

DEPARTMENT OF THE ARMY
SOUTHWESTERN DIVISION, CORPS OF ENGINEERS
1100 COMMERCE STREET
DALLAS, TEXAS 75242-0216

07 FEB 2006

REPLY TO
ATTENTION OF:
CESWD-RBT

MEMORANDUM FOR Commander, Tulsa District, ATTN: CESWT-EC-H

SUBJECT: Updated Pages for Upper Red River Drought Contingency Plan

1. Reference Memorandum CESWT-EC-H, 10 January 2006, SAB.
2. Compliance checks of revisions provided at the 05 January 2006 review meeting have been completed. The revised pages are approved for distribution to the involved state and federal agencies.

A handwritten signature in black ink, appearing to read "Robert Slockbower", followed by a horizontal line.

Robert Slockbower, P.E.
Director, Regional Business Directorate

CESWT-EC-H

9 January 2006

JWC
CLARK/plf/7097

MEMORANDUM FOR Commander, Southwestern Division ATTN: CESWD-RBT

SUBJECT: Updated Upper Red River Drought Contingency Plan

1. Reference memorandum from CESWD-RBT, 9 February 2005, Updated Upper Red River Drought Contingency Plan for Waurika Lake and Lake Texoma (Enclosure 1).

GDF
ESTEP
7132

2. Final plan is submitted as requested (Enclosure 2). Comments have been resolved per the meeting with Mr. Gary Goodwin on 5 January 2006 (Enclosure 3). Table 7-2 has been updated as discussed in subsequent e-mails (Enclosure 4). Copies will be distributed upon approval of final plan.

3. If you have any questions or need further assistance, please contact Mr. John Clark at 918-669-7097.

A
HOLEMAN
7302

FOR THE COMMANDER:

Signed

4 Encls

RALPH R. HIGHT, P.E.
Chief, Engineering and
Construction Division

RPH
HIGHT
7008

CESWD-RBT

9 FEB 2005

MEMORANDUM FOR Commander, Tulsa District, CESWT-EC-HM

SUBJECT: Updated Drought Contingency Plan, Upper Red River, Oklahoma and Texas

1. Reference email CESWT-EC-HM dated 17 Dec 2004, SAB.
2. The updated drought contingency plan has been reviewed and comments are enclosed (Encl). After incorporation of the comments, the updated document is approved for distribution to the appropriate state and federal agencies.

Encl

11511
ROBERT SLOCKBOWER, P.E.
Director, Regional Business Directorate

MR. GOODWIN RBT

MR. BELL RBT

MR. FANO RBT

MR. SLOCKBOWER RB

**DROUGHT CONTINGENCY PLAN
FOR
WAURIKA LAKE AND LAKE TEXOMA
UPPER RED RIVER BASIN**

**APPENDIX DCP-1
TO
RESERVOIR REGULATION MASTER MANUAL
RED RIVER BASIN**

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

DROUGHT CONTINGENCY PLAN
FOR
WAURIKA LAKE AND LAKE TEXOMA
UPPER RED RIVER BASIN

APPENDIX DCP-1
TO
RESERVOIR REGULATION MASTER MANUAL
RED RIVER BASIN

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DROUGHT CONTINGENCY PLAN

UPPER RED RIVER BASIN

I – INTRODUCTION

1-01. Purpose of Document. The purpose of this Drought Contingency Plan (DCP) is to provide a basic reference for water management decisions and responses to a water shortage in the Upper Red River Basin induced by climatological droughts. As a water management document, it is limited to those drought concerns relating to water control management actions. Because of the long-term nature of a drought and the uncertainties of the specific problems that may result, this document details only a limited number of specific actions that can be carried out related to water control. Its primary value is in documenting data needed in decisions and defining the coordination needed to manage the District's water resources to insure that they are used in a manner consistent with the needs which develop. This Drought Contingency Plan is Appendix DCP-1 to the Reservoir Regulation Master Manual, Red River Basin, November 1962. It covers Waurika Lake and Lake Texoma in the Red River Basin.

II – AUTHORITIES

2-01 Authorities.

a. ER 1110-2-1941, "Drought Contingency Plans", 15 September 1981. This regulation provides policy and guidance for the preparation of drought contingency plans as part of the Corps of Engineers overall water management activities.

b. Section 216, Public Law 91-611, (84 Stat 1830) Rivers and Harbors Act 1970. This act authorizes the Secretary of the Army to review the operation of existing Corps projects and recommend to Congress modification of their structure or operation to improve the environment.

c. ETL 110-2-251, "Preparation of Water Control Manuals", dated 14 March 1980. This document provides a guide for preparing water control manuals for individual water resource projects to include drought contingency plans.

d. ER 1110-2-240, "Water Control Management", 8 October 1982. This regulation prescribes policies and procedures to be followed in water management activities including special regulations to be conducted during droughts. It also sets the responsibility and approval authority in development of water control plans.

e. Multiple letters, CESWD-ED-WR, dated 8 June 1988, subject: Drought Contingency Plans. This letter directs the Districts within the Southwestern Division to initiate preparation of drought contingency plans for their basins and projects.

f. PL 84-99, "Emergency Supplies of Clean Drinking Water" as amended by PL 95-51. This law provides the authority under which the Chief of Engineers may under certain statutory conditions construct wells and transport water to farmers, ranchers, and political subdivisions within areas determined to be drought distressed.

g. ER 500-1-1, "Emergency Employment of Army and Other Resources, Natural Disaster Procedures". This ER identifies the mission, authorities, responsibilities, and chain of command of the Corps in provision of disaster assistance. Specifically, it establishes guidance in the application of PL 84-99 and PL 95-51 and sets reporting and assistance request procedures.

h. EM 1110-2-3600, "Management of Water Control Systems", 30 November 1987. This regulation requires that the drought management plan be incorporated into the project water control manuals and master water control manuals. It also provides guidance in formulating strategies for project regulation during droughts.

i. Section 6, Flood Control Act of 1944. Provides the authority the Secretary of the Army to make contracts with the states, municipalities, private concerns, or individuals at such prices and on such terms, as he may deem reasonable for domestic and industrial uses for surplus water that may be available at any reservoir under control of the Department of the Army.

j. EC 1105-2-181, "Municipal and Industrial Water Supply Storage". An Army General Counsel opinion of 13 March 1986, states that Section 6 of the 1944 Flood Control Act empowers the Secretary of the Army to make reasonable reallocations between different project purposes. Thus, water stored for purposes no longer necessary, or a better use in certain cases, can be considered surplus. Authorizes the District Engineer to reallocate up to 50 acre-feet of storage for withdrawals. An assessment of availability of storage can be made prior to any specific request in order to be ready to respond to urgent requests in a timely manner.

k. Multiple memorandum, CECW-RP, 11 Jul 88, subject: Request for Withdrawal of Small Amounts of Water Over Short Periods of Time. Drought and other emergencies affecting domestic, municipal, and industrial water supplies will likely generate requests for water stored in Corps reservoirs. This memo outlines an expedited process for dealing with such requests that can be included in drought contingency plans. District Commanders should take the initiative to make Section 6 assessments, Flood Control Act of 1944, of the availability of storage for limited withdrawals (up to 50 acre-feet of water may be allocated by the District Engineer in accordance with EC 1105-2-181). Agreements for small amounts of water withdrawals (50 acre-feet or less) may be accomplished at the District level for a term of no more than one year, and a clause may be included for an automatic renewal.

l. ER 405-1-12. Provides guidance for issuing an appropriate real estate instrument for water withdrawal users who will be installing water lines or other facilities or equipment.

m. PL 100-71, Supplemental Appropriations Act, 11 July 1987. This regulation directed the Secretary of the Army to establish an advisory committee for Lake Texoma. The purpose of the committee is to provide information and recommendation to the Corps regarding the operation of Lake Texoma.

n. The Oklahoma Water Resources Board is charged with the appropriation of Oklahoma's waters and any redistribution or proposed use of those waters requires Board approval.

o. The Texas Water Commission is charged with the appropriation of Texas' waters and any redistribution or proposed use of those waters requires Board Commission approval.

III – DROUGHT IDENTIFICATION

3-01. Severity. For the purposes of this plan, a drought is defined as a climatically induced water shortage. It is generally of wide aerial coverage and its impacts are usually over a large spectrum of interests. The guidance contained here relates specifically to naturally developed shortages. The development of an isolated shortage at a specific location caused by overuse of the resource while in a normal climatic pattern is considered a man-made event. While a man-made event may be quite severe, it is expected to be isolated to a small area. Such shortages will be treated through routine water management procedures and coordination channels.

The National Weather Service (NWS) utilizes a numerical index to quantify the status of the climatically induced water balance between rainfall and soil moisture. This index, the Palmer Drought Severity Index (PDSI), is routinely calculated for each NWS climatologic division in Oklahoma and Texas on a weekly basis. The Palmer Drought Index is regionally specific and reflects the cumulative excess or deficiency in moisture relative to seasonal norms. It typically ranges from +6 to -6 but may exceed these values in cases of a long duration of abnormal rainfall. The PDSI is standardized and is insensitive to man-made drought. It provides a drought severity indicator that can be used to compare diverse climatological regions, is recognized by the NWS, and is readily available. Because the PDSI does not account for storage in large reservoirs or streamflow, it is better suited for describing how severely a drought might affect agriculture and small water storage reservoirs than for describing critical conditions in the Corps' large multipurpose lakes. For this reason, the PDSI will be used to describe drought severity in general, but pool levels will be used at the individual projects covered by this drought contingency plan to determine when specified coordination and action should begin. The PDSI scale along with the NWS characterization of the corresponding hydrological moisture status is shown in Table 3-1.

TABLE 3-1

PALMER DROUGHT SEVERITY INDEX SCALE

PDSI Value	Hydrological Conditions
> 4.0	Extremely wet
3.0 to 4.0	Very wet
2.0 to 3.0	Moderately wet
1.0 to 2.0	Slightly wet
0.5 to 1.0	Incipient wet spell
0.5 to -0.5	Near normal
-0.5 to -1.0	Incipient drought
-1.0 to -2.0	Mild drought
-2.0 to -3.0	Moderate drought
-3.0 to -4.0	Severe drought
-4.0 and below	Extreme drought

The basic definition of a drought to be used in determining its severity for lake storages is "a severe reduction in stream flows or lake levels". The drought is considered critical when, based on present lake inflow, existing conservation storage, and projected water usage, there is insufficient water to meet the needs of the users. The severity of the drought will be determined by evaluating stream flow as compared to normal flow for the time of year, rainfall as compared to normal, the Palmer Index, remaining conservation storage, and projected water usage.

3-02. Historical.

a. Oklahoma. Droughts have occurred throughout Oklahoma for the recorded period from the 1890's through the 1980's. Plate 3-1 is a map which shows the climatic divisions of Oklahoma and Texas that contain the drainage basin of the Red River upstream of Denison Dam (Lake Texoma). Some of the more severe droughts are described below. Plots of the Palmer Drought Severity Indices (PDSI) for Climatological Divisions 7 and 8 of Oklahoma are shown on Plates 3-2 thru 3-7. Plots of the Palmer Drought Severity Indices for Texas Climatological Divisions 1 thru 3 are presented in Plates 3-8 thru 3-16.

(1) Drought of 1894 - 1895. A severe drought from 1894 through 1895 culminated a period of abnormally dry weather which had existed since 1886. Precipitation for the period 1 October 1894 to 1 May 1895 was far below normal throughout the state. Numerous dust storms occurred throughout the state during this drought.

(2) Drought of 1909 - 1914. Abnormally dry weather existed over most of Oklahoma from 1909 through 1914. The average rainfall in August of 1913 was the lowest of record for any summer month up to that time. Most streams in central and western Oklahoma were dry the latter part of August 1913 and many wells failed. Precipitation for the 6-year period was about 80 percent of normal except the panhandle which recorded near normal.

(3) Drought of 1916 - 1918. Dry weather occurred across Oklahoma in 1916 and continued through the spring of 1918. In 1916 and 1917, precipitation varied from 62 percent of normal in southeast Oklahoma to 87 percent of normal in the panhandle and east-central areas. This below normal precipitation caused wells and springs to dry up creating a scarce supply of domestic and livestock water.

(4) Drought of the 1930's. The longest drought in Oklahoma's history began in the panhandle in 1932 and was not broken in that area until after October 1940, a period of 100 consecutive months. During 53 of the 100 months, the drought was classified as either severe or extreme. Above normal rainfall in 1941 was the first since 1928 in the panhandle. This period in western Oklahoma is known as the dust bowl era. By 1934, the drought had overrun the rest of the state. By August 1936, the drought had reached its most severe stage statewide. For a 22-day period from 4 to 25 August 1936, maximum temperatures were 100 degrees or higher over practically the

entire state. Four of the five occurrences of Oklahoma's record maximum temperature of 120 degrees were observed in July and August 1936. Dust storms were numerous and severe throughout this drought period. The most severe PDSI for this drought period for the Upper Red River basin was -5.59 in August 1936.

(5) Drought of the 1950's. The period 1952 through 1956 was the driest five consecutive years in Oklahoma's weather records. Precipitation ranged from 64 percent of normal in north-central Oklahoma to 84 percent of normal in southern Oklahoma. By the fall of 1952, lakes and streams were at near record low levels. The drought reached its most severe stage statewide in September 1956. The most severe PDSI for this drought period for the Upper Red River Basin was -6.56 in September 1956. During the month, extreme drought existed in all sections of the state. Though the drought of the fifties was not as prolonged as that of the thirties, never was the damage more wide spread or more severe for the length of time involved. This drought has been used as the critical period for the conservation storage design of many Corps of Engineers lakes in Oklahoma.

(6) Drought of 1962 - 1964. Abnormally dry weather developed in east-central Oklahoma in March 1962 and in north-central areas in November of that year. By Early 1963, the drought had spread across the entire state. In 1963, the eastern third of Oklahoma experienced its driest year for the 88-year period from 1900 through 1987. Heavy rains in August 1964 broke the drought in all but the panhandle and east-central areas of the state. The drought continued through March 1967 in east-central Oklahoma. The most severe PHDI and PDSI for this drought period in the Upper Red River Basin was -4.36 in October 1963.

(7) Drought of 1965 - 1968. In north-central and southwest Oklahoma, the need for rain was apparent in the fall of 1965. In 1966, precipitation across the state was well below normal; and, by the end of the year, mild to moderate drought conditions existed all across the state. During the first half of 1967, the drought became severe or extreme for all except the panhandle of Oklahoma. Above normal snowfall and rainfall in 1968 ended drought conditions within the state. The PDSI in the Upper Red River Basin reached -4.83 in August 1967.

(8) Drought of 1969 - 1971. This drought began in central and east-central areas in July 1969 and by the summer of 1970 had overspread the entire state. Heavy periods of rain in September and October 1970 ended the drought except in north-central and western Oklahoma. Above normal rainfall in July 1971 brought relief to southwest Oklahoma. By October 1971, there were no drought conditions across the state. The PDSI reached -5.48 in July 1971 in Southwestern Oklahoma.

(9) Drought of 1980 - 1982. This drought began in June 1980. The inflow into the Tulsa District lakes during the summer of 1980 was about 30 percent of normal; and, during the fall and winter the inflows were about 35 percent of normal. For the entire year of 1981, the inflows averaged about 25 percent of normal. The drought

was broken by above average rainfall in May and June 1982. The most severe PDSI for the Upper Red River basin was -3.84 in November 1980.

b. Waurika Lake. The Waurika Lake drainage area lies in the extreme western edge of the South-Central Climatological Division of Oklahoma. For the years 1931 to 2002, these Divisions had 14 periods of extreme or severe drought. Extended severe or extreme drought has the greatest impact upon pool levels assuming normal consumptive use and high evaporation rates.

The drought of November 1955 to September 1956 was the most severe drought on record, though not the longest. The PDSI for the South-Central Division reached a minimum of -6.56 in September of 1956 while the PDSI for the Southwest Division reached a minimum of -4.80 also in September of 1956. The total flow past the Beaver Creek gage near Waurika (2.3 miles downstream of the then future Waurika damsite) for this 11-month drought period was 18,406 ac-ft compared to a normal flow for the same period of 104,979 ac-ft. The average basin rainfall for this period was 11.7 inches while normal basin average rainfall for this period is 27.3 inches.

During the drought of November 1965 to March 1967, the South-Central Climatological Division had 3 months of severe and 1 month of extreme drought with a minimum PDSI of -4.70 in March 1967. The Southwest Division had 7 months of severe drought and 5 months of extreme drought with a minimum PDSI of -3.76 in March 1967. The total flow past the Beaver Creek gage near Waurika for this 17-month drought was 14,067 ac-ft compared to a normal flow for the same period of 148,260 ac-ft. The basin average rainfall for this period is 38.2 inches.

During the drought of August 1938 to March 1940, the South-Central Climatological Division had 5 months of severe and 3 months of extreme drought with a minimum PDSI of -4.65 in March 1940. The Southwest Climatological Division had 2 months of severe and 6 months of extreme drought with a minimum PDSI of -4.45 in March 1940. No flow information is available for this drought because the Beaver Creek gage was not established until 1953.

c. Lake Texoma. The contributing drainage basin of Lake Texoma (33,783 square miles) lies in the Southwest, South-Central, Central, and West-Central Climatological Divisions of Oklahoma and the High Plains, Low Rolling Plains, and North-Central Divisions of Texas. Extreme or severe drought existed in parts, or all of the basin 14 times in the years 1931 to 2002.

The drought of October 1955 to February 1957 was the most severe since records have been kept. The PDSI reached the lowest level in September 1956. The PDSI ranged from a low of -6.56 in Oklahoma's South-Central Division to -4.80 in Oklahoma's West-Central Division. The minimum annual rainfall for the Red River basin above Denison Dam occurred in 1956 (17.95"). The average annual basin rainfall for the period 1930 to 2002 was 26.34 inches. The minimum annual inflow into Lake Texoma was also in 1956 (974,700 ac-ft). The average annual inflow for the

period 1906 to 2003 is 4,241,656 ac-ft. The minimum pool of record at Lake Texoma (599.96 NGVD) occurred in March 1957 as a result of the 17 month drought.

The drought of August 1938 to March 1940 is used as the drought of record for the purpose of water supply yield studies and determining the critical hydropower period. The drought steadily worsened through March 1940. One month later, in April 1940, heavy spring rains broke the drought. The PDSI reached the lowest level in March 1940 and ranged from -4.65 in Oklahoma's South-Central Division to -2.84 in Oklahoma's West-Central Division. The total flow past the Denison Damsite (under construction from August 1939 to January 1944) was 1,337,300 ac-ft compared to a normal flow for this period of 6,194,542 ac-ft.

IV – BASIN AND PROJECT DESCRIPTION

4-01. Basin Description.

a. General. The Red River Basin above Denison Dam (which impounds Lake Texoma), Oklahoma/Texas, lies in portions of Oklahoma, Texas and New Mexico and is about 430 miles in length, has a maximum width of 150 miles and contains 39,719 square miles of which 5,936 square miles are classified as normally non-contributing. A map of the Upper Red River Basin is shown on Plate 4-1. The Red River rises in Curry County, New Mexico, near the Texas-New Mexico state line, about 1,300 miles above the mouth, and flows easterly across the Texas Panhandle and along the Oklahoma-Texas state boundaries to the Denison Dam (mile 725.9). The major tributaries entering the Red River above Denison Dam, Oklahoma/Texas, are the western tributaries (Salt Fork, North Fork, and Pease River), Cache Creek, Wichita River, Little Wichita River, and the Washita River. The western tributaries, which have a nearly common point of confluence, are all quite similar. They rise on the eastern edge of the high plains and flow southeastward through wide, ill-defined channels. The remaining tributaries above Denison Dam are (with the exception of the Washita) shorter than the western tributaries and possess more clearly defined channels. The Beaver Creek watershed is located in southwestern Oklahoma, in portions of Jefferson, Stephens, Cotton, and Comanche Counties. The Beaver Creek Basin, including Cow Creek, contains 857 square miles of which 562 square miles are upstream from the Waurika Dam. Beaver Creek rises in the foothills of the Wichita Mountains and flows in a southerly direction to its confluence with the Red River at mile 883. The creek is about 88 miles long. Larger towns within 75 miles of Waurika Lake include Lawton, Altus, Anadarko, Chickasha, Pauls Valley, Ardmore, and Duncan, Oklahoma; and Gainesville and Wichita Falls, Texas. Cities within 100 miles of Lake Texoma include Oklahoma City, Norman, Ada, and Durant, Oklahoma; and Denison, Sherman, and Denton, Texas. State Highway 53 and other state roads provide access to various parts of the basin.

b. Climate. The climate in the Red River Basin above Denison Dam is generally mild with long summers and high temperatures. Winters are short and moderate except in the western portion of the basin where winters are more severe. The western half of the basin is located in a semiarid region where wind movements are generally excessive and the evaporation is high. In the eastern portion of the watershed, precipitation is usually adequate for agricultural purposes and wind movements and evaporation are moderate. Climatic characteristics for that portion of the basin above Waurika Lake are shown in Table 4-1. The average monthly and annual rainfall above Waurika Lake and runoff data at the damsite are shown in Table 4-2. The estimated monthly evaporation data applicable at Waurika Lake is shown in Table 4-3. Estimated monthly and annual inflows for Waurika Lake are shown in Table 4-4. Climatic data, average monthly and annual rainfall, runoff data, estimated monthly evaporation, and inflow data applicable at Lake Texoma are shown in Tables 4-5 thru 4-8.

TABLE 4-1

BEAVER CREEK BASIN CLIMATIC DATA**Rainfall**

Average annual	30.25 inches
Maximum annual (1941)	47.4 inches
Minimum annual (1939)	18.6 inches
Percent during growing season (April through October)	74%

Snowfall

Mean annual	6 inches
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Temperature

Mean annual	63° F
Maximum recorded (Apache, Oklahoma 19 July 1936)	116° F
Minimum recorded (Marlow and Lawton, Oklahoma, 18 January 1930)	-12° F

TABLE 4-2

**AVERAGE MONTHLY AND ANNUAL RAINFALL
AND RUNOFF ABOVE WAURIKA DAM**

Month	Average Rainfall (1) (inches)	Percent of Average Annual Rainfall	Average Runoff (2)(3)		Percent of Average Annual Runoff
			(acre-feet)	(inches)	
January	1.29	4.3	4,190	0.14	3.6
February	1.47	4.9	7,180	0.24	6.1
March	2.05	6.8	10,260	0.34	8.8
April	2.68	8.9	11,160	0.37	9.5
May	4.84	16.2	29,710	0.99	25.4
June	3.57	11.9	20,200	0.67	17.3
July	2.22	7.4	4,070	0.14	3.5
August	2.29	7.6	2,140	0.07	1.8
September	3.2	10.7	5,710	0.19	4.9
October	2.96	9.9	10,910	0.36	9.3
November	1.85	6.2	5,630	0.19	4.8
December	1.52	5.1	5,860	0.20	5.0
Total	29.95	100.0	117,000	3.90	100.0

(1) Period of record - January 1930 through December 2002.

(2) Period of record - January 1926 through December 2002.

(3) Drainage area above Waurika Dam = 562 square miles.

TABLE 4-3

ESTIMATED MONTHLY PAN EVAPORATION
(Waurika Lake)

Month	Evaporation (inches) (1)	
	Normal Conditions	Drought Conditions (2)
January	2.53	3.02
February	3.02	3.94
March	5.30	8.16
April	7.28	10.08
May	8.29	12.16
June	9.25	13.66
July	11.65	16.27
August	10.47	16.34
September	7.95	12.48
October	5.73	7.30
November	3.49	4.42
December	2.59	3.32
Total inches per year	77.55	111.06

(1) National Weather Service class "A" pan, (1980-2004).

(2) Using January-December 1956 as an example drought year.

TABLE 4-4
ESTIMATED MONTHLY AND ANNUAL FLOWS IN ACRE-FEET
WAURIKA LAKE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1926	0	0	210	4290	960	2100	1560	2640	5340	12810	510	9300	39720
1927	7320	6750	4890	19800	3840	3090	3900	3090	3960	3390	870	1620	62520
1928	1140	6300	3180	10410	3150	63600	6120	1560	1200	0	330	2700	99690
1929	1560	2850	9090	1740	55500	12150	4800	870	2760	3840	960	270	96390
1930	60	0	0	5070	35400	1860	570	600	330	49800	7800	15300	116790
1931	2310	7080	13860	9180	2490	810	990	780	0	26700	20300	3930	88430
1932	4500	12120	1440	2880	2220	54900	2460	2160	1170	840	0	4560	89250
1933	2640	3270	18000	7680	17100	660	1050	3420	3000	1800	150	1560	60330
1934	1800	3600	6270	1920	660	1200	0	0	1830	1140	1080	990	20490
1935	1140	1710	2490	2310	60200	35800	2250	1290	1500	1110	1290	5310	116400
1936	300	0	0	0	33600	4380	450	0	20340	2550	0	390	62010
1937	210	0	3180	7200	1080	2370	1020	1200	1350	420	660	1020	19710
1938	1500	36900	40200	15870	30600	9210	1140	540	600	0	0	0	136560
1939	0	0	3000	570	540	1380	690	750	0	0	0	0	6930
1940	0	2100	0	11220	12900	3690	20900	3000	1380	990	4650	10050	70880
1941	7380	12270	1920	16400	23200	68700	2910	2340	9300	127800	12360	6660	291240
1942	870	2460	2340	51900	7950	30200	1740	3420	5760	13740	1770	6480	128630
1943	0	0	2040	5400	96900	29000	3420	120	450	0	0	0	137330
1944	2250	8430	4380	8850	1690	18240	4020	2400	2040	13200	4350	6060	75910
1945	4200	10560	20220	12180	3510	50100	8580	2910	71400	6120	750	0	190530
1946	960	6690	5640	3060	6360	6300	0	1650	1860	840	0	17400	50760
1947	1650	330	0	29700	62100	8280	840	0	0	1540	1580	4800	110820
1948	390	3750	8190	4200	1590	6600	2550	870	600	0	0	0	28740
1949	3360	6960	6480	2910	36500	13680	1140	510	1710	4200	390	0	77840
1950	0	6990	0	1590	64500	23000	8640	8160	5190	1440	0	0	119510
1951	0	3060	3720	2790	106900	66900	9150	2340	1320	3450	810	0	200440
1952	0	0	2850	3120	38100	6540	3660	990	0	0	0	0	55260
1953	0	0	12720	3840	1200	18080	6790	841	413	48830	7930	8060	108704
1954	1220	1580	1360	3660	82040	6400	171	6	0	0	0	0	96437
1955	33	190	1400	83	103700	15220	2760	296	4830	9520	72	297	138401
1956	451	647	376	713	2810	2570	10470	0	0	2780	1690	108	22615
1957	58	199	817	43220	161700	34610	3660	527	3110	1640	6750	1380	257671
1958	3310	1790	5350	5220	16800	8330	1980	915	383	30	70	367	44545
1959	538	474	424	3190	13400	1210	3440	4330	5360	20370	9140	17250	79126
1960	8650	8550	4510	2890	12940	2830	9170	1190	333	6110	636	4440	62249
1961	2150	2030	7550	5850	6810	12860	3630	3140	8660	1800	7970	4250	66700
1962	3010	2420	2780	3370	12110	126900	6250	942	1860	7830	8570	6160	182202
1963	3010	2660	8150	13950	2980	1120	1760	39	11	4	208	76	33968
1964	233	1030	756	532	6680	558	0	1370	4860	353	13880	829	31081
1965	1300	936	912	3750	3730	6460	8	46	3000	522	0	0	20664
1966	3	286	201	2660	329	271	0	6330	3680	168	5	7	13940
1967	6	4	117	7860	3400	985	9430	23	329	502	11	8	22675
1968	1440	776	4040	596	9490	25370	999	13	1360	2930	13440	1720	62174
1969	2770	10310	7600	5880	45050	6310	236	977	4270	225	257	585	84470
1970	631	534	2730	2630	3670	761	0	0	13700	604	125	131	25516
1971	221	796	344	281	50	3130	321	10320	2220	1880	241	5310	25114
1972	866	654	418	4140	7680	295	74	0	0	3260	26820	1070	45277
1973	9420	1970	33020	26570	4700	26890	7070	3380	3830	4270	8590	2280	131990
1974	2200	2230	4750	3770	8150	2130	280	3690	13000	7769	15083	2817	65869
1975	5455	15235	9721	6472	103295	26474	8589	2826	3774	1763	1642	1545	186791
1976	1527	1297	2797	5524	3007	1323	627	1	16799	15302	29007	16768	93979
1977	711	619	1387	941	56329	7678	758	2124	4197	211	62	196	75213
1978	127	1248	1321	816	39698	32052	2275	2284	764	830	249	140	81804
1979	130	1680	5920	9320	10600	69400	4410	1640	980	327	5900	2330	112637
1980	1428	2449	3014	1943	12228	4026	251	61	2562	577	646	1463	30648
1981	275	1987	3211	4452	8310	19154	2284	2574	3724	18745	1868	293	66877
1982	4103	2977	8846	3326	123272	54446	21421	2243	1118	61	1656	3360	226829
1983	4135	9877	5157	5652	27213	10333	811	720	59	150932	454	1935	217278
1984	1374	3584	12307	5099	3471	3897	1023	1864	0	18946	5460	28798	85823
1985	33441	70831	77375	38677	16919	47781	1987	2062	2419	31866	4405	1864	329627
1986	2439	4641	9719	11256	15193	14122	954	2342	27986	85229	39272	17553	230706
1987	26955	52958	37586	9024	173097	27927	14776	4294	4383	3570	4621	30773	389964
1988	18188	4988	51421	36760	4480	7710	1800	80	14580	130	1378	2538	144053
1989	4470	11980	11560	1870	9150	111870	5700	2650	16940	1660	350	980	179180
1990	4000	10990	58670	107220	91440	10120	9490	4590	1520	360	4220	1780	304400
1991	5830	1720	4940	6500	20550	21770	16990	5820	57120	18000	9960	88950	258150
1992	22310	11160	13980	15970	33420	77550	14120	3640	4300	0	42530	42720	281700
1993	20730	50500	51370	29790	83500	12920	2510	920	6240	460	40	4420	263400
1994	2580	6430	13670	8100	48990	8290	11880	2640	2590	15124	22959	2676	145929
1995	3808	2817	9868	38777	102111	88900	7984	10356	10088	1944	694	4443	281790
1996	1101	2202	7299	8113	3451	4840	2301	15094	34523	1674	25300	4899	110797
1997	3233	33184	6387	38182	19131	19617	8489	3233	87	17395	1515	16714	167194
1998	32668	16721	80709	23802	7051	3261	397	664	46	1250	2132	1884	170585
1999	7180	5435	11802	17703	10850	25974	1736	2053	307	4731	268	3203	91242
2000	2360	2896	6942	5117	4096	6208	1607	0	0	39105	38648	5117	112096
2001	22076	36070	13190	8291	35048	4126	783	30	2549	0	744	2241	125148
2002	3094	2390	5891	23504	3114	5645	4661	1845	516	0	0	397	51057
2003	1031	2212	3223	3322	8509	7591	484	992	311	0	298	307	28280
MEAN	4152	7120	10169	11057	29442	20039	4028	2123	5642	10632	5492	5716	115611
MAXIMUM	33441	70831	80709	107220	173097	126900	21421	15094	71400	150932	42530	88950	389964
MINIMUM	0	0	0	0	50	271	0	0	0	0	0	0	6930

TABLE 4-5

UPPER RED RIVER BASIN CLIMATIC DATA**Rainfall**

Average annual	26.68 inches
Maximum annual (1941)	45.13 inches
Minimum annual (1956)	17.95 inches
Percent during growing season	73%

Snowfall

Mean annual	7.3 inches
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Temperature

Mean annual	62.2° F
Maximum recorded at Altus on 19 July 1936 and Tishomingo on 26 July 1943.	120° F
Minimum recorded at Tulia, Texas 12 February 1899.	-23° F

TABLE 4-6

**AVERAGE MONTHLY AND ANNUAL RAINFALL
AND RUNOFF ABOVE DENISON DAM**

Month	Average Rainfall (1) (inches)	Percent of Average Annual Rainfall	Average Runoff (2)(3)		Percent of Average Annual Runoff
			(acre-feet)	(inches)	
January	1.09	4.1	176,300	0.10	4.1
February	1.31	5.0	223,870	0.12	5.2
March	1.73	6.6	323,500	0.18	7.6
April	2.45	9.3	466,060	0.26	10.9
May	4.13	15.7	838,480	0.47	19.6
June	3.36	12.8	750,210	0.42	17.5
July	2.13	8.1	248,780	0.14	5.8
August	2.25	8.5	171,900	0.10	4.0
September	2.83	10.7	248,340	0.14	5.8
October	2.43	9.2	379,610	0.21	8.9
November	1.42	5.4	227,580	0.13	5.3
December	1.21	4.6	224,510	0.12	5.2
Total	26.34	100.0	4,279,100	2.37	100.0

(1) Period of record - January 1930 through December 2002.

(2) Period of record - January 1906 through December 2002.

(3) Contributing drainage area above Denison Dam = 33,783 square miles.

TABLE 4-7

ESTIMATED MONTHLY PAN EVAPORATION
(Lake Texoma)

Month	Evaporation (inches) (1)	
	Normal Conditions (2)	Drought Conditions (3)
January	2.43	3.25
February	3.25	4.22
March	5.64	6.70
April	7.03	7.84
May	7.92	9.12
June	9.71	12.39
July	10.84	13.09
August	10.22	12.81
September	7.33	9.31
October	5.49	6.34
November	3.73	4.11
December	2.61	3.02
Total inches per year	76.20	92.20

(1) National Weather Service class "A" pan.

(2) Period of record - 1941 through 1990.

(3) Using January-December 1956 as an example drought year.

TABLE 4-8
ESTIMATED MONTHLY AND ANNUAL FLOWS IN ACRE-FEET
LAKE TEXOMA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1906	178900	122700	192500	591500	1594000	969300	518300	1725000	825300	341900	114200	247200	7420800
1907	299400	132200	317900	101800	818400	1354000	747100	306800	133300	624700	261200	211500	5308300
1908	169700	94300	149400	1225000	4114000	4403000	969100	147000	111300	644400	140400	472800	12640400
1909	81200	62800	73200	64900	71300	442100	93500	66400	34200	25000	114000	393000	1521600
1910	101300	63300	49500	166500	152800	144300	240300	91400	40600	20700	16800	17600	1105100
1911	20500	113900	74000	74700	92500	141600	332700	261000	352600	51800	28000	359000	1902300
1912	151900	131100	538000	600400	503600	563500	254600	453200	249900	194300	176700	92200	3909400
1913	131600	91600	106400	119000	448900	120300	345000	89800	237400	406400	430800	1708000	4235200
1914	213400	122200	199800	533800	1407000	630200	206000	739700	572400	187500	138600	124200	5074800
1915	184500	135000	341900	1799000	1957000	3549000	915600	529400	398100	1336000	227900	127300	11500700
1916	797500	275000	131600	1264000	440300	559300	175200	69500	151100	195500	89300	51500	4199800
1917	39500	29400	35700	111900	124200	360600	164800	164200	122000	38100	22000	41200	1253600
1918	48000	35500	32000	727700	216400	618900	89200	31400	230900	912500	502200	452600	3897300
1919	309900	206600	116800	656300	1261000	514900	405800	118700	131500	1313000	649800	190000	5874300
1920	329000	173100	104500	290400	1329000	378500	195500	614900	924700	739700	599200	219500	5898000
1921	186300	289400	346200	624200	140900	1294000	282800	79900	59500	56000	48800	33800	3441800
1922	30700	28100	96500	884800	1335000	354100	148200	41200	28000	30100	92200	51800	3120700
1923	37500	217200	86300	251300	924800	1316000	105800	41800	482000	2144000	879000	607000	7092700
1924	174000	98900	305000	571000	383000	159000	103000	82500	66100	67500	43900	41900	2095800
1925	45600	41400	35700	303000	472000	72900	35300	245000	1000000	379000	169000	46700	2845600
1926	97200	566000	119000	357000	363000	202000	453000	555000	299000	1640000	151000	314000	5116200
1927	276000	263000	282000	1566000	250000	344000	527000	264000	106000	381000	77400	171000	4507400
1928	135000	163000	105000	375000	1019000	1170000	498000	186000	53000	28100	127000	88500	3947600
1929	101000	70000	206000	278000	1087000	584000	217000	51500	569000	141000	149000	105000	3558500
1930	103000	287000	132000	82700	1350000	515000	81800	35700	55900	602000	104000	498000	3847100
1931	89800	312000	271000	224000	285000	91600	205000	52300	20800	296000	298000	290000	2435500
1932	836000	679000	183000	183000	358000	918000	779000	159000	212000	84200	38000	323000	4752200
1933	176000	66100	344000	194000	1322000	172000	102000	309000	327000	105600	62600	73000	3253300
1934	113300	100400	308100	179200	230500	133100	27900	12900	318600	82800	192200	71000	1770000
1935	51100	36000	382800	185900	2690000	1333000	369200	148300	341700	98000	98400	310900	6045300
1936	71900	51700	64800	39200	549000	408700	75600	25700	985500	451800	71600	87000	2882500
1937	155800	79700	184500	242600	105500	656500	85900	261900	180800	232100	57600	95200	2338100
1938	161400	1100000	637600	465000	1147000	686400	158500	92800	57700	32700	40800	23800	4603700
1939	102900	45300	61400	144900	90300	241800	143500	116500	23900	25400	23900	14800	1034600
1940	11200	28400	15300	209800	458000	422400	445200	227400	82100	23900	257600	205600	2386900
1941	140500	400700	145000	563100	1975000	3093000	475800	219900	308000	2523000	1515000	322700	11681700
1942	178100	160100	196100	2586000	896000	651000	176800	167300	365300	476000	488900	179200	6520800
1943	180400	102500	157000	573300	1675000	701300	131800	42300	40700	45600	28700	27500	3706100
1944	72200	236000	277400	192200	333400	403900	98600	73900	37700	230300	117000	145600	2218200
1945	116600	434100	1924000	1352000	379800	1053000	777700	286600	447100	1226000	99000	62900	8158800
1946	485600	539200	294200	222300	376600	512300	263900	137800	177900	151300	336900	786400	4284400
1947	102400	54300	99900	867900	2182000	785800	165400	64900	23100	61200	65500	295200	4767600
1948	65700	276700	389700	100200	482000	480500	509900	71100	26700	1400	1100	12500	2417500
1949	88500	416200	232200	140200	1064000	856500	113200	49600	243800	214300	42700	68400	3529600
1950	187700	253400	55800	106000	1428000	408700	958400	1089000	855000	227400	38400	50600	6568400
1951	75100	142600	154300	81800	1610000	1792000	413300	68400	68400	74500	72700	19000	4572100
1952	37000	49300	105500	324500	566300	186000	50400	2000	2000	1900	10000	23900	1358800
1953	18700	19000	143000	230400	174800	101100	274000	128600	38200	627000	270000	121700	2146500
1954	63600	16800	23200	133200	1680000	414200	8100	6100	6800	75500	6300	51700	2485500
1955	48900	66100	112800	102000	1187000	732000	179200	99700	326400	1045000	82800	46100	4028000
1956	37300	88500	51100	45700	264300	181400	73000	27600	4300	68500	64300	68700	974700
1957	29900	73300	138200	1732000	4705000	1936000	224200	96200	383000	146000	598700	112800	10175300
1958	285700	125200	257700	336900	814300	269600	228600	112600	35100	15400	23600	22700	2527400
1959	32400	32200	66300	166600	460900	495500	380900	146600	180200	1047000	155700	449900	3614200
1960	407600	412700	279300	183200	408400	387400	280300	95100	83500	779400	141800	321700	3780400
1961	135200	164900	351300	328000	251000	477000	267000	90000	259200	196600	333200	197800	3051200
1962	76000	97800	111800	193200	182400	1495000	221900	135800	404300	178300	328600	272700	3697800
1963	64300	87400	146000	244400	140600	245400	79400	10800	27000	9700	15200	20400	1090600
1964	25100	74700	85500	120700	206800	192500	29200	90000	264400	67300	585000	95900	1837100
1965	88900	135600	64600	131000	357000	338400	98100	42400	333300	422300	97600	62500	2171700
1966	68600	218200	111600	518800	285400	71800	28700	192300	350800	119700	12800	15400	1994100
1967	30200	27800	42800	705200	265900	302900	183400	48200	140200	52200	35100	44600	1878500
1968	273200	110200	530300	289000	972500	807400	264000	56800	180400	119000	179700	187400	3969900
1969	131700	347400	467300	357800	1307000	308200	45000	44600	260900	107300	47100	103100	3527400
1970	67100	167900	309300	329100	271200	162800	14900	2800	315100	455800	49600	28900	2174500
1971	46500	46400	48000	57000	80300	162100	50200	243900	238800	290200	83900	522300	1869600
1972	49900	35200	43800	99900	370800	88000	53400	16500	51000	141800	694800	73500	1718600
1973	351800	265800	769600	1404900	202500	948700	141900	172700	578100	572400	701500	273300	6383200
1974	82900	136200	221000	174600	688100	290000	30400	129900	665300	536100	829900	133100	3917500
1975	226200	508300	620400	409500	1161200	1142100	601100	454400	155600	63100	92700	84800	5519400
1976	85000	63000	147700	435400	348500	276000	97900	21900	218400	66100	81200	44700	1885800
1977	70700	159200	476300	265900	1118100	468800	95600	156700	125500	2000	36500	20000	2995300
1978	20800	96000	167300	150900	359400	1084700	79700	46700	39400	17800	52000	23800	2138500

TABLE 4-8
ESTIMATED MONTHLY AND ANNUAL FLOWS IN ACRE-FEET
LAKE TEXOMA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1979	57100	91400	434800	248200	488100	788200	163600	139500	73200	27400	57800	44200	2613500
1980	61700	67400	44800	60300	523200	637000	57900	5700	143300	127200	26900	114600	1870000
1981	29400	59900	328800	140500	408500	719500	58900	41700	45900	2246700	241000	67500	4388300
1982	133800	281600	197800	105500	2542000	1732000	502500	146200	48800	30400	86600	110600	5917800
1983	89500	193200	212000	223100	680300	398100	149500	44100	11500	1415300	477000	104900	3998500
1984	126000	130500	244100	201300	135700	167800	32000	31800	13900	261100	181100	493500	2018800
1985	712200	631100	1492200	963400	594100	1467400	148400	58300	39200	793200	214600	136300	7250400
1986	85700	163800	149600	358400	520900	670000	94200	24900	661500	1958500	1035000	510400	6232900
1987	579200	924100	1507200	326100	1064300	2926200	700200	144000	220400	140000	198700	858800	9589200
1988	504100	221300	813300	680700	176700	145200	104900	26200	315200	109800	69100	82200	3248700
1989	141900	348500	323500	154400	736600	2380600	344500	116900	607000	111900	97000	46300	5409100
1990	281600	221600	1985100	3101800	3094000	546300	152800	149500	194300	86840	175540	94710	10084090
1991	272630	122980	223340	249720	547830	1494740	273120	164030	819360	470380	478210	1993590	7109930
1992	764630	598710	663870	436760	525920	1792260	647400	162640	287400	56830	570840	999070	7506330
1993	450640	1008990	1045490	1008200	3135870	652160	249720	108890	273720	203500	104130	330450	8571760
1994	99970	275500	546640	269950	935210	333720	457880	58610	136860	238417	744804	316963	4414524
1995	176333	112266	521165	669035	1671297	3129765	382022	1163323	540107	305360	143605	146581	8960859
1996	161060	98778	166812	270351	90249	239805	180300	313195	895848	333030	753333	332236	3834997
1997	164631	948708	487346	1364053	1161339	804904	223739	230284	222549	234251	138845	435180	6415829
1998	977469	583347	2027137	597430	350286	184862	24595	11703	15967	61885	137853	115638	5088172
1999	92233	174151	357823	324203	544173	517694	176135	24794	82315	23207	25290	113258	2455276
2000	50282	54447	268863	252381	262020	275211	186380	3967	0	610025	920741	344534	3228851
2001	447874	1351954	560735	297426	627679	354352	29356	26876	340369	209854	60794	208168	4515437
2002	80728	98877	330649	962047	194185	285822	129820	138944	55558	0	0	20430	2297060
2003	122620	108497	157490	94811	283343	386187	93046	4066	117165	9402	23504	18010	1418141
MEAN	175748	222692	321809	462269	832813	746498	247190	170190	247002	371955	223172	220318	4241656
MAXIMUM	977469	1351954	2027137	3101800	4705000	4403000	969100	1725000	1000000	2523000	1515000	1993590	12640400
MINIMUM	11200	16800	15300	39200	71300	71800	8100	2000	0	0	0	12500	974700

c. Upper Red River Basin Projects. Federal reservoir projects in the Upper Red River system above Denison Dam (Lake Texoma) are Waurika, Tom Steed, Kemp, and Altus on the Red River drainage; Foss, Fort Cobb, and Arbuckle on the Washita River drainage; and Texoma located on the Red River below the confluence of the Washita River. Releases from all the upstream projects eventually flow into Lake Texoma. Waurika and Texoma are the only two projects in the Upper Red River basin which are wholly regulated by the Corps of Engineers. The other projects are operated by the Corps only for flood control purposes. Conservation storages for all the projects in the Upper Red River basin are shown in Table 4-9.

TABLE 4-9

BASIN STORAGE

<u>Project</u>	<u>Conservation Storage (Ac-Ft)</u>	<u>Equivalent Runoff (Inches)</u>
Altus	132,810	1.18
Arbuckle	62,600	9.31
Fort Cobb	72,570	4.33
Foss	165,480	2.07
Kemp	268,090	2.42
Tom Steed	88,970	13.79
Waurika	190,200	6.35
Texoma	1,467,280	0.81

4-02. Project Description.

a. Waurika Lake.

(1) General. Waurika Lake is on Beaver Creek, a tributary of the Red River. The damsite is about 6 miles northwest of Waurika, and the lake is located in Jefferson, Stephens, and Cotton Counties. The project was authorized for flood control, municipal and industrial water supply, water quality control, recreation, irrigation, and fish and wildlife by Public Law 88-253. Construction began in July 1971, and the project was placed into flood control operation in August 1977. Pertinent data is shown in Table 4-10.

TABLE 4-10

PERTINENT DATA – WAURIKA LAKE**Location**

Beaver Creek at River Mile 27.

Drainage Area

562 square miles.

Project Purposes

Flood control, irrigation, water supply, water quality, recreation, and fish and wildlife. A unit of the multipurpose system which regulates flood control, generation of hydropower, navigation, and other beneficial water uses on the Red River.

Elevations, Areas, And Storages

Based on 1991 resurvey.

Feature	Elevation (feet, NGVD)	Area (acres)	Storage	
			(acre-feet)	(inches)
Top of dam	995.0	-----	-----	-----
Spillway crest	970.0	18,390	451,100	15.05
Top of flood control pool	962.5	15,510	325,600	10.86
Top of conservation pool	951.4	10,100	190,150	6.34
Top of inactive	910.0	830	4,370	0.15
Flood control storage	951.4 – 962.5	-----	135,450	4.52
Conservation Storage	910.0 – 951.4	-----	185,800	6.20
Invert at lowest intake	893.0	-----	12	-----
Streambed	889.0	-----	-----	-----

Hydraulic Design Data

Outlet works

Discharge at top of conservation pool,
elevation 951.4

5,520 c.f.s.

Discharge at top of inactive pool,
elevation 910.0

2,500 c.f.s.

Structures

Embankment

Type

Rolled earthfill with impervious core

Maximum height above streambed

106 ft

Crest width

32 ft

Length (including spillway)

16,637 ft

TABLE 4-10 (Cont.)

Structures

Spillway		
Location		Right abutment
Type		Uncontrol rock-cut
Overflow width		300 ft
Outlet works		
Type and size	1 - 11.0 ft wide by 15.5 ft high oblong conduit	
Location	Right center of main embankment	
Control	2 service and 2 emergency 5.5-foot wide by 13.5-foot high hydraulically operated slide gates	

The project provides flood control for the Beaver Creek valley below the lake and additional protection for a limited area along the Red River. Water from Waurika Lake could be used for water quality control and regulation of flows in Beaver, Cache, and Cow Creeks. Municipal and industrial water supply storage and water conveyance facilities are provided to supply present and future urban needs. The lake is the center of water-oriented recreation for a large area. The recreation facilities were completed in 1980 and the water conveyance facilities in 1981.

The Oklahoma Department of Wildlife Conservation is licensed to manage 10,387 acres of land and water for fish and wildlife purposes. All of that acreage, as well as 927 acres managed for fish and wildlife by the Corps, is operated for hunting.

(a) Sedimentation. The estimated 100-year sediment storage requirement is 40,000 acre-feet. Estimates of sediment distribution show about 8,700 acre-feet will deposit in the flood control pool; 29,300 acre-feet in the conservation pool; and 2,000 acre-feet in the inactive pool.

(b) Conservation storage. When the project was initially designed, the future needs for water supply and water quality control in the area exceeded the average flow of Beaver Creek. Therefore, the project was developed to provide the maximum dependable yield. Based on the 1957 original survey, the project initially provided 199,740 acre-feet of conservation storage as follows:

Water Supply	82,000 AF
Joint Water Supply-Water Quality	69,400 AF
Irrigation	18,800 AF
Subtotal	170,200 AF
Reserved for 100-yr sediment	29,540 AF
Total	199,740 AF

The conservation storage was estimated to yield 40.0 m.g.d. through a 50-year drought or 47.0 m.g.d. through a 20-year drought. The irrigation storage is estimated to yield 4.5 m.g.d. Since impoundment in 1977, the conservation storage has been reduced to an estimated 190,200 AF, based on the 1991 resurvey. The amount of conservation storage reserved for sediment has decreased to 20,000 acre-feet.

(c) Water conveyance facilities. The water conveyance facilities from Waurika Lake consist of an intake and pumping station located on the eastern side of the lake in Sec. 28, T2S, R8W, near Chisholm Trail Ridge recreation area and water supply facilities through the outlet works structure at the dam. The water supply facilities through the outlet works structure supply water to the city of Waurika. The facilities with the intake near Chisholm Trail Ridge distribute water to the cities of Lawton, Duncan, Comanche, Walters, and Temple, Oklahoma, and transport water for water quality control to discharge points on Cache and Claridy Creeks. The facilities contain relift pumping stations on the Duncan and Lawton pipeline routes, surge protection systems, chlorination facilities, operation and control systems, impact basins, and maintenance and support facilities. The water conveyance system was constructed by the Corps of Engineers, is operated by the Waurika Project Master Conservancy District, and is capable of delivering water upon demand to any of the using communities. The line sizes in a single run can be reduced to fully utilize the available energy. To this extent, two of the four main gravity flow pipeline segments were designed with two consecutive pipe sizes. The Waurika pipeline is routed from a manhole at the damsite to about 6 miles southeast to the Waurika water treatment plant. The pipeline is 16 inches and delivers the water demand by gravity flow. The Lawton pipeline conveys water through a 42-inch pipe from the intake pump at the lake to Lake Ellsworth, a distance of approximately 45 miles. A relift pumping station is located near the ridge between Beaver Creek and Cache Creek, about mile 21.5 on the waterline. A combination 12- and 10-inch pipeline, 10 miles long, conveys water from the Lawton relift area by gravity flow in a south-southwest direction to a tee located near the city of Walters. A 6-inch branch line, 1,500 feet long, connects the Walters outlet building from the tee. A combination 8- and 6-inch branch, 9 miles long, also connects to the tee to supply Temple Lake. The Duncan pipeline conveys the water through a combination 30- and 36-inch pipeline from the intake at the lake, a distance of 19 miles, to the Duncan water treatment plant, located about 2 miles east of the city of Duncan. A relift pumping station is located at about mile 11 on the waterline. Also, an 8-inch waterline branching off the main Duncan line at about mile 8 conveys water a distance of 2 miles to the city of Comanche water treatment plant. The main control station for the system is at the lake intake site where essential information is received and manual override of the pumps can be assumed. Each pumping facility consists of four electric-motor-driven pumps, each having a capacity of one-fourth of the required station capacity. Protection against surges caused by power failures or other unscheduled tripouts is provided by surge reservoirs and surge relief valves at the pump stations and at high points on the pipelines. When a downsurge occurs, the reservoirs supply water to the pipelines through quick opening valves in order to prevent separation of the water column.

(2) Physical constraints. The top of the inactive pool is at elevation 910.0 and contains 4,370 acre-feet based on the 1991 resurvey. The streambed at the dam is at elevation 889.0. The invert of the flood control conduit is at elevation 893.0. As the pool elevation decreases, several problems are encountered with recreational facilities. There are a total of five boat ramps at Waurika Lake, all of which are Corps maintained. The limiting elevations of these ramps range from 940.0 to 930.0. The receding shoreline results in many public use facilities such as camping sites, picnic areas, and group shelters being a significant distance from the water's edge. Swimming beaches are seriously affected at elevation 940.0 and become virtually useless at elevation 928.6. The marina operator begins experiencing problems with accessibility and insufficient water depth at elevation 946.0. At elevation 931.0, the marina is rendered unusable and requires structural changes to regain usefulness. At pool elevations between 940.0 and 928.6, boating hazards, such as tree stumps and brush piles, are marked and buoyed. As the pool descends, new hazards are encountered which may or may not be easily detected. The project personnel make every effort to locate and buoy new hazards as they occur.

The original sediment survey estimated that 40,000 acre-feet would settle in the lake area during the life of the project. As the pool elevation decreases during a drought, and storage accounting procedures are initiated, additional loss of storage will be considered. Should the pool elevation fall below elevation 905.0, the existing pool gage orifice would have to be extended downward or a temporary gage would have to be installed.

b. Lake Texoma.

(1) General. Denison Dam is located at river mile 725.9 on the Red River and is about 5 miles northwest of Denison, Texas. The project is authorized for flood control, hydroelectric power, water supply, regulating flows of the Red River for improving navigation, recreation, and other beneficial uses. Construction on the project began in 1939 and final storage began in 1944. Pertinent data for Lake Texoma is shown in Table 4-11.

TABLE 4-11

PERTINENT DATA, LAKE TEXOMA

Location

Red River at mile 725.9

Drainage Area

39,719 square miles above the dam, of which 33,783 are contributing

Project Purposes

Flood control, power, water supply, regulating flows of Red River, improving navigation, recreation, and other beneficial uses

Elevations, Areas, And Storages

Based on 2002 sedimentation survey

Feature	Elevation (feet, NGVD)	Area (acres)	Storage	
			(acre-feet)	(inches) (1)
Top of Dam	670.0	-----	-----	-----
Top of Surcharge Pool	643.0	148,850	5,497,040	3.05
Top of Flood Pool	640.0	141,420	5,061,060	2.81
Spillway Crest	640.0	141,420	5,061,060	2.81
Top of Conservation pool	617.0	74,690	2,516,230	1.40
Top of Inactive Pool	590.0	40,430	1,048,950	0.58
Streambed	505.0	-----	-----	-----
Flood Control Storage	617.0-640.0	-----	2,544,830	1.41
Conservation Storage	590.0-617.0	-----	1,467,280	0.81

(1) Runoff from normal contributing drainage area of 33,783 square miles.

Power Data

Power heads, average net	
Power pool full	103.2 feet
Power pool empty	75 feet
Critical hydroperiod	92.2 feet
Continuous power	18,400 kw.
Dependable capacity	
Initial	54,000 kw.
Ultimate	135,000 kw.
Load factor	
Initial	34.1
Ultimate	13.6

TABLE 4-11 (Cont.)

Installed capacity		
Initial (two 35,000-kw.)		70,000 kw.
Ultimate (five 35,000-kw.)		175,000 kw.
<u>Hydraulic Design Data</u>		
Outlet works		
Discharge at top of conservation pool, elevation 617.5		60,300 c.f.s.
Discharge at bottom of conservation pool, elevation 590.0		50,400 c.f.s.
<u>Structures</u>		
Embankment		
Type		Rolled earthfill
Maximum height above streambed		165 feet
Crest width		40 feet
Length (including spillway)		17,200 feet
Spillway		
Location		Near right abutment
Type		Uncontrolled chute
Overflow width		2,000 feet
Outlet works		
Type and size		Three 20-foot-diameter conduits
Location		Near right end of embankment
Control		Six 9'x19' vertical lift gates and two 9'x19' emergency gates
Invert elevation		523.0 feet
Dikes		
Type		Rolled earthfill
Number and location		Two - Near Platter, Okla., and Cumberland Levee
Maximum height above ground surface		
Dike near Platter, Okla.		15 feet
Cumberland Levee		90 feet
Length		
Dike near Platter, Okla.		5,870 feet
Cumberland Levee		23,480 feet

(2) Physical constraints. When the Lake Texoma project was initially designed and constructed, the only project purpose using conservation storage was hydroelectric power generation. The designed conservation storage was based on the projected future use of hydropower demand and storage for sedimentation. Later, water supply, navigation, low flow regulation, and recreation were added as project purposes.

A portion of the hydropower storage was later reallocated to municipal and industrial water supply storage. The current conservation storage based on the 2002 sediment survey is 1,467,280 acre-feet. Lake Texoma currently has a total water supply storage of 150,000 acre-feet with a total dependable yield of 150.0 MGD. The Water Resource Development Act of 1986 authorized an additional 300,000 acre-feet of storage for reallocation to water supply storage upon completion of a reallocation study.

As the pool elevation decreases, several problems are encountered with recreational facilities. There 82 boat ramps at Lake Texoma, 55 of which the Corps maintains. The limiting elevations of these ramps range from 613 to 610. The receding shoreline results in many public use facilities such as camping sites, picnic areas, and cabins being a significant distance from the water's edge. Swimming beaches and fishing docks are seriously affected at elevation 612 and become virtually useless at elevation 610.

Historically, marina operators begin experiencing problems with accessibility and sufficient water depth at elevation 612. At elevation 607, most of the marinas are rendered unusable and require significant structural changes (relocation and dredging) to regain usefulness.

At pool elevations between 617.0 and 612.0, boating hazards such as tree stumps and rock outcrops are marked and buoyed. As the pool descends, new hazards are encountered which may or may not be easily detected. The project personnel make every effort to locate and buoy new hazards as they occur.

The Cumberland Pool becomes isolated from the main body of Lake Texoma at approximately elevation 619.0. The invert elevation of the Cumberland Cut is about 613.0 feet NGVD near the midpoint of the cut. At the dividing elevation of 619.0 feet NGVD, the Cumberland Pool contains 28,170 acre-feet.

Sedimentation in the conservation pool at Lake Texoma occurred at the rate of about 7,000 acre-feet per year from 1942 to 2002. The sedimentation rate of 3,268 acre-feet per year was deposited in the inactive storage during this same period. As the pool elevation decreases during a drought and storage accounting procedures are initiated, additional loss of storage since the last sediment survey should be considered.

Should the pool elevation fall below elevation 571.0, the existing pool elevation gage float well will no longer work and a temporary gage would have to be installed.

V. – WATER USES AND USERS

5-01. Current Project Water Uses And Users.

a. Waurika Lake uses. The primary objectives of the Waurika project are flood control on Beaver Creek, water supply, water quality, recreation, propagation of fish and wildlife, and a supply of water for irrigation. The Waurika Project Master Conservancy District has contracted for approximately 27.6 percent of the water supply storage in the lake between elevation 910.0 and 951.4.

(1) Water supply. Water supply is an authorized project purpose at Waurika Lake, and 82,000 acre-feet of conservation storage is allocated for that purpose. Additionally, water supply and water quality are authorized as a joint project purpose with an allocation of 69,400 acre-feet of conservation storage. Thus, a total of 151,400 acre-feet of conservation storage is allocated for water supply and water quality, of which 41,800 acre-feet (27.6%) is contracted to the Waurika Project Master Conservancy District (WPMCD).

(2) Water quality. Water quality is an authorized project purpose at Waurika Lake, and conservation storage was allocated for that purpose jointly with water supply.

Releases for water quality control can be made directly from the project into Beaver Creek through the low-flow pipe equipped with a multi-level intake. In addition, water quality releases can be made into Cow and Cache Creeks by transporting water through the water conveyance facilities. Before the project was constructed, the Public Health Service recommended a schedule of water quality releases to be made into Cow and Cache Creeks from the Waurika Project to dilute the sources of pollution on these streams. Field studies of the requirements of these streams conducted by the Corps of 1981 and 1982, indicated flow augmentation in Cache Creek was not needed due to better waste treatment facilities and in Cow Creek would be ineffective the majority of the time. Therefore, water quality releases will be made only in response to critical and/or emergency water quality problems as identified by the Corps or the Oklahoma Water Resources Board (OWRB). The OWRB will notify the Corps of these problems along with their release recommendations, and the Corps will, upon verification, respond to these problems. Whenever water quality releases are required from the water conveyance system, the Water Management Section will instruct the Waurika Project Master Conservancy District to make the releases. The releases into Cache Creek will be made through a manually operated valve located near the stilling basin of Lake Ellsworth upstream of the city of Lawton. The releases into Cow Creek will be made through a manually operated valve located on Claridy Creek, a tributary of Cow Creek, entering Cow Creek downstream of the city of Duncan and upstream of the Sun Oil Company refinery. The initial water quality storage in Waurika Lake, based on 50-year frequency drought, has an average yield of 23 cfs.

(3) Recreation. Recreation is an authorized project purpose at Waurika Lake, but no storage was allocated for that purpose.

(4) Fish and wildlife. Fish and wildlife is included as a purpose pursuant to Public Law 85-624. The Oklahoma Department of Wildlife Conservation (ODWC) is licensed to operate 13,000 acres of project land and water as a game management area. The outlet works contains facilities for drawing and mixing water from three different levels at times when releases through the low flow pipe are being made.

(5) Irrigation. Irrigation is an authorized project purpose at Waurika Lake, and 18,800 acre-feet of conservation storage is allocated for that purpose; however, none has yet been contracted.

b. Lake Texoma uses. The authorized current uses of water in Lake Texoma are flood control storage, hydroelectric power generation, municipal and industrial water supply, recreation, and regulation of flows (low flow regulation) on the Red River. Secondary or incidental uses are irrigation, fish and wildlife, and water quality.

(1) Hydropower. The Southwestern Power Administration (SWPA) is the federal agency charged with the scheduling and marketing of hydropower-generated electricity at Denison Dam. SWPA enters into contracts with preference customers to provide peaking capacity and energy from an electrically interconnected system of reservoirs. These contracts provide 1200 hours per year of peaking energy for each kilowatt of capacity marketed. If available, SWPA may use banked energy or purchase thermal energy to provide these requirements in lieu of generating at the hydroelectric projects. The power and energy produced at Denison Dam is not currently marketed as a part of the interconnected system, but is instead marketed as an isolated project. The current customers are entitled to the entire power and energy output at Denison, but they are required to provide support for the Whitney project in Texas. Table 5-1 shows the monthly firm energy at Lake Texoma based on Corps studies.

TABLE 5-1

FIRM ENERGY AT LAKE TEXOMA

Month	Firm Energy (GWH)	* Water Required (cfs)
January	10.04	1,700
February	8.02	1,500
March	9.01	1,500
April	8.97	1,550
May	11.20	1,900
June	12.58	2,200
July	14.58	2,350
August	13.78	2,300
September	10.96	1,900
October	9.52	1,600
November	8.84	1,550
December	<u>9.52</u>	<u>1,600</u>
Annual	126.47	1,800

* Based on pool elevation at 617.0.

The Denison Dam powerhouse operates a small hydroelectric power unit to provide electricity for the project's needs. This unit operates continually at an average discharge of 19 cubic feet per second (cfs).

SWPA follows the Corps guidelines which limit water surface drawdown to 1 foot per week and 3 feet per month while in the power pool. This drawdown rate limit was established by the Corps to prevent any adverse impacts on recreation and to limit bank erosion and embankment sloughing. This drawdown rate can be exceeded during a power emergency with a deviation approval from SWD.

(2) Water supply. Municipal and industrial water supply was not an original project purpose, but was added later under authority of the Water Supply Act of 1958, Public Law 85-500. This law specifically reallocated 21,300 acre-feet of storage for water supply from hydropower to meet the needs of Denison, Texas. The Water Resource Development Act of 1986 authorized an additional 300,000 acre-feet of storage for reallocation to water supply storage upon completion of a reallocation study. Presently, 150,000 acre-feet of conservation storage is allocated to water supply with a dependable yield of 150.0 MGD.

(3) Recreation. Public recreation development around Lake Texoma consists of 10 public use areas, 2 State parks, (Texas' Eisenhower State Park and Oklahoma's Texoma State Park), and one city park, (Tishomingo, Oklahoma). Facilities within these areas include 285 picnic sites, 720 camping sites, 83 boat ramps, and 210 commercial docks. Private recreational investment includes 22 active concessions that operate on a lease basis. About 5.9 million people visited the lake during 2004.

Although recreation is an authorized project purpose, no storage is provided specifically for that purpose and no special regulations are made for recreational activities. The seasonal pool plan recommended by the Lake Texoma Advisory Committee does enhance recreation interests in the lake by raising the normal pool elevation during the months of June, July, and August which should benefit most recreational activities.

Table 5-2 in the Table Section lists major associations and State and local agencies with interests or responsibilities in recreation at Lake Texoma. The impacts of various pool levels and releases rates upon recreation and recreational interests are given in Table 5-3.

TABLE 5-3

IMPACTS OF VARIOUS POOL LEVELS
AND RELEASE RATES ON RECREATIONS

<u>Lake Elevation</u>	<u>Impacts</u>
617.0	Normal elevation. No recreational problems.
614.0	Lowest elevation at which no problems occur.
614.0 – 612.0	Large boats may have problems in some areas.
612.0 – 611.0	Project Manager begins receiving telephone calls complaining about low pool. Several boat ramps must be closed. Boating hazards which were previously submerged are now dangerous and require marking. Marinas begin experiencing problems with sufficient water depth and accessibility. Negative publicity begins to appear in local newspapers and radio news.
611.0 – 610.0	Marinas experience significant problems with adequate water depth. Many marinas must be moved to deeper water. Cumberland pool is now isolated from main body of water. More boat ramps must be closed. Swimming beaches begin to close. Boating hazards greatly increase (elevation 610.0 is the probable elevation of original reservoir clearing). Negative publicity increases.
610.0 – 607.0	Many marinas must be closed or moved to deeper water. Recreation associations actively request the Corps to curtail hydropower generation, and lobby Members of Congress to legislate relief. Most boat ramps close at 607.0. At elevation 607.0 negative publicity intensifies and reaches regional coverage.
607.0 – 605.0	Those marinas that cannot be moved to deeper water are essentially unusable at 605.0. Only a few boat ramps are usable. The media may cover the low lake level as it would a catastrophe.
605.0 – 602.0	Recreation is limited to very small boats that can be easily launched. All concessionaires are severely, if not totally, disabled by the low lake level.

(4) Regulation of flows. Regulation of flows on the Red River is an authorized project purpose at Lake Texoma. No storage has been allocated for this

purpose; however, hydropower releases are usually adequate to meet downstream water rights and to incidentally maintain water quality and provide fish and wildlife enhancement. Normally low flow releases in addition to power generation requirements are also made through the turbines. Sometimes, however, the quality of the water being discharged through the hydropower turbines is poor. This usually occurs during the late summer and continues until cooler weather causes the lake to turn over. During these times the dissolved oxygen (D.O.) in the water immediately downstream of the dam becomes too low for some types of fish to survive. One type of fish which is affected first by low D.O. levels is the Striped Bass. The D.O. levels below Denison Dam are monitored during the summers to detect this condition before the fish start dying. Although no water quality storage is provided, a low flow release of 50 c.f.s. is made through one of the flood control conduits when the D.O. level becomes critical. The water released in this manner becomes highly aerated and has proven adequate for maintaining the D.O. at a high enough level to prevent a fish kill. During extreme drought conditions, either the Corps Drought Management Committee (CDMC) or the Interagency Drought Management Committee (IDMC) will have to determine if this 50 cfs release should be made or if the water is more beneficial for some other conservation use. It might also be possible to release the 50 cfs to benefit the fish, and then withdraw it from the river further downstream to use for water supply.

(5) Irrigation. Irrigation is not an authorized project purpose at Lake Texoma; therefore, no storage is allocated for irrigation. Numerous water rights have been issued both downstream and in the reservoir for the primary purpose of irrigation. These water rights are limited to lake inflow and cannot be taken from storage.

(6) Fish and wildlife. See section 5-01.b.(4).

(7) Water quality. See section 5-01.b.(4).

c. Waurika Lake users. The Waurika Project Master Conservancy District (WPMCD) has contracted for 27.609 percent of the water supply storage in the lake. The required withdrawals for municipal and industrial water supply will be released through the water conveyance system and the 14-inch-diameter water supply pipe in the outlet works structure. The WPMCD will report the water volume withdrawn during the preceding 24 hours to the Waurika Project Office by 8:00 a.m. each day. Accounting procedures for conservation storage in multipurpose projects have been developed by the Tulsa District and approved by the Southwestern Division to regulate the withdrawal of water from lakes by each water supply user (described in detail in section 8-02.d).

d. Lake Texoma users. Current users of the water in Lake Texoma include Southwestern Power Administration, marina operators, fishermen, boaters, campers, hunters and water supply users. Table 5-4 lists water supply storage users and invert elevations of their withdrawal facilities.

TABLE 5-4

WATER SUPPLY CONTRACTS
LAKE TEXOMA

REVISED: 14 September 2005

User Name	Date Approved	Present Storage (ac-ft)	Future Storage (ac-ft)	Total Storage (ac-ft)	Yield (MGD)	Invert Elevation (feet NGVD)
City of Denison, Texas Wet well #1: Wet well #2:	09/21/53	21,300	0	21,300	21.300	588.8 600.0
Texas Power and Light No withdrawal facilities in Lake Texoma.	08/08/61	16,400	0	16,400	16.400	
Red River Authority of Texas Wet well inlet	11/18/69	450	0	450	0.450	612.0
Red River Authority of Texas Wet well inlet	08/02/83	2,054	0	2,054	2.054	612.0
North Texas Municipal Water District The extendable submersible pumps	12/17/85	85,406	0	85,406	85.406	530.0
Buncombe Creek View Addition	04/09/92	1	0	1	0.001	
Greater Texoma Utility Authority, acting as agent for: City of Sherman*	09/24/92	5,500	0	5,500	5.500	
	09/24/97	5,500	0	5,500	5.500	
(GTUA F/Sherman)	09/23/05	11,600		11,600	11.600	
Oklahoma Tourism & Recreation	09/23/05	275	0	275	.275	
Not Under Contract	—	0	1,514	1,514	1.514	
North Texas Municipal Water District (Pending Reallocation)	(Pending)	100,000	0	100,000	100.000	
Total		248,486	1,514	250,000	250.000	

* Authorized by Congress

5-02. Potential project water uses and users.

a. Waurika Lake uses. The Bureau of Reclamation found that a total of 5,854 acres of land below the damsite was suitable for irrigation. Based on a 20-year drought, including conveyance losses, farm waste, and deep percolation losses, the project would provide a yield of 4.5 MGD for irrigation purposes. The irrigation yield would be from a storage of 18,800 acre-feet and is sufficient to irrigate 2,000 acres of land.

b. Lake Texoma uses. Potential uses for the water in Lake Texoma will probably be the same as the current uses. What may change are the amounts of water used for each purpose. For instance, in a severe drought, more water may be needed for consumptive uses at the expense of recreation, hydroelectric power generation, and irrigation. The Water Resource Development Act of 1986 authorized an additional 300,000 acre-feet of storage for reallocation to water supply storage upon completion of a reallocation study.

Although improvement of navigation is one of the designated purposes of Lake Texoma and Denison Dam, there is no storage provided nor is there currently any significant commercial navigation along the Red River upstream of Fulton, Arkansas. It is possible that releases for navigation will be required at some future time.

c. Waurika Lake users. The Jefferson County Irrigation District has been organized, but the cost of constructing the irrigation facilities is prohibitive at this time. Therefore, the development of the irrigation project will probably be delayed for future development. The Waurika Project Master Conservancy District has informally asked to purchase the irrigation storage for water supply use in the event that the irrigation project is not developed.

d. Lake Texoma users. Potential users for the water in Lake Texoma could include just about anyone in the Red River basin and even outside the basin. Potential users of water in Lake Texoma will be competing for a limited amount of water and some very difficult decisions will have to be made to determine how it will be divided.

5-03. Available storage surplus to current needs. It should be noted that all potential water users must comply with appropriate state laws concerning water rights and uses, and will obtain such permits as are required by the States of Texas or Oklahoma. Information concerning necessary water use permit approval in Texas may be obtained from: Texas Commission on Environmental Quality, (512) 239-1000, P.O. Box 13087, Austin, Texas 78711-3087. Information concerning necessary water use permit approval in Oklahoma can be obtained from: Oklahoma Water Resources Board, (405) 530-8800, 3800 N. Classen, Oklahoma City, OK 73118.

a. Waurika Lake. Currently, 41,800 acre-feet of the 82,000 acre-feet allocated to water supply is under contract. The remaining 40,200 acre-feet of water supply storage and an additional 69,400 acre-feet of joint water supply and water quality storage (dependable yield of 26.2 MGD) are available to meet water needs during a drought. Part of the remaining conservation storage (18,800 acre-feet for irrigation, and 15,600 current sediment reserve) could be used to provide short-term withdrawals of 50 acre-feet or less in accordance with EC-1105-181. Inactive storage (4,370 acre-feet, based on 1991 survey) in excess of sediment storage could be used to meet water needs in a critical drought situation.

b. Lake Texoma. Currently, 148,486 acre-feet of the 150,000 acre-feet allocated to water supply is under contract. The remaining 1,514 acre-feet of water supply storage (dependable yield of 1.514 MGD) is available to meet future water supply needs. A reallocation study is currently underway and if approved, the North Texas Municipal Water District has applied for 100,000 acre-feet of this storage for water supply. The Water Resource Development Act of 1986 authorized an additional 300,000 acre-feet of storage for reallocation to water supply storage upon completion of a reallocation study. Part of the remaining 1,462,000 acre-feet in conservation storage (allocated to hydropower storage) could be used to provide short-term withdrawals of 50 acre-feet or less in accordance with EC-1105-181 (if considered a more beneficial use). Inactive storage (1,048,949 acre-feet based on 2002 survey) in excess of sediment storage could be used to meet water needs in a critical drought situation. However, use of the inactive storage could result in a request for credit by the Southwestern Power Administration. The Corps has no revenue stream to fund such a credit.

It should be noted that all potential water users must comply with appropriate state laws concerning water rights and uses, and will obtain such permits as are required by the States of Texas and/or Oklahoma.

VI – CONSTRAINTS

6-01. Constraints.

a. Upper Red River Basin legal constraints. The Red River Compact is an agreement between the states of Arkansas, Louisiana, Oklahoma, and Texas to provide an equitable apportionment of the water of the Red River and its tributaries. The river has been divided into five reaches with each reach further divided into sub-basins. The water of a sub-basin is allocated to a state or states by mutual agreement. Water will be withdrawn, released, or reallocated in a manner which meets the obligations of the Compact.

b. Waurika Lake.

(1) Legal constraints. The Oklahoma Water Resources Board reports active water rights totaling 493.6 acre-feet per year on Beaver Creek downstream of Waurika Dam. These water rights are owned by 7 users. Releases from inflow to satisfy downstream water rights will be made at the request of the Oklahoma Water Resources Board. The Oklahoma Water Resources Board will inform the Water Management Section as to the amount and time distribution of the required release. No withdrawal from storage in the lake will be made for downstream water rights unless the water right holder has contracted storage available in the lake. The releases for the water rights will be made through the 12-inch-diameter low flow pipe in the outlet works.

(2) Institutional constraints. Temperature sensing equipment has not been provided in the lake; however, multiple-level intakes are constructed in the wet well of the outlet works structure. Releases required for downstream water rights will be made through the multiple-level intakes to provide downstream water temperatures as close as possible to objective temperatures. The objective temperature curve is based on computed natural stream temperatures in the vicinity.

c. Lake Texoma.

(1) Legal constraints. Normally, regular hydropower releases are adequate to meet downstream water rights and to incidentally maintain water quality. All downstream water rights and reservoir withdrawal contracts are only entitled to their portion of lake inflow. A list of water rights, both in the reservoir and below the damsite, is kept by the Water Management section.

Releases from inflow to satisfy downstream water rights will be made at the request of the Oklahoma Water Resources Board (for Oklahoma water rights) and the Texas Commission on Environmental Quality (for Texas water rights). These two agencies will inform the Corps of Engineers Water Management Section as to the amount and time distribution of the required release. No withdrawal from storage in the lake will be made for downstream water rights unless the water right owner has contracted storage available in the lake. Releases from storage will not be made when

the pool recedes below elevation 590.0 feet NGVD (bottom of the conservation pool). Inflow may be passed through the outlet works; however, if a water right owner properly demands their water right.

Public Law 100-71 of the Supplemental Appropriations Act (July 11, 1987) directed the Secretary of the Army to establish the Lake Texoma Advisory Committee and directed the Corps of Engineers, taking into consideration recommendations of the Southwestern Power Administration (SWPA) and the Lake Texoma Advisory Committee, to develop a management plan for the conservation pool in Lake Texoma. The current seasonal pool plan, approved and implemented in 1992 and modified slightly in 1997, attempts to maintain a pool elevation between elevations 619 and 615, depending upon the time of year. When the pool elevation drops to 612.0 feet NGVD, a public information program will be implemented. When the pool is between 612.0 and 607.0 feet NGVD, the Corps will notify SWPA that hydroelectric power generation should only be made when needed for rapid response, short-term peaking purposes as determined by SWPA. When the pool elevation is between 607.0 and 590.0 feet NGVD, the corps will notify SWPA that hydroelectric power generation should only be made to satisfy critical power needs on the power scheduling entity's electrical system as determined by SWPA. The Corps will also notify municipal and industrial water users that they should implement water conservation measures designed to lessen the impact of municipal and industrial water withdrawals.

(2) Institutional constraints. The Water Control Manual allows the emergency release of water to improve water quality which relieves fish distress. The Southwestern Division must approve the release as a deviation request after coordination with the SWPA, Oklahoma Water Resources Board, and Texas Commission on Environmental Quality. Tests have shown that a 50 cfs release through the flood conduit restores adequate water quality.

VII – DROUGHT MANAGEMENT PLAN

7-01. Introduction.

a. General concept of plan. The Drought Management Plan will be used to conserve stored water and to identify surplus water available during drought conditions. The PDSI will be used to determine regional drought conditions and the depletion of stored water will determine drought conditions at specific Corps of Engineers storage projects.

b. General description of levels. Table 7-1 and Table 7-2 show the duration of the PDSI and lake elevations for each level which will initiate the actions to be taken. Storage will be the primary indicator for the levels with consideration given to Inflow, rainfall, and PDSI values. A general description of each level follows.

TABLE 7-1
DROUGHT ACTION LEVEL DESIGNATIONS

Feature		Elevation	Storage	Storage
		Waurika Lake	Waurika Lake Acre-feet	Percent Remaining
Top of conservation pool		951.4	190,200	100
Duration (1) Level Limits (months)				
I	0-18	951.4	190,200	100
II	18-36	945.2	133,140	70
III	36-54	939.7	95,100	50
IV	>54	932.6	57,060	30
Bottom of conservation pool		910.0	0	0

(1) Duration refers to the number of consecutive months that the applicable PDSI value has been below zero.

TABLE 7-2
DROUGHT ACTION LEVEL DESIGNATIONS

Feature		Elevation	Storage	Storage
		Lake Texoma	Lake Texoma Acre-feet	Percent Remaining
Top of conservation pool		617.0	1,467,280	100
Duration (1) Level Limits (months)				
I	0-18	617.0	1,467,280	100
II	18-36	612.0	1,122,654	77
III	36-54	607.0	820,396	56
IV	>54	599.9	440,180	30
Bottom of conservation pool		590.0	0	0

(1) Duration refers to the number of consecutive months that the applicable PDSI value has been below zero.

(2) Level I. This level is designed as an alert phase in which the water managers monitor the onset of an apparent drought situation. Level I operations extend from 100% to 70% conservation storage. The plan requires normal operational procedures and coordination for monitoring of storages, users, releases, etc. needed to perform normal low flow activities and disseminate status reports within the Corps, other agencies, and users.

(3) Level II. The plan calls for expanding actions ongoing in Level 1. In addition, a Corps Drought Management Committee (CDMC) will be activated. Level II operations extend from 70% to 50% conservation storage. As needed, the requests will be coordinated through the CDMC to assure the various functional elements of the District are responding to the drought in a coordinated and consorted effort. Requests for drought related actions will be forwarded to the CDMC for its evaluation and recommended actions. The CDMC will coordinate requests and actions with appropriate state and federal agencies. The Water Management Section coordinates and implements the plans and deviations through their routine command channels.

(4) Level III. During this phase of drought, the Commander will activate the Interagency Drought Management Committee (IDMC) as the interface between the CDMC and the water user's needs in the basin as represented by the committee members. Level III operations extend from 50% to 30% conservation storage. The IDMC will provide user input and consolidate the state and federal positions on drought actions. This committee will provide the CDMC with justifications, priorities and suggested actions which will serve the most critical needs with the remaining project storage.

(5) Level IV. Level IV operations extend from 30% to 0% conservation storage. Coordination of actions during this level will follow the same procedures as in level III. But by level IV, conditions have worsened to the extent that inactive storage utilization must be considered. Water rationing and apportionment may be required to maintain critical water needs.

Lake Texoma levels vary somewhat from these preset percentages due to legislation (PL 100-71), which designates elevations 612.0 and 607.0 as critical points in the conservation pool for public notification.

7-02. Drought Management Committees. The most important aspect of the drought management plan is the development of a procedure to communicate with other Corps elements, state and Federal agencies, and the public concerning drought conditions and required or proposed actions. This communication process should include all appropriate agencies at a time when decisions need to be made and options are still available. Two committees are formed as a part of the Drought Management Plan. These committees play an important role in establishing priorities, justifications, actions and responses the District will require during drought conditions.

a. The first committee is the Corps Drought Management Committee (CDMC). This committee will be chaired by the District Engineer or his designated representative and will be composed of representatives from:

- Program and Project Management Division (PPMD)
- Engineering and Construction Division
- Operations Division
- Planning Division
- Real Estate Division
- Public Affairs office (PAO)
- Office of Counsel
- Emergency Management/Security Division
- Safety and Occupational Health Office

b. A second committee, Interagency Drought Management Committee (IDMC) is chaired by the Commander or his designated representative and is composed of, but not limited to, representatives from the following Federal and State agencies:

- Southwestern Power Administration (SWPA)
- United States Fish and Wildlife Service (USFWS)
- Environmental Protection Agency (EPA)
- National Weather Service (NWS)
- United States Geological Survey (USGS)
- Oklahoma Water Resources Board (OWRB)
- Texas Commission on Environmental Quality (TCEQ)
- Oklahoma and Texas Departments of Health
- Oklahoma Department of Wildlife Conservation (ODWC)
- Texas Parks and Wildlife Department (TPWD)
- Oklahoma Department of Agriculture, Food, and Forestry
- Oklahoma Department of Environmental Quality (ODEQ)
- Oklahoma and Texas Governors' Office
- Oklahoma Department of Energy
- Oklahoma Tourism and Recreation Department

c. Functions.

(1) Corps Drought Management Committee (CDMC). This committee will coordinate requests and actions related to water management, as needed, to assure the various functional elements of the District are responding to the drought in a coordinated and concerted effort.

(2) Interagency Drought Management Committee (IDMC). This committee will be an interface between the CDMC and the basin water users as represented by the committee members. The IDMC will provide user input and consolidate the state and federal positions on drought actions.

7-03. Drought Management Plans. The following procedures as shown in Table 7-3 will govern drought actions to be taken at the two Corps projects in the Upper Red River Basin.

TABLE 7-3
DROUGHT MANAGEMENT PROCEDURES

Level	Lake	Elevation	Action to be Taken	Impacts	Coordination Requirements
Level – I					
100%-70% Conservation Storage	Waurika Lake	951.4-945.2	Begin monthly reservoir accounting of conservation storage with 75% remaining	Provides status of water storage utilization	Project Offices, Operations Division, and SWPA
			Notify Federal and State Fisheries of lake conditions for management purposes	Allows fishery programs to coincide with low lake levels	ODWC, TPWD, USFWS, and Operations Division
100%-77% Conservation Storage	Lake Texoma	617.0-612.0	Monitor low-flow releases, lake drawdowns, excessive gate leakage, and usage of stored water	Conserves water and assures proper release amounts	Project Offices
			Monitor lake inflows	Provides account of flow available for water rights	OWRB and/or TCEQ, SWPA
			Forecast lake levels	Provides information for planning business operations and recreational uses	Project Offices, Operations Division, and National Weather Service, SWPA
			Notify public of lake safety hazards and closed boat ramps	Provides public a safer and more convenient use of the lake	Project Offices, Safety Office and PAO
Level – II			Activate CDMC (Ad Hoc)	Provides decision making structure to view problem	CDMC
70%-50% Conservation Storage	Waurika Lake	945.2-939.7	Monthly reservoir accounting of conservation storage and promoting water conservation by authorized users.	Provides status of water utilization and restricts nonessential water use	Notify users once 50% or less of <u>their</u> storage remaining. Options to purchase any additional storage available.
77%-56% Conservation Storage	Lake Texoma	612.0-607.0	Notify users of their invert elevation level	Allows development of alternative before losing withdrawal capability	Affected water users, Project Offices, and CDMC
			Verify flow rating tables	Provides more accurate determination of inflow and release rates	H&H Branch, SWPA, and USGS
			Minimize gate leakage	Conserves water	Project Offices and Operation Division
			Cease releases for non-critical project testing and inspections	Delays maintenance program	Project Offices and Operations Division
			Analyze potential use of flood storage in other projects	Provides alternative water source during critical period	CDMC, SWD, Operations Division, OWRB, and SWPA

TABLE 7-3 (Cont.)

Level	Lake	Elevation	Action to be Taken	Impacts	Coordination Requirements
Level – III 50%-30% Conservation Storage	Waurika Lake	939.7-932.6	CDMC will meet monthly or more frequent as necessary (weekly)	Allows time for decisions and action to be taken	CDMC
			Activate IDMC	Provides input to Corps decision making process from state and local interests	IDMC, CDMC, and SWD
	Lake Texoma	607.0-599.9	Weekly reservoir accounting of conservation storage	Provides more frequent status of water storage utilization	Conservation Users (contract storage), Project Offices, Operations Division, IDMC, CDMC, & SWD
			Notify EOC	Provides response time to meet critical needs	EOC
			Minimize special event releases	Conserves water for critical needs	SWD, CDMC, IDMC, Project Offices, Ops. Division, PAO and requesting sponsors
			Define surplus water for M&I use and costs	Provides for quick response to water supply requests	SWD, CDMC, and IDMC
Level – IV 30%-0% Conservation Storage	Waurika Lake Lake Texoma	932.6-910.0 599.9-590.0	Forecast lake levels	Provides information for planning business operations and recreational users	Project Offices and Operation Division
			IDMC will meet weekly or as needed for specific drought problems	Allows quick response to critical needs	IDMC, CDMC, Project Offices, Ops. Division, PAO and requesting sponsors
			Discounting special event releases	Conserves water for critical needs	SWD, CDMC, IDMC, Project Offices, Ops. Division, PAO and requesting sponsors
			IDMC plan priorities for use of surplus water	Allows consensus recommendations on use of surplus water	IDMC
			CDMC allocates usage of surplus water	Allows usage of surplus water for priority purposes	IDMC, CDMC
			Notify contract water users of need to contract for emergency water needs	Assures current customers know requirements for emergency water	Affected water users, IDMC, CDMC, Project Offices, and Ops. Division
			Contract emergency water supplies	Sets specific water withdrawals of users	CDMC, SWD, and water users
			Forecast lake levels	Provides information for planning business operations and recreational users	Project Offices, Operations Division, and National Weather Service

VIII – INTERAGENCY COORDINATION AND PROCEDURES

8-01. Interagency Coordination.

a. Offices within the Corps of Engineers.

(1) Office, HQ USACE. The Office, HQ USACE, coordinates the overall policies for the operation of flood control and multiple purpose reservoirs. In addition to daily flood situation reports during floods, monthly reports of reservoir operations, and special reports covering periods of flooding and drought are submitted to the Office, HQ USACE, through the Southwestern Division.

(2) Southwestern Division. The Office of the Division Engineer, Southwestern Division, furnishes a channel for coordination of policy with the Office, HQ USACE and other agencies, and furnishes guidance for formulation of regulations for the operation of the reservoirs. Regulations for the operation of all reservoirs are prepared by the District Office and are subject to approval by the Southwestern Division Commander. During emergencies, the Division Office coordinates reservoir operation between Districts in the Division and between the Southwestern Division and the Mississippi Valley Division.

(3) Other Districts. The present method of reservoir operation, which consists of storing floodwaters which would contribute to flooding on the Red River below Denison Dam, will in most cases produce maximum benefits farther downstream in the Vicksburg District. In those instances where drought problems downstream from the Tulsa District require special consideration, reservoir operations are coordinated between the Districts in so far as possible to produce maximum benefits. Whenever drought is occurring below Denison Dam, pertinent hydrologic data is transmitted to the Vicksburg District downstream which may be affected. This includes notification of changes in releases of 10,000 cfs or more from Denison Dam and a forecast of stages at Fulton, Arkansas.

b. Other Federal Agencies.

(1) National Weather Service (NWS). Cooperation with this agency consists of exchange of meteorological and hydrologic data and reports with a view to prevention of duplication of effort in obtaining and disseminating data. The Tulsa River Forecast Center of the NWS is the collection center for the Red River Reporting Network, which is supported by and maintained for the Tulsa District, Corps of Engineers. The National Oceanic and Atmospheric Administration furnish published climatological data to the Tulsa District.

(2) Geological Survey (USGS). The Corps of Engineers and the United States Geological Survey (USGS) cooperate in the construction, maintenance, and operation of many of the stream gaging stations in this District. During floods, this District and the USGS cooperate so that the maximum number of measurements can

be made without duplication of effort. The USGS is kept informed of hydrologic data collected through the reporting networks. Flood reports and stage forecasts for use by the Corps of Engineers are based on data obtained by both agencies.

(3) Bureau of Reclamation. Cooperation between the Bureau of Reclamation and the Tulsa District consists of mutual planning and economic studies for flood control and irrigation projects. The District also furnishes the Bureau with stream gaging data and pertinent data on all of its authorized or proposed projects. Regulations for the use of flood control storage in projects constructed by the Bureau of Reclamation are reviewed and approved by that agency prior to publication in the Federal Register. The Bureau is informed by letter of all flood control operations. The Bureau is responsible for the operation within the conservation pool of projects constructed by the Bureau.

(4) Southwestern Power Administration (SWPA). The Southwestern Power Administration (SWPA) is the marketing agency for power and energy produced at all Corps of Engineer projects which include the Denison Project in the Red River basin. Cooperation with SWPA consists of furnishing information on daily flow conditions, and pool elevations, and four-day estimates of anticipated inflow volume expected as an aid to planning for power production from existing projects.

(5) Office of Civil Defense Mobilization and Army Commanders. The Division Engineer maintains adequate liaison and coordination with OCDM Regional Directors and Army Commander. The District Engineer coordinates the planning of the Corps of Engineers Division and District organization for civil defense support with the appropriate State Government officials. This support includes using the resources at their command to aid in preventing human suffering, to mitigate destruction or damage to the public property of the United States, and assist state and local governments in essential recovery operations when and as directed by the OCDM Regional Director.

(6) Other Federal Agencies. Other agencies with which the Tulsa District cooperates by interchange of information include the United States Fish and Wildlife Service, National Park Service, United States Public Health Service, and the United States Environmental Protection Agency. EPA has regulatory authority for municipal and industrial discharges in the states. These agencies cooperate, largely in an advisory capacity, in obtaining maximum recreational, fish and wildlife, public health, and water quality benefits from operation and development consistent with operation for the authorized purposes.

c. State Agencies. The Corps of Engineers is required by Congress to maintain close liaison to determine the desires of the affected states. The Tulsa District cooperates with several state agencies during the time reservoirs are being planned, both before and after authorization. The recommendations and requirements of the Boards of Water Resources, Game and Fish Commissions, Public Health Departments and other state agencies are determined at that time in order to insure the maximum degree of cooperation. After completion of the reservoirs, these agencies cooperate in

obtaining maximum recreational, fish and wildlife, and public health benefits incidental to operation for authorized purposes. In addition, the District, during time of flood emergency, exchanges information with State Government officials, the State Highway Departments, State Police, and others. At all times cooperation is maintained with the appropriate State agency to insure compliance with all state water laws.

8-02. Technical Procedures.

a. Normal Water Supply Contracting Procedures. The following are steps in negotiating a water supply contract with the Corps of Engineers for water supply storage space in Corps lakes.

- STEP 1 - A potential water supply user contacts the Corps District Office regarding withdrawal of water from a Corps project, furnishing the amount of water required and, in some instances, an estimated schedule of use along with the date of first use and purpose for which the water is to be used. At this time, you should also have initiated water right application with the applicable State agency.
- STEP 2 - After making a determination as to the authority to be used in contracting with the potential user, either for surplus water under the Flood Control Act of 1944 or storage under the Water Supply Act of 1958, as amended, the Corps prepares cost estimates reflecting repayment options available to the potential users. These options are lump sum and repayment over a period for the ultimate amount to be used. Should no "municipal and industrial" storage space be available for contract, a reallocation from another project purpose could be considered.
- STEP 3 - After discussing the cost options and details of the type of contract required with you, the Corps' District Office will prepare an appropriate draft contract for submittal to higher authority (through the Division Office and the Office of the Chief of Engineers) for review, comments, and approval.
- STEP 4 - Upon receipt of higher authority comments, the District Office will appropriately revise the draft contract and submit the finalized contract to the user for execution.
- STEP 5 - User reviews and approves or rejects the contract. If the revised contract is rejected as presented, Steps 3 and 4 may be repeated if a contract is still desired by the user.
- STEP 6 - After you-executed contract is returned, the District Engineer will sign the contract and the final contract submitted through the Division Office and the Office of the Chief of Engineers to the Assistant Secretary of the Army (Civil Works) for his approval, if necessary.

STEP 7 - After approval of the contract by the Secretary of the Army or his duly authorized representative, it is returned to the District where a copy of the approved contract is forwarded to the user.

ESTIMATED TIMEFRAME FOR EACH STEP

Step 1	0 weeks
Step 2	1 – 4 weeks
Step 3	26 – 52 weeks
Step 4	4 – 6 weeks
Step 5	6 – 10 weeks
Step 6	6 – 10 weeks
Step 7	<u>4 – 6 weeks</u>
	47 – 88 weeks
	11 – 20 months
	(say 1 – 1-1/2 years)

b. Emergency Water Supply Contracting Procedures. Drought and other exigencies affecting domestic, municipal, and industrial water supplies will likely generate requests for water stored in Corps reservoirs. When these situations occur, requests may require immediate action. Section 6 of the Flood Control Act of 1944 provides an opportunity to be responsive to such requests. The following paragraphs outline an expedited process for dealing with such requests for withdrawal of small amounts of water over short periods of time.

Under Section 6 of the Flood Control Act of 1944, the Secretary of the Army is authorized to make contracts with States, municipalities, private concerns, or individuals at such prices and on such terms as he may deem reasonable for domestic and industrial uses for surplus water that may be available at any reservoir under the control of the Department of the Army.

Surplus water is defined to be:

Water stored in a Department of the Army reservoir which is not required because the authorized need for the water never developed or the need is reduced by changes which have occurred since authorization of the construction;
or

Water which would be more beneficially used as municipal and industrial water than for the authorized purpose and which when withdrawn would not significantly affect authorized purposes over some specified time period.

In providing surplus water, the preferred approach is for a State or subdivision to enter into a contract with the Secretary of the Army and to agree to act as wholesaler

for all of the water requirements of individual users. This places the local Governments in a position to help their citizens during difficult times and minimizes the potential for problems that could arise if the Secretary was to determine who was entitled to shares of surplus water based on assessments of local needs.

District Commanders should take the initiative to make Section 6 assessments of the availability of storage for limited withdrawals. This assessment can be made prior to any specific request in order to be ready to respond to urgent requests in a timely manner. The assessment should also summarize the impacts of such withdrawals and should be kept on file. The District Commander has been delegated authority to contract for up to 99 acre-feet of storage. Under emergency conditions, these contracts are limited to 1 year in duration.

Preferably, one agreement for each reservoir with the State or political subdivision can be used to distribute the water to small users. If this is not possible, individual agreements may be executed. The District Engineer is authorized to sign these agreements. However, if the User will be installing water lines or other facilities or equipment, then an appropriate real estate instrument must be issued under ER 405-1-12.

Table 8-1 lists current standard charges for surplus water withdrawals from Waurika Lake and Lake Texoma.

TABLE 8-1
STANDARD MINIMUM AND STANDARD UNIT CHARGE
FOR WATER WITHDRAWALS

Lake	Cost for first	Cost for each
	50,000 gallons	additional 1,000 gallons
	(\$)	(\$)
Waurika	\$50	\$0.672
Texoma	\$50	\$0.062

Agreements for small amounts of water withdrawals (50 acre-feet or less) may be accomplished via the form shown in Table 8-2. All moneys received from these agreements shall be deposited in the Treasury of the United States as miscellaneous receipts.

It should be noted that the Governor must make a declaration of emergency before an emergency water withdrawal permit can be approved. Also, all potential water users must comply with appropriate State laws concerning water rights and uses and will obtain such permits as are required by the states of Texas and /or Oklahoma.

TABLE 8-2

EMERGENCY WATER WITHDRAWAL PERMIT

Permit No. _____

WATER WITHDRAWAL PERMIT
_____ LAKE

Pursuant to the authority contained in Section 6 of the Flood Control Act of 1944 and in recognition of the declaration of emergency in the State of _____, as declared by the Governor, this permit grants permission to _____ to withdraw water subject to the following conditions:

- a. Payment of _____ 1/ for the withdrawal of up to _____ 2/ gallons of water during _____ 3/. You will report the amount of each withdrawal to the Project Office.
- b. 4/ Right-of-entry and permission to withdraw water is granted only at the location(s) designated by the Corps of Engineers.
- c. Should facilities, such as roads, etc. be damaged by you as a result of emergency uses, you may be assessed and billed a follow up charge to help in the cost of necessary repairs.
- d. User copy of this permit must be displayed during water withdrawal.
- e. You certify that water withdrawn from the project is for domestic and/or industrial purposes and will not be used for crop irrigation purposes.
- f. You agree to comply with appropriate State laws concerning water rights and uses and will obtain such permits as are required.
- g. You shall hold and save the Government, including its officers, agents, and employees, harmless from liability of any nature or kind for or on account of any claim for damages which may be filed or asserted as a result of the withdrawal of water from the Project by you, or as a result of the operation or maintenance of any facilities or appurtenances owned and operated by you.

User's Name _____
(Print)

Address _____
Telephone _____

User's Signature _____

Government Approval _____
(District Engineer)

Today's Date _____

1/ The dollar value of the storage utilized as determined by the Section 6 pricing policy, in compliance with EC 1105-2-181 procedures, or \$50., whichever is larger. The \$50 represents the minimum cost for storage that will be marketed.

2/ The number of gallons that the storage utilized yields on an annual basis. The minimum amount being the yield represented by a cost of \$50.

3/ Explain the time period allowed for the withdrawal as well as other time related specifications for the withdrawal, such as a maximum rate over any given time period. The period shall not exceed 1 year.

4/ If you will be installing water lines or other facilities or equipment, an appropriate real estate instrument must be issued under ER 405-1-12.

c. Other Water Supply Procedures. Public Law 84-99 as amended by Section 82(2) of Public Law 93-251 provides the Chief of Engineers with discretionary authority to provide emergency supplies of clean drinking water, on such terms as he determines to be advisable, to any locality which he finds is confronted with a source of contaminated drinking water causing or likely to cause a substantial threat to the public health and welfare of the inhabitants of the locality. Work under this authority requires a request from the governor of the state where the source of water has become contaminated and is normally limited to 30 days. Loss of water source or supply is not correctable under this authority. Public Law 95-51 further amended Public Law 84-99 to provide the Secretary of the Army acting through the Chief of Engineers authority under certain statutory conditions to construct wells and to transport water to farmers, ranchers, and political subdivisions within areas the Chief determines to be drought distressed. Any farmer, rancher, or political subdivision within a distressed area may make a written request for assistance. Corps assistance will only be considered when non-Federal interests have exhausted reasonable means for securing necessary water supplies (within the limits of their financial resources) including assistance from other Federal agencies. Federally owned equipment must be used to the maximum extent possible. Assistance can be provided to transport water for human and livestock consumption. The Corps provides the cost of transporting water; however, cost of purchasing water is the non-Federal interests' responsibility. In addition, assistance can be provided to construct wells. Federal costs for well construction must, however, be repaid. (ER 500-1-1)

d. Accounting Procedures for Conservation Storage.

(1) Data needed in performing the accounting include:

- (a) pool elevations
- (b) inflows
- (c) withdrawals and releases

(2) Storage to be accounted is obtained from capacity tables by subtracting the storage at the lowest conservation level from that at the highest conservation level. Water supply storage in individual accounts will be based on a percentage of that shown in the capacity tables. This percentage will be that stated in the contract or implied therein and will be constant for the period of the contract. An accounting is also necessary where one user owns all the conservation storage with a certain percent being for present use and the remaining portion for future use.

(3) Total loss is the change in storage not due to releases, withdrawals, or inflows.

(4) Losses are charged to each user in proportion to their average remaining storages. Uncommitted storage is treated as if a user who made no withdrawals held it.

(5) Inflows, after deductions for downstream water rights and users with vested rights and no storage, are credited to the storage account of each user in proportion to their contracted storages. If a user's inflow share is greater than his storage deficit, the surplus inflow is distributed to the other users in proportion to their contracted storages. Any inflow in excess of that needed to fill the conservation storage will not be accounted under these procedures since it will enter flood control storage.

(6) Releases made for the purpose of following a seasonal guide curve will be charged to uncommitted storage if available or alternately to power storage when applicable.

IX – PUBLIC INFORMATION

9-01: Public Information. During a drought, it is very important to keep the public informed. This will be accomplished in a variety of ways. First, the Water Management personnel will provide information by phone or e-mail and answer written requests for information. If the volume of inquiries becomes too large, the Public Affairs Office (PAO) will become responsible for the dissemination of information to the public and media and pass on additional questions to the appropriate section.

The Public Affairs Office will be responsible for coordination with the media. This will include setting up interviews and press conferences and providing written statements to the media.

The project managers at Waurika Lake and Lake Texoma will also disseminate information to the public locally. This will be done via telephone, e-mail, website, local newspapers, and radio and television stations. Also, the Lake Texoma Advisory Committee may develop a public information plan to be activated during drought or flood periods.

X – RESPONSIBILITY

10-01. Responsibility. This Drought Contingency plan has been prepared in accordance with ER 1110-2-1941, ER 1110-2-240, and EM 1110-2-3600. The Tulsa District, Water Management Section is responsible for the preparation, revision, and implementation of this plan. The Water Management section of the Southwestern Division will have the responsibility for review and approval.

TABLE 5-2

MAJOR ASSOCIATIONS AND FEDERAL, STATE, AND LOCAL AGENCIES
WITH INTERESTS OR RESPONSIBILITIES IN RECREATION
AND TOURISM AT LAKE TEXOMA

<u>Association or Agency</u>	<u>Area of Interest or Responsibility</u>
Lake Texoma Association Ramona Clark P.O. Box 610 Kingston, OK 73439	Recreation and Tourism at Lake Texoma
Texas Parks and Wildlife Department Paul Kisel 50 Park Rd 20 Denison, TX 75020	Maintain and Promote Texas Parks and State Wildlife Refuges.
Bruce Hysmith Route 4, Box 157 Denison, TX 75020	Responsible for fisheries management at Lake Texoma.
Texas Travel & Tourist Center Joe Paz P.O. Box 1809 Denison, TX 75021	Promote Recreation and Tourism at Lake Texoma.
Oklahoma Department of Recreation and Tourism Tina Gilliland P.O. Box 52002 Oklahoma City, OK 73152	Maintain and Promote Oklahoma Parks and Promote Recreation and Tourism at Lake Texoma
Pottsboro Chamber of Commerce Jenny Mapp P.O. Box 995 Pottsboro, TX 75076	Promote Recreation and Tourism to Lake Texoma and specifically to the Pottsboro, Texas area.

TABLE 5-2, (Cont'd)

Lake Texoma Advisory Committee Jerry Chapman 5100 Airport Drive Denison, TX 75020	This committee, established by a provision of Public Law 100-71, purposes to provide information and recommendations to the Corps of Engineers regarding the operations of Lake Texoma for its congressionally authorized purposes. Recreation is a congressionally authorized purpose. *
Oklahoma Department of Wildlife Conservation Fisheries Manager Route 1, Box 188 Caddo, OK 74729	Promotes wildlife conservation and regulates hunting and fishing within the boundaries of the State of Oklahoma. This agency manages approximately 18,000 acres of public Hunting areas around Lake Texoma.
U.S. Fish and Wildlife Service Johnny Beall Hagerman Lodge 6465 Refuge Rd Sherman, TX 75092	Manages the Hagerman National Wildlife Refuge on the Big Mineral Arm in Texas.
U.S. Fish and Wildlife Service Kris Patton Tishomingo NWR Route 1, Box 151 Tishomingo, OK 73460	Manages the Tishomingo National Wildlife Refuge on the Washita Arm in Oklahoma.

* On the following pages are additional names (members) of the Lake Texoma Advisory Committee, who have major interest in the management of Lake Texoma.

Frank Acker
Little River Conservation District
201 N. Central Room 124
Idabel, OK 74745

Greg Arnold
P.O. Box 1481
Texarkana, TX 75504

Richard Brontoli
Red River Valley Association
P.O. Box 709
Shreveport LA 71162-0709

Jerry Chapman
Greater Texoma Utility Authority
5100 Airport Drive
Denison, TX 75020

O'neal Dubberly
Tex-La Electric Coop., Inc.
P.O. Box 631623
Nacogdoches, TX 75963

Lacy Harber
LJH Corporation
Route 2, Box 49-Y
Denison, TX 75020

Director
Texas Commission of Env Quality
P.O. Box 13087
Austin, TX 78711

Alfred Mackin, Jr.
Lamar County Soil & Water Consv
1745-B Ballard Drive
Paris, TX 75460

Rick Cantu
U.S. Fish and Wildlife
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Sherman, TX 75092

Tom Wootton
Buncombe Creek Resort
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Kingston, OK 73439

Phil Alford
Route 2, Box 286
Lewisville, AR 71845

William J. Bertrand
Domtar Industries, Inc.
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Ashdown, AR 71822-8356

Curtis Campbell
Red River Authority of Texas
520 Hamilton Building
Wichita Falls, TX 76301

Jane Jayroe
Oklahoma Dept of Rec & Tourism
P.O. Box 52002
Oklahoma City, OK 73152

Paul Kisel
Texas Parks & Wildlife Dept
50 Park Road 20
Denison, TX 75020

Director
University of Oklahoma Bio Sta
730 Van Fleet
Norman, OK 73069

Kenneth P. Guidry
Red River Waterway Commission
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Natchitoches, LA 71458

Paul Mauck
Oklahoma Dept of Wildlife Consv
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Caddo, OK 74729

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Rayburn Co Electric Coop
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Rockwall, TX 75087

Jim Parks
North Texas Municipal Water Dist
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Wylie, TX 75098-2408

George Robbins
Southwestern Power Administration
One West Third Street
Tulsa, OK 74103

Gene Short
Grayson County Commissioner
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Sherman, TX 75090

Johnny Beall
Hagerman National Wildlife Refuge
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Sherman, TX 75092

Randy Young
Arkansas Soil & Water Conserv Comm
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Little Rock, AR 72201

Bill Porter, Assistant State Conservationist
Natural Resources Conservation Service
100 USDA, Ste 206
Stillwater, OK 74074-2651

Craig Giggelman
U.S. Fish and Wildlife
711 Stadium Drive
Arlington, TX 76011

Cong Ralph Hall
ATTN: Judy Rowton
101 E. Pecan
Sherman, TX 75090

Sen Greg Estes
ATTN: Robin McCoy Eastern Dist Dir
1117 Gallagher, #340
Sherman, TX 75090

Sen James Inhofe
ATTN: Tim Gains
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Tulsa, OK 74104

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Oklahoma Water Resources Board
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Oklahoma City, OK 73118-2855

Lynn Lowe
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Texarkana, AR 71854

Terry Borgmann
Little Glasses Resort
Route 3 – Box 108
Madill, OK 73446

Worth Matteson
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Foreman, AR 71836

Rich Worstell
500 Harbour View Road
Gordonville, TX 76245

James Dunegan
State Representative
P.O. Box 425
Calera, OK 74730

Cong Ralph Hall
ATTN: Marlene Hess
Cooke Co. Courthouse
Gainesville, TX 76240

Sen Kay Bailey Hutchinson
ATTN: Mary Fae Kamm
LB 606 10440 N Ctrl Exprswy
Ste 1160
Dallas, TX 75231-2261

Lake Texoma Association
ATTN: Ramona Clark
P.O. Box 610
Kingston, OK 73439

Jerry Brabander
Field Supervisor
Fish and Wildlife Services
222 S. Houston, Ste A
Tulsa, OK 74127

U.S. Senator Don Nickles
ATTN: G.T. Bynum
409 S Boston, Ste 3310
Tulsa, OK 74103

Warren L. Allen, Gen Mgr
Domtar Industries Inc., Ashdown Mill
285 Hwy 71 S
Ashdown, AR 71822-8356

William A. Abney
Red River Compact Comm of TX
P.O. Box 1386
Marshall, TX 75671

Hon Bill Lindsay
Mayor of Denison
108 West Main
Denison, TX 75020

Edmond J. Preau
LA Dept of Transportation & Dev
P.O. Box 94245
Baton Rouge, LA 70804-9245

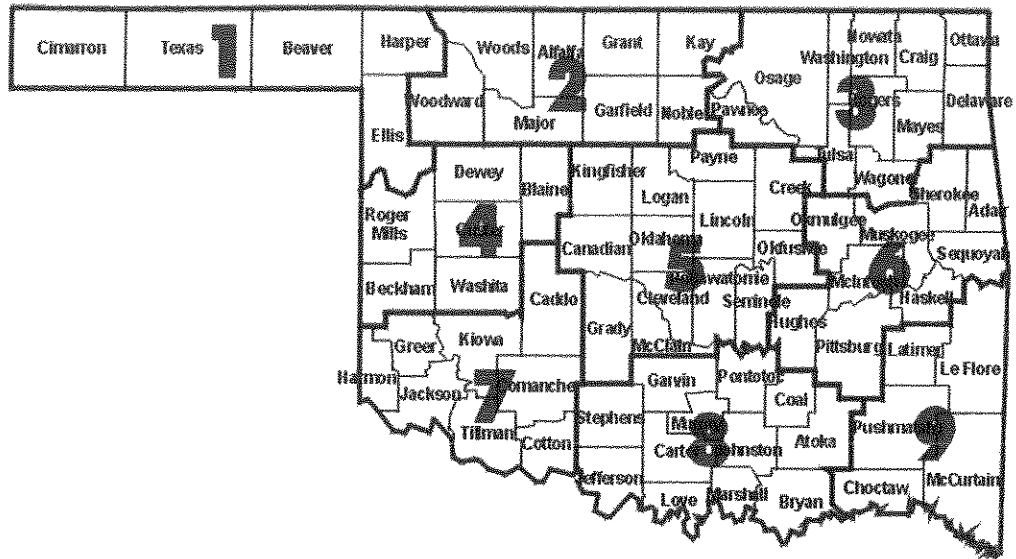
Rad Richardson
Sherman Area Cham of Commerce
P.O. Box 1029
Sherman, TX 75091

Anna McKinney
Denison Chamber of Commerce
313 W. Woodard Street
Denison, TX 75020

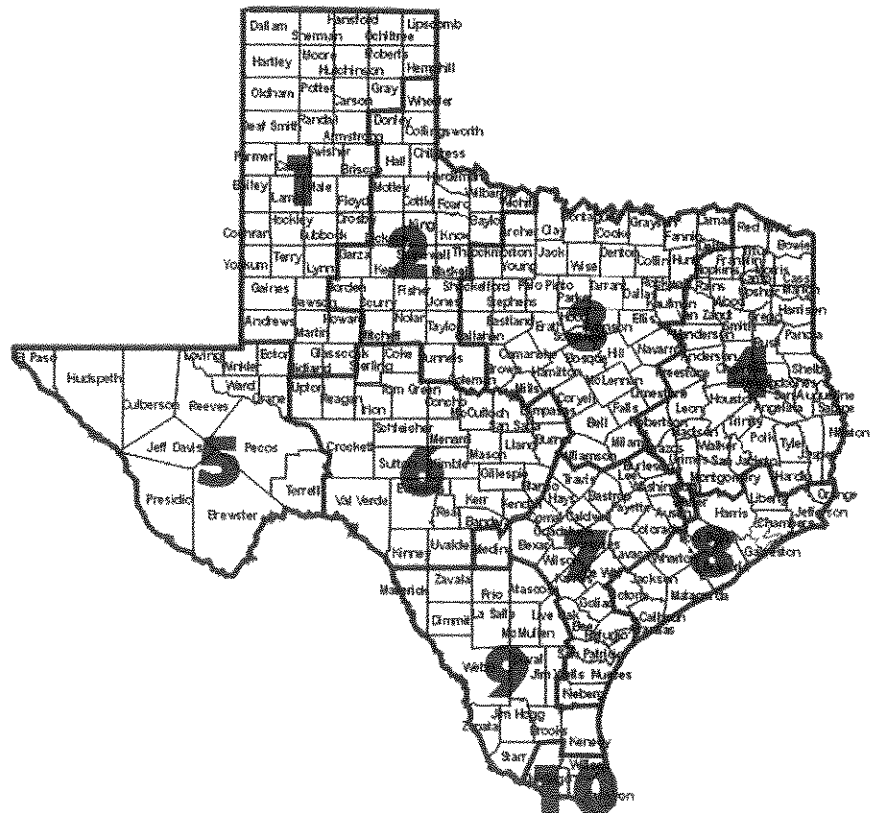
St Rep Ron Clark
ATTN: Barbara Erickson
P.O. Box 2910
Austin, TX 78768



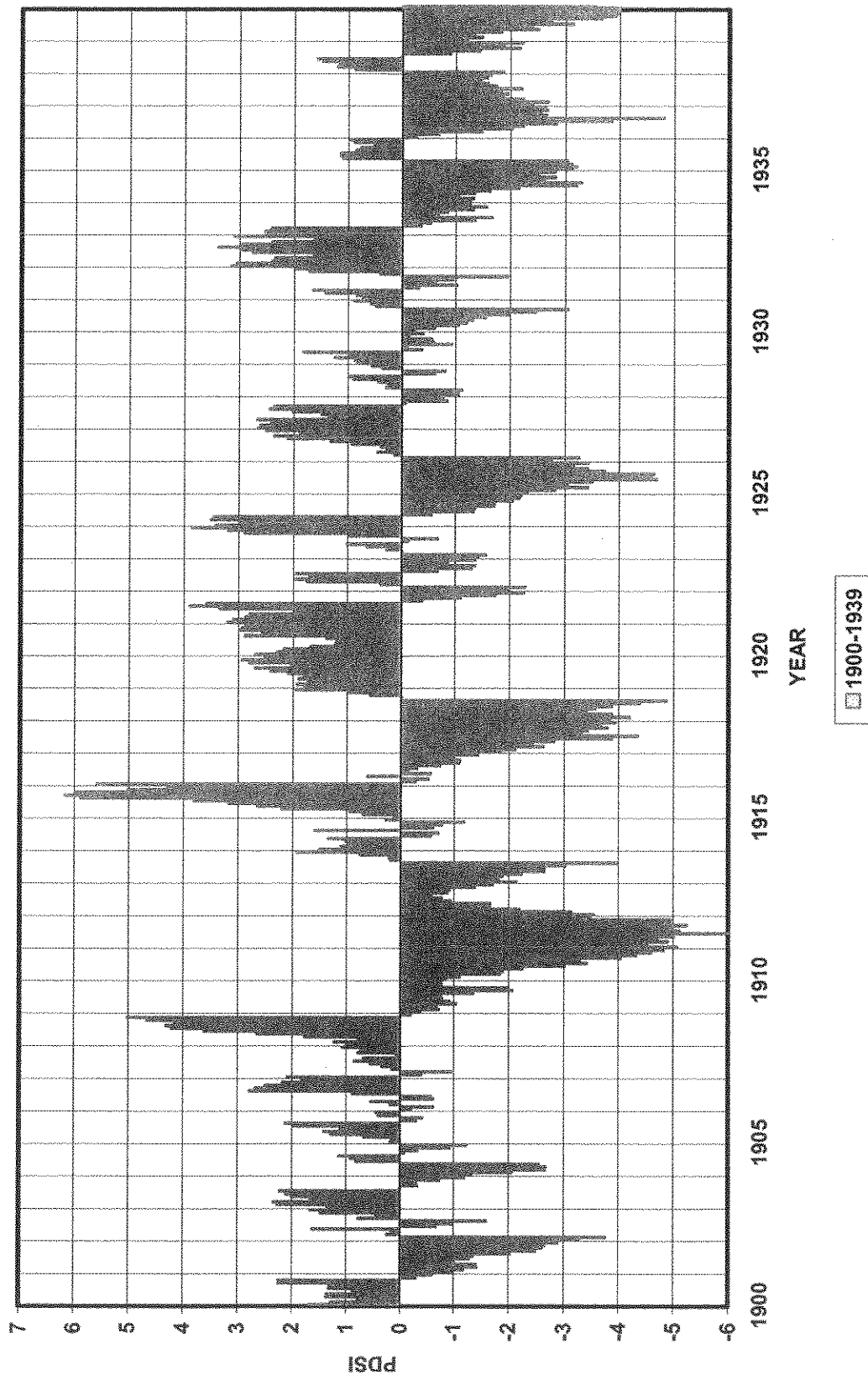
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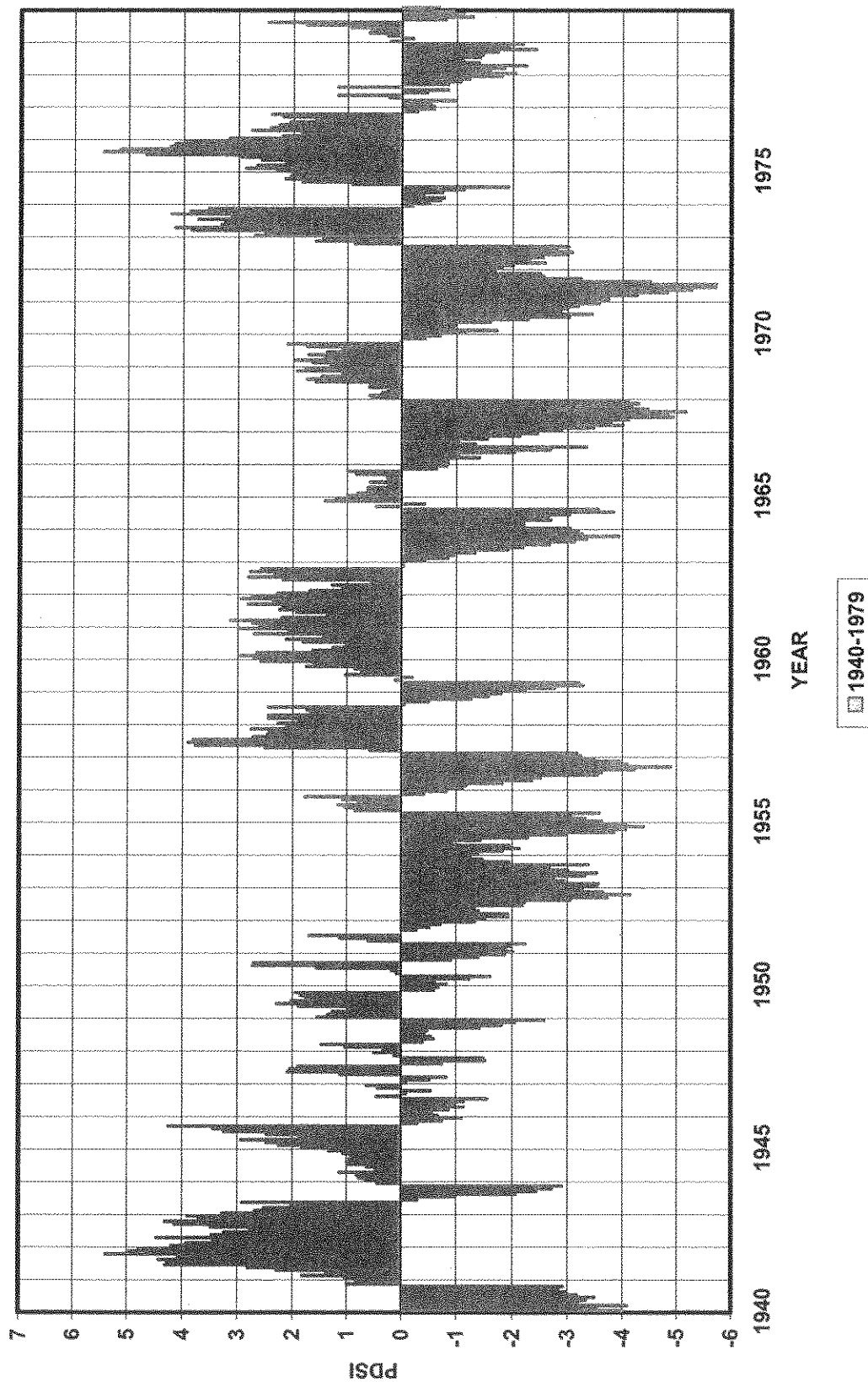
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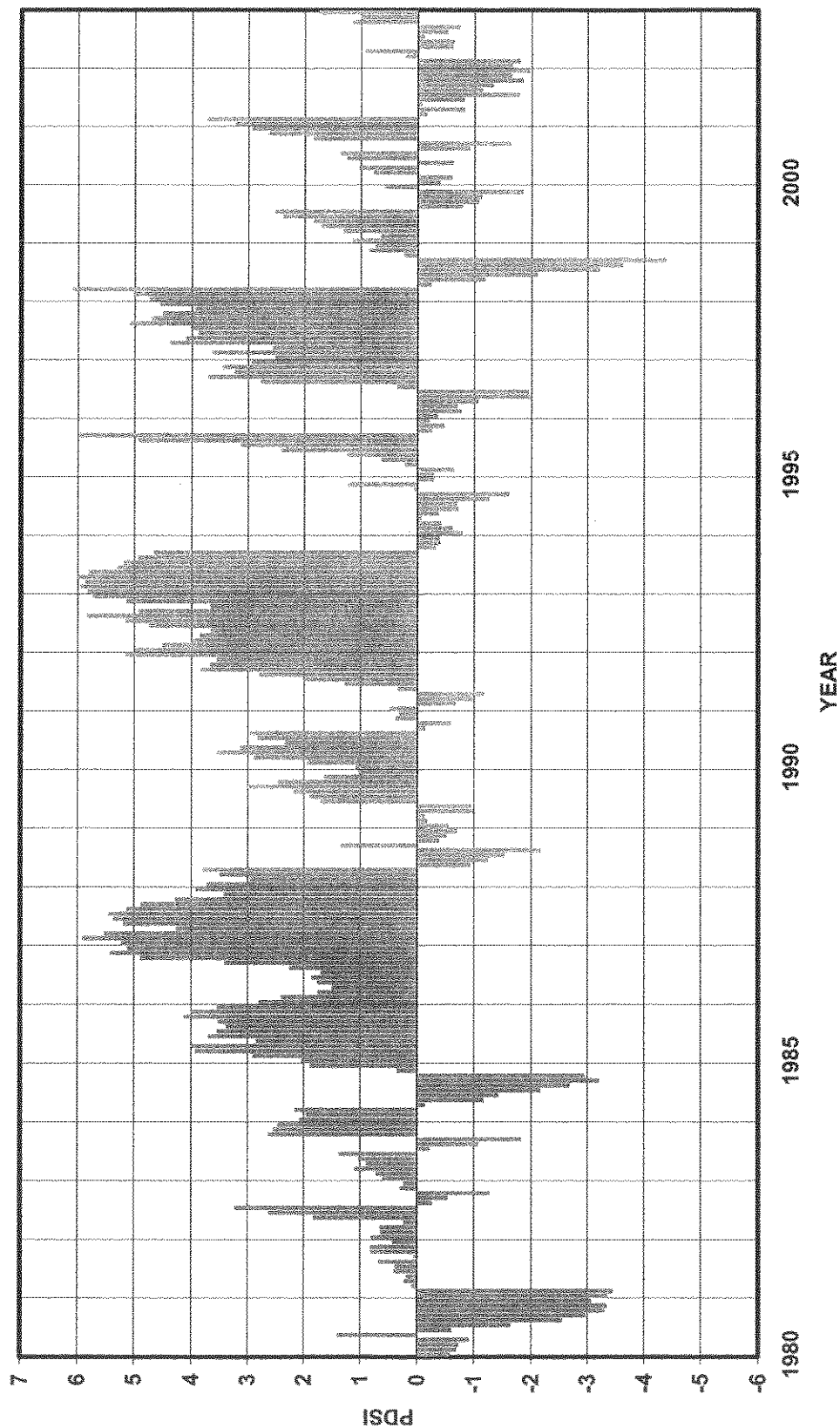
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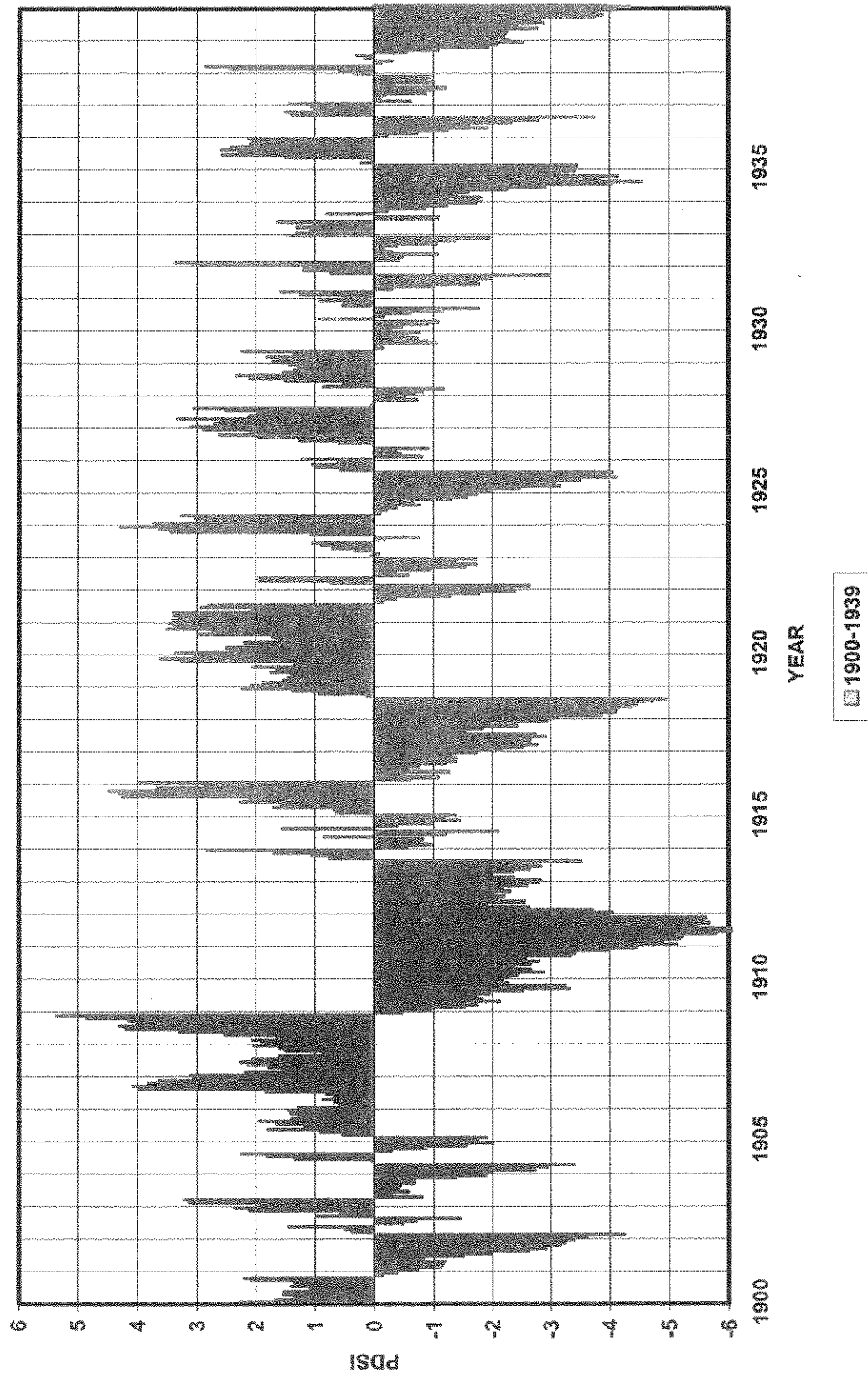
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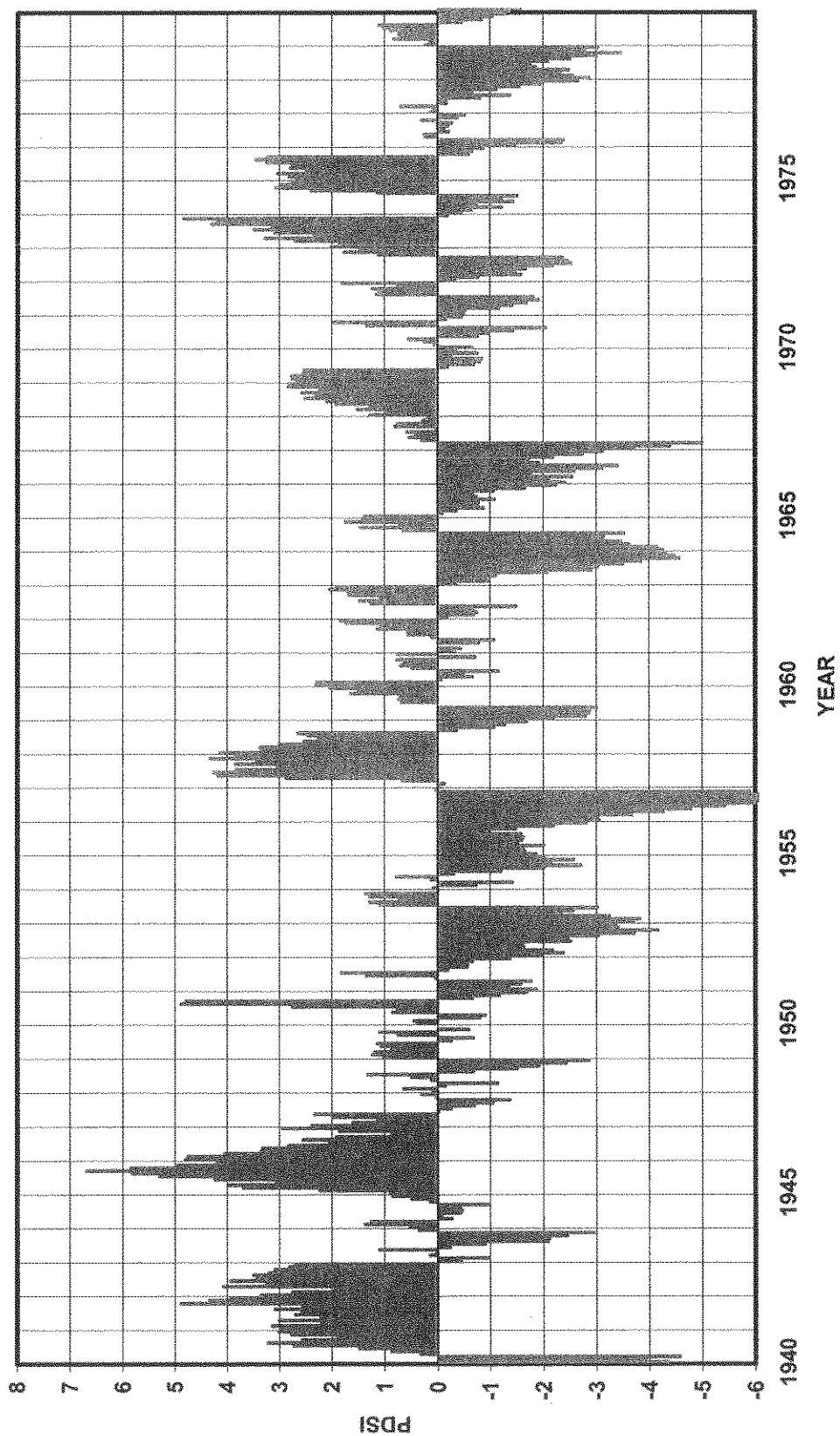
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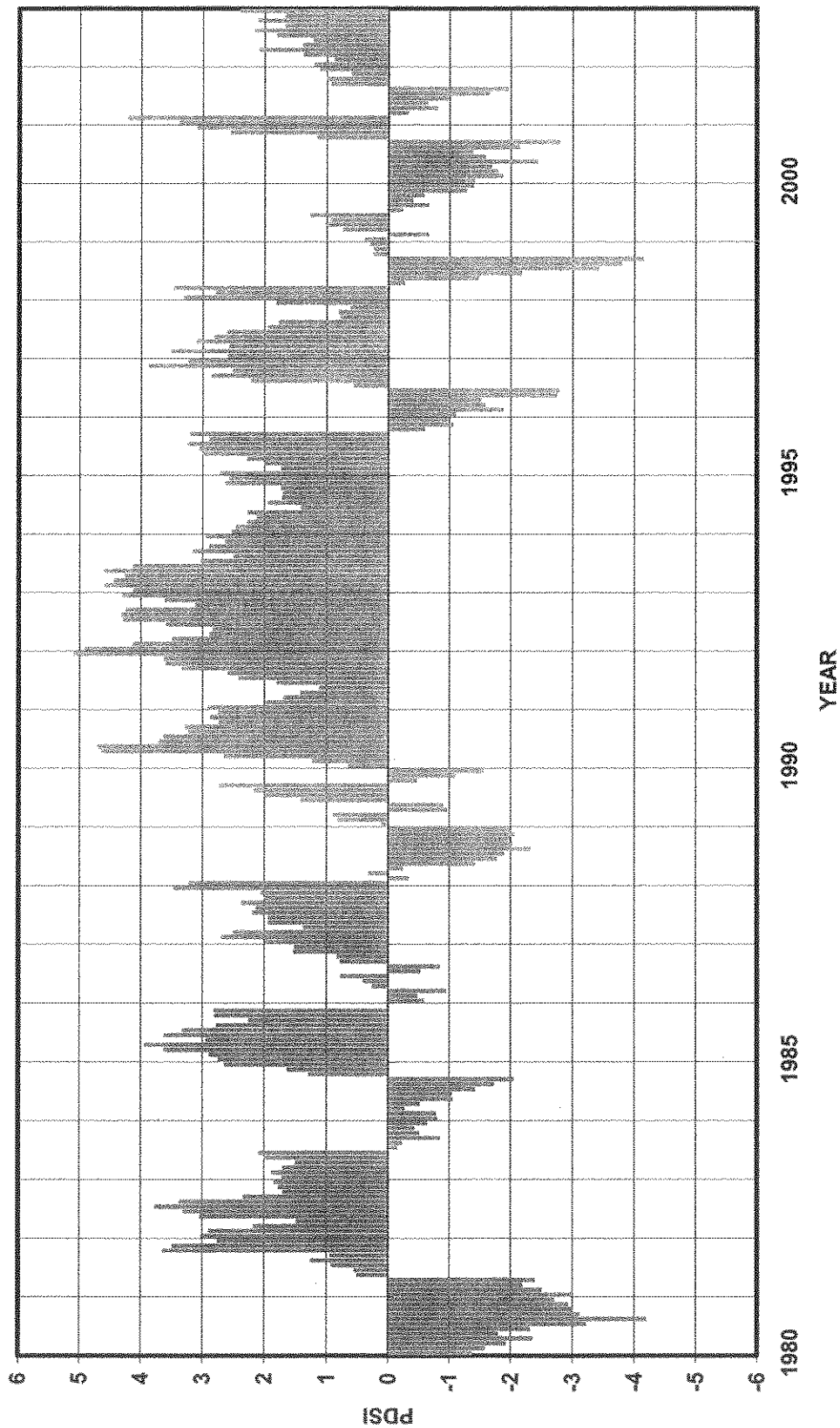
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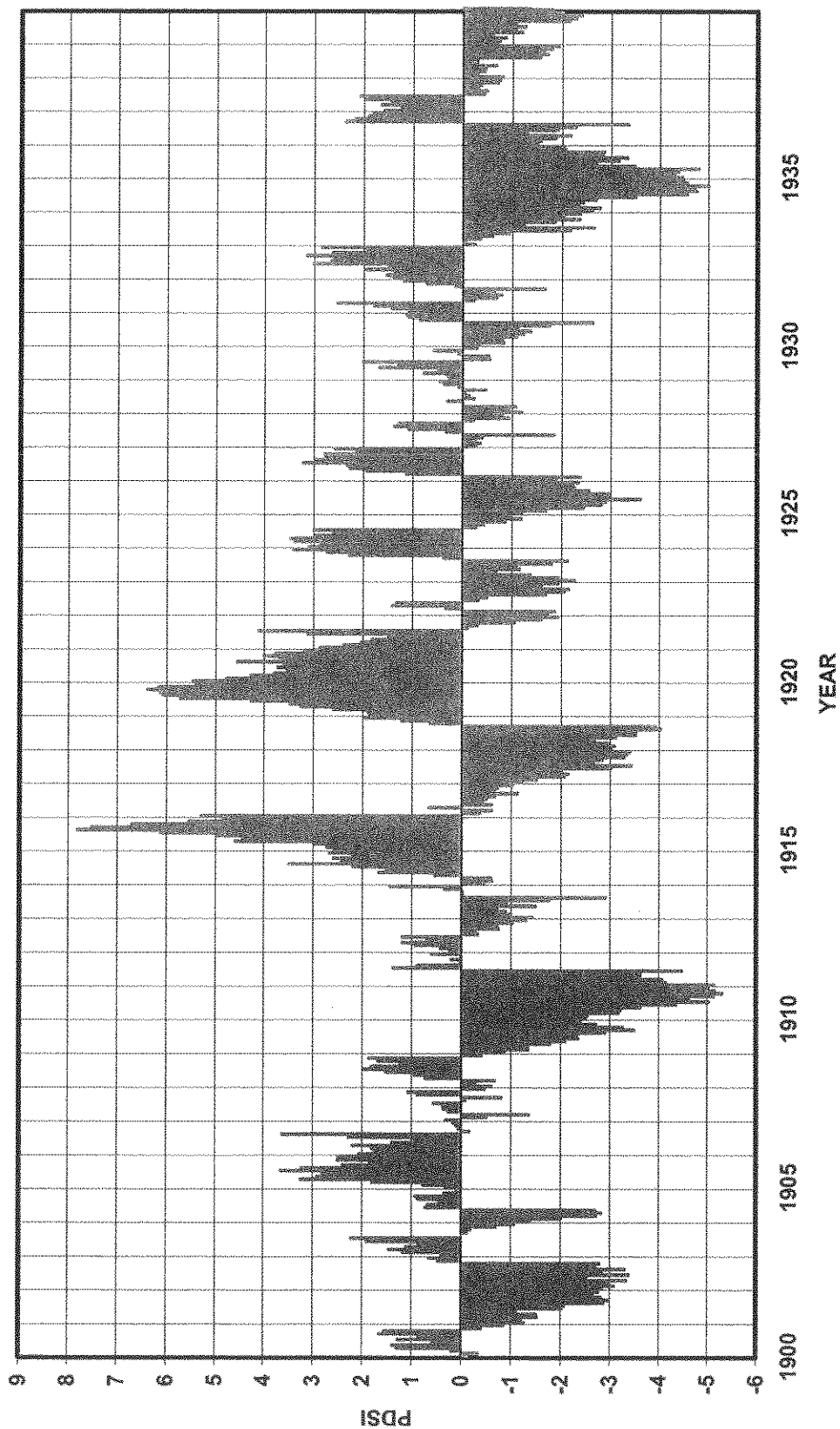


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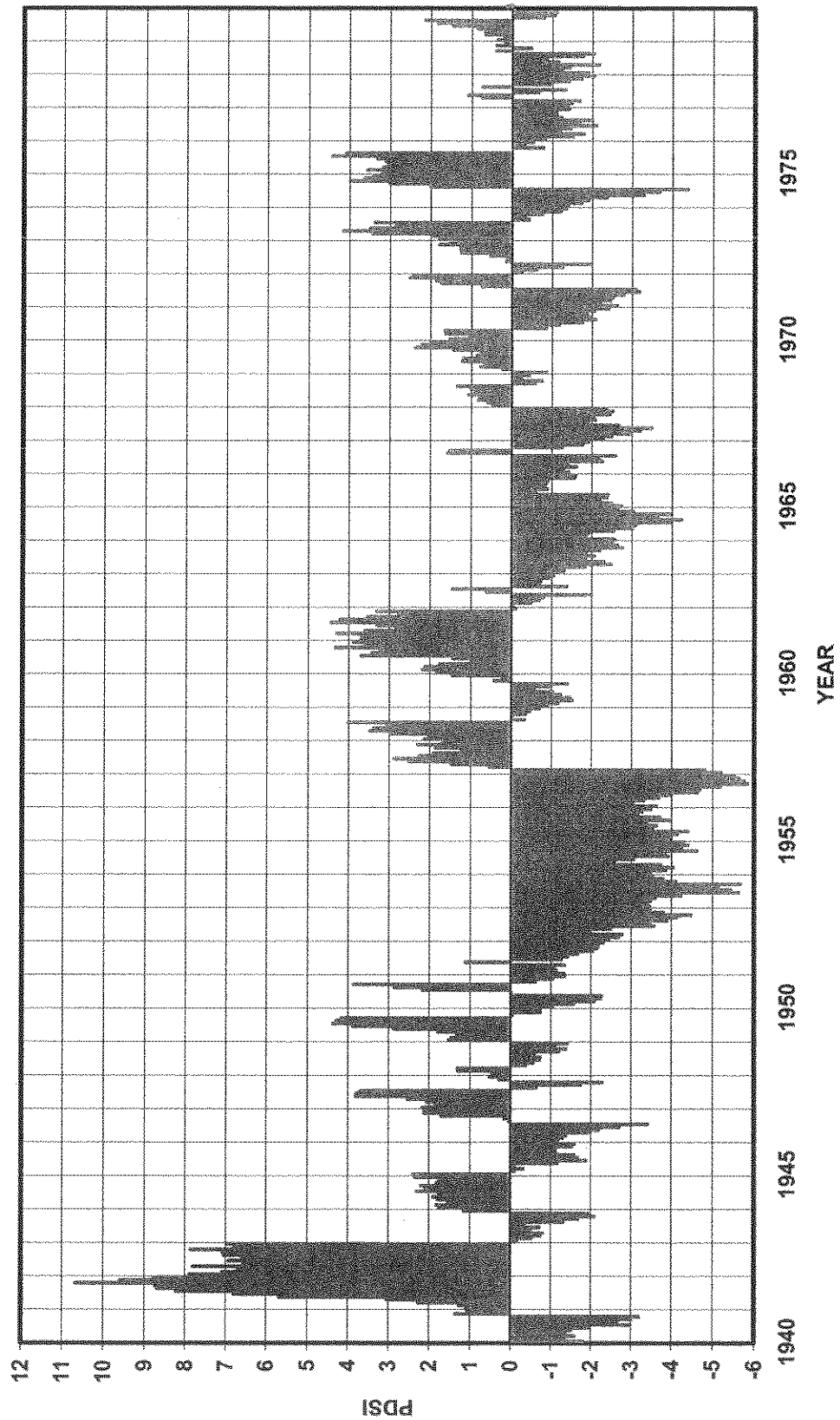
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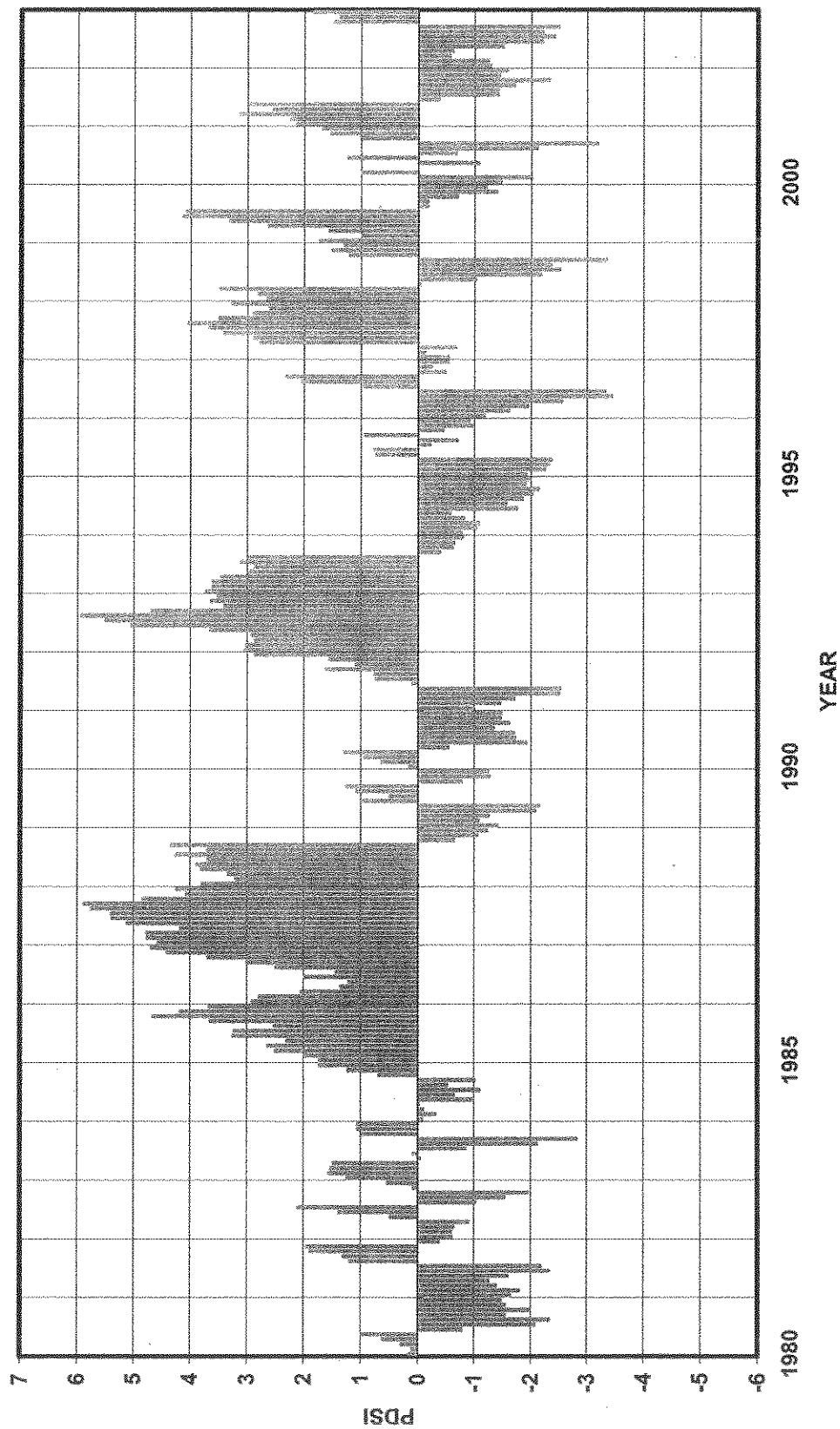
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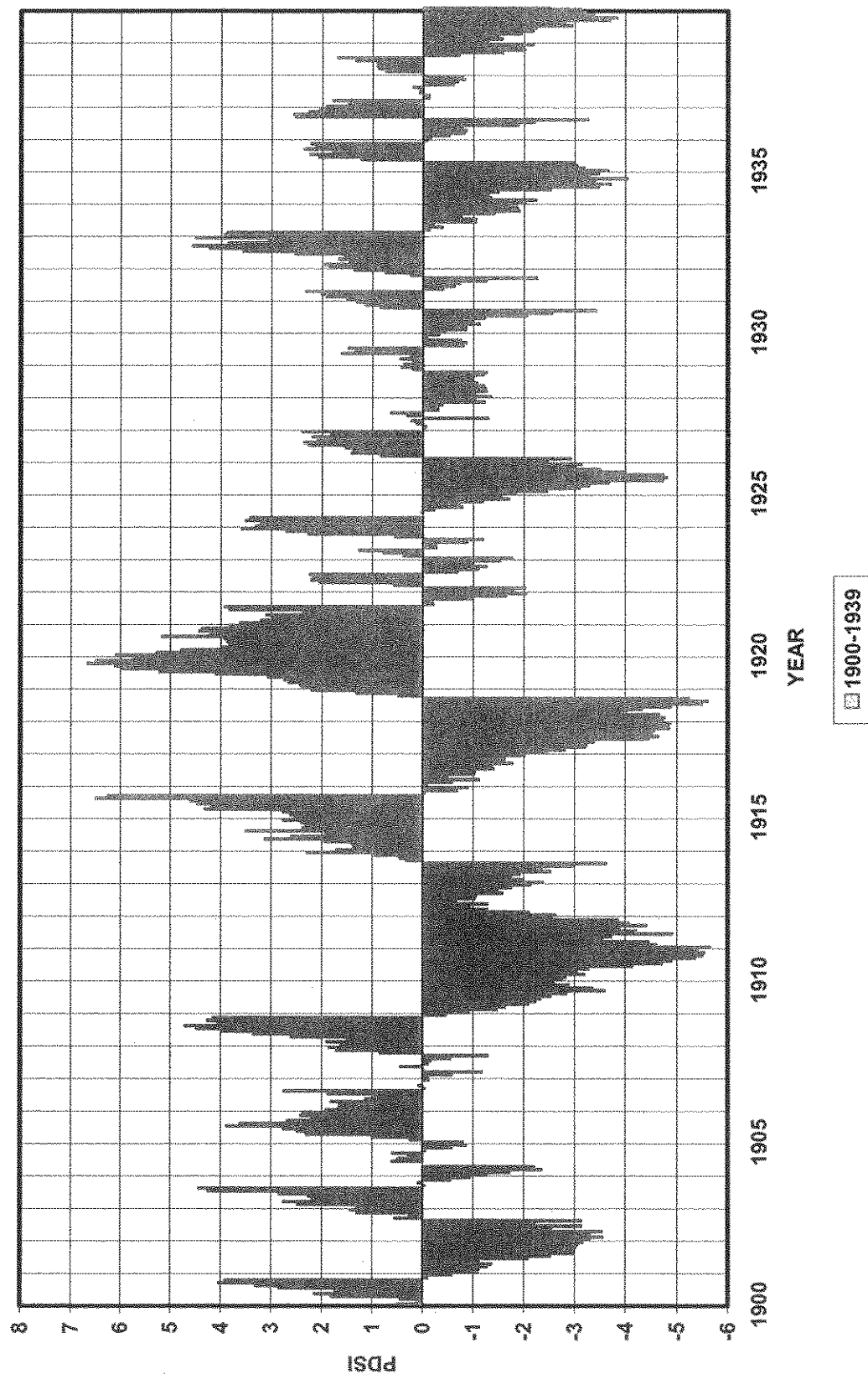


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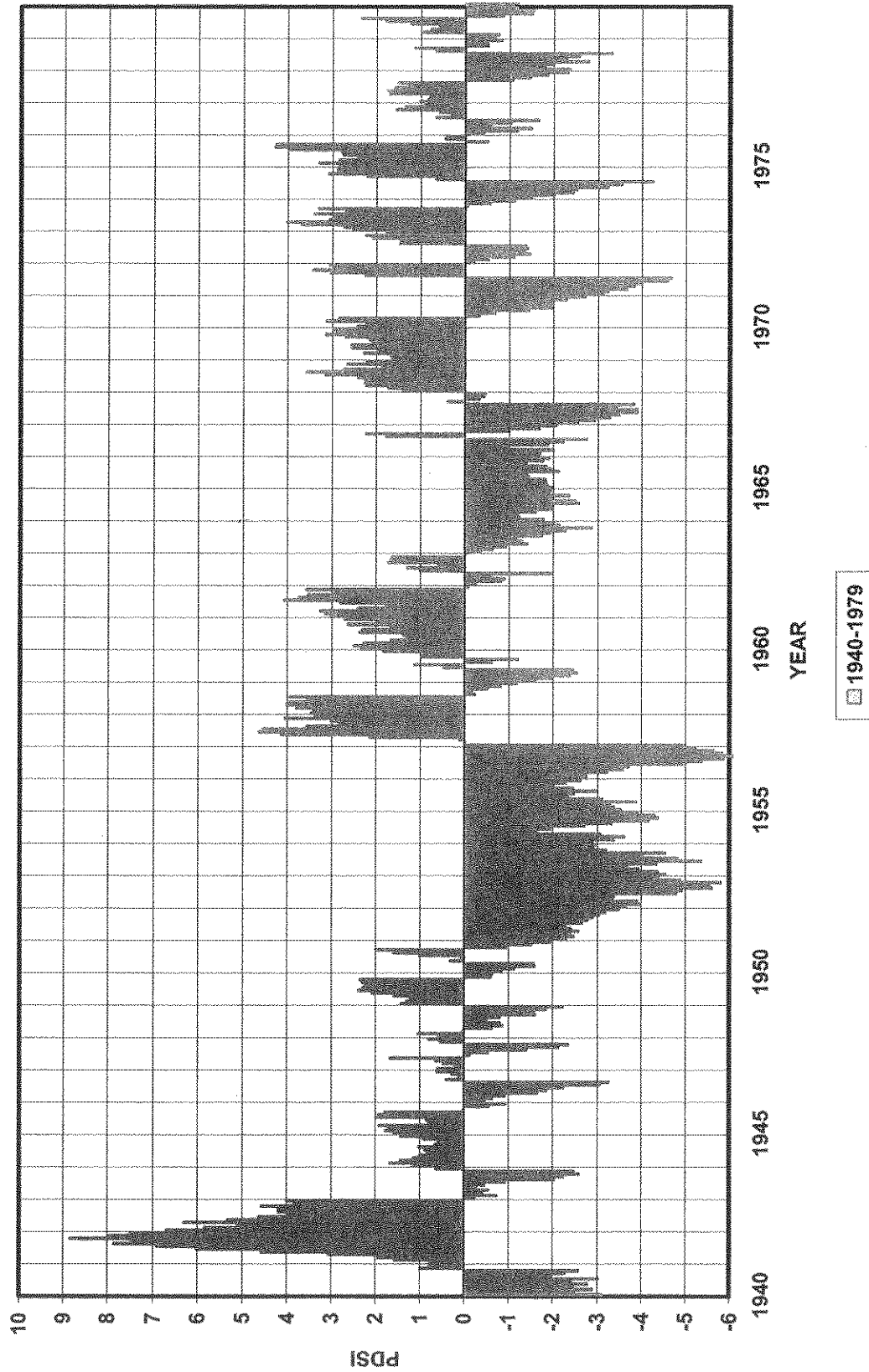
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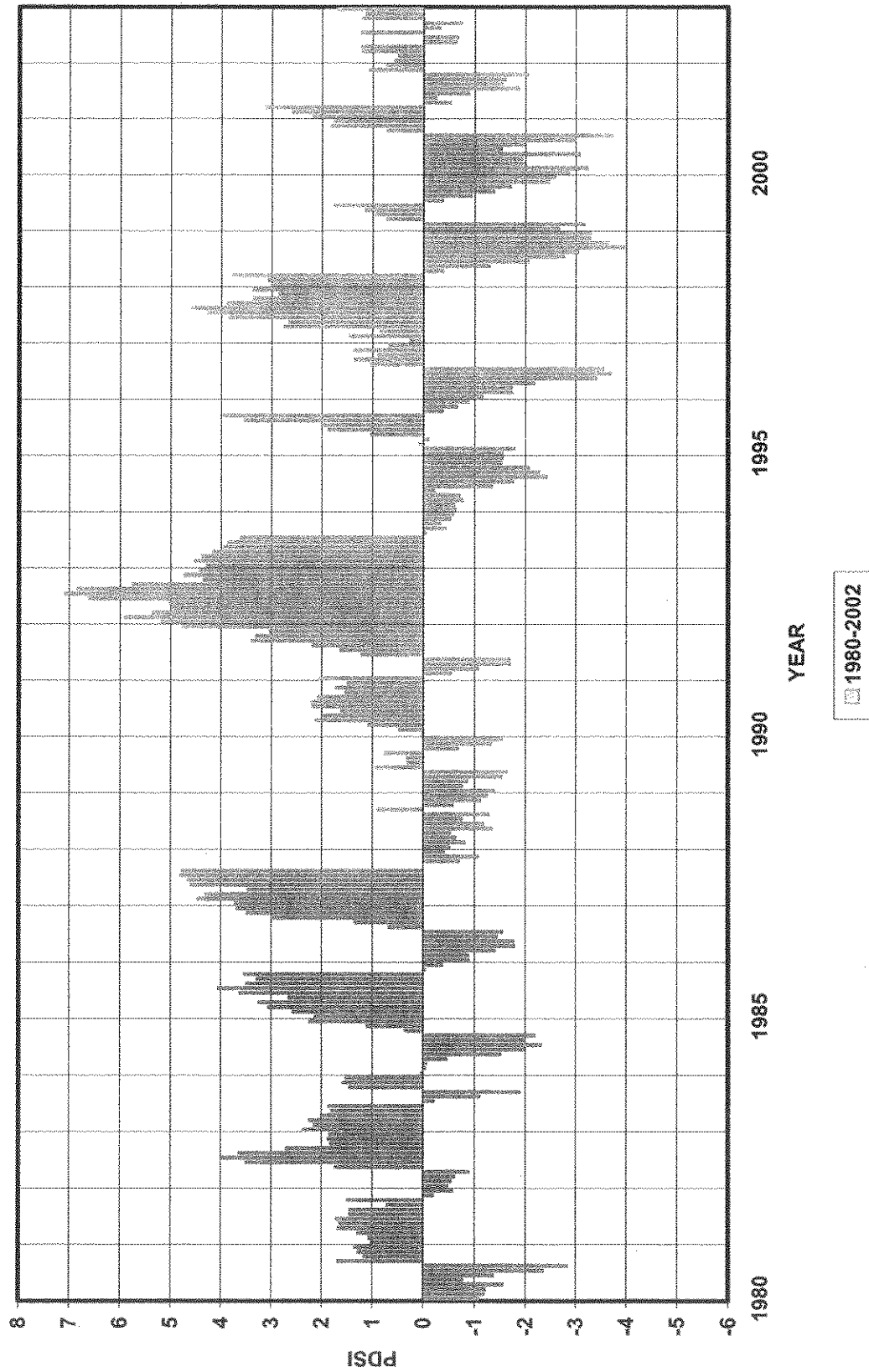
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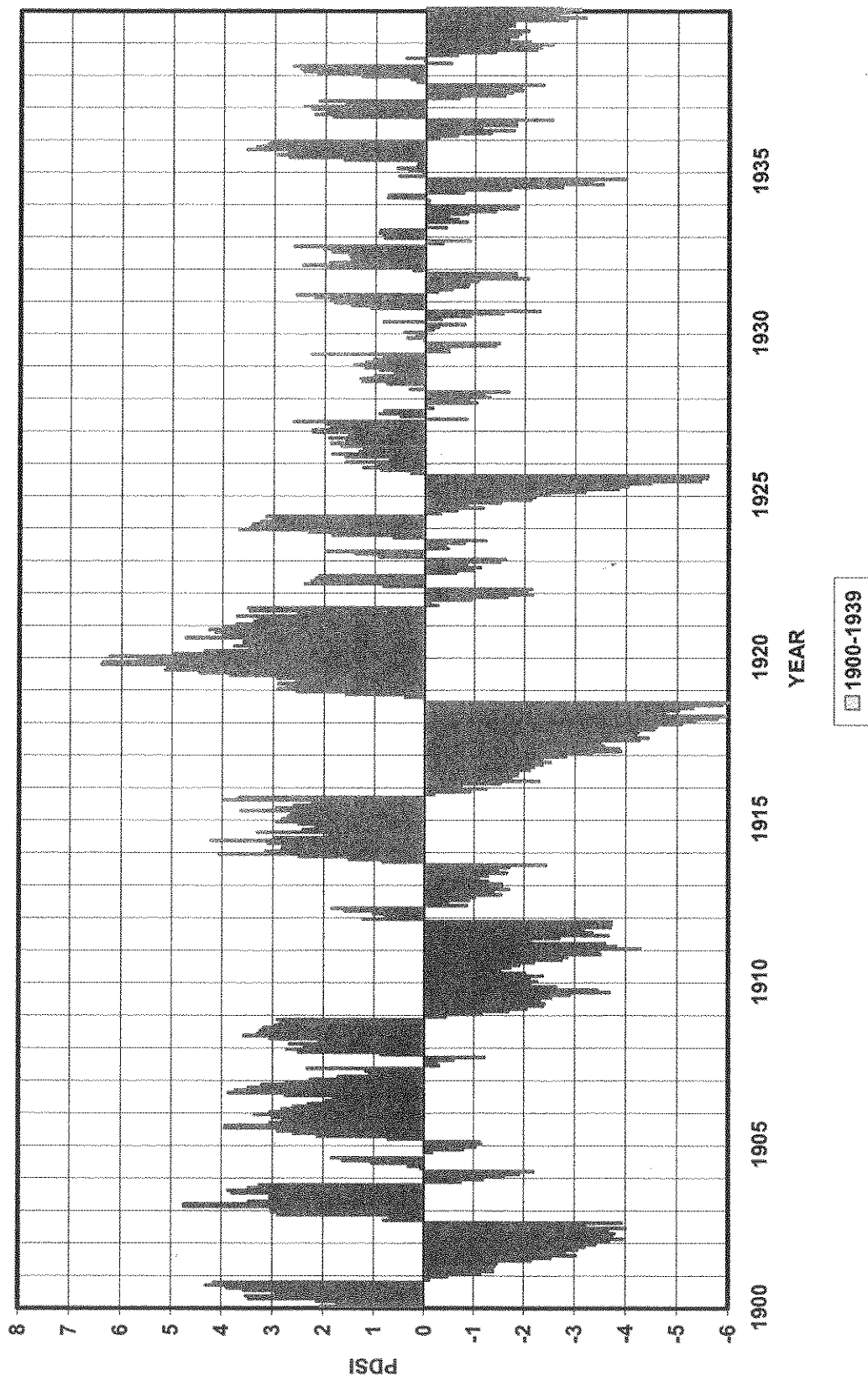
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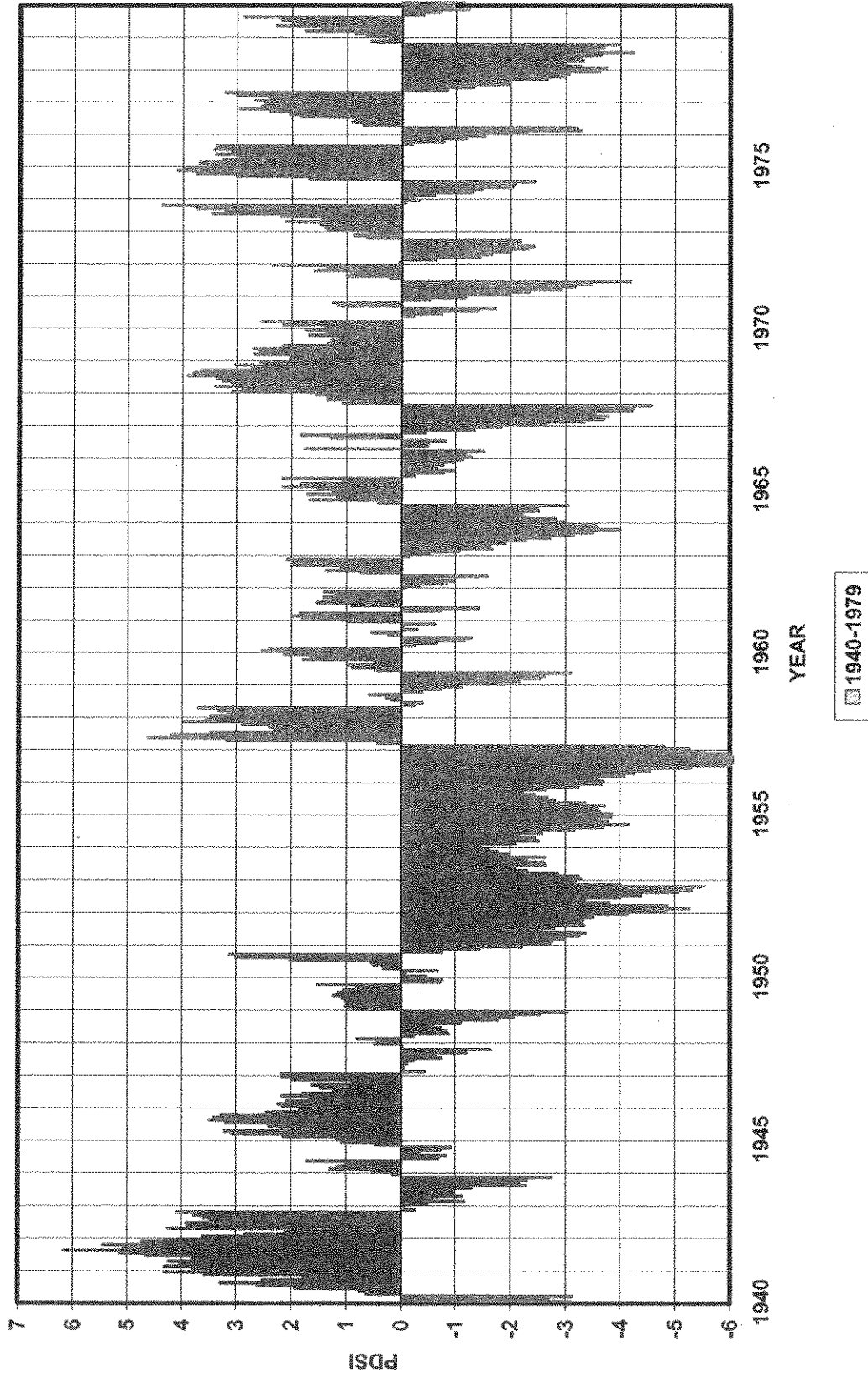
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