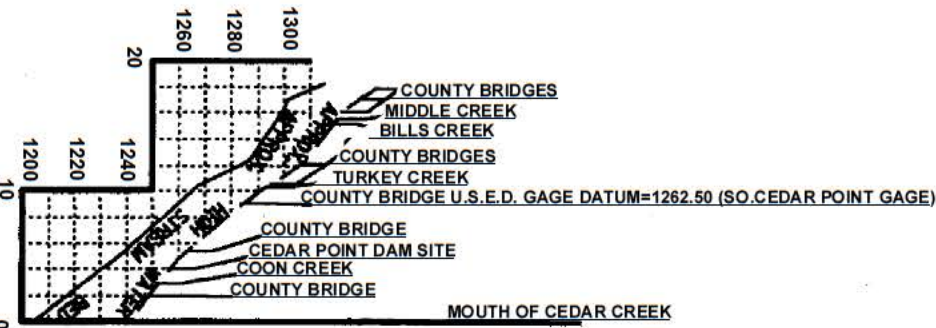
GRAND (NEOSHO) RIVER PROFILE

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL

CEDAR CREEK PROFILE

RIVER MILES UPSTREAM FROM MOUTH

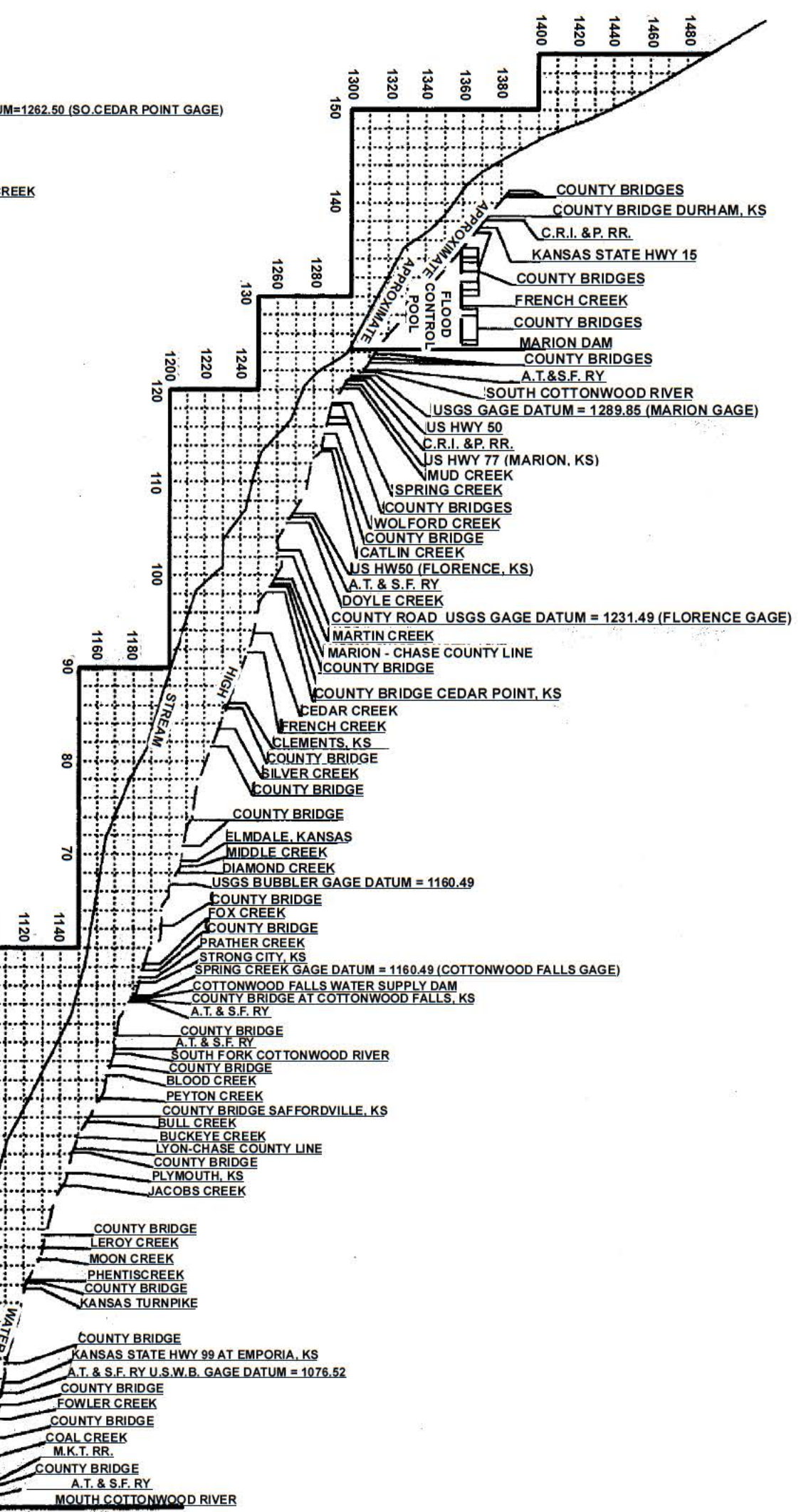
ELEVATIONS IN FEET (N.G.V.D.)



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

COTTONWOOD RIVER PROFILE

RIVER MILES UPSTREAM FROM MOUTH

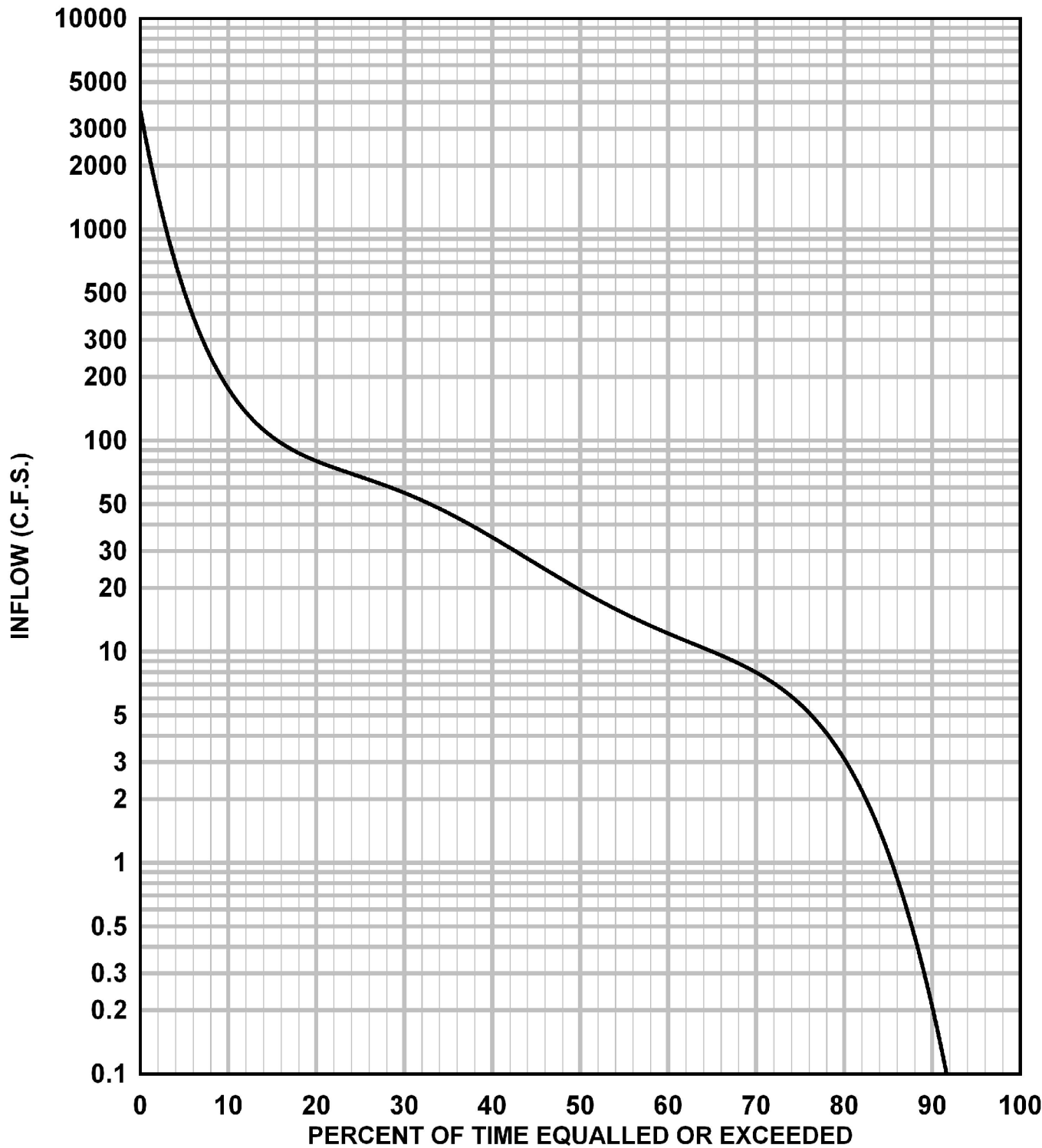


COTTONWOOD RIVER AND CEDAR CREEK PROFILES

ARKANSAS RIVER WATERSHED
 COUNCIL GROVE LAKE
 NEOSHO RIVER, KANSAS

Note: Plate size is 11" x 17"

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



NOTES:

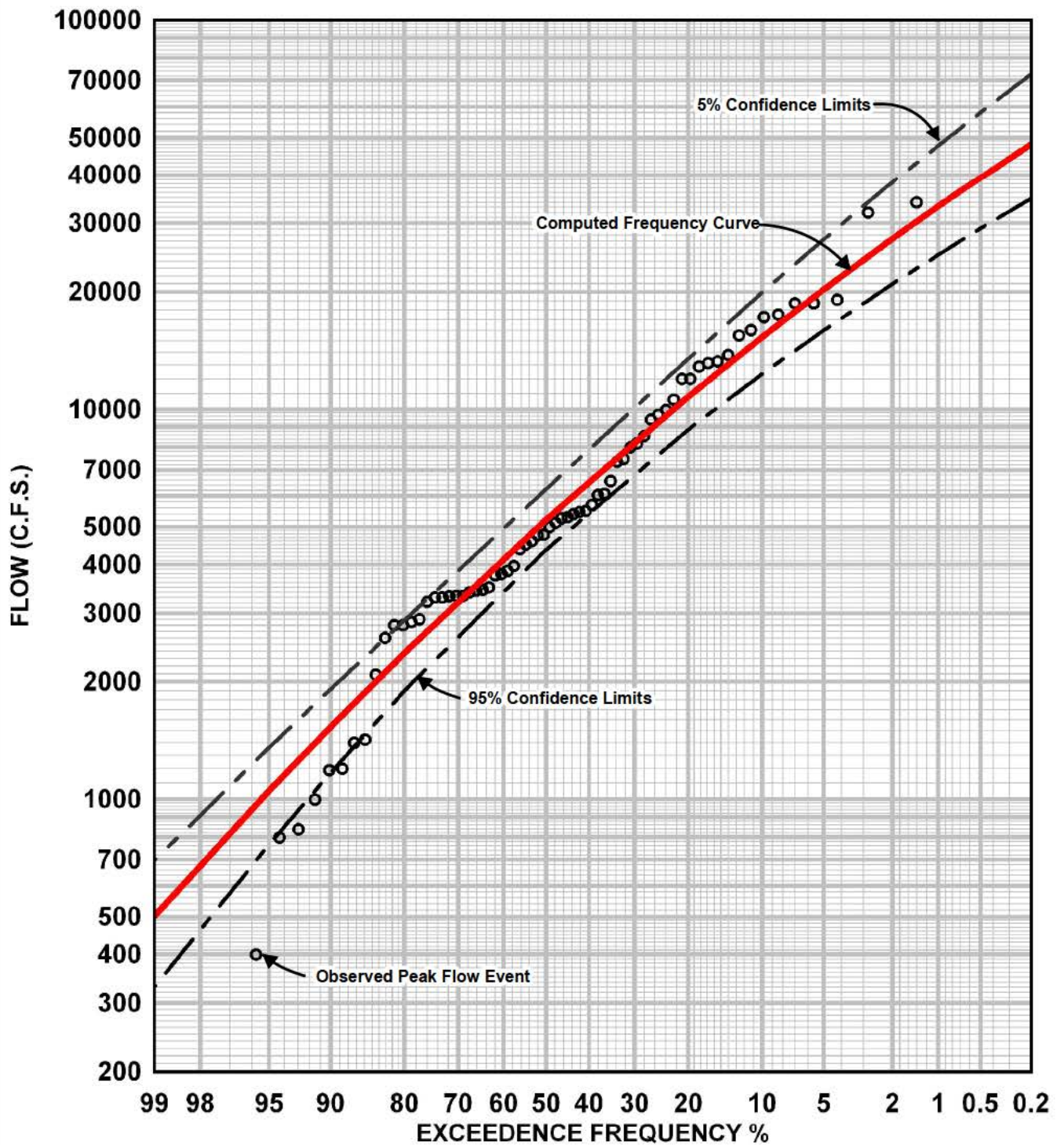
1. BASED ON PERIOD OF RECORD
JAN. 1940 THRU DEC. 2008
2. COMPUTED FROM RIVERWARE 5.2.10
MODEL: ARKRWBASE4008R2

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

FLOW DURATION CURVE

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

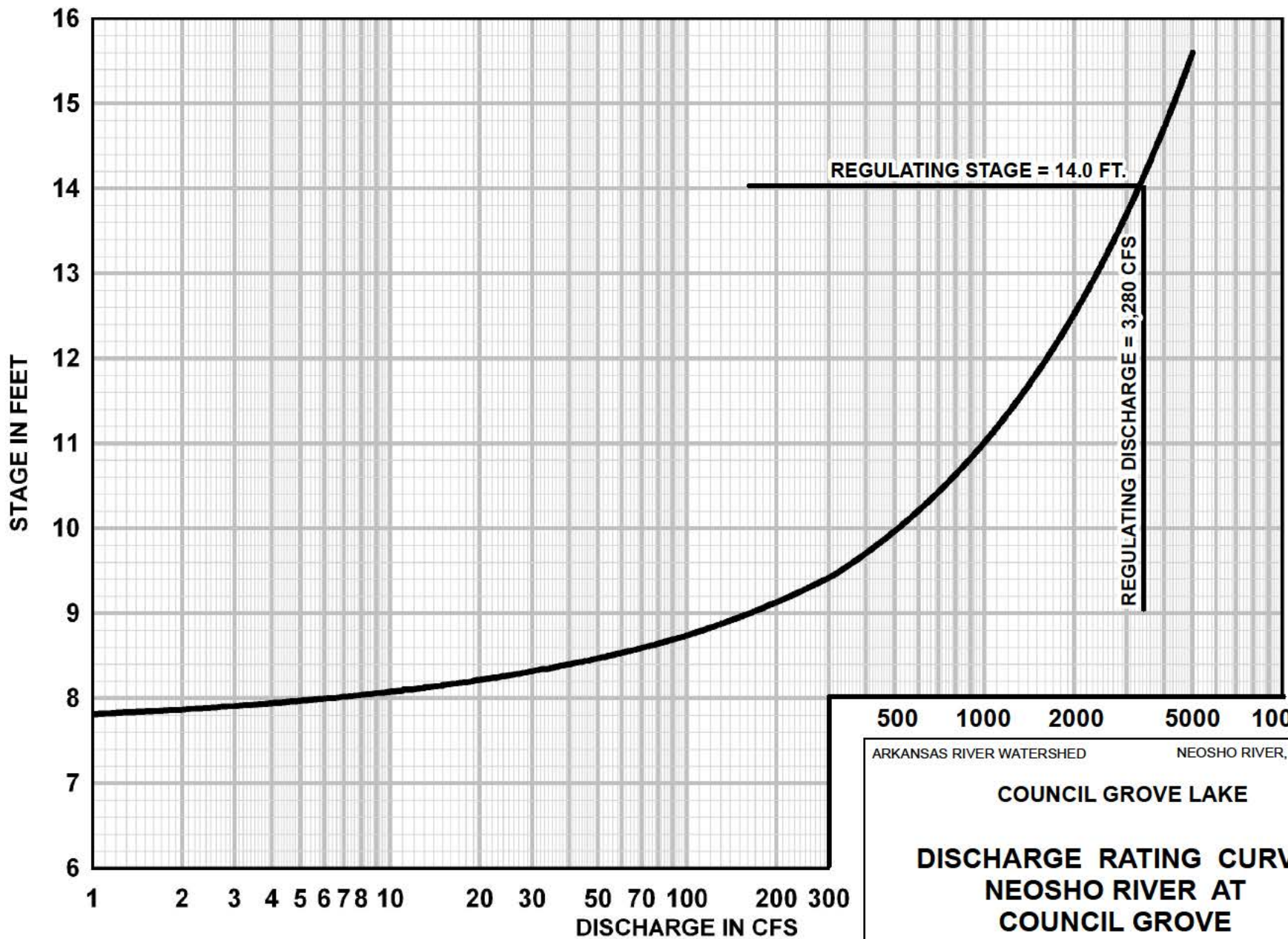
COUNCIL GROVE LAKE

**PEAK INFLOW
PROBABILITY
CURVE**

NOTES:

1. BASED ON ANNUAL PEAK INFLOS FOR PERIOD OF RECORD (1940-2008)
2. BULLETIN NO. 17B "GUIDELINES FOR DETERMINING FLOOD FLOW FREQUENCY" WAS USED.
3. THE ADOPTED SKEW COEFFICIENT OF -0.4 WAS USED.

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



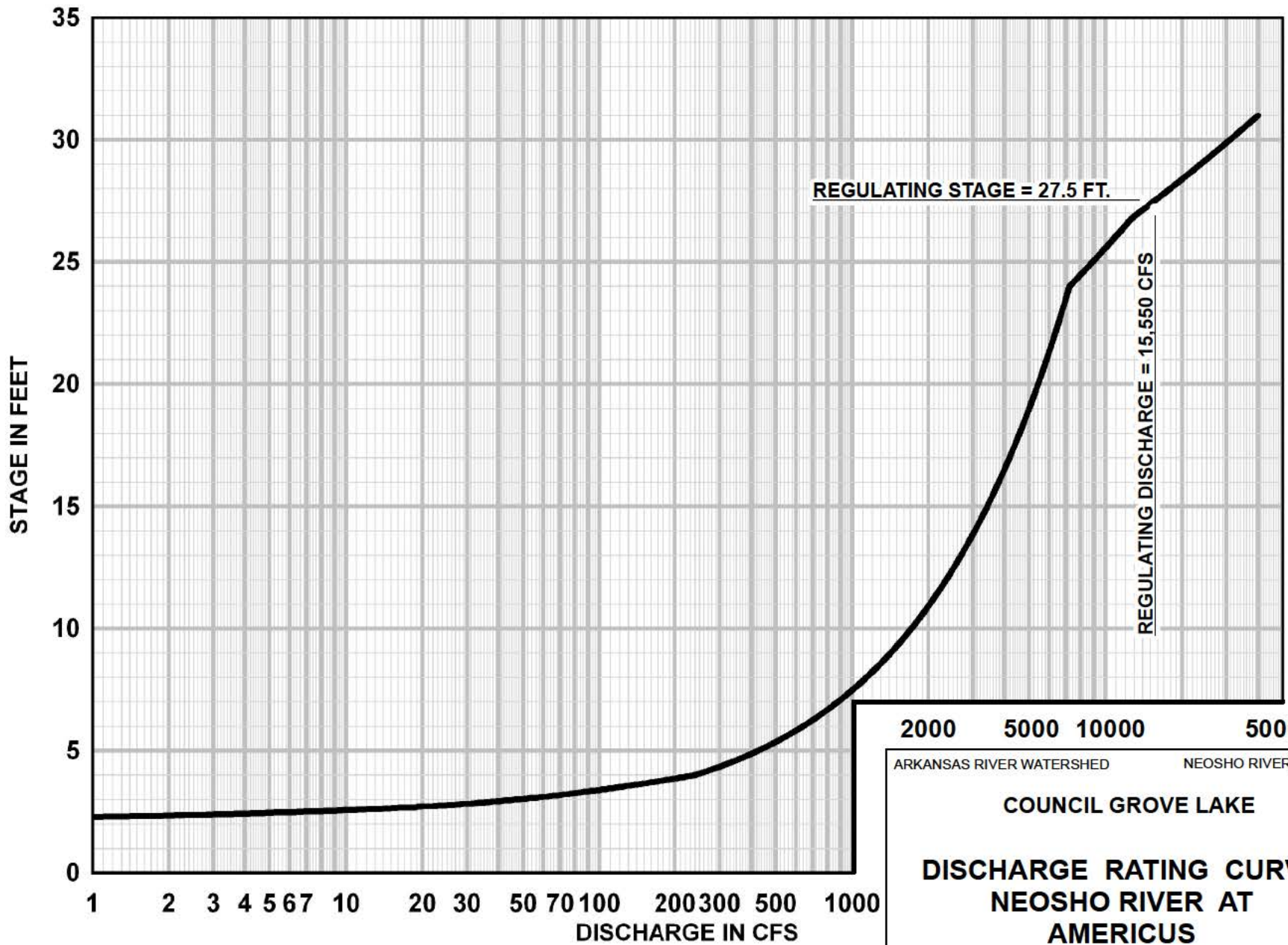
500 1000 2000 5000 10000

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

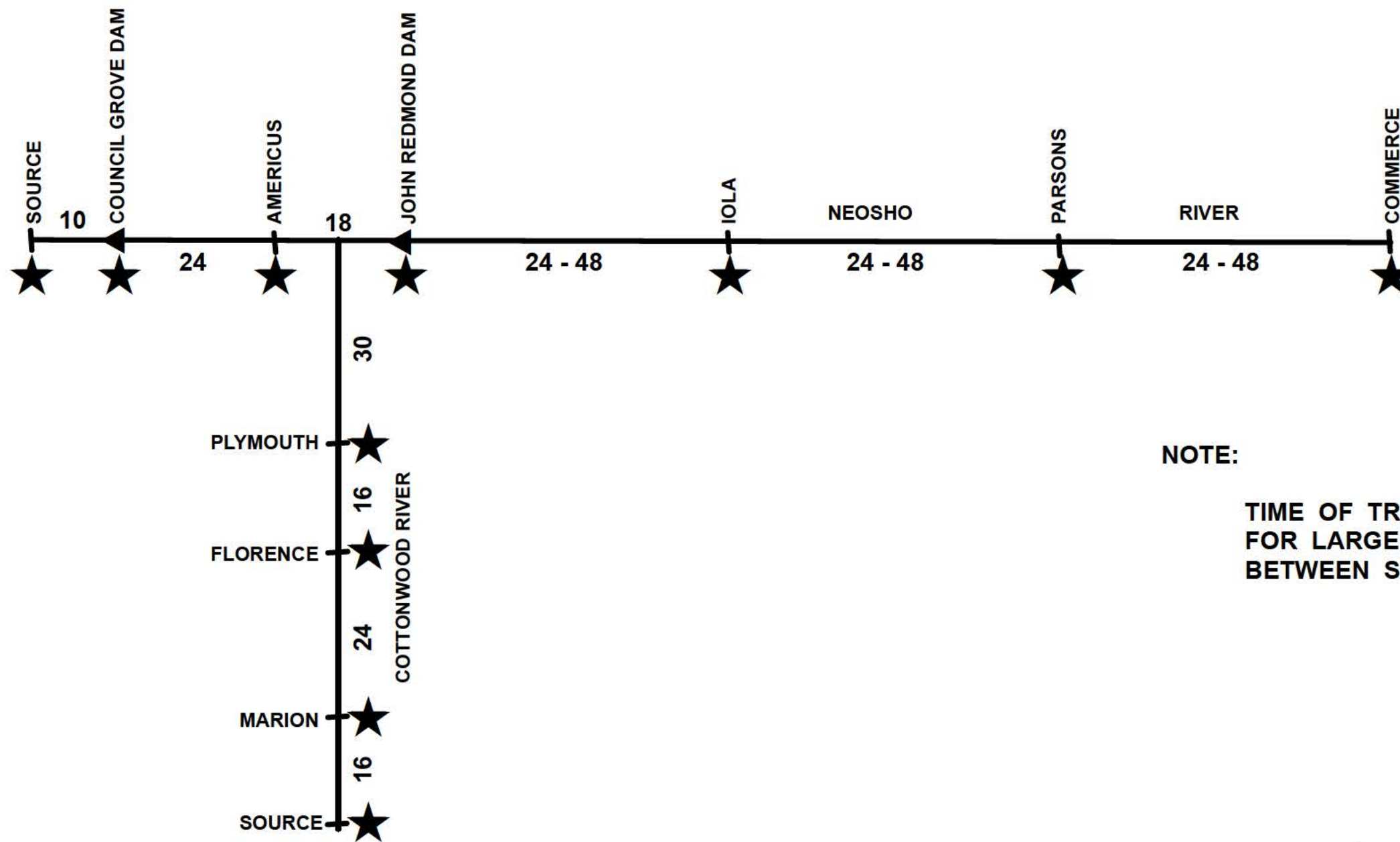
COUNCIL GROVE LAKE

**DISCHARGE RATING CURVE
NEOSHO RIVER AT
COUNCIL GROVE**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



2000 5000 10000 50000
 ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS
COUNCIL GROVE LAKE
DISCHARGE RATING CURVE
NEOSHO RIVER AT
AMERICUS
 DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



NOTE:

**TIME OF TRAVEL IN HOURS
FOR LARGE RISES IS SHOWN
BETWEEN STARS (★ 24 ★)**

Note: Plate size is 11" x 17"

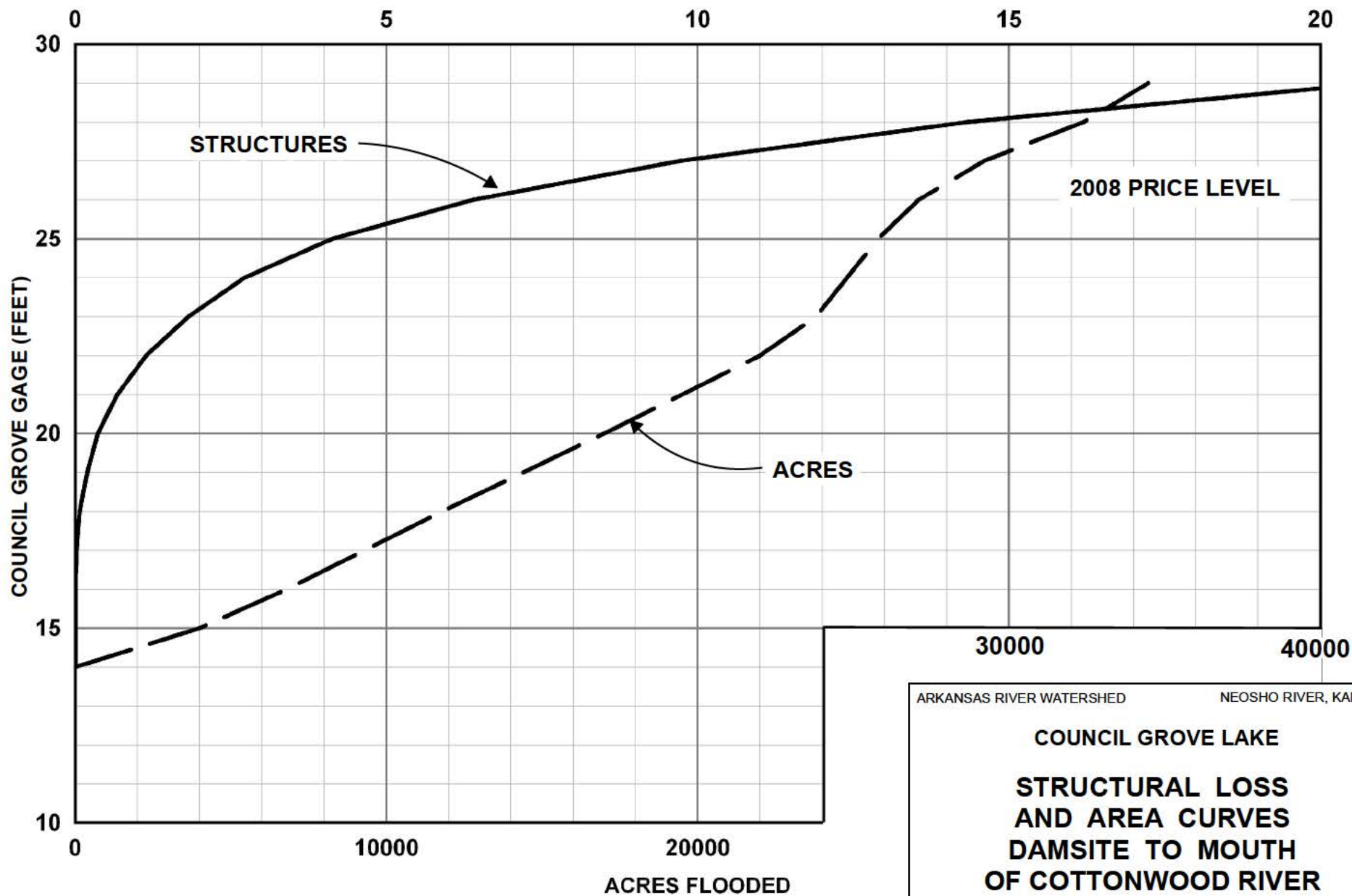
ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**TIME OF CREST
TRAVEL**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL

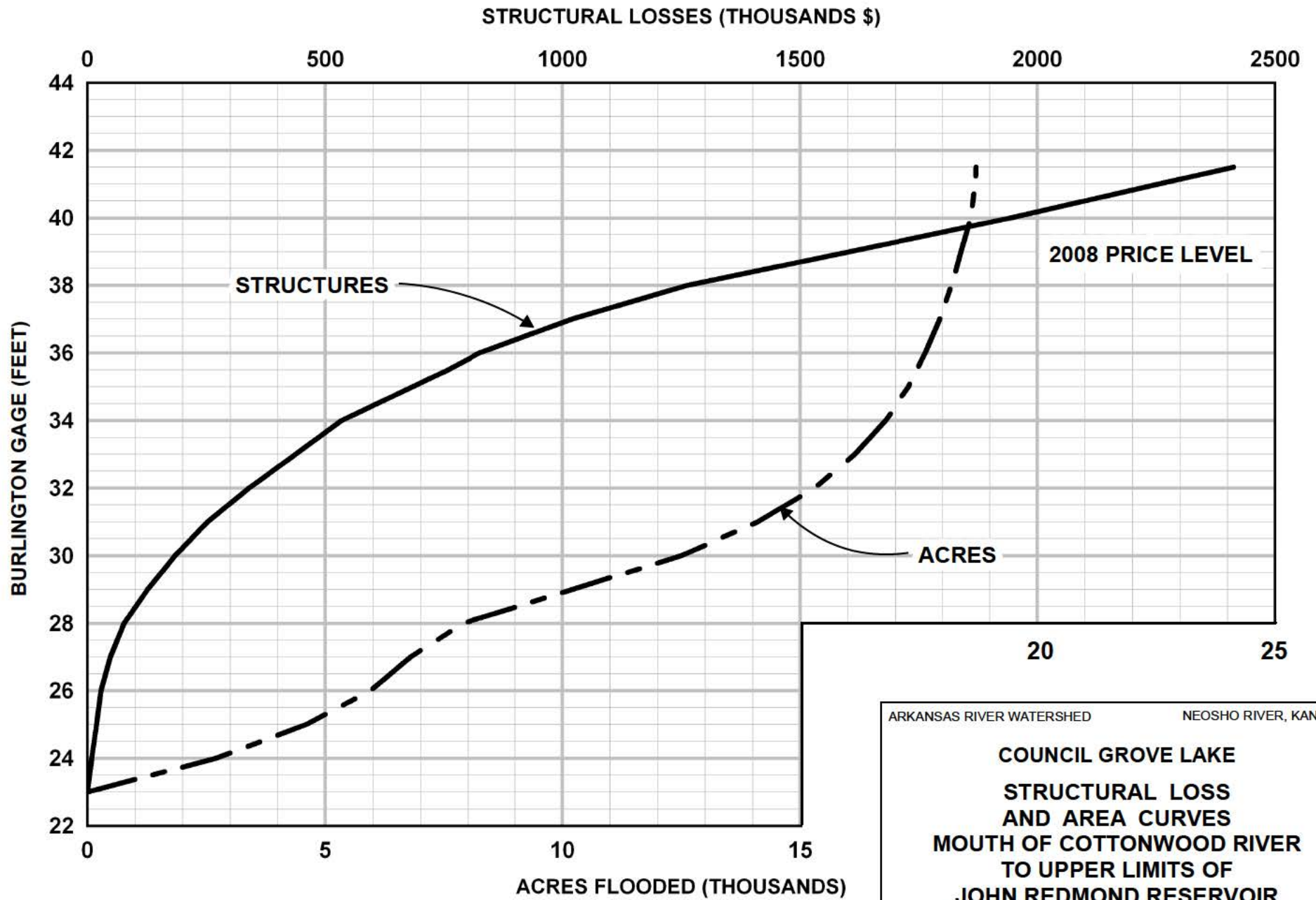
STRUCTURAL LOSSES IN MILLIONS \$



ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

**COUNCIL GROVE LAKE
STRUCTURAL LOSS
AND AREA CURVES
DAMSITE TO MOUTH
OF COTTONWOOD RIVER**

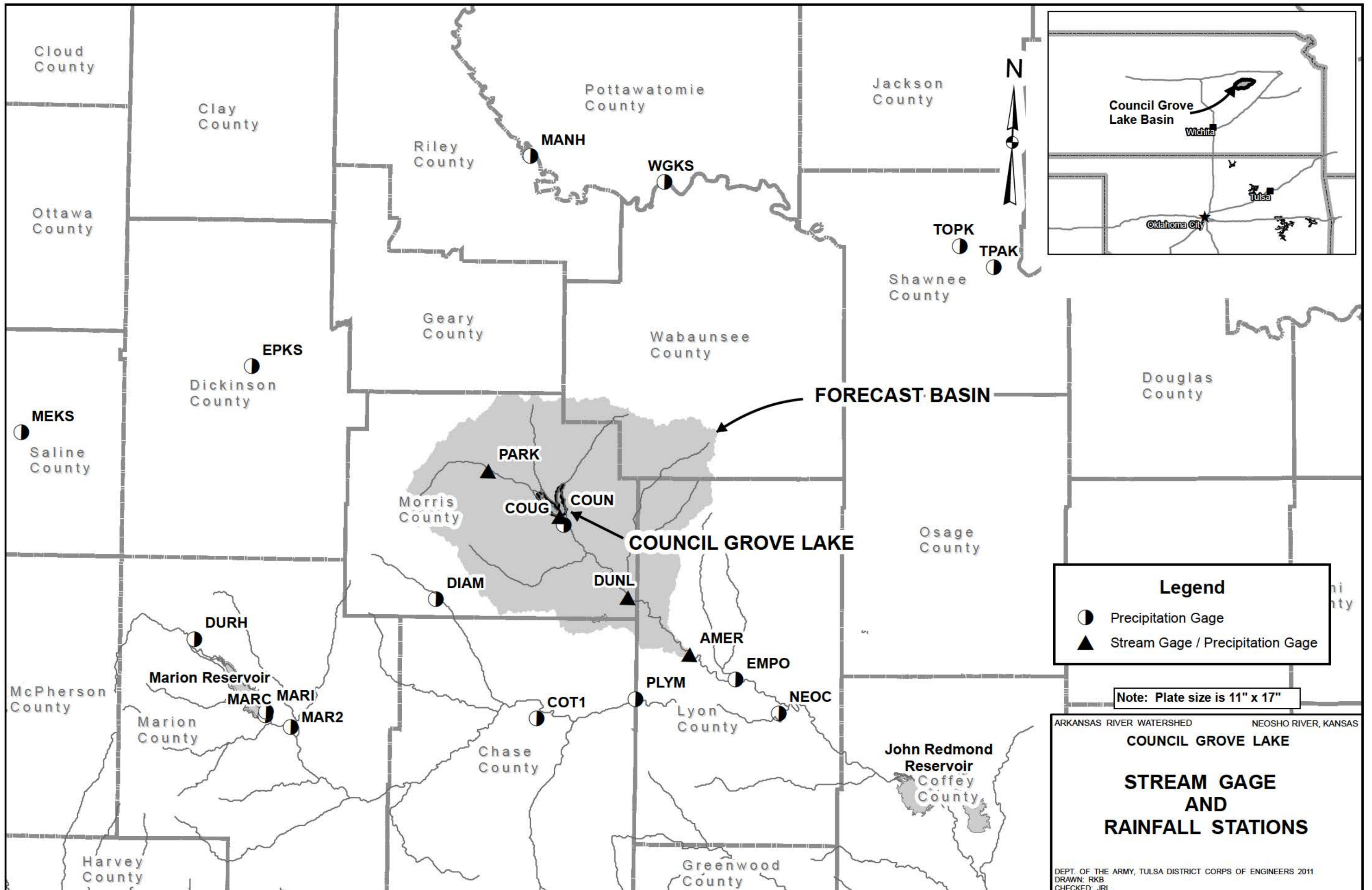
DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

**COUNCIL GROVE LAKE
STRUCTURAL LOSS
AND AREA CURVES
MOUTH OF COTTONWOOD RIVER
TO UPPER LIMITS OF
JOHN REDMOND RESERVOIR**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



Legend

- Precipitation Gage
- ▲ Stream Gage / Precipitation Gage

Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NIOSHO RIVER, KANSAS

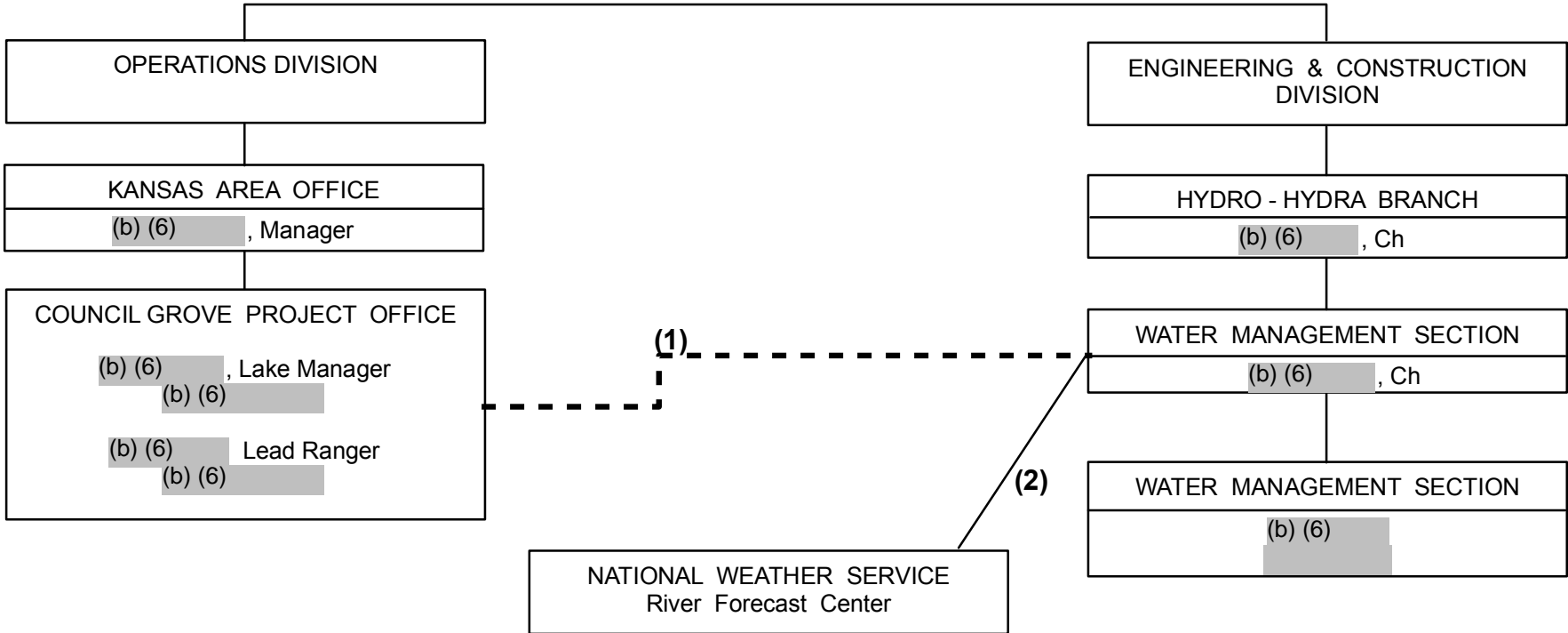
COUNCIL GROVE LAKE

STREAM GAGE AND RAINFALL STATIONS

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL

**U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT**

DISTRICT ENGINEER

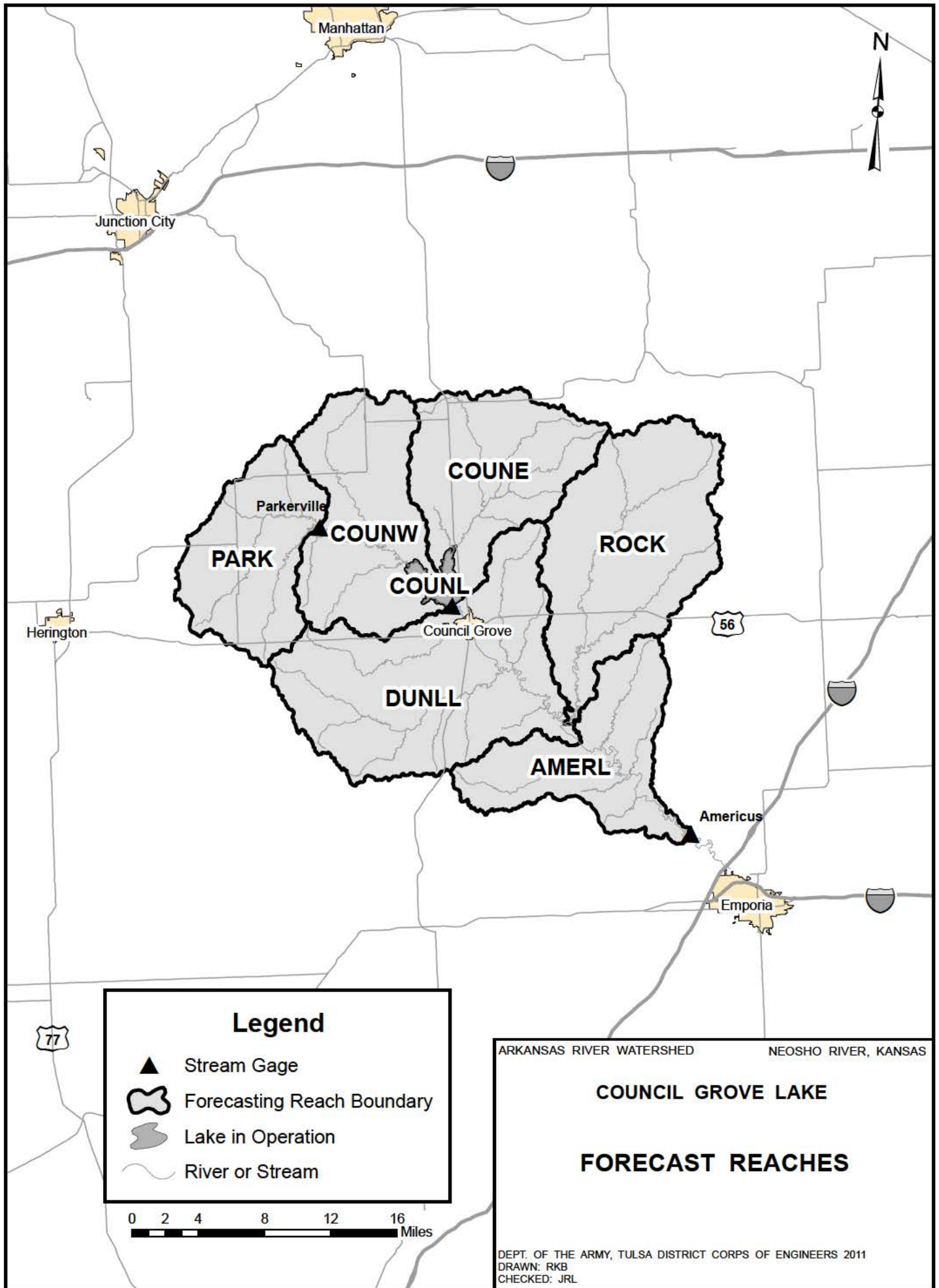


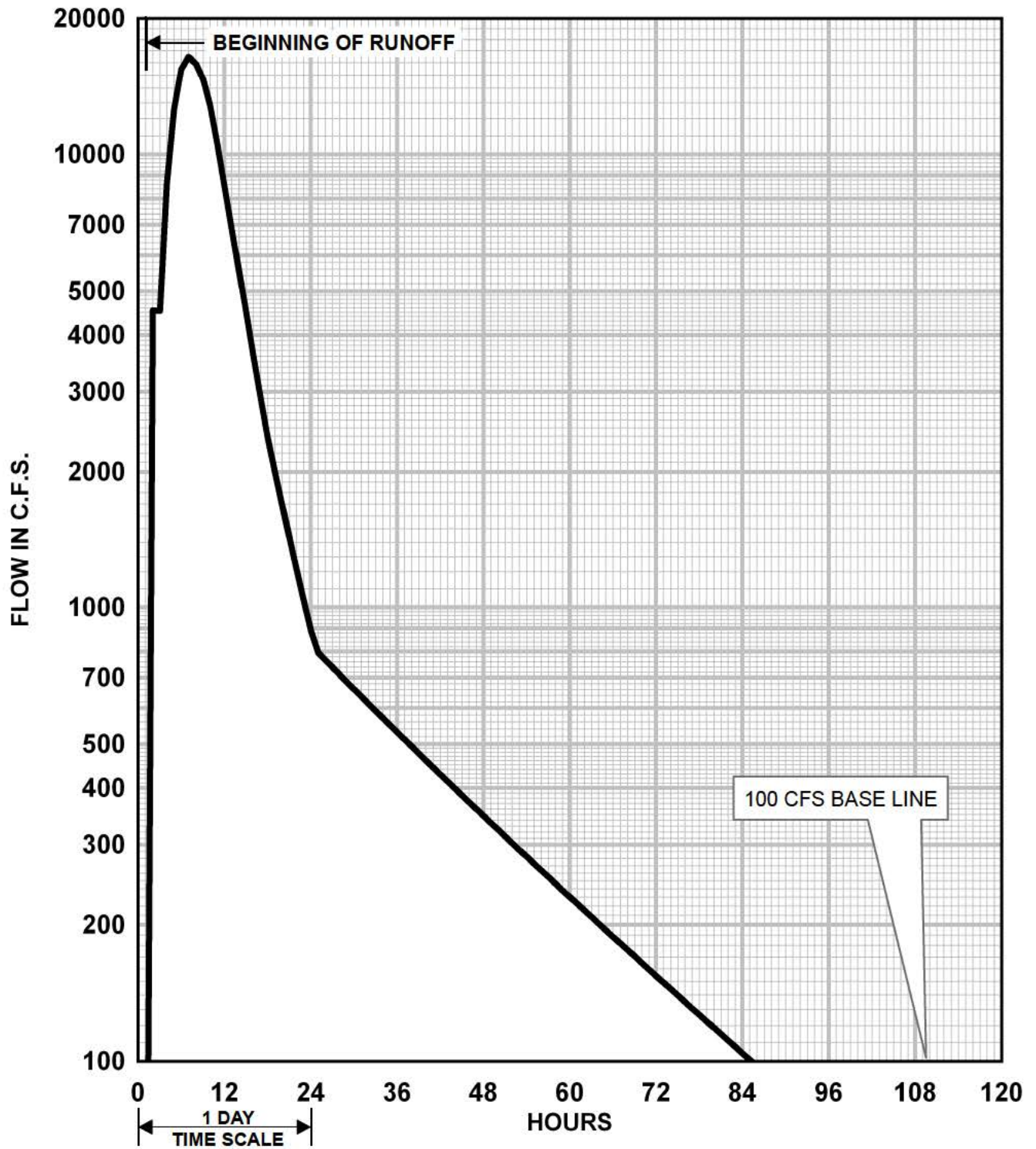
1. DIRECT COMMUNICATIONS ARE MAINTAINED BETWEEN COUNCIL GROVE PROJECT OFFICE AND THE WATER MANAGEMENT SECTION FOR TRANSMISSION OF RESERVOIR DATA, REGULATIONS AND INSTRUCTIONS.
2. PRECIPITATION AND STREAM GAGE DATA ARE SHARED BY THE NATIONAL WEATHER SERVICE, RIVER FORECAST CENTER.

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

**COUNCIL GROVE LAKE
ORGANIZATION FOR
FLOOD CONTROL REGULATION**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RAB
CHECKED: JRL





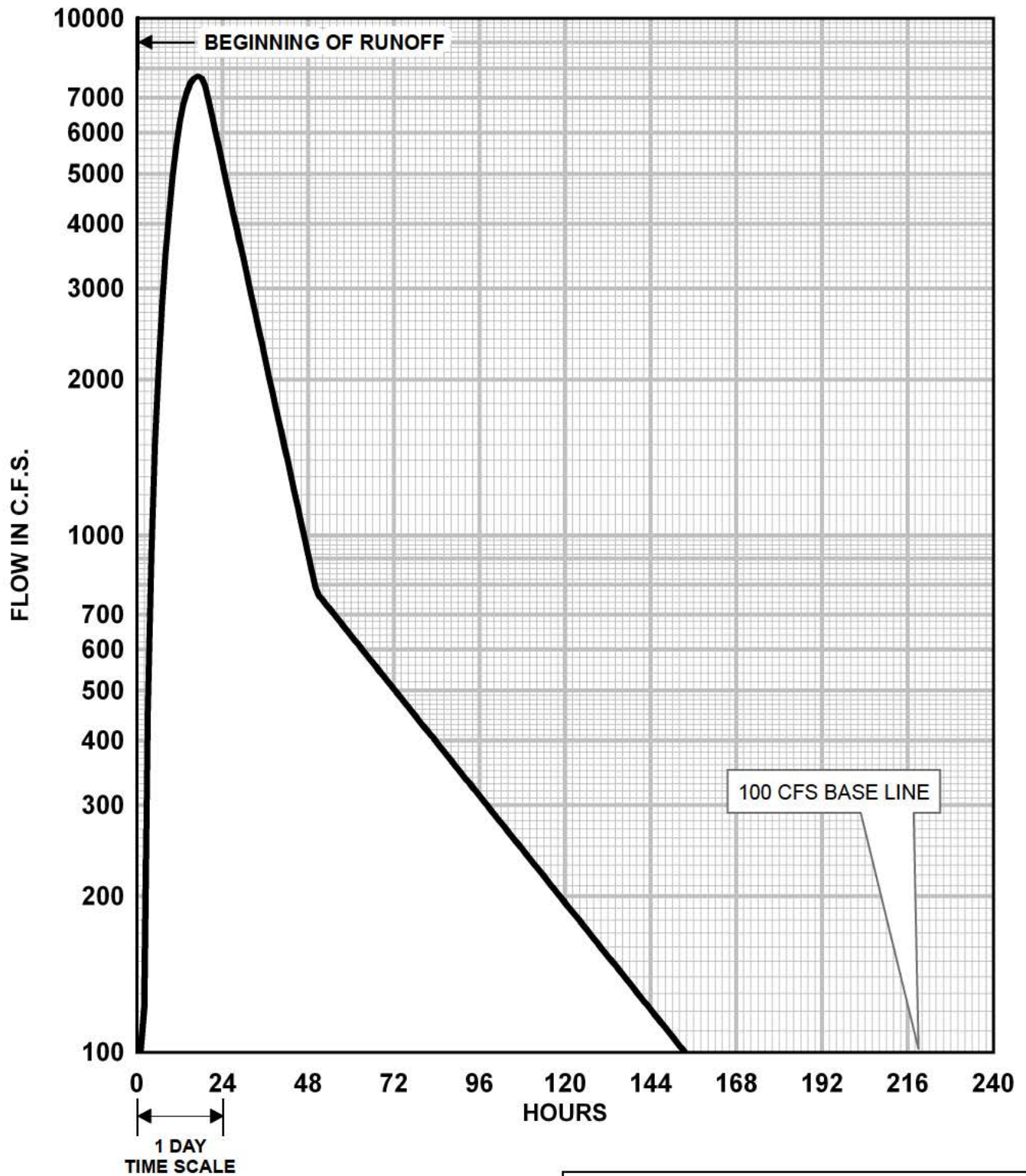
**DRAINAGE AREA = 246 SQ. MI.
 1" RUNOFF = 13,112 AC.FT.
 PEAK FLOW = 16,476 C.F.S.**

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**UNIT HYDROGRAPH FOR AREA
 ABOVE COUNCIL GROVE DAM**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



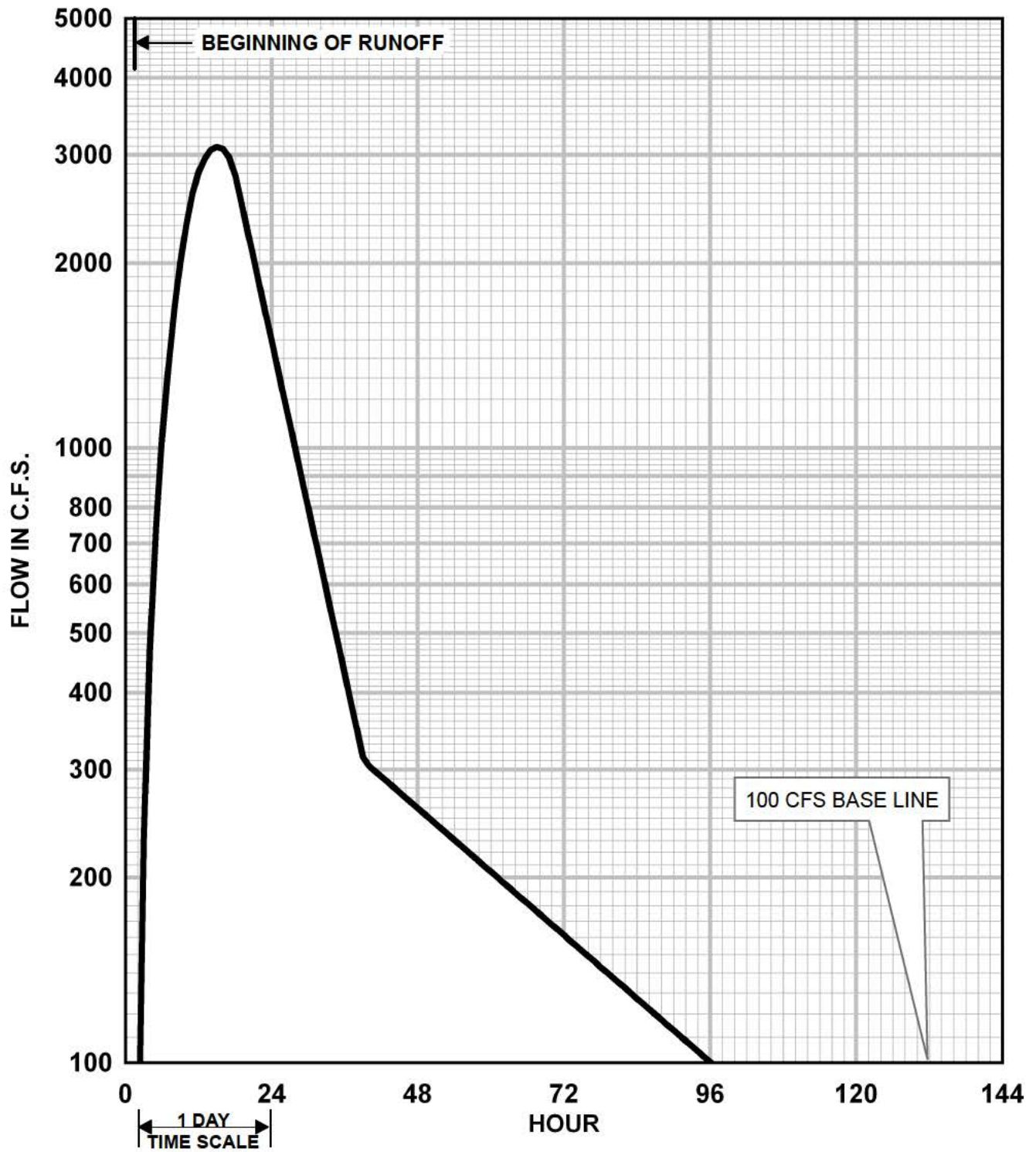
**DRAINAGE AREA = 282 SQ. MI.
 1" RUNOFF = 15,031 AC.FT.
 PEAK FLOW = 7,724 C.F.S.**

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**UNIT HYDROGRAPH FOR AREA
 BELOW COUNCIL GROVE DAM
 AND ABOVE DUNLAP GAGE**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



DRAINAGE AREA = 94 SQ. MI.
 1" RUNOFF = 5,010 AC.FT.
 PEAK FLOW = 3,092 C.F.S.

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**UNIT HYDROGRAPH FOR AREA
 BELOW DUNLAP GAGE AND
 ABOVE AMERICUS GAGE**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL

EXAMPLE OF
 SWD FORM 156
 25NOV552
 1/94 BY SWT

COUNCIL GROVE RESERVIOR DISCHARGE AND INFLOW COMPUTATION

COMPUTED BY: JWC DATE: JULY 93 CHECKED BY: DATE: BOOK NO.

DATE	TIME	POOL ELEVATION	M STORAGE (1000'S A.F.)	Δ STORAGE		GATES OPERATING		DISCHARGE IN c.f.s.						INFLOW		
				ACRE FEET	c.f.s.	NO. & TYPE	OPENING	INSTANTANEOUS			AVERAGE					
								FLOOD CONTROL	POWER	TOTAL	FLOOD CONTROL	POWER	EVAP.		TOTAL	
22	2400	1294.19	144.45													
23	0800	1294.29	145.11													
	1045	1294.32				2 CG	1.0'	700		700						
	1200	1294.32	145.31	4/200	4/600						4/220			4/220	4/820	
	1400	1294.30	145.18	6/70	6/140	2 CG	1.5'	1200		1200	6/380			6/380	6/520	
	1600	1294.29														
	1720	1294.27				2 CG	2.0'	1600		1600						
	2030	1294.23				2 CG	2.8'	2100		2100						
	2400	1294.18	144.38	24/-70	24/-35						24/780			24/780	24/745	
24	0800	1294.00	143.19	08/-1200	08/-1800	2 CG	2.8'	2100		2100	8/2100		.34	8/2100	8/300	

(1) (2) (3) (4) (5) (6) (7)

- (1) RESERVOIR CAPACITY TABLE.
- (2) SUBTRACT STORAGE AT BEGINNING OF PERIOD FROM STORAGE AT END OF PERIOD. IF POOL IS RISING, CHANGE IN STORAGE IS POSITIVE (+), IF FALLING NEGATIVE (-).
- (3) $\frac{\text{CHANGE IN STORAGE (A.F.)} \times 12}{\text{NO. OF HOURS IN PERIOD}} = \text{CHANGE IN STORAGE IN C.F.S.}$
- (4) FROM DISCHARGE RATING CURVES.
- (5) AVERAGE DISCHARGE DURING PERIOD.
- (6) PAN EVAPORATION APPLIED TO EVAPORATION CURVES.
- (7) INFLOW + CHANGE IN STORAGE (D.F.S) + AVERAGE DISCHARGE + EVAPORATION.

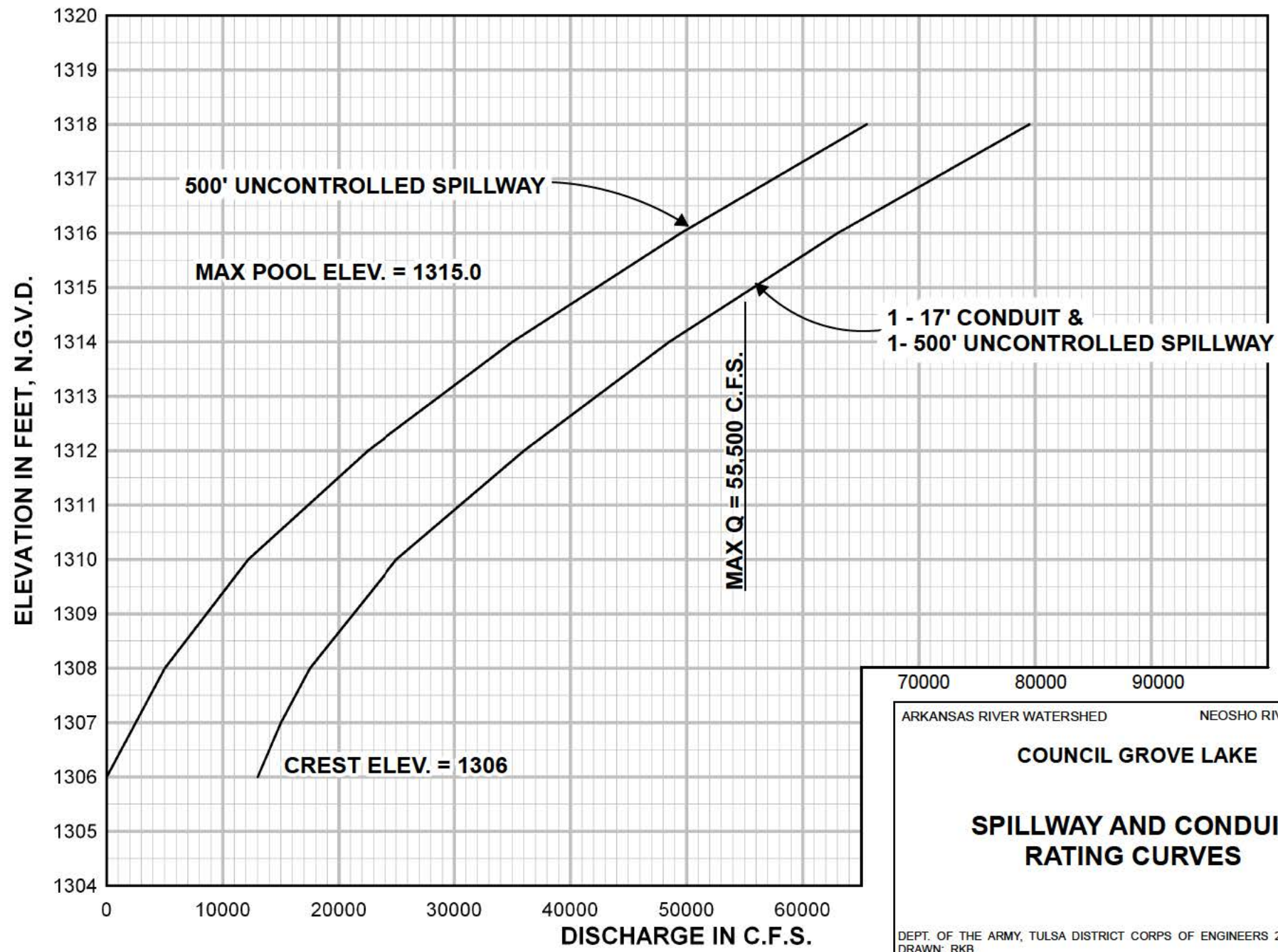
NOTE: DURING FLOOD PERIODS EVAPORATIONS IF USUALLY NEGLECTED IN PRELIMINARY INFLOW CALCULATIONS.
 NUMBER OF HOURS FOR THE INFLOW PERIOD IS INDICATED BY 4/

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

SAMPLE INFLOW COMPUTATION

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



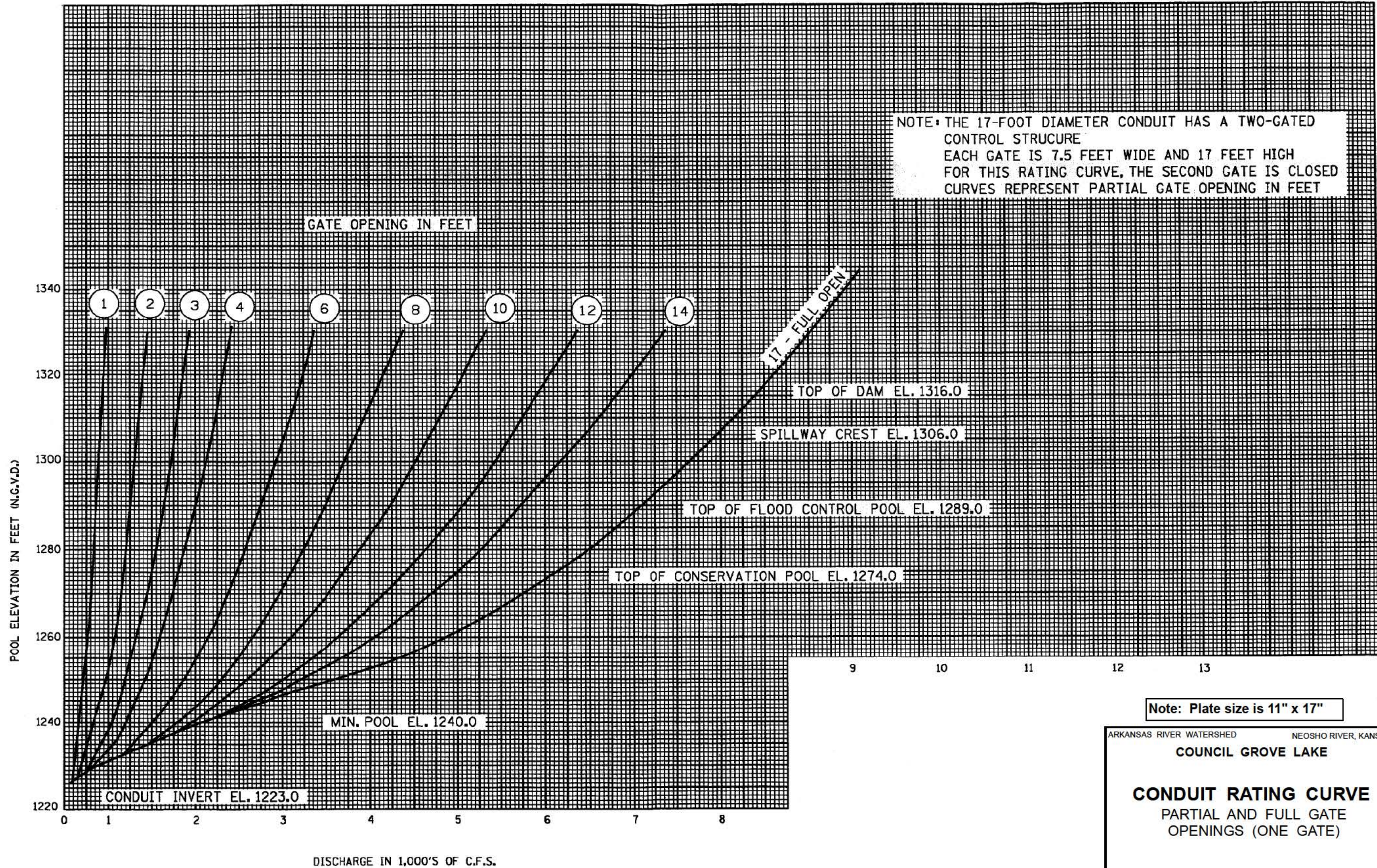
70000 80000 90000

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

SPILLWAY AND CONDUIT RATING CURVES

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



Note: Plate size is 11" x 17"

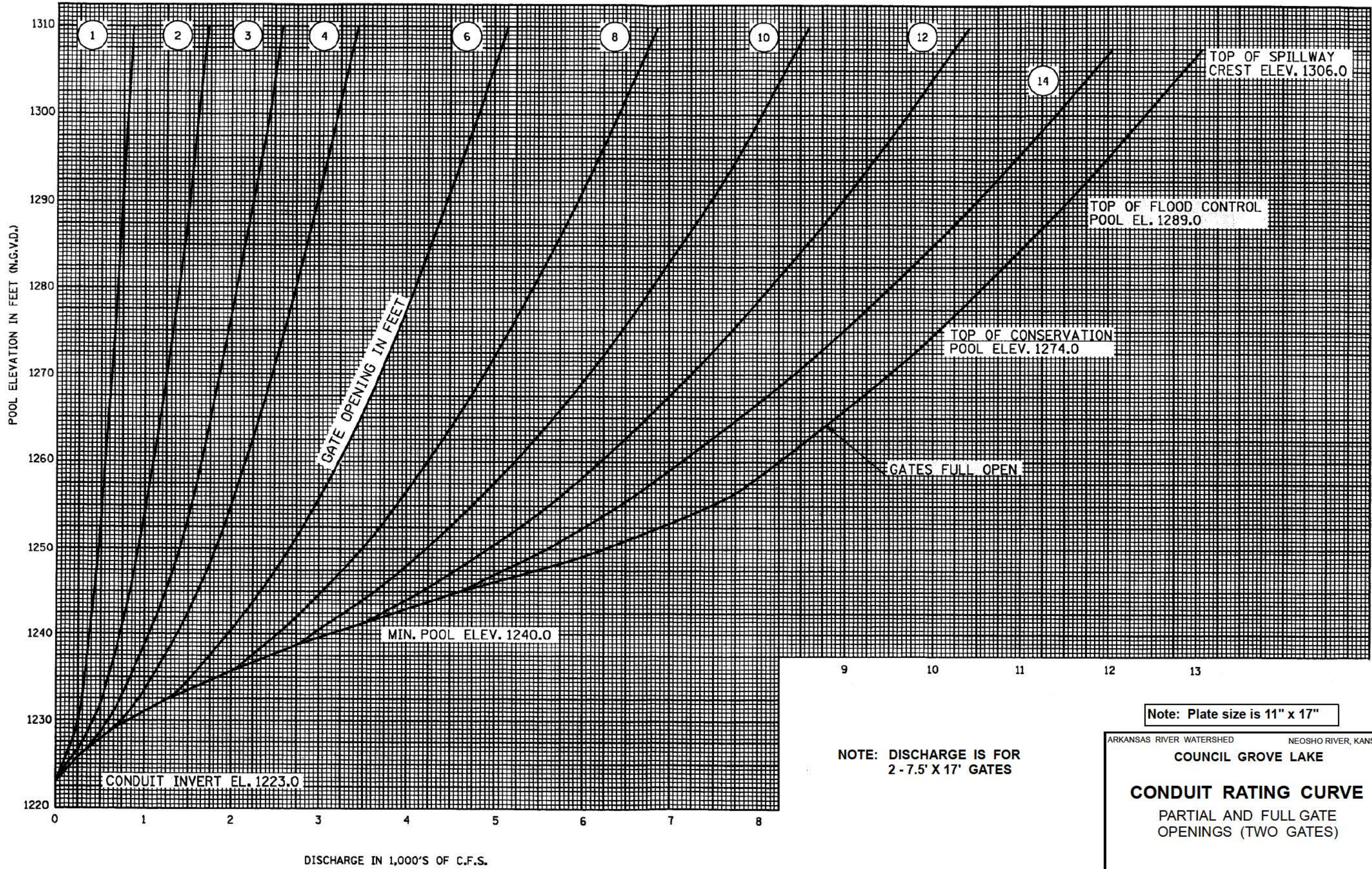
ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

CONDUIT RATING CURVE

PARTIAL AND FULL GATE
OPENINGS (ONE GATE)

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



Note: Plate size is 11" x 17"

NOTE: DISCHARGE IS FOR
2 - 7.5' X 17' GATES

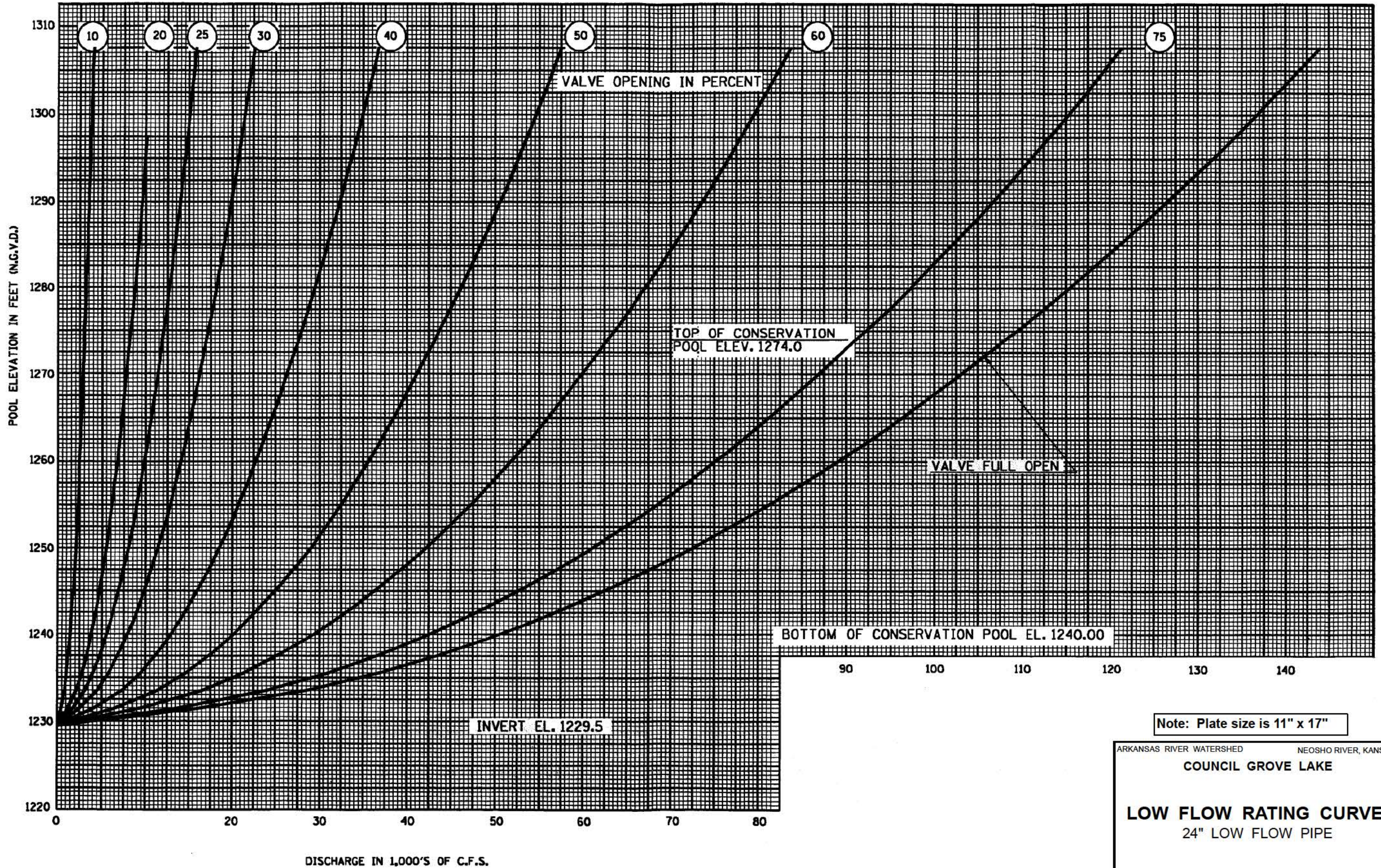
ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

CONDUIT RATING CURVE

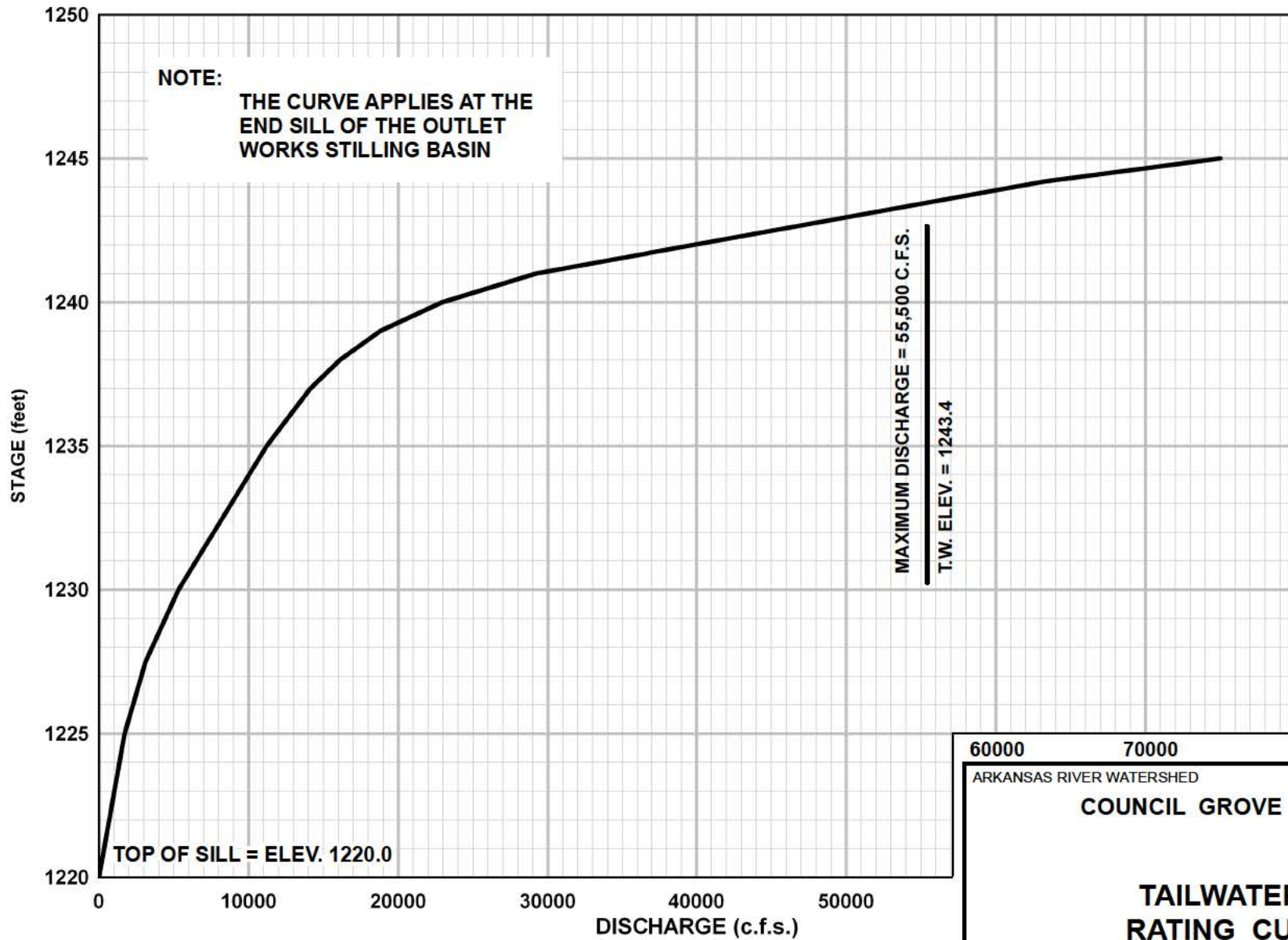
PARTIAL AND FULL GATE
OPENINGS (TWO GATES)

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS
COUNCIL GROVE LAKE
LOW FLOW RATING CURVE
 24" LOW FLOW PIPE
 DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL

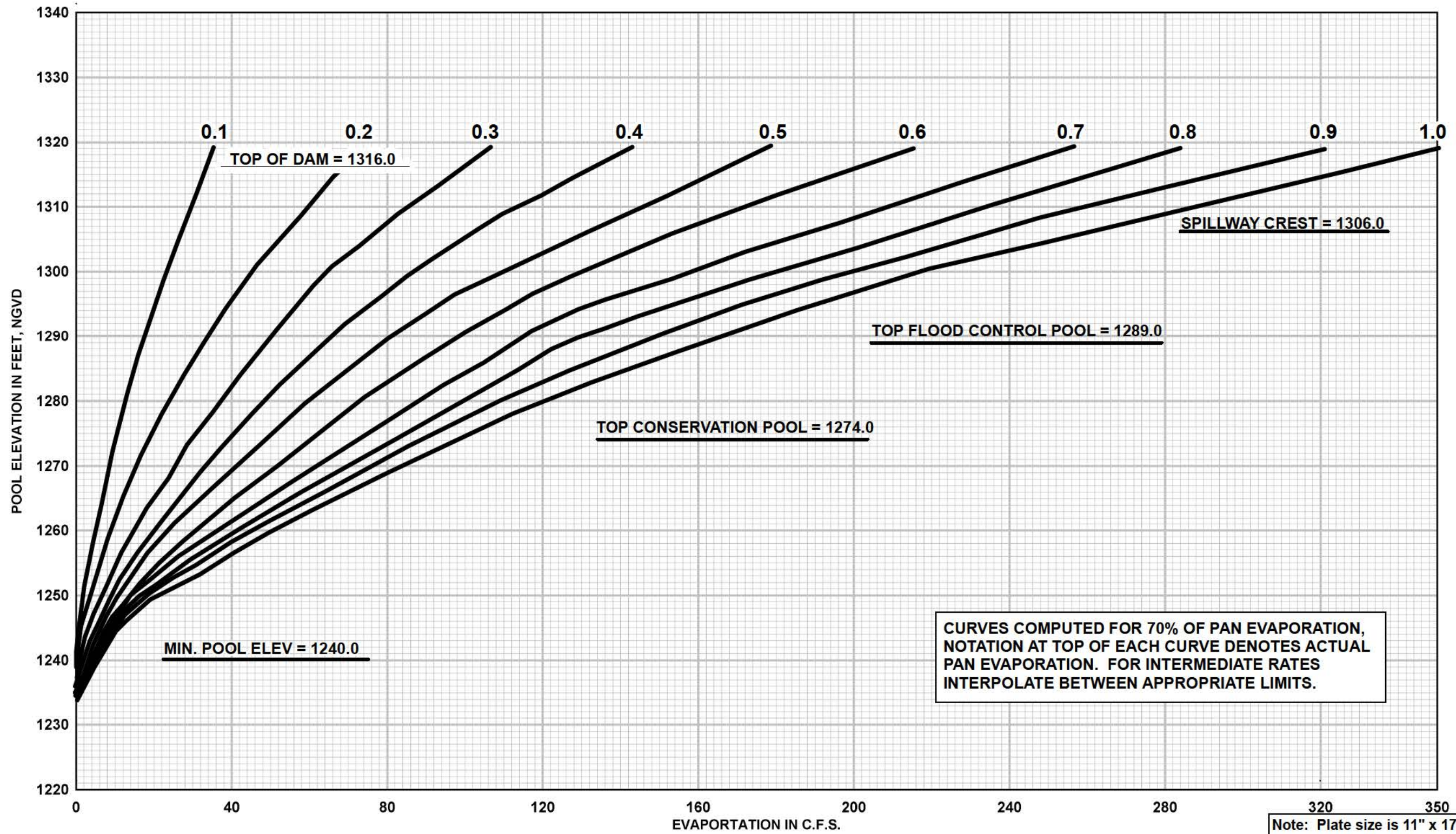


60000 70000
ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**TAILWATER
RATING CUVE**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



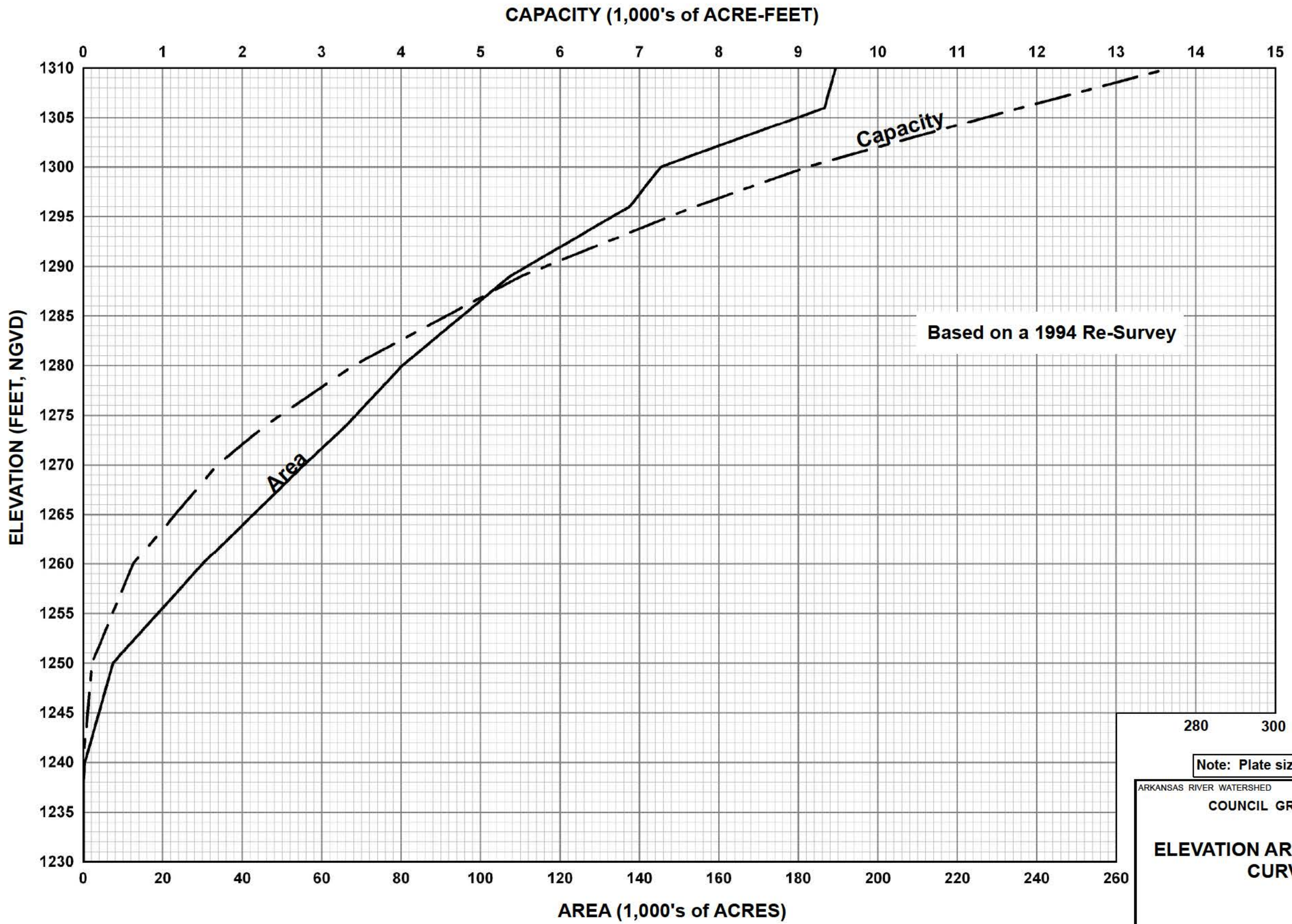
Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

EVAPORATION CURVES

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



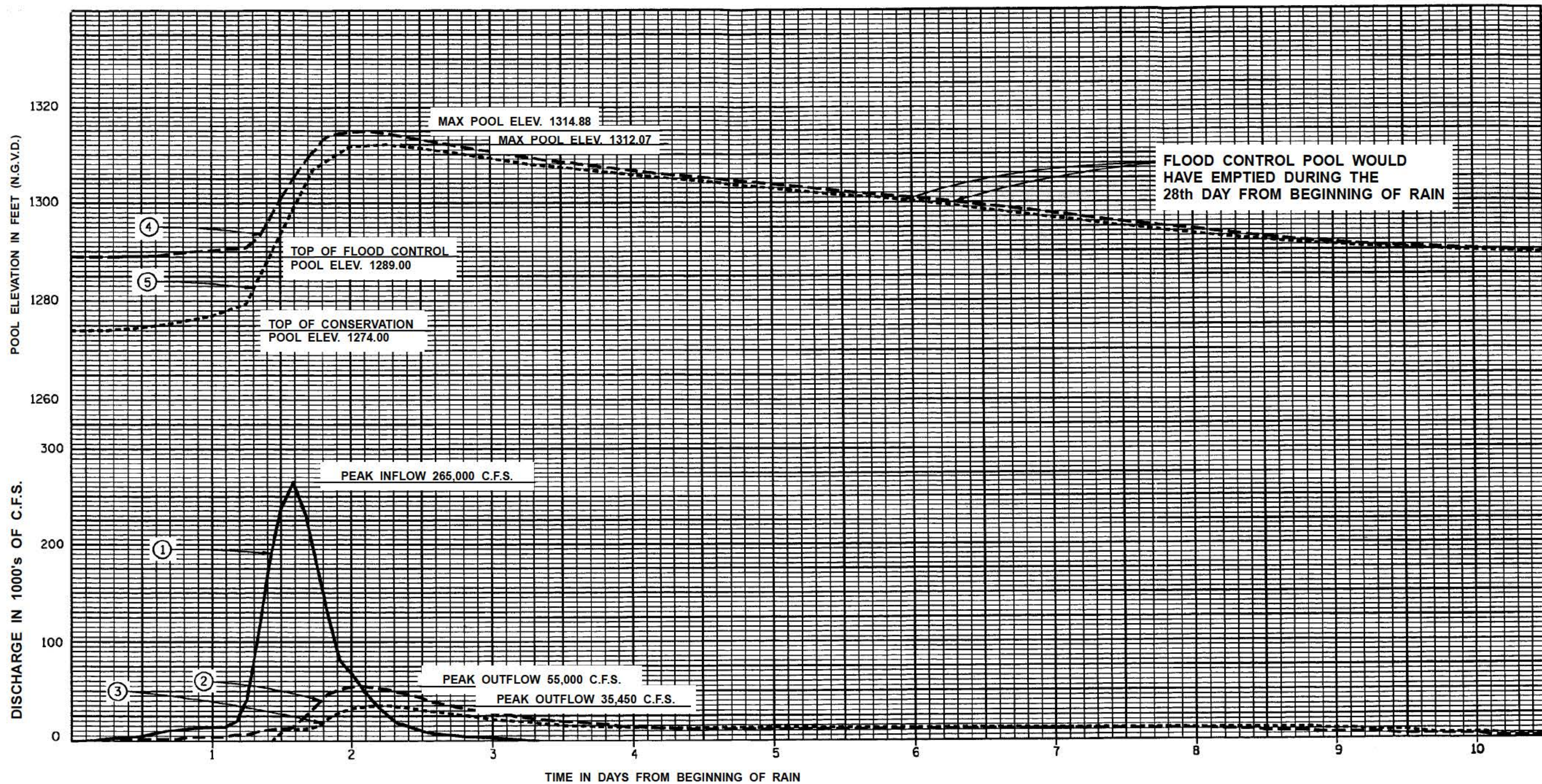
Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

ELEVATION AREA CAPACITY CURVES

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



Note: Plate size is 11" x 17"

NOTE: EMERGENCY OPERATION

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

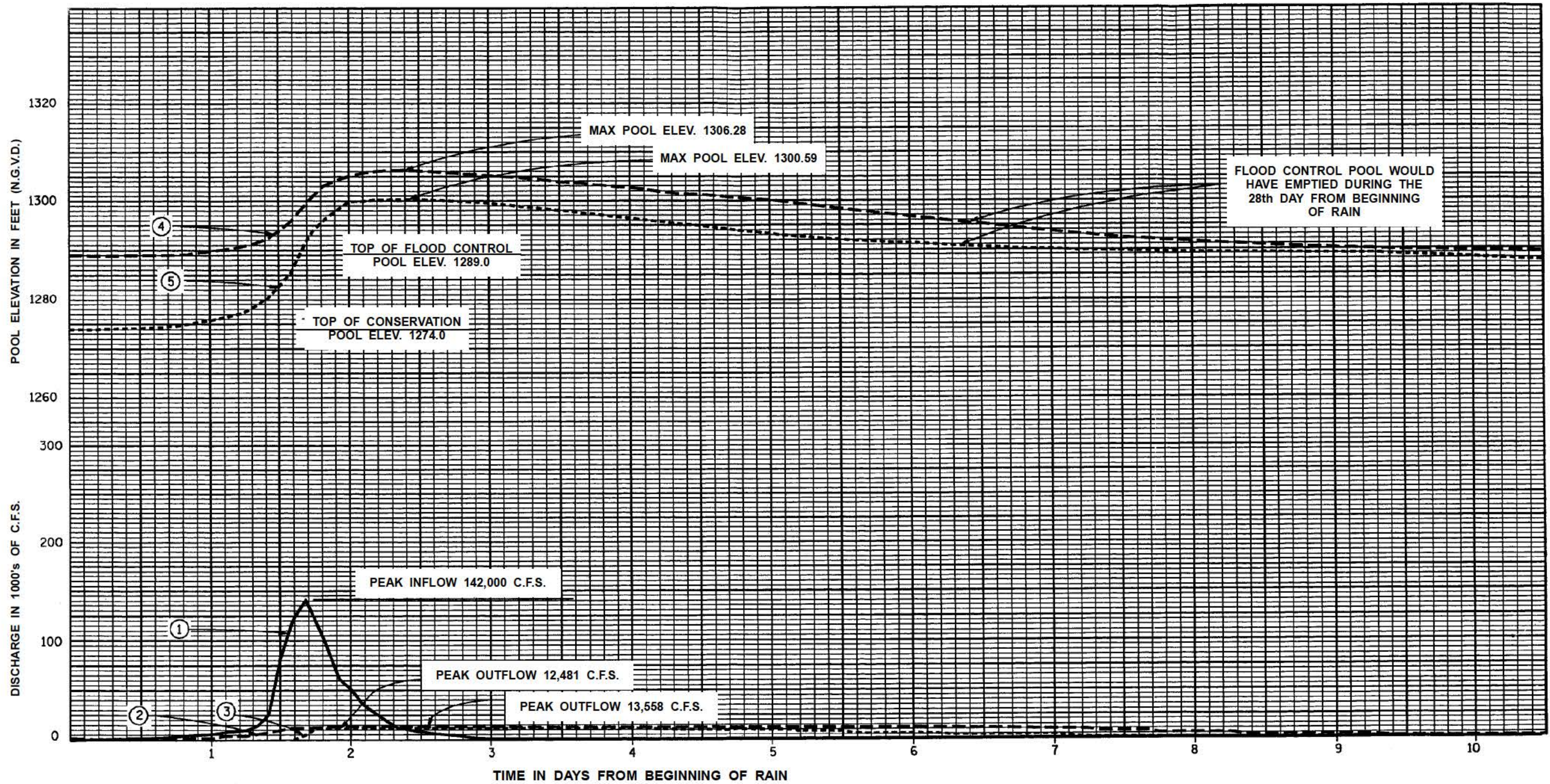
ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

OPERATIONAL HYDROGRAPHS

SPILLWAY DESIGN FLOOD

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



NOTE: EMERGENCY OPERATION

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

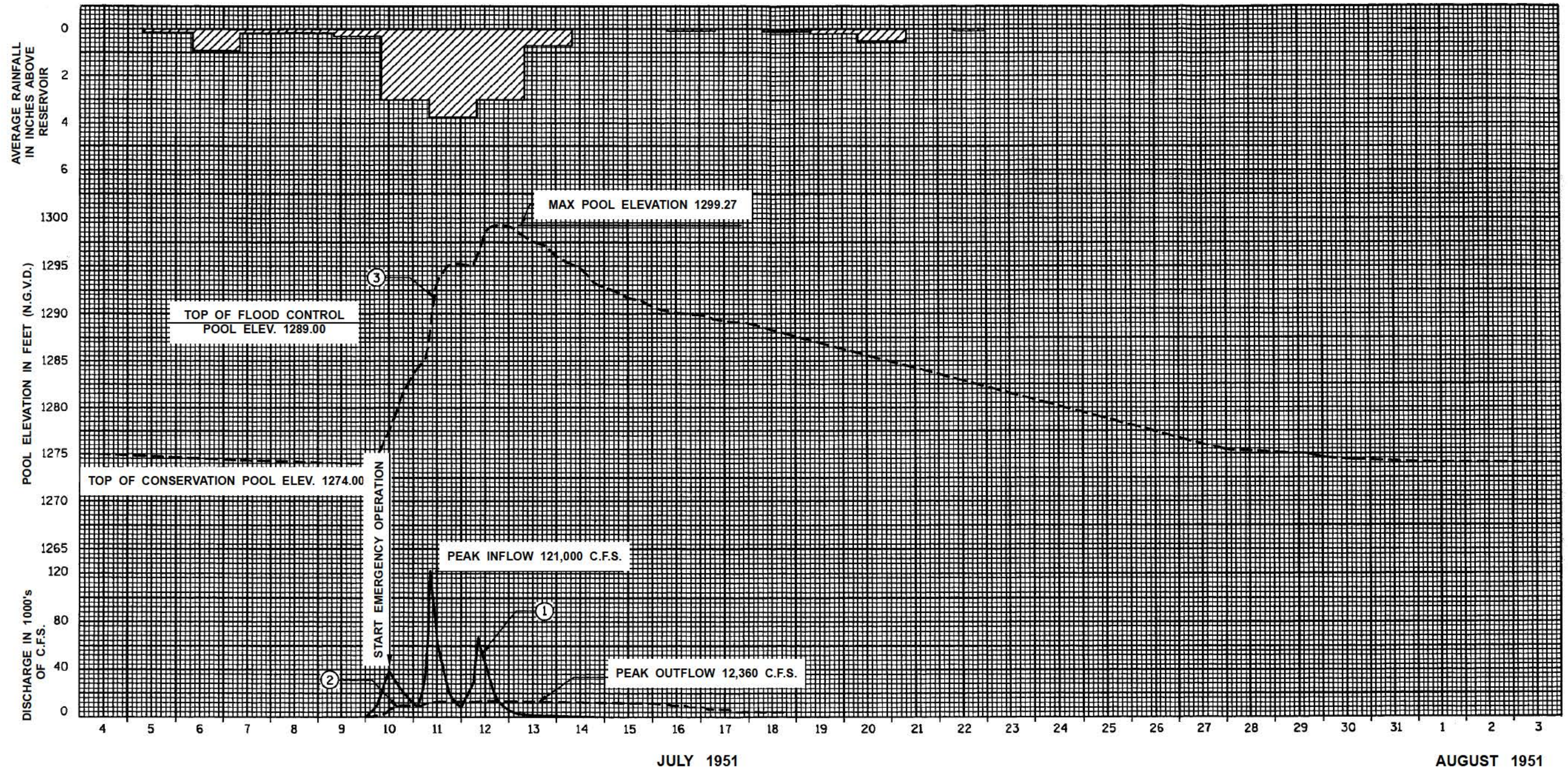
Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

OPERATIONAL HYDROGRAPHS
STANDARD PROJECT FLOOD
 (1/2 SPILLWAY DESIGN FLOOD)

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



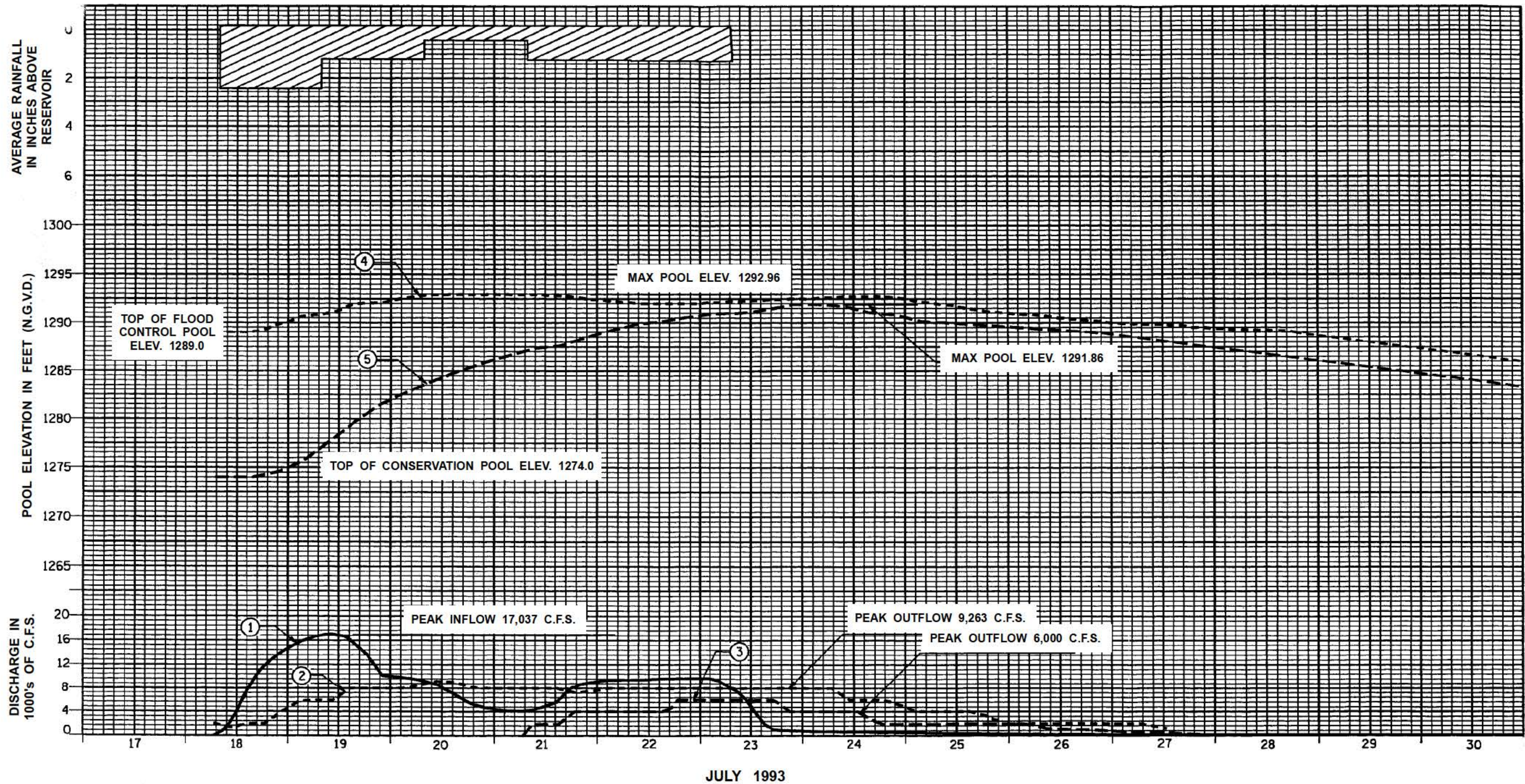
NOTE: EMERGENCY OPERATION

- ① INFLOW HYDROGRAPH
- ② OUTFLOW - FLOOD ON EMPTY POOL
- ③ POOL STAGE - FLOOD ON EMPTY POOL

Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS
COUNCIL GROVE LAKE
OPERATIONAL HYDROGRAPHS
 FLOOD JUN. - JUL. 1951

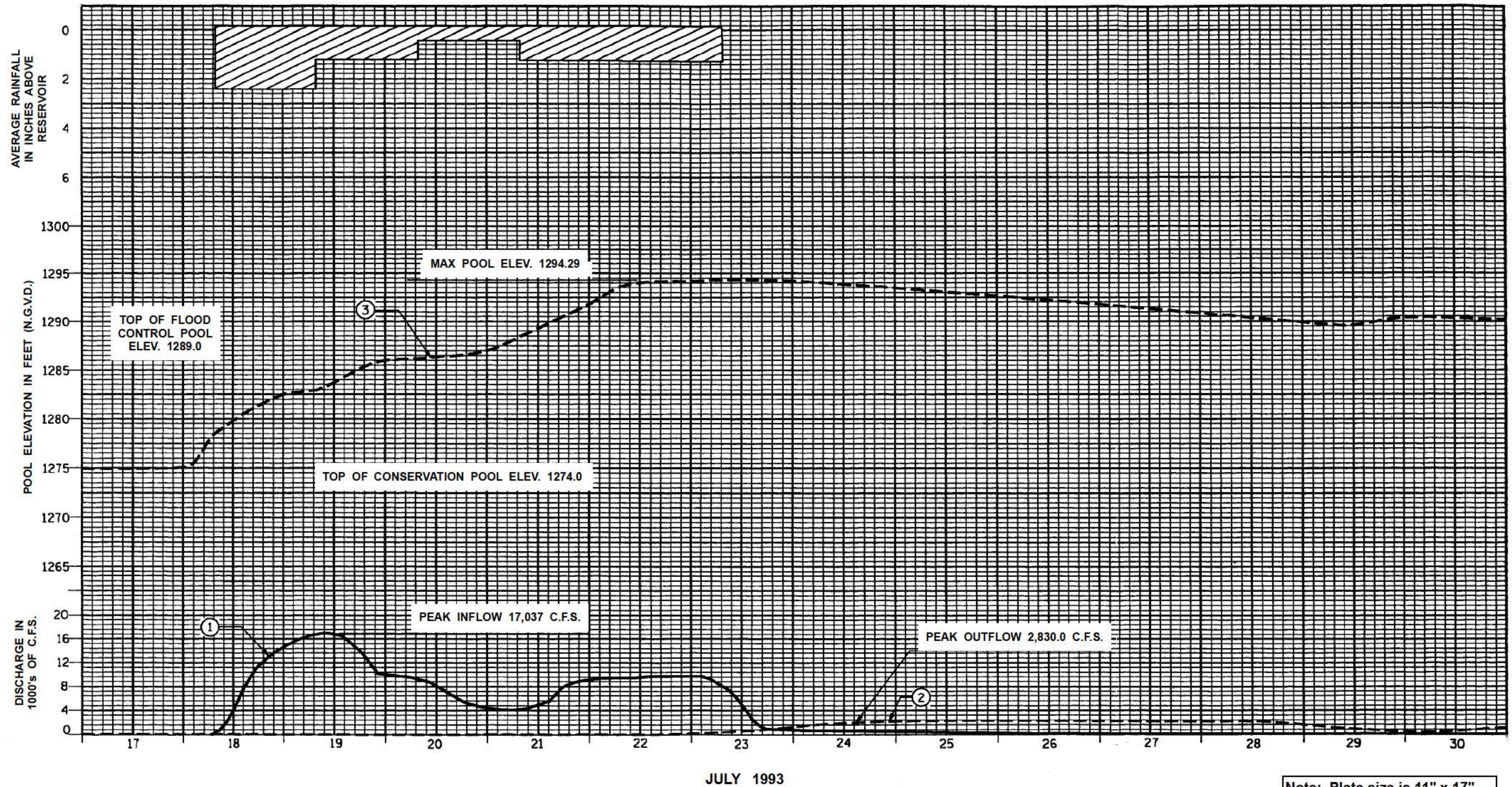
DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



Note: Plate size is 11" x 17"

- NOTE: EMERGENCY OPERATION
- ① INFLOW HYDROGRAPH
 - ② OUTFLOW - FLOOD ON FULL POOL
 - ③ OUTFLOW - FLOOD ON EMPTY POOL
 - ④ POOL STAGE - FLOOD ON FULL POOL
 - ⑤ POOL STAGE - FLOOD ON EMPTY POOL

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS
COUNCIL GROVE LAKE
OPERATIONAL HYDROGRAPHS
 FLOOD JULY 1993
 DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

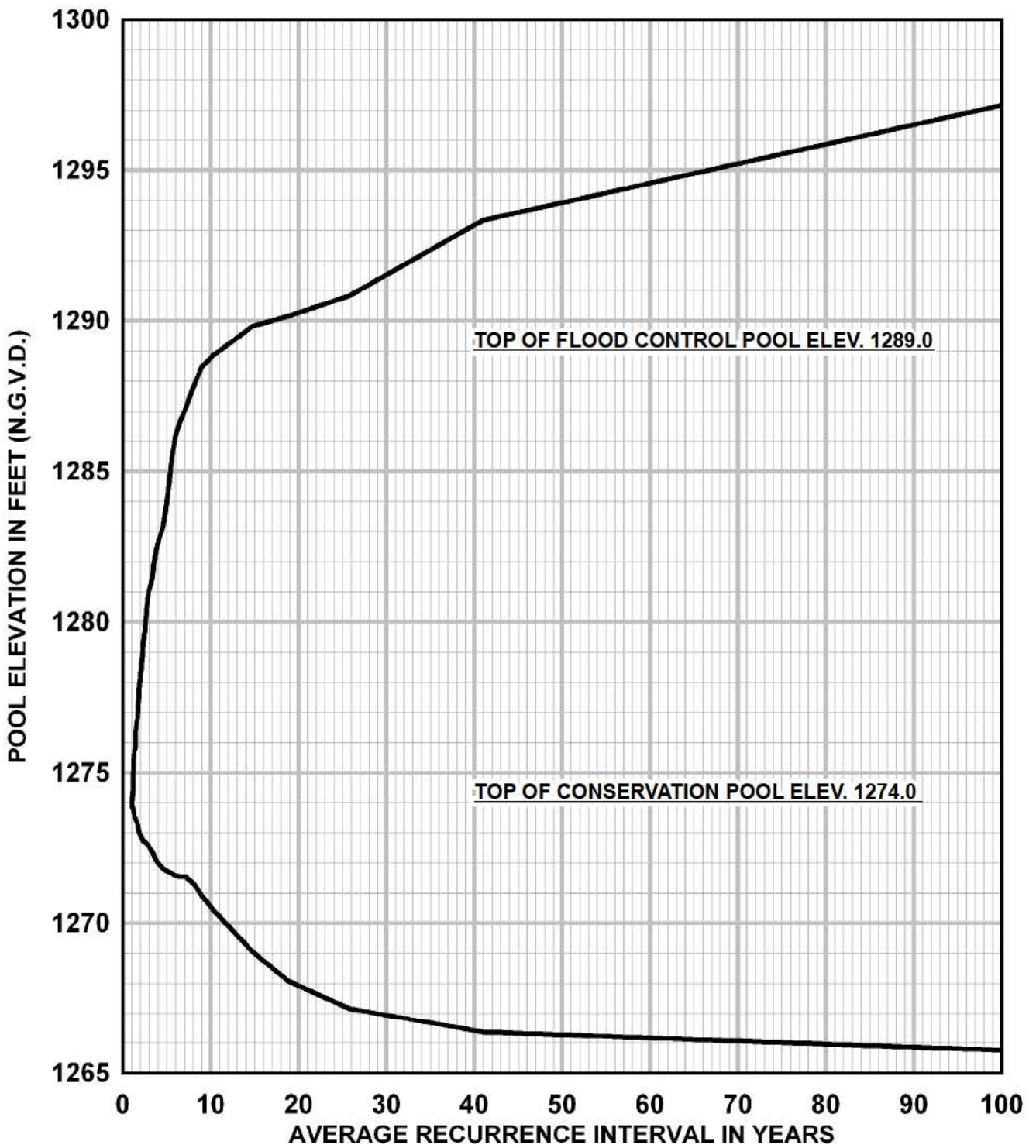
COUNCIL GROVE LAKE

ACTUAL HYDROGRAPHS
FLOOD OF JULY 1993

NOTE: NORMAL OPERATION

- ① INFLOW HYDROGRAPH
- ② OUTFLOW HYDROGRAPH - ACTUAL
- ③ POOL STAGE - ACTUAL

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



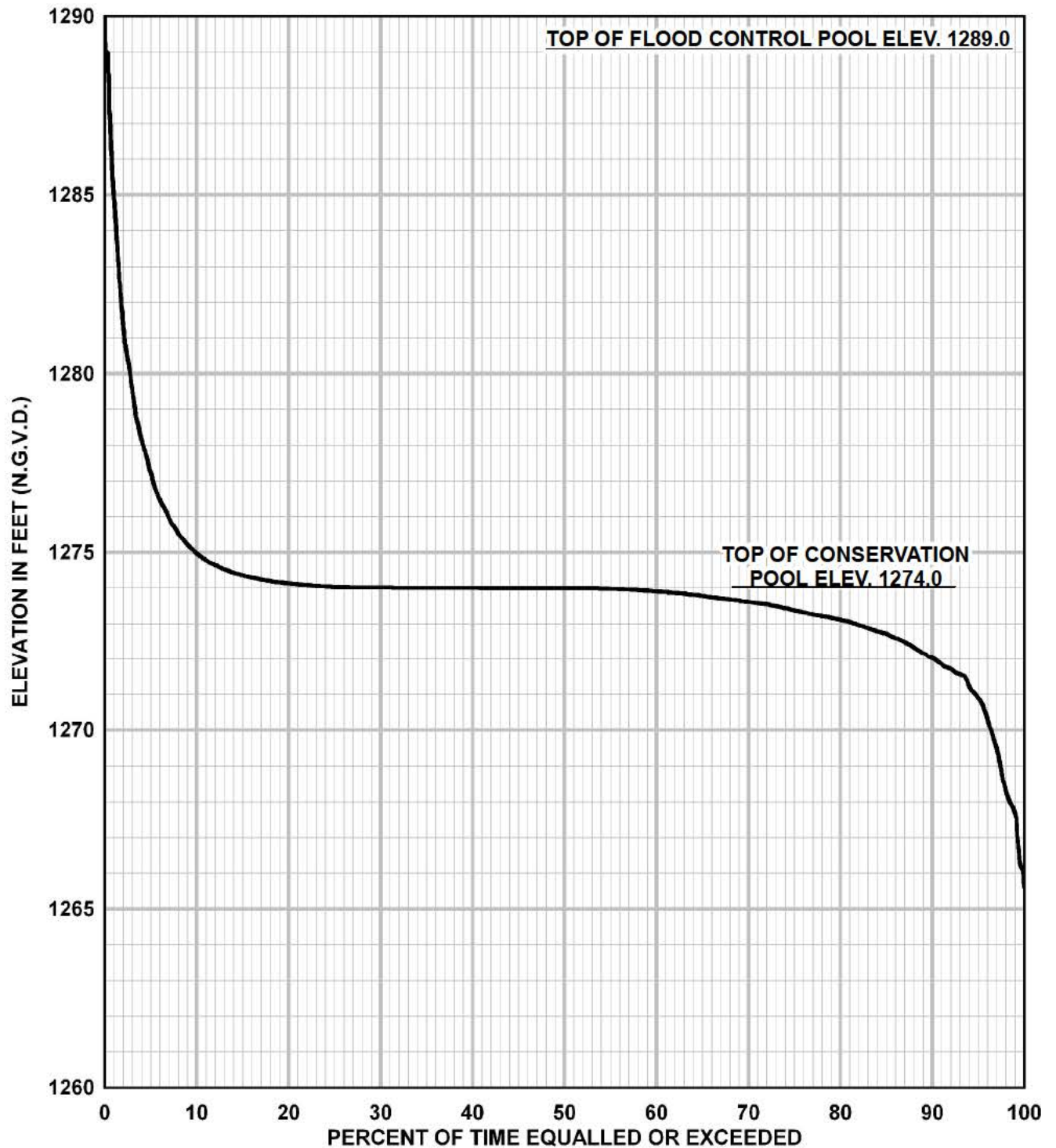
ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**POOL ELEVATION
PROBABILITY CURVE**

1. BASED ON PERIOD OF RECORD 1940 TO 2008
2. COMPUTED FROM RIVERWARE 5.2.10
MODEL: ARKRWBASE4008R2

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



NOTES:

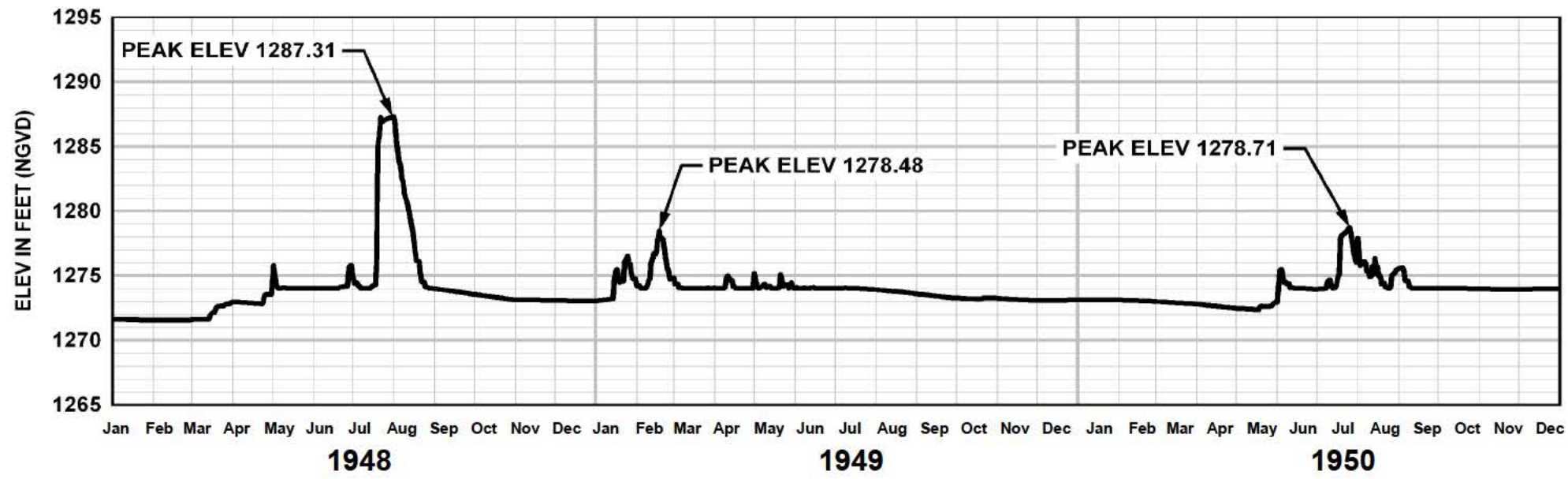
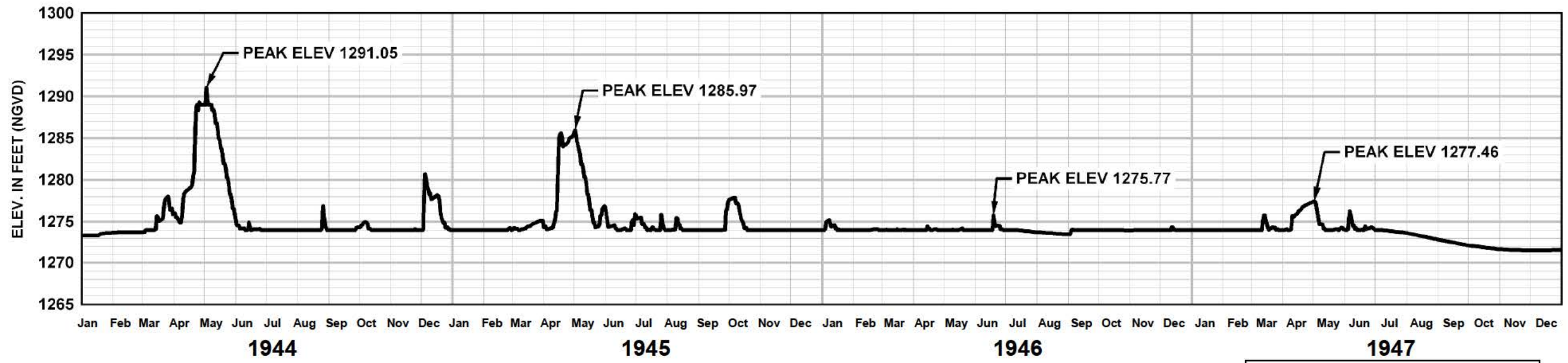
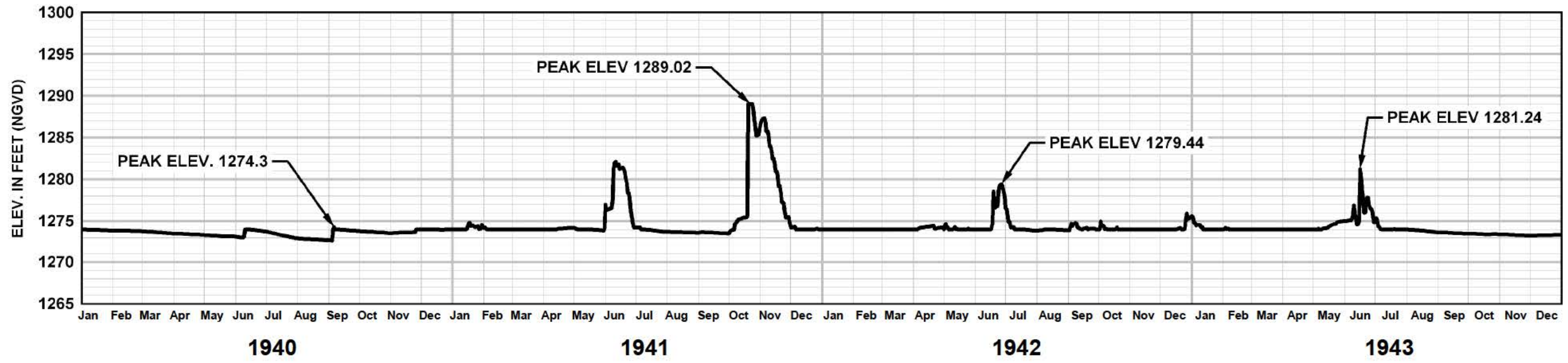
1. BASED ON PERIOD OF RECORD
JAN. 1940 THRU DEC. 2008
2. COMPUTED FROM RIVERWARE 5.2.10
MODEL: ARKRWBASE4008R2

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**POOL ELEVATION
DURATION CURVE**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



NOTE: Pool elevations for Jan 1940 through Dec 1979 are based on a simulation using the RiverWare computer program. Elevations for Jan 1980 through Sep 2010 are actual historical values.

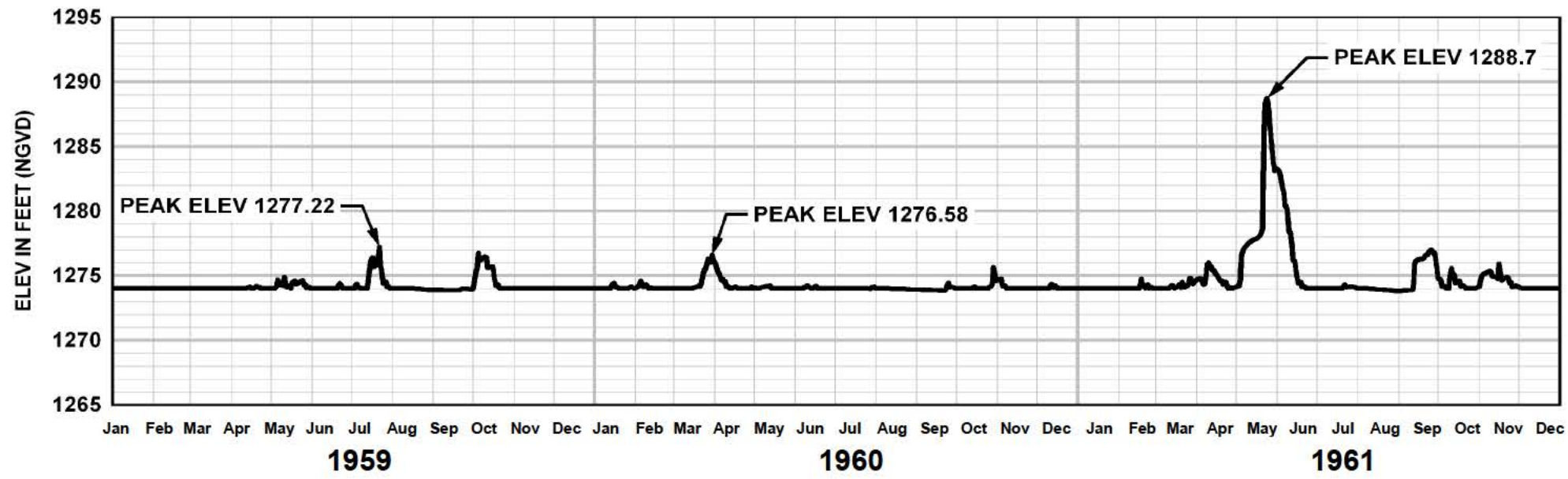
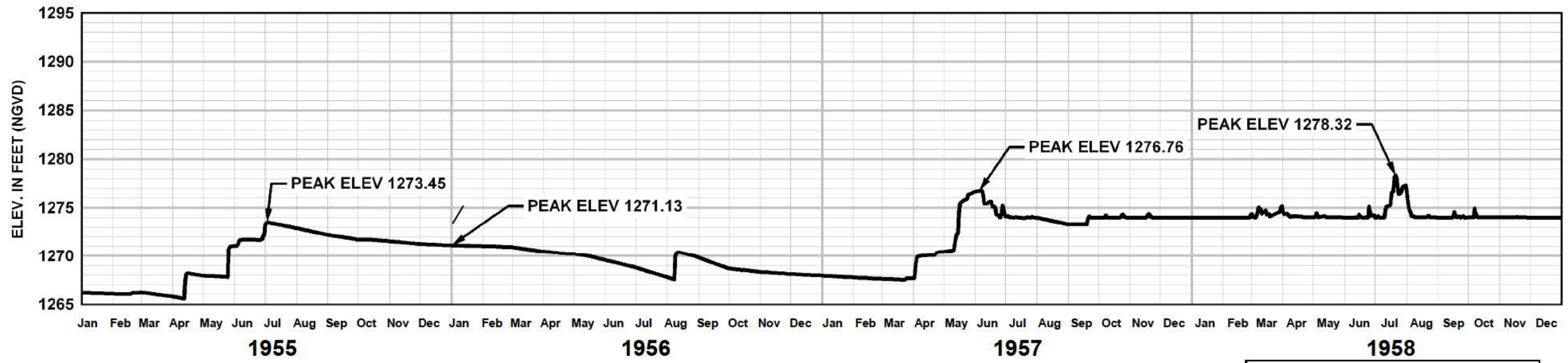
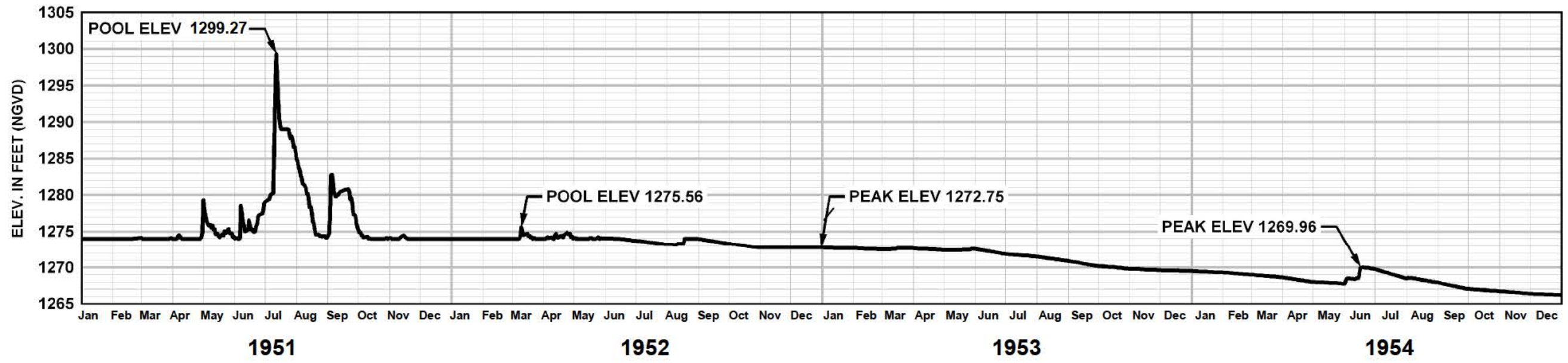
Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**POOL ELEVATION
HYDROGRAPHS
1940 - 1950**

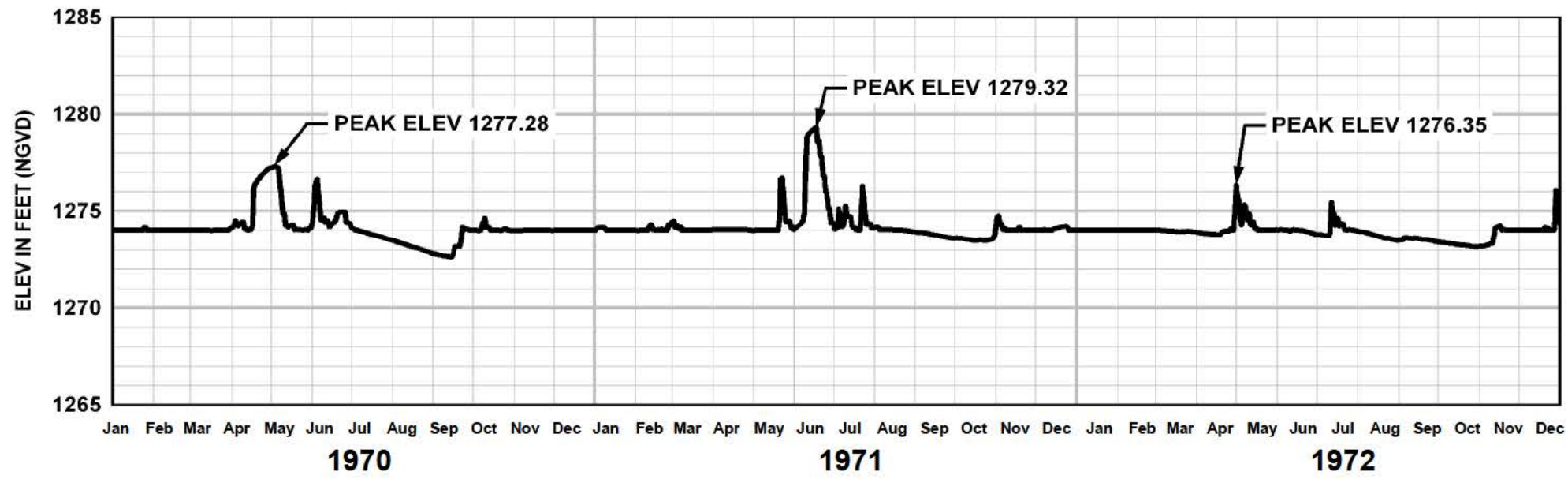
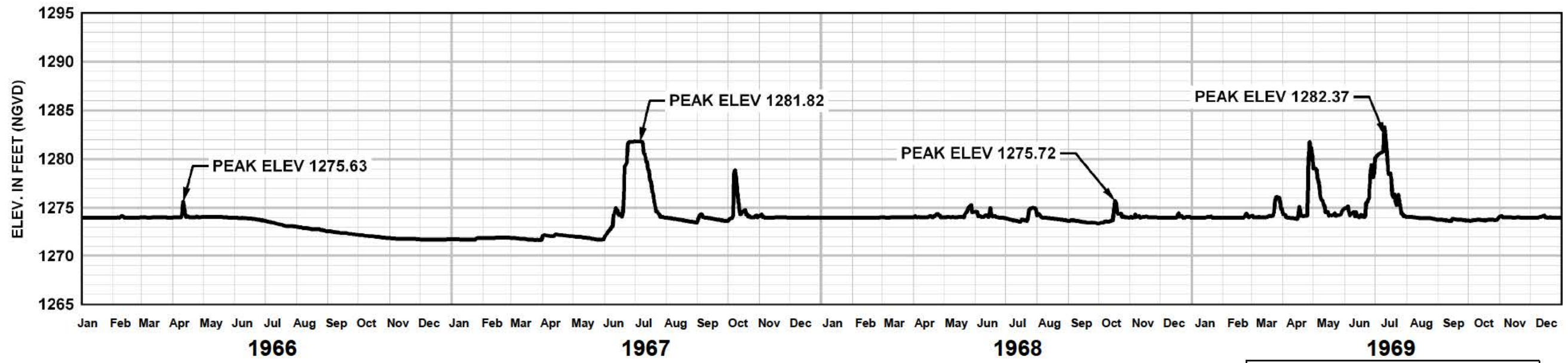
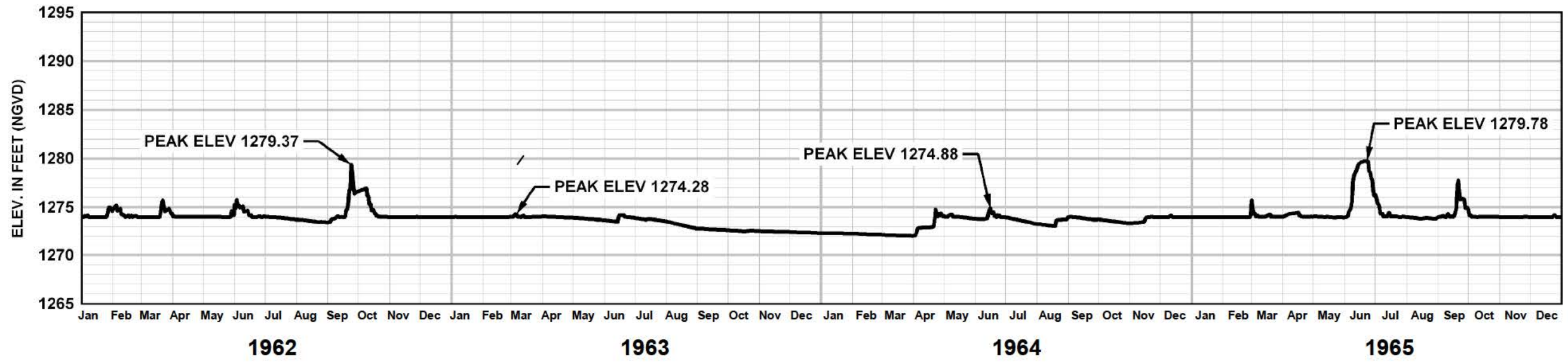
DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



NOTE: Pool elevations for Jan 1940 through Dec 1979 are based on a simulation using the RiverWare computer program. Elevations for Jan 1980 through Sep 2010 are actual historical values.

Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS
COUNCIL GROVE LAKE
POOL ELEVATION
HYDROGRAPHS
1951 - 1961
 DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



NOTE: Pool elevations for Jan 1940 through Dec 1979 are based on a simulation using the RiverWare computer program. Elevations for Jan 1980 through Sep 2010 are actual historical values.

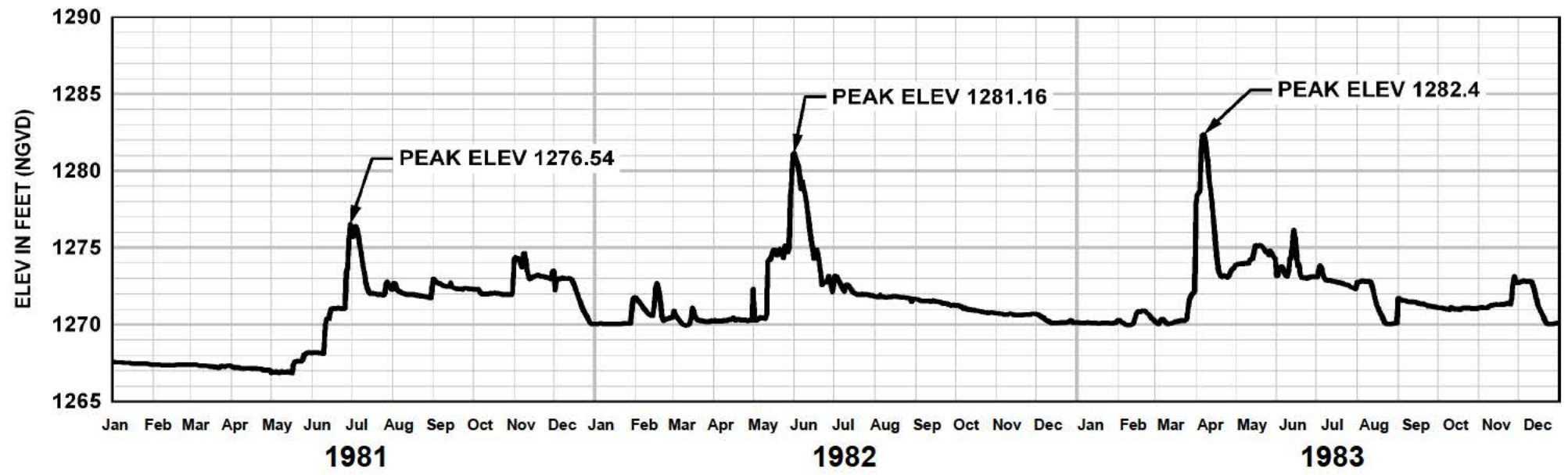
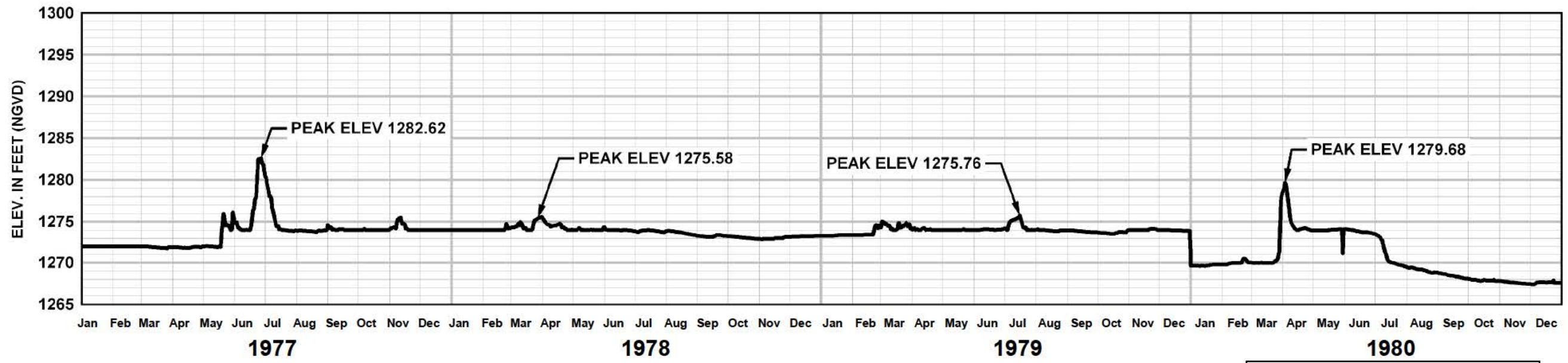
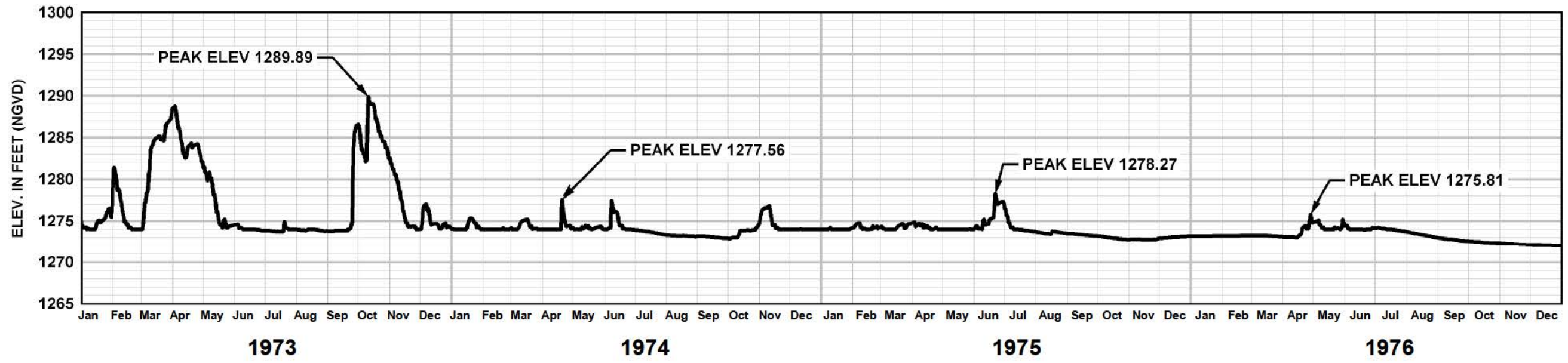
Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**POOL ELEVATION
HYDROGRAPHS
1962 - 1972**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



NOTE: Pool elevations for Jan 1940 through Dec 1979 are based on a simulation using the RiverWare computer program. Elevations for Jan 1980 through Sep 2010 are actual historical values.

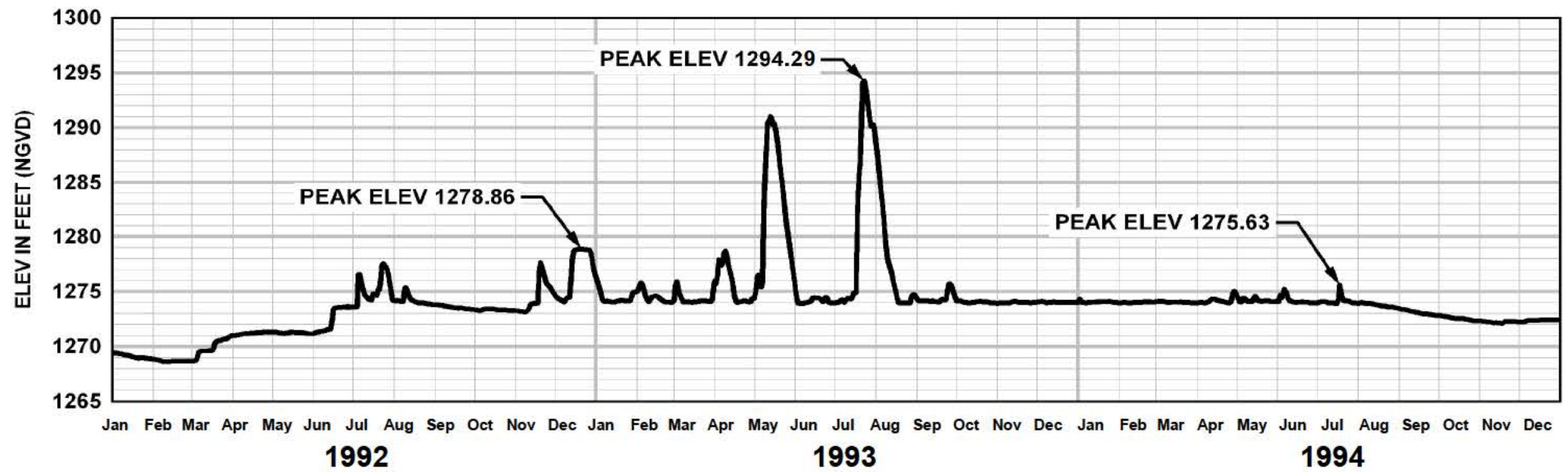
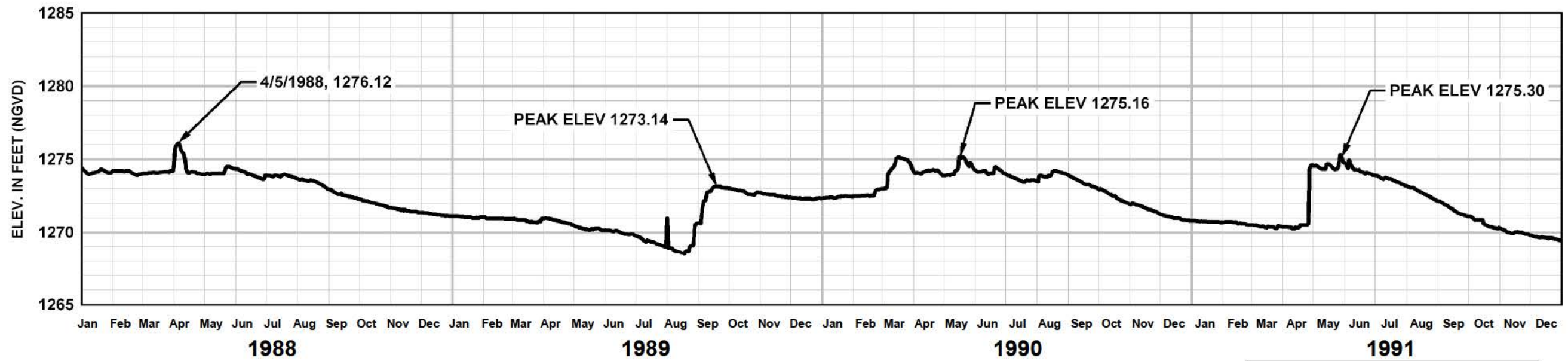
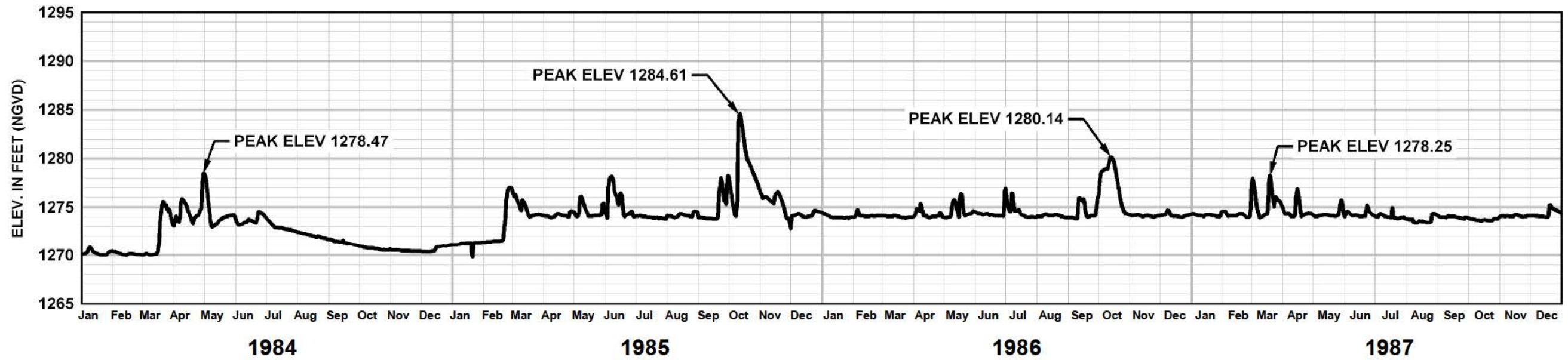
Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**POOL ELEVATION
HYDROGRAPHS
1973 - 1983**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



NOTE: Pool elevations for Jan 1940 through Dec 1979 are based on a simulation using the RiverWare computer program. Elevations for Jan 1980 through Sep 2010 are actual historical values.

Note: Plate size is 11" x 17"

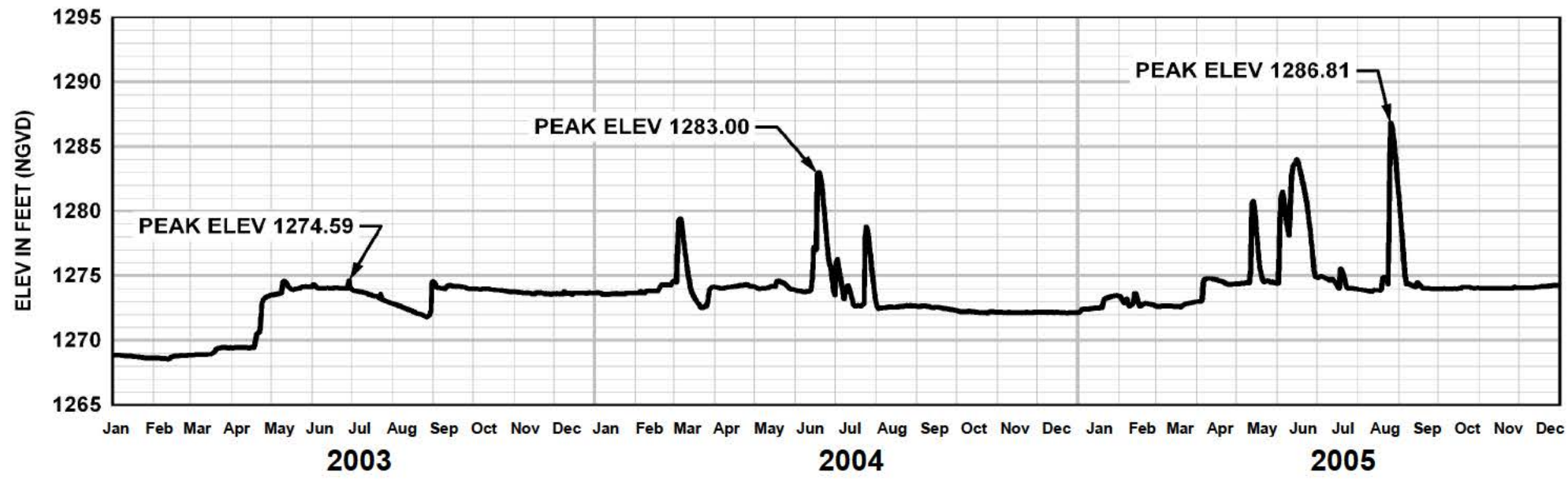
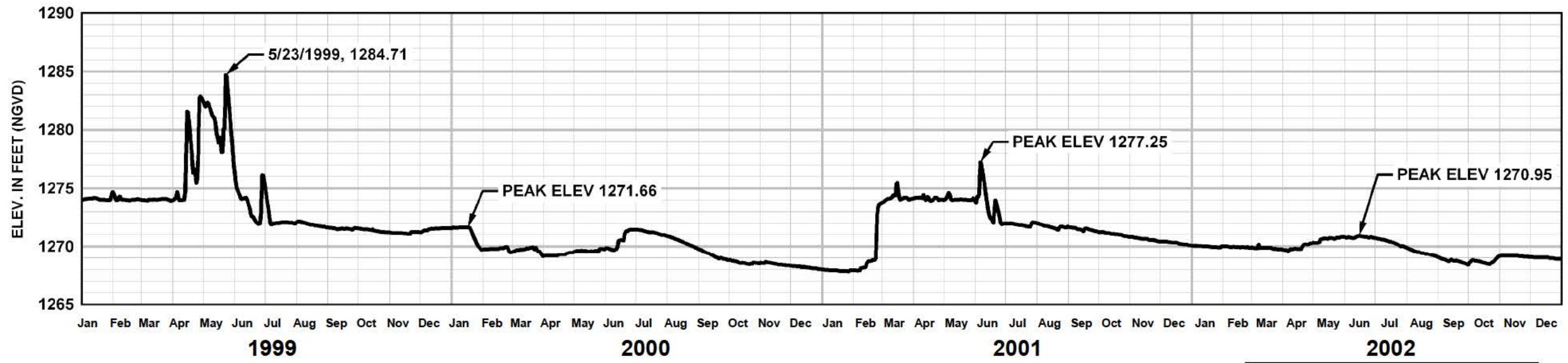
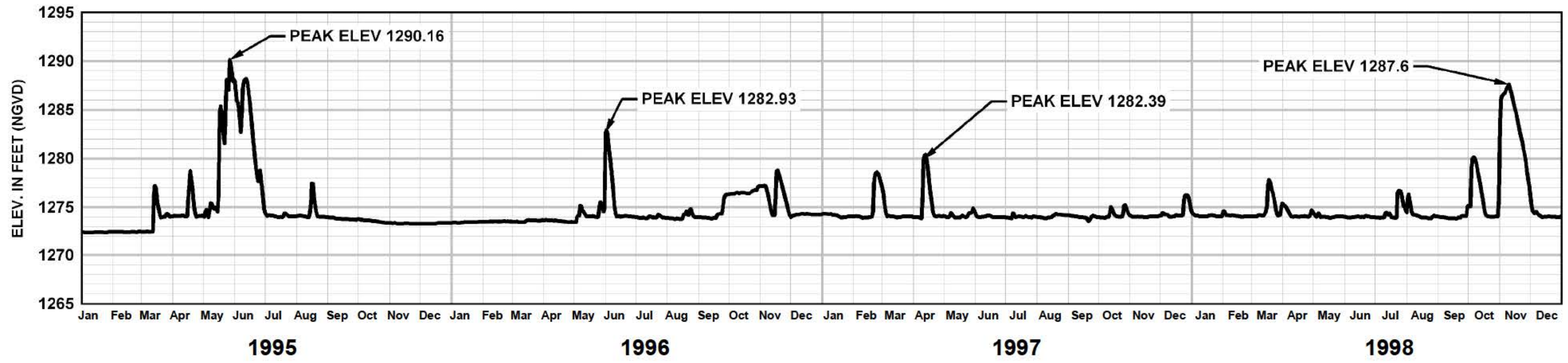
ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

POOL ELEVATION HYDROGRAPHS

1984 - 1994

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
 DRAWN: RKB
 CHECKED: JRL



NOTE: Pool elevations for Jan 1940 through Dec 1979 are based on a simulation using the RiverWare computer program. Elevations for Jan 1980 through Sep 2010 are actual historical values.

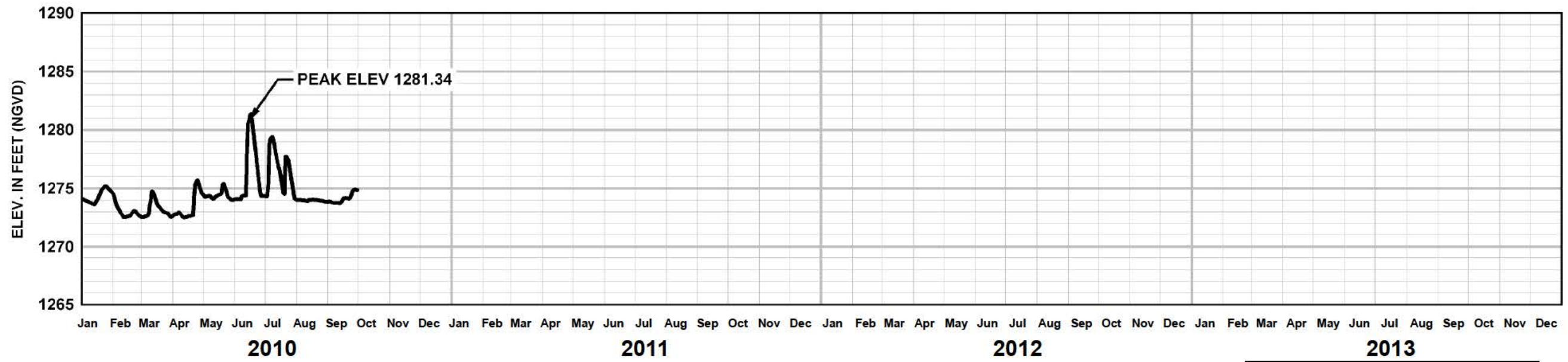
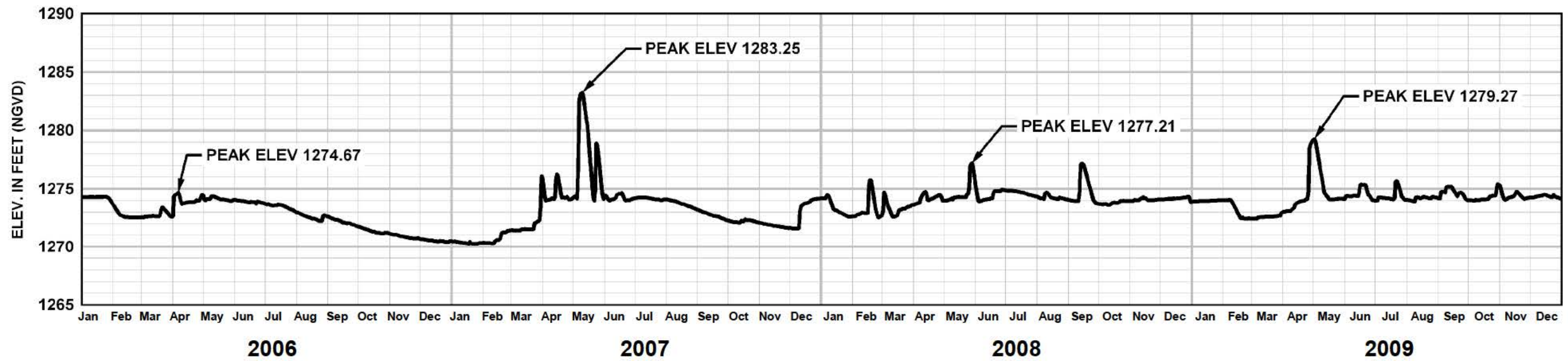
Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**POOL ELEVATION
HYDROGRAPHS
1995 - 2005**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL



NOTE: Pool elevations for Jan 1940 through Dec 1979 are based on a simulation using the RiverWare computer program. Elevations for Jan 1980 through Sep 2010 are actual historical values.

Note: Plate size is 11" x 17"

ARKANSAS RIVER WATERSHED NEOSHO RIVER, KANSAS

COUNCIL GROVE LAKE

**POOL ELEVATION
HYDROGRAPHS
2006 - 2010**

DEPT. OF THE ARMY, TULSA DISTRICT CORPS OF ENGINEERS 2011
DRAWN: RKB
CHECKED: JRL