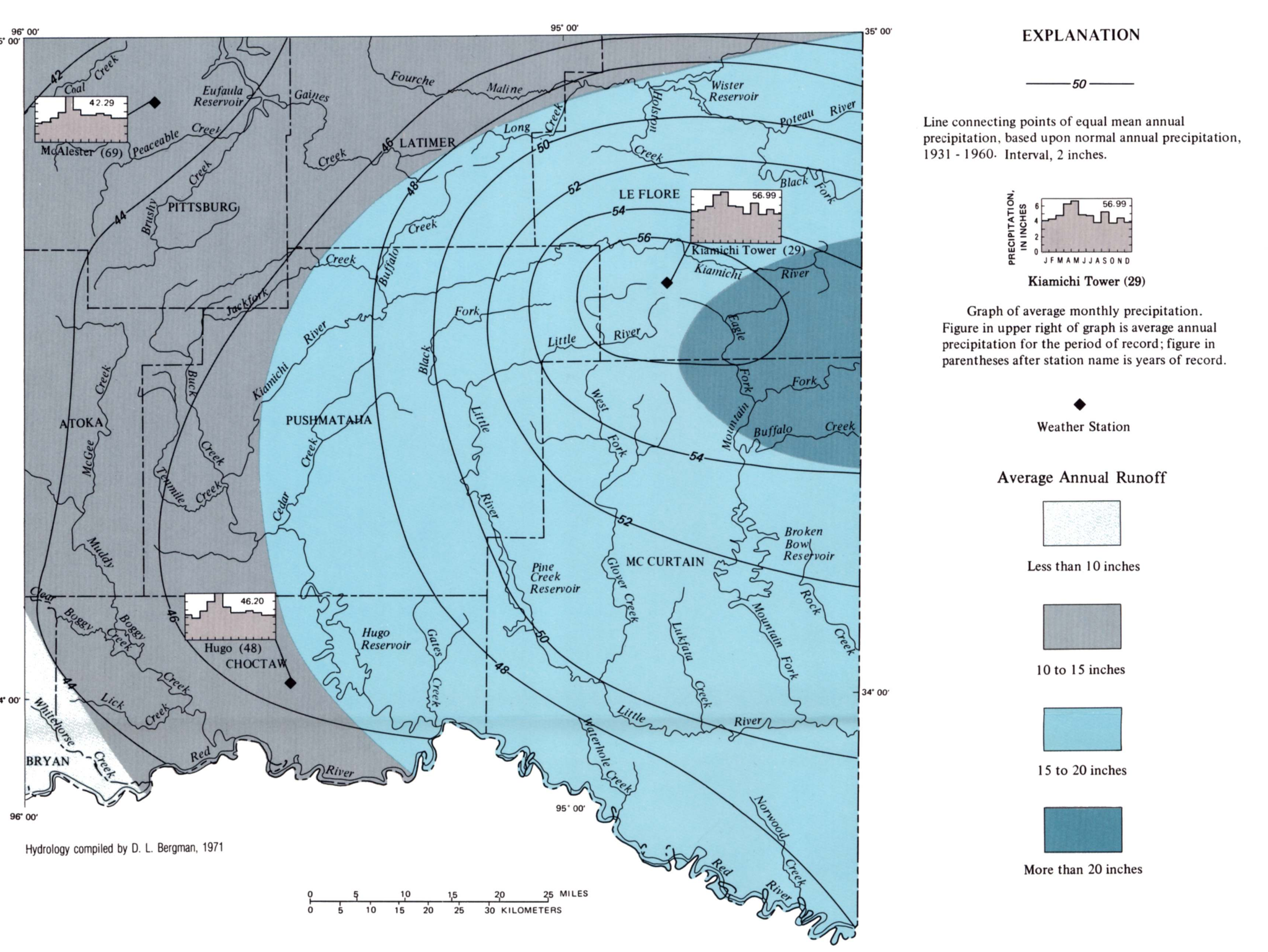

Figure 7: Map showing distribution of precipitation and runoff.

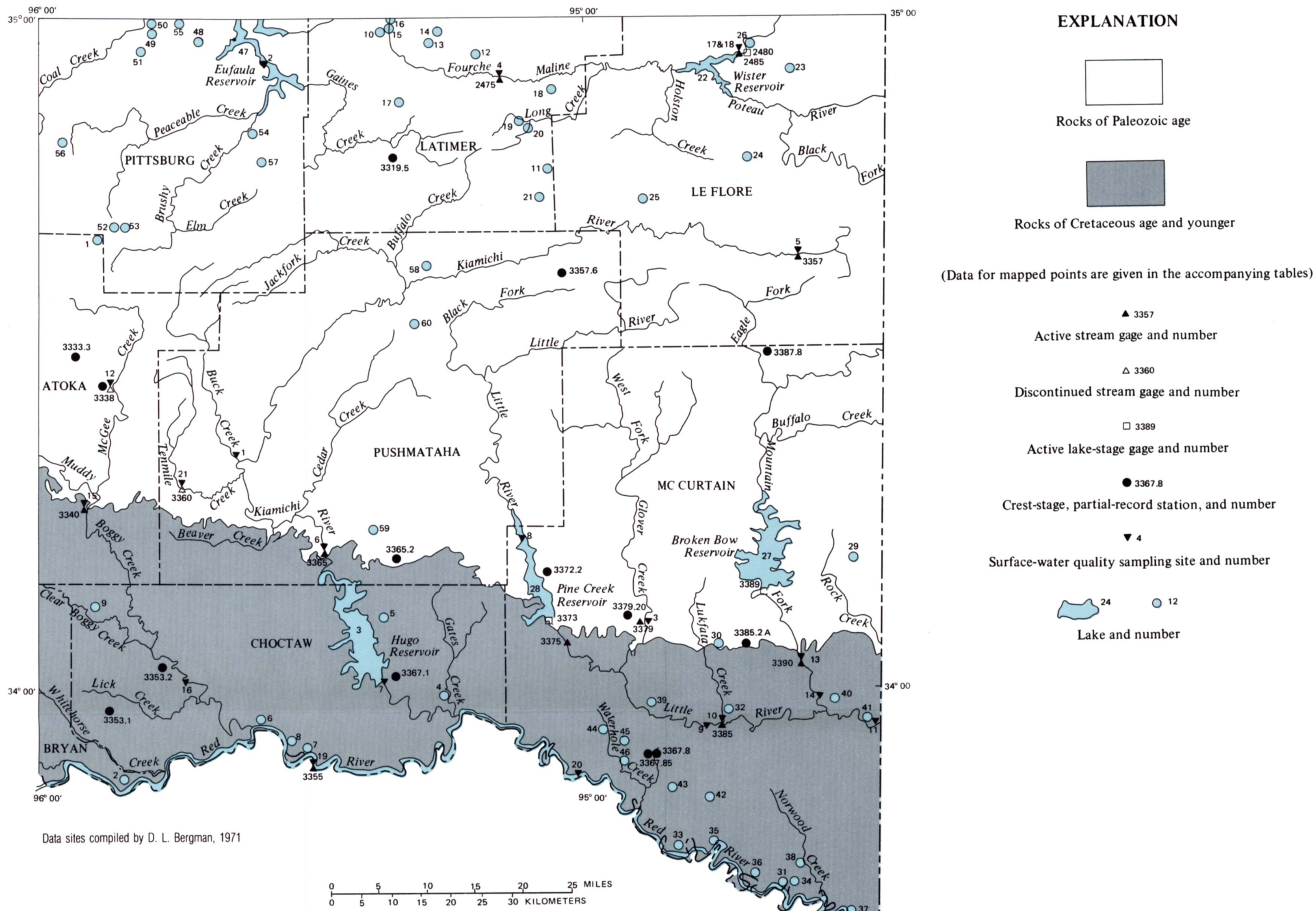

Figure 10: Map showing location of gaging stations, water-quality sampling sites, and lakes.

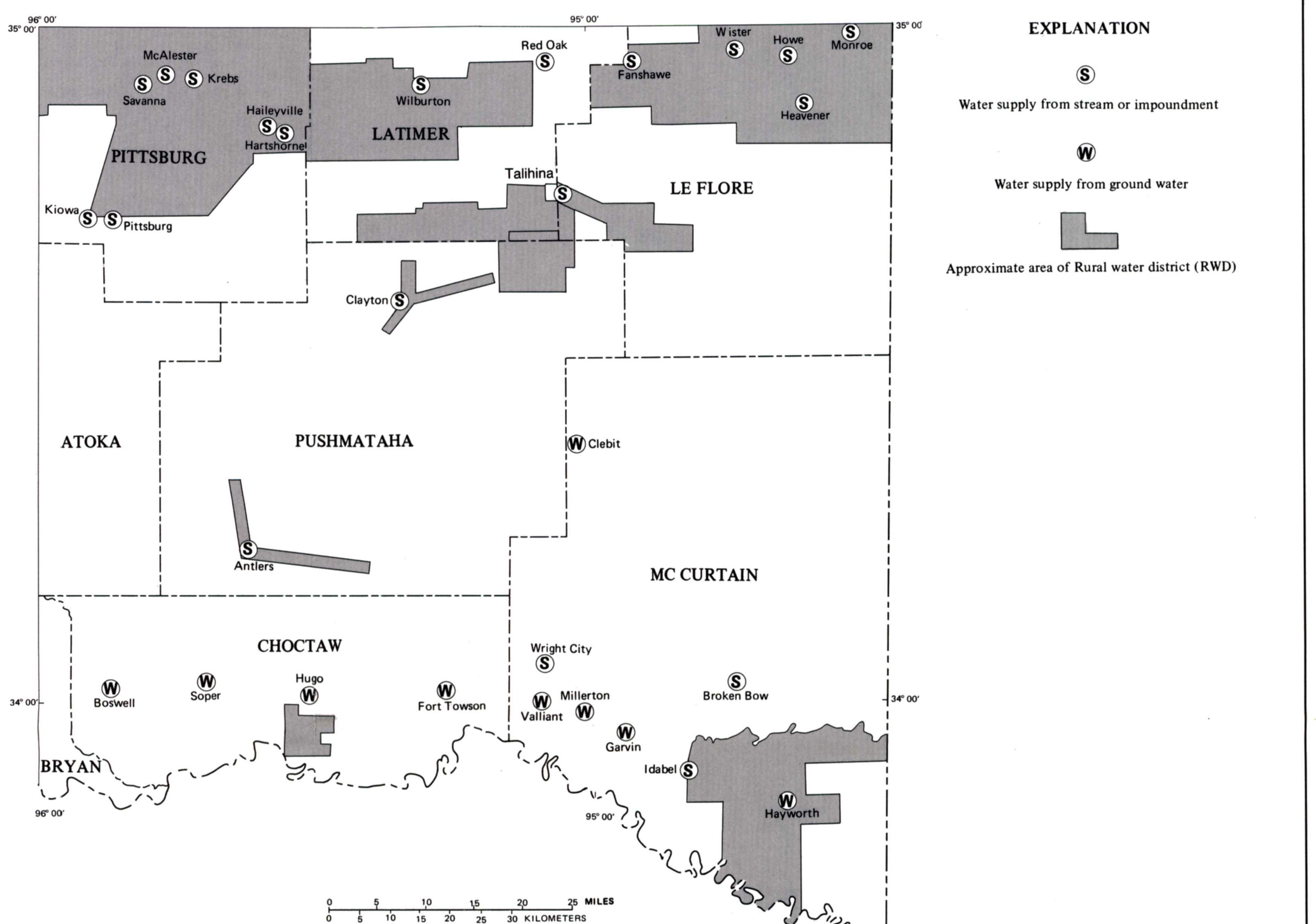

Figure 11: Map showing municipal water systems and rural water districts.

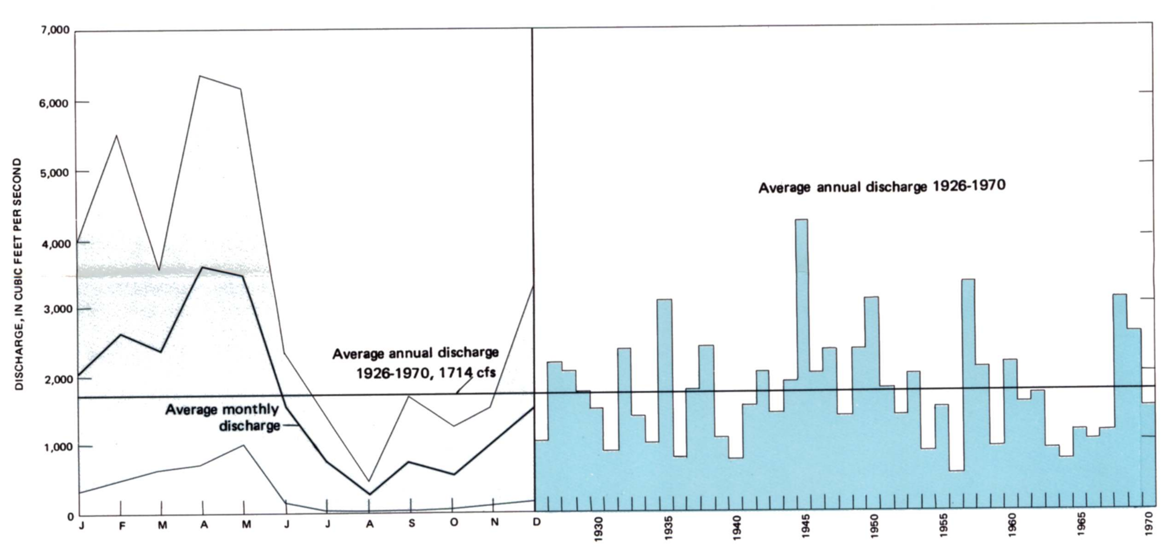

Figure 8: Discharge characteristics of the Kiamichi River.

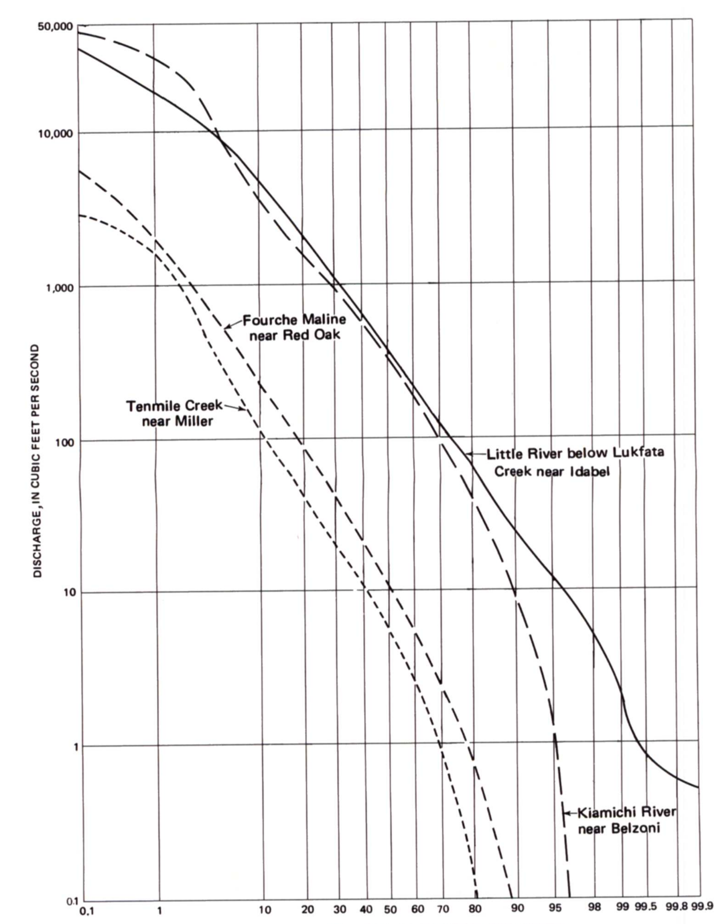

Figure 9: Flow-duration curves for selected streams.

Table 1. - Summary of Streamflow Records

Stream	Station number	Drainage area (sq mi)	Period of record	Discharge (cubic feet per second) Maximum	Minimum	Average	Remarks
Fourche Maline near Red Oak	7-2475	122	1938-	41,500	0	122	Some regulation by flood-retarding structures.
Poteau River near Wister	2485	993	1938-	78,600	0	1,127	Flow regulated by Wister Lake since 1949.
McGee Creek near Stringtown	3338	86.6	1956-68	10,200	0	89.7	
Muddy Boggy Creek near Farris	3340	1,087	1937	61,900	0	875	Some regulation by Atoka Lake on North Boggy Creek since 1959.
Red River at Arthur City, Texas	3355	44,531	1905-11, 1936-	400,000	130	8,203	Regulated by Lake Texoma since 1943.
Kiamichi River near Big Cedar	3357	40.1	1965-	16,300	0		
Tenmile Creek near Miller	3360	68	1955-69	5,930	0	77.2	
Kiamichi River near Belzoni	3365	1,423	1925-	71,400	0	1,720	
Little River near Wright City	3375	645	1929-31, 1944-	78,200	0	917	
Glover Creek near Glover	3379	315	1961-	33,100	0	401	
Little River below Lukfata Creek near Idabel	3385	1,226	1946-	76,000	0.4	1,646	
Mountain Fork near Eagletown	3390	787		101,000	0	1,268	Regulation by Broken Bow Lake since 1968.

Table 2. - Peak Discharge at Partial - Record Stations During Crest Stage

Stream	Station number	Drainage area (square miles)	Period of record	Maximum discharge (cubic feet per second)
Pine Creek near Higgins	7-2319.5	9.99	1964-69	8,600
Chickasaw Creek tributary near Stringtown	3333.3	3.19	1965-69	3,540
McGee Creek near Stringtown	3338	86.6	1969[1]	7,020
Rock Creek near Boswell	3353.1	.94	1965-69	550
Bokchito Creek near Soper	3353.2	16.6	1965-69	5,920
Kiamichi River tributary near Albion	3357.6	1.5	1965-69	900
Frazier Creek near Oleta	3365.2	19.4	1964-69	2,750
Rock Creek near Sawyer	3367.1	3.39	1964-69	980
Perry Creek near Idabel	3367.8	7.53	1965-69	2,600
Bokchito Creek near Garvin	3367.85	2.96	1965-69	620
Big Branch near Ringold	3372.2	1.99	1964-69	1,460
Fifteen Creek near Glover	3379.20	1.23	1967-69	885
Yanubbee Creek near Broken Bow	3385.2	9.10	1964-69	2,800
Mountain Fork tributary near Smithville	3387.8	.85	1965-69	215

[1]Continuous-record station prior to 1969.

Table 3. - Summary of Chemical Analyses of Surface Water

(Results in milligrams per liter except sodium adsorption ratio and specific conductance.)

Location number	Sampling stations	Period of record	Years of record	Sampling frequency (D-daily) (P-periodic)	Sulfate (SO_4) Max.	Min.	Chloride (Cl) Max.	Min.	Dissolved solids (residue at 180°C) Max.	Min.	Hardness (as $CaCO_3$) Max.	Min.	SAR (sodium adsorption ratio) Max.	Min.	Specific conductance (micromhos per centimeter at 25°C) Max.	Min.
1	Buck Creek near Moyers	1956-60	3	P	....	....	20	4.2	....	....	36	14	2.0	0.5	150	58
2	Gaines Creek near Krebs	1946-62	7	P	239	7.8	24	2.0	470	30	188	15	2.0	.2	690	57
3	Glover Creek near Glover	1949-63	3	P	11	2.8	4.8	1.9	67	23	38	12	.6	.2	90	39
4	Fourche Maline near Red Oak	1952-59	6	P	....	....	18	1.8	129	63	88	11	1.7	.1	650	38
5	Kiamichi River near Big Cedar	1965-68	4	P	6.8	1.8	6.6	1.0	31	18	14	4	1.0	.2	50	17
6	Kiamichi River near Belzoni	1948-63	8	D,P	14	2.8	41	2.5	145	25	50	11	1.4	.3	270	22
7	Kiamichi River near Sawyer	1962	1	P	12	4.8	72	2.1	218	42	64	14	2.6	.5	360	59
8	Little River near Ringold	1962	1	P	7.3	2.0	6.2	.8	34	18	24	7	.8	.1	60	30
9	Little River near Idabel	1948-62	7	D,P	54	1.4	302	2.0	602	40	98	9	8.4	.4	1,310	21
10	Little River below Lukfata Creek near Idabel	1961-63	3	P	11.8	1.4	62	1.8	187	21	54	11	2.4	.1	310	38
11	Little River near Cerrogordo	1961-63	3	P	9.8	1.9	38	1.8	114	24	40	8	2.1	0	200	31
12	McGee Creek near Stringtown	1956-58	3	P	....	....	10	2.0	....	....	56	17	.8	.2	510	60
13	Mountain Fork River near Eagletown	1948-63	5	D,P	14	1.0	18	.8	68	15	27	6	1.0	.2	130	21
14	Mountain Fork River below Eagletown	1961-63	3	P	7.9	1.0	4.6	.8	50	21	21	8	.8	.1	65	29
15	Muddy Boggy Creek near Farris	1948-64	13	D,P	161	4.6	139	2.5	513	35	219	14	3.0	.2	1,150	51
16	Muddy Boggy River near Unger	1962	1	P	27	13	156	11	459	117	220	6.4	2.7	.5	830	171
17	Poteau River at Wister Reservoir near Wister	1956-64	9	P	43	2.9	24	1.2	87	34	38	10	1.0	.2	150	44
18	Poteau River near Wister	1948-55	3	D,P	23	8.8	8.2	2.5	108	56	39	13	.6	.4	230	44
19	Red River at Arthur City, Tex.	1960-63	4	P	262	12	400	15	1,130	111	386	58	5.2	.7	1,800	162
20	Red River at New Boston, Tex.	1961-63	3	P	255	28	385	25	1,220	166	495	84	5.2	1.0	1,980	277
21	Tenmile Creek near Miller	1955-58	3	P	....	....	14	2.2	....	....	104	14	1.0	.3	240	46

Table 4. - Lakes with a Surface Area of 20 Acres or More

Map number	County and designation		Surface Area (Acres)	Capacity (acre-feet)
	ATOKA			
1	Kiowa Katy Club Lake		125	600
	BRYAN			
2	Van Sickle Lake		74	600
	CHOCTAW			
3	Hugo Reservoir		13,250	157,300
4	Lake Raymond Gary		390	2,900
5	Schooler Lake		35	208
6	Boggy Cutoff Lake		20	160
7	Red River Cutoff		25	200
8	Roebuck Lake		350	5,250
9	Jerry Craft		120	600
	LATIMER			
10	Lake Carlton		46	552
11	Talihina Lake		22	308
12	Fourche Maline Watershed	Site 1	20	239
13	Fourche Maline	Site 2	21	197
14		Site 3	21	219
15		Site 4	32	445
16		Site 5	94	1,943
17	(Church Lake)	Site 7	160	3,109
18		Site 12	43	232
19		Site 13	49	471
20		Site 14	33	417
21	Rock Creek Watershed	Site 1	34	164
	LE FLORE			
22	Wister Reservoir		4,000	30,000
23	Howe Coal Company		105	435
24	Cedar Lake		93	1,488
25	Bohannon Lake		20	100
26	Crooked Slough		38	152
	McCURTAIN			
27	Broken Bow Reservoir		14,200	918,000
28	Pine Creek Reservoir		3,750	53,800
29	Dr. M. M. Henderson		26	130

Map number	County and designation	Surface Area (Acres)	Capacity (acre-feet)
	McCURTAIN		
30	Broken Bow Lake	55	225
31	Broken Bow Cutoff	175	700
32	Noey Lake (Burris)	40	200
33	Charlie Lake	95	500
34	Clear Lake	110	440
35	1941 Cutoff	300	2,000
36	Long Log Lake	80	320
37	Breedlove Lake	55	220
38	Ward Lake	410	2,900
39	Mohawk Lake	20	80
40	Forked Lake	20	1,000
41	Old River Lake	50	250
42	Earl Young Lake	25	150
43	Waterfall-Guilford Watershed Site 4	30	104
44	Whitegrass-Waterhole Creeks Watershed Site 6	76	302
45	Whitegrass-Waterhole Creeks Watershed Site 8	28	103
46	Whitegrass-Waterhole Creeks Watershed Site 9	23	91
	PITTSBURG		
47	Eufaula Reservoir	102,500	2,378,000
48	Krebs Lake	30	216
49	Talowanda No. 1	124	1,300
50	Talowanda No. 2	244	2,500
51	Penitentiary Lake	78	624
52	Lake Austin	60	600
53	Pittsburg Lake	24	182
54	Brown Lake (USNAD)	550	4,000
55	Dow Lake	93	520
56	Fin and Feather Lake	62	868
57	Hartshorne Lake	55	352
	PUSHMATAHA		
58	Nanih Waiya Lake	131	968
59	Lake Ozzie Cobb	117	512
60	Clayton Lake	75	1,050
61	Clayton Reservoir	11,300	183,000

PRECIPITATION AND RUNOFF

With average annual precipitation ranging from 42 to 56 inches (fig. 7), the McAlester-Texarkana Quadrangle includes the region of greatest precipitation in Oklahoma. The large amount of precipitation is mainly due to the orographic effects of the Ouachita Mountains. Under the influence of prevailing southerly winds, warm, moist air is brought inland from the Gulf of Mexico. As the air moves northward, the topography causes it to be pushed upward from elevations of about 500 feet along the Red River to as much as 2,500 feet along the crests of Rich and Kiamichi Mountains. This upward movement results in cooling of the air with consequent condensation of moisture, which then falls as precipitation.

Precipitation over the entire quadrangle averages about 48 inches per year. Of this amount, 24 percent falls during April and May, the wettest months, whereas only 13 percent falls during December and January, the driest months. The three precipitation graphs (fig. 7), selected to be representative of different parts of the area, show the variations in monthly distribution of precipitation from north to south and east to west.

Creeks and rivers provide drainage for the McAlester-Texarkana Quadrangle and are the principal source of water supply for much of the area. About 25 percent of the area is drained by Little River and its major tributary, Mountain Fork. The Kiamichi River drains about 20 percent of the total area. Most of the remainder of the quadrangle is drained by the Poteau River, Fourche Maline, Gaines Creek, and Muddy Boggy Creek.

The amount and distribution of streamflow are controlled largely by climate, but topography, geology, vegetation, and man's activities are also significant. Total runoff in the McAlester-Texarkana Quadrangle ranges from less than 10 inches to more than 20 inches (fig. 7). As would be expected, the area of greatest runoff generally coincides with the area of greatest precipitation. The amount of runoff decreases toward the west, parallel with the decrease in precipitation.

Streamflow not only varies from one part of the quadrangle to another, but also from year to year and during different parts of the year. These variations are shown by the graphs of streamflow of the Kiamichi River, which are based on 45 years of record (fig. 8).

Average annual streamflow for the period of record is 1,714 cfs (cubic feet per second) but has ranged from as little as 514 cfs in 1956 to as much as 4,205 cfs in 1945. The graph also shows that the average annual discharge for the period of record was exceeded during 21 of the 45 years. The 7 years from 1961 through 1967 was the longest period of below-average runoff.

The graph of average monthly streamflow (fig. 8) shows that peak flows occur during April and May, the months of greatest precipitation. The period of low flow occurs during August, when precipitation is low and evaporation and transpiration are high. The shaded area on the graph represents the range in average flow that occurs two-thirds of the time. For example, two-thirds of the time the average flow of Kiamichi River during the month of May is between 1,000 and 6,180 cfs, whereas during the month of August the range is from 3.7 to 438 cfs.

During dry periods, streams are fed by ground water draining from the rocks in the stream basin. All streams in the McAlester-Texarkana Quadrangle, except Little River and Red River, have gone dry at one time or another during the period for which records are available (table 1). Most of the smaller streams go dry nearly every year. The shape of the lower part of the flow-duration curves (fig. 9) shows the low-flow tendency of the streams providing a means of comparing the general storage characteristics of different rock types in a stream basin if the stream is not regulated. For example, the steep slope in the low range of the flow-duration curves for Kiamichi River, Fourche Maline, and Tenmile Creek shows the lack of sustained flow. These streams drain areas underlain by rocks that have only limited storage capacity and cannot provide water to maintain streamflow during dry periods. Consequently, Tenmile Creek is dry about 20 percent of the time, Fourche Maline is dry about 12 percent of the time, and Kiamichi River is dry about 4 percent of the time.

South of T. 5 S., near Wright City, Little River crosses the Antlers Formation (of Cretaceous age) and alluvial deposits. These rocks contribute to the stream's base flow, as is indicated by the upward curvature in the low range of the flow-duration curve, and, as is shown by the curve, Little River has a flow of 0.5 cfs, or greater, 99.9 percent of the time. Base streamflows are likely to be sustained in the lower reaches of Kiamichi River and Muddy Boggy Creek where they cross the Antlers and younger formations.

Additional low-flow information on major streams in the quadrangle is given in reports by Laine (1963) and Westfall (1963a and 1963b).

STREAMFLOW DATA

Streamflow data are available for 12 continuous-record sites in the McAlester-Texarkana Quadrangle (fig. 10) and are published in reports of the U.S. Geological Survey (see below). Supplemental peak-discharge data from 14 crest-stage, partial-record sites in small, unregulated watersheds are also included in these reports. The locations of continuous-record gaging stations and crest-stage partial-record stations are shown on the map, and selected data are given in tables 1 and 2.

Prior to 1961, the records of streamflow and reservoir contents were published in an annual series of U.S. Geological Survey Water-Supply Papers entitled "Surface-Water Supply of the United States;" the records for Oklahoma are in Part 7 of that series. The records for the 5-year period from 1961-65 are contained in a two-volume publication of the same series. Beginning with the 1961 water year, streamflow records also have been issued by the Geological Survey in annual reports on a state-boundary basis. These basic data reports are released by the district offices primarily for local needs.

The summary of streamflow records gives the station location; station number; drainage area; period of published record available through 1969; the maximum, minimum, and average discharge for the complete years of record; and remarks on regulation. The average discharge is not given for stations having less than 5 complete years of daily record.

Additional data on Muddy Boggy, Kiamichi, and Little Rivers are given in the following reports:

Laine, L. L., 1963, Surface water of Kiamichi basin in southeastern Oklahoma, with a section on quality of water by T. R. Cummings: U.S. Geological Survey open-file report, 39 p.

Westfall, A. O., 1963a, Surface water of Little River basin in southeastern Oklahoma, with a section on quality of water by R. P. Orth: U.S. Geological Survey open-file report, 66 p.

______1963b, Surface water of Muddy Boggy River basin in south-central Oklahoma, with a section on quality of water by T. R. Cummings: U.S. Geological Survey open-file report, 71 p.

CHEMICAL QUALITY OF SURFACE WATER

The U.S. Geological Survey published an annual series of Water-Supply Papers, "Quality of Surface Waters of the United States," from 1941 through 1964. Records for streams in the McAlester-Texarkana Quadrangle are in part 7 of this series. Beginning in the 1964 water year, water-quality data were published annually on a statewide basis; these data also are published in the U.S. Geological Survey Water-Supply Paper series. Chemical-quality data published in these reports include concentrations of dissolved solids and individual constituents such as sodium, calcium, sulfate, chloride, and such characteristics as hardness, sodium-adsorption ratio, specific conductance and pH. Fluvial-sediment information is included for suspended-sediment discharges and concentrations, and for partial size distribution of suspended and bed material. Water-temperature data are given for daily observations. A summary of selected data is given in table 3.

The usability of surface water for municipal, industrial, and irrigation supplies is controlled by its quality. Under natural conditions, the chemical quality depends, in a large part, upon the kinds, abundance, and solubility of minerals making up the rocks in a stream basin. Rocks in the Ouachita Mountains contribute only small amounts of dissolved minerals, and the total dissolved solids of streams that originate in this area seldom exceed 250 mg/l. Dissolved solids increase slightly, however, in the lower reaches of these streams where they flow across Cretaceous formations that contribute additional mineralization.

The quality of stream waters also depends, in part, on the amount of precipitation available for dilution. Average annual precipitation in the McAlester-Texarkana Quadrangle ranges from 42 to 56 inches, making enough water available normally to provide adequate dilution.

Man's activities may have a profound effect, usually adverse, on the chemical quality of stream and lake waters. Because of the sparse population and the low level of industrialization in most of the McAlester-Texarkana Quadrangle, the effect of man's activities has been slight. Only Muddy Boggy and Gaines Creeks, both of which receive runoff from abandoned coal-mine tailings, have been significantly affected. Some mineralization of Little River near Idabel may be due to man's activities, but part of the mineralization in all three streams may be derived from natural sources.

The high mineral content of water in the Red River, particularly sulfate and chloride, makes it unsuitable for municipal use and marginal for irrigation. The source of these constituents is gypsum- and salt-bearing formations west of the McAlester-Texarkana Quadrangle.

More detailed information on the quality of surface waters in the McAlester-Texarkana Quadrangle is available in the reports by Westfall (1963a and 1963b) and Laine (1963) listed above.

LAKES

Because of the variability of streamflow and the unavailability of large amounts of ground water in much of the McAlester-Texarkana Quadrangle, lakes and ponds are an important part of the area's water resources. In addition to the four major lakes or reservoirs, Hugo, Wister, Broken Bow, and Pine Creek, which lie entirely within the quadrangle, there are at least 55 lakes with a surface area of more than 20 acres (table 4). This estimate is based on data provided by the Oklahoma Water Resources Board, the U.S. Department of Agriculture, and the U.S. Army Corps of Engineers. Lakes smaller than 20 acres and farm ponds probably number in the hundreds, with more being constructed each year.

Water supply and flood control are the major uses of lakes in the area. One lake, Broken Bow, is also used for power generation. Recreation is a significant use of the area's lakes. For example, in 1971 the U.S. Corps of Engineers report that approximately 1,278,000 people visited or utilized Broken Bow Reservoir for recreational purposes.

WATER USE

The total amount of water used in the McAlester-Texarkana Quadrangle in 1970 is estimated at 15 billion gallons. Approximately 54 percent of this amount, or about 8.1 billion gallons, was taken from surface-water sources; the remaining 6.9 billion gallons was taken from ground-water sources.

The most intensive area of ground-water development is in the southern one-fourth of the quadrangle (fig. 11), where in 1970, about 4 billion gallons were pumped for domestic, municipal, and industrial use.

Because of the difficulty in obtaining sufficient water in many parts of the area, 15 rural water districts had been established by the end of 1970, with several others in the active planning stage. Rural water districts supplied an estimated 175 million gallons to approximately 12,000 persons during 1970 for a per capita consumption of about 40 gallons per day. All but two of the districts obtain their supply from surface-water sources. The current trend of expansion and development is expected to continue to meet the increasing rural demand for reliable quantities of good quality water.

RECONNAISSANCE OF THE WATER RESOURCES OF THE MC ALESTER AND TEXARKANA QUADRANGLES, SOUTHEASTERN OKLAHOMA

By

Melvin V. Marcher and DeRoy L. Bergman

U. S. Geological Survey

1983