Lurry, D.L.,1994, Estimated freshwater withdrawals in Texas, 1990

INTRODUCTION

"The mission of the U.S. Geological Survey is to provide geologic, topographic, and hydrologic information that contributes to the wise management of the Nation's natural resources and that promotes the health, safety, and well-being of the people" (U.S. Geological Survey, 1986). The Water Resources Division of the U.S. Geological Survey (USGS) accomplishes its mission by collecting and analyzing data on the quantity and quality of ground water and surface water, on water use, and on quality of precipitation. In 1977, the USGS established the National Water-Use Information Program to collect uniform, current, and reliable information on water use. The Texas District of the USGS and the Texas Water Development Board participate in a cooperative program to collect and publish water-use information for Texas. Data contained in this report were made available through the cooperative program.

This report presents 1990 freshwater withdrawal estimates for Texas by source and category. Withdrawal source is either ground water or surface water. Withdrawal categories include: self-supplied irrigation, thermoelectric-power generation, water supply, industrial and mining, and other (domestic, commercial, livestock). Withdrawal data are aggregated by county, major aquifer, and principal river basin. Only the four major categories of irrigation, thermoelectric-power generation, water supply, and industrial and mining are illustrated in this report, although all data are tabulated.

Terminology

Withdrawal is the amount of water withdrawn or diverted from a ground- or surface-water source. **Use** is the amount of water which is brought into a facility (or to an irrigation area) for use, and is equal to the withdrawal plus delivery minus any losses that occurred prior to use. **Freshwater** is water containing less than 1,000 mg/L (milligrams per liter) of dissolved solids. The following definitions are used by the USGS for each category of use:

1. **Irrigation** is water applied artificially on lands to assist in the growing of crops and pastures or maintaining recreational lands such as parks and golf courses.
2. **Thermoelectric-power generation** is water used for cooling purposes in the production of electrical power using fossil-fuel (coal, oil, or natural gas), geothermal, or nuclear energy.
3. **Water supply** is water withdrawn by public and private water suppliers and delivered to users that do not supply their own water.
4. **Industrial** use is water used for purposes such as fabrication, processing, washing, and cooling in the production of steel, chemical and allied products, paper and allied products, mineral processing not performed on mine site, and petroleum refining. The water may be obtained from a water supply or may be self supplied.
5. **Mining** use is water used in the extraction of minerals occurring naturally such as coal, ores, crude petroleum, and natural gas. It also includes quarrying, well operation (dewatering), milling (crushing, screening, washing, and flotation), and other reparations customarily done at the mine site or as part of a mining activity. Mining withdrawals are combined with the industrial category in this report.
6. **Domestic** use is self-supplied water used for normal household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens; also termed residential use. The water may be obtained from a water supply or may be self supplied.
7. **Commercial** use is water used by motels, hotels, restaurants, office buildings, commercial facilities, fish hatcheries, and civilian and military institutions. The water may be obtained from a water supply or may be self supplied.
8. **Livestock** use is water used by livestock. Livestock as used here includes cattle, sheep, goats, hogs, poultry, horses, rabbits, bees, and fur-bearing animals in captivity.

Withdrawal data in this report are shown in two types of illustrations. The choropleth maps are those maps that show ranges of withdrawals by county. The choropleth map for thermoelectric-power generation is shown as total withdrawals only, because 99 percent of these withdrawals are from surface water. The maps showing the withdrawals by aquifer and river basin indicate amounts and proportions of withdrawals. The circles, or pies, are sized proportional to the amount (million gallons per day) withdrawn. The colors of the pie slices represent the categories of use for the withdrawals within each aquifer or basin. Estimations for 1990 indicated no significant pumpage from the Blaine aquifer and no significant withdrawals from the Rio Grande closed basin. The amount of estimated freshwater withdrawals for 1990 by county, use, and source for the 254 counties in Texas are listed in table 1. Amounts listed in table 1 are rounded to three significant figures above 100 and to two significant figures below 100.

Approach

The Texas Water Development Board collects water-use data through an annual survey of municipalities and industries. Periodically, the Texas Water Development Board also estimates water use for other categories such as irrigation, mining, and livestock. Additional data are collected or estimated by the Texas Water Commission, the Texas Railroad Commission, several river authorities, and the USGS.

The USGS and the Texas Water Development Board compile water-use data differently and have different definitions of several categories of use. For example, the USGS primarily compiles data by site of withdrawal, and the Texas Water Development Board compiles data by site of use or final user. When large quantities of water are transferred between other counties or river basins, these differences in accounting procedures can create misleading information. Also, the definitions of the various categories vary between agencies. For example, the Texas Water Development Board has a municipal category that includes withdrawals minus sales to other user categories. Their industrial category includes self-supplied industrial withdrawals, all purchases of water for industrial use, and some categories considered commercial by the USGS, such as fish hatcheries, pipelines, gas production and distribution, and metals and minerals distribution. Commercial operations such as feedlots are considered livestock use by the USGS.

The different definitions and approach to data compilation require the USGS to recompile the Texas Water Development Board data to obtain the information needed for the National program. Thus, all information contained in this report is calculated and cannot be compared directly to the Texas Water Development Board water-use totals.

Total withdrawals by water source were obtained by the Texas Water Development Board from mail-out surveys. The Texas Water Development Board developed special data-retrieval procedures for the USGS water-use program. The data were provided to the USGS as withdrawal site totals by use category for approximately 450 geographic regions in the State. These regions represent the part of a river basin that is contained within a county, so that county and river-basin data must be aggregated separately. Because of the time constraints of the National Water Use Information Program, water-use data for 1990 were estimated using 1988 Texas Water Development Board data. The percentage of population change between 1988 and 1990 for each geographic region was used to extrapolate to estimate 1990 water withdrawals for water supply and domestic users. Thermoelectric-power-generation withdrawals were estimated by the USGS from statistics on the amount of power generated by each power plant during 1990. Thermoelectric-power generation water-use information from the Texas Water Development Board commonly is for consumptive use and does not correspond to USGS withdrawal data. Irrigation withdrawals for 1989 were used because of time constraints and were considered by the Texas Water Development Board to be the most accurate data available. Intensive irrigation surveys are done at 5-year intervals. Industrial, mining, livestock, and commercial withdrawals for 1988 were used because of time constraints and the small percentage of change in those categories over 2 years. The average annual precipitation may be helpful in interpreting and comparing the original and estimated withdrawal data for 1988, 1989, and 1990; average precipitation in Texas was 21.01 in. during 1988, 25.59 in. during 1989, and 31.77 in. during 1990.

Acknowledgments

Water-use data used to derive the estimates contained in this report were made available to the USGS by the Texas Water Development Board. Specific details about withdrawals, sources, transfers, and retrievals were provided by William Moltz, Texas Water Development Board, Water Uses and Projection Unit. Individual water supply and industrial facilities managers supplied original withdrawal information to the Texas Water Development Board.

ESTIMATED FRESHWATER WITHDRAWALS

During 1990 the total quantity of freshwater withdrawn in Texas for all purposes was estimated to be 20,100 Mgal/d. Total surface-water withdrawals were estimated to be 12,700 Mgal/d or 63 percent of the total, and ground-water withdrawals were about 7,390 Mgal/d, or 37 percent of the total. Irrigation withdrawals accounted for 42 percent of total withdrawals and for 76 percent of ground-water withdrawals. Withdrawals for thermoelectric-power generation were 35 percent of the State total and accounted for about 56 percent of the total surface water withdrawn. Withdrawals for water-supply purposes accounted for 15 percent of total withdrawals. Ground water was the source for 41 percent and surface water was the source for 59 percent of water-supply withdrawals.

The largest total amount of freshwater withdrawn for irrigation purposes was in Hidalgo County, followed by Cameron and Hale Counties. The largest total amount of freshwater withdrawn for thermoelectric-power generation purposes was in Titus County, where withdrawals were twice as much as those in Freestone County, which had the next largest withdrawals. The largest amount of water withdrawn for water-supply purposes was in Harris County, followed by Dallas and Bexar Counties.

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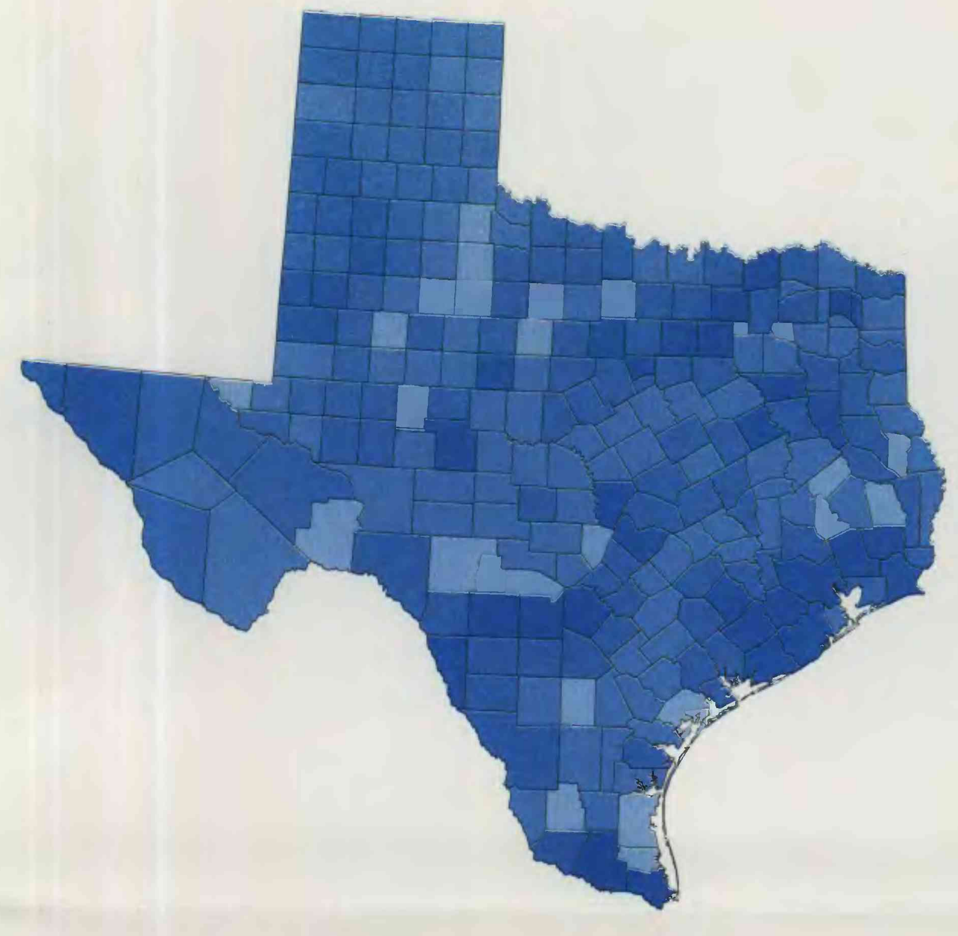
CONVERSION FACTORS AND ABBREVIATED WATER-QUALITY UNIT

Multiply	By	To obtain
inch (in.)	25.4	millimeter
million gallons per day (Mgal/d)	0.001	billion gallons per day
	1.121	thousand acre-feet per year
	0.0015547	thousand cubic feet per second
	0.6944	thousand gallons per minute
	0.003785	million cubic meters per day

Abbreviated water-quality unit:

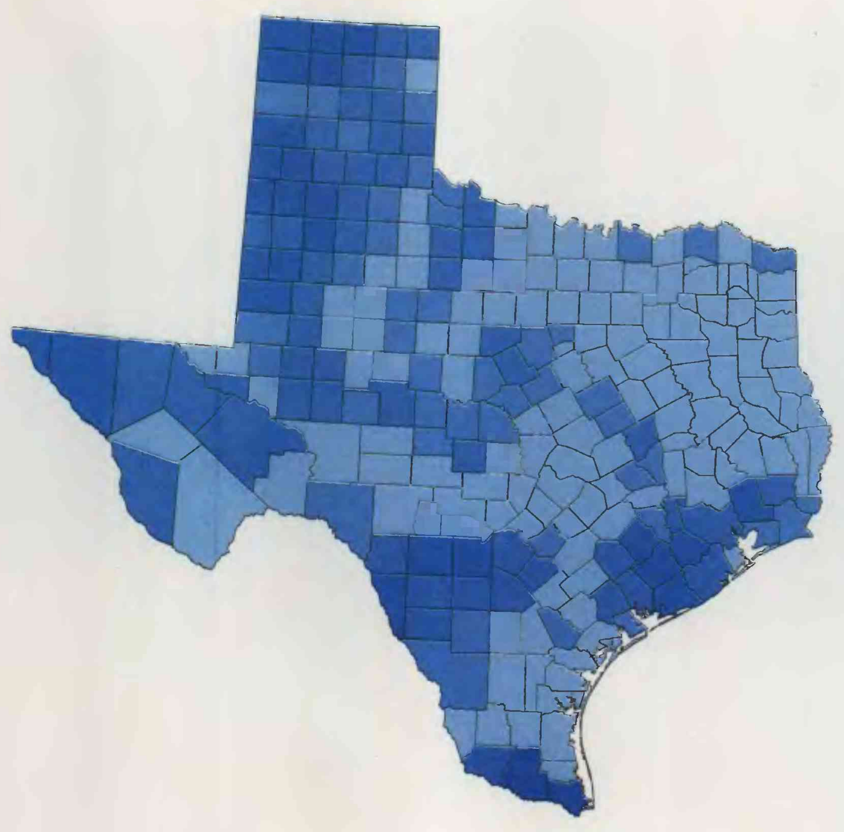
mg/L, milligram per liter



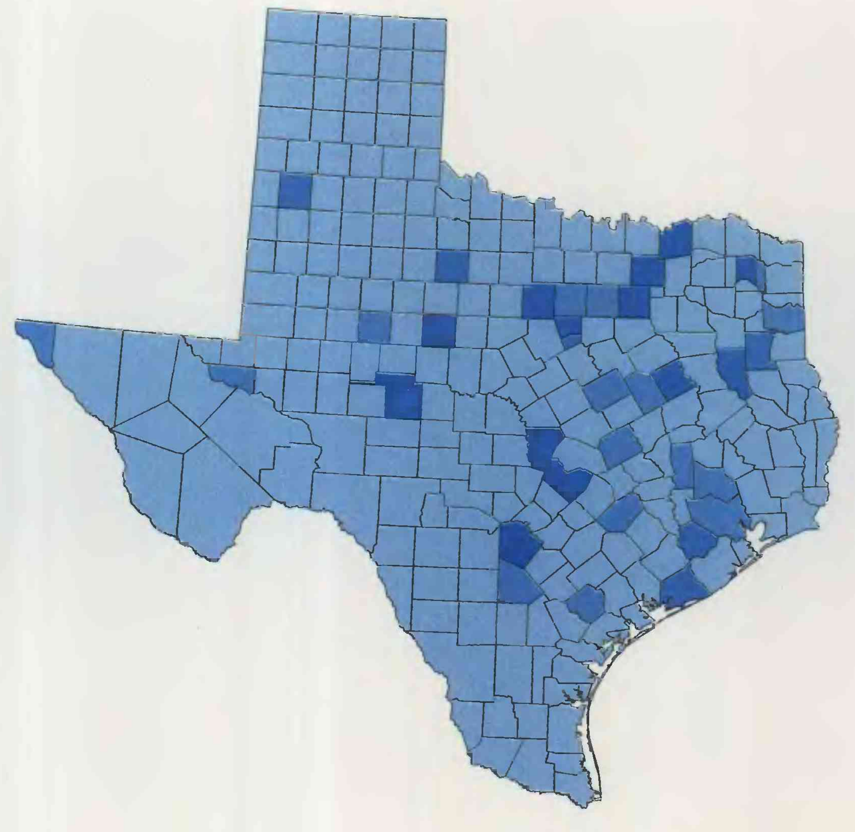
EXPLANATION
WITHDRAWALS, IN MILLION GALLONS PER DAY

- 0.0 - 1.9
- 2.0 - 9.9
- 10.0 - 99
- 100 - 499
- 500 - 2,000

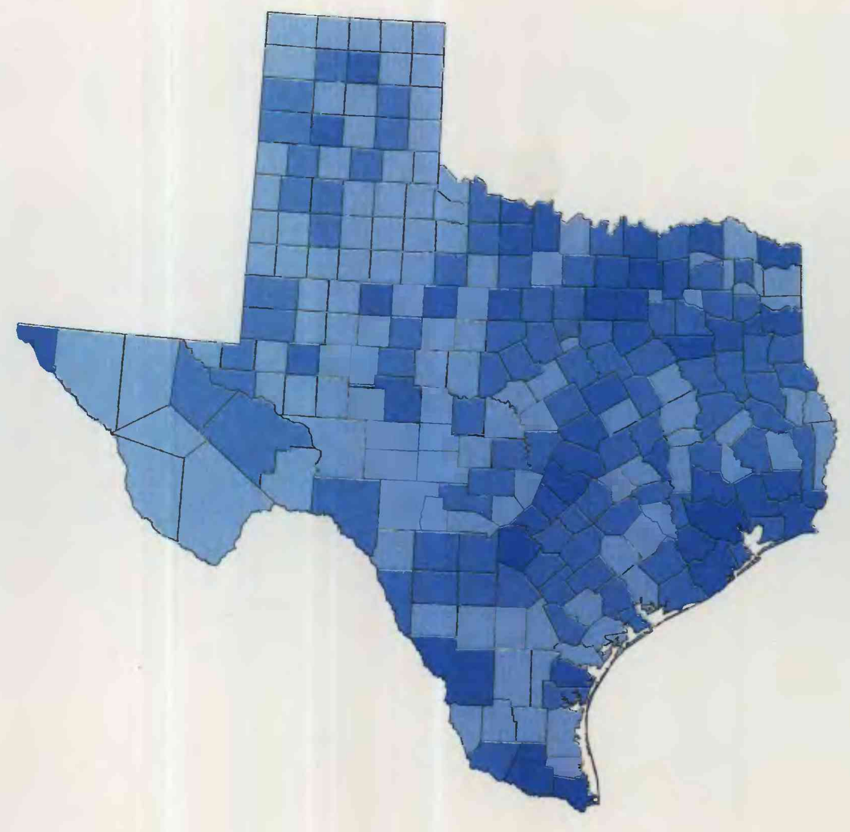
TOTAL FRESHWATER WITHDRAWALS



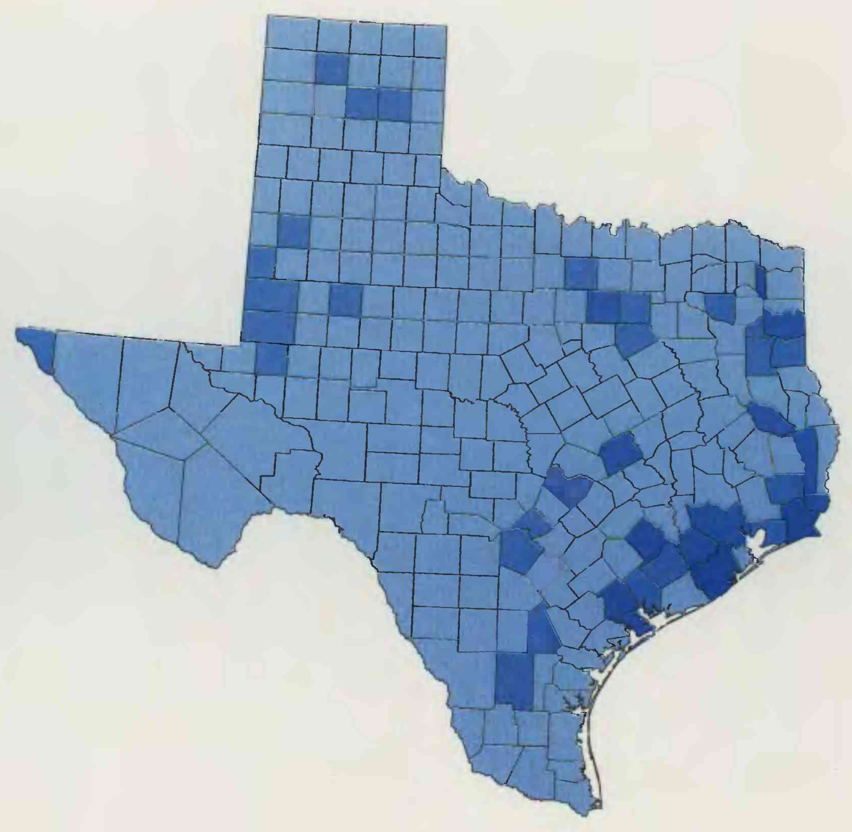
TOTAL IRRIGATION WITHDRAWALS



TOTAL THERMOELECTRIC-POWER-GENERATION WITHDRAWALS



TOTAL WATER-SUPPLY WITHDRAWALS



TOTAL INDUSTRIAL AND MINING WITHDRAWALS

Table 1. Estimated freshwater withdrawals in Texas, 1990, by county, use, and source

[Amounts are in million gallons per day. Figures may not add to totals because of independent rounding. --, not detected]

County	Irrigation			Thermoelectric-power generation			Water supply			Industrial and mining			Other (Domestic, commercial, and livestock)			Total		
	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total
Anderson	0.02	0.31	0.33	--	--	--	3.4	4.0	7.4	0.40	--	0.40	2.9	0.92	3.8	6.7	5.2	12
Andrews	2.5	.09	2.6	--	--	--	2.3	--	2.3	3.6	--	3.6	.46	.04	.50	8.9	.13	9.0
Angelina	--	--	--	--	--	--	9.2	--	9.2	15	8.7	24	.38	.24	.62	25	9.0	34
Aransas	--	--	--	--	--	--	.32	--	.32	.19	--	.19	.01	.04	.05	.52	.04	.56
Archer	--	.33	.33	--	--	--	--	12	12	--	--	--	.20	1.4	1.6	.20	13	13
Armstrong	9.4	--	9.4	--	--	--	.17	--	.17	.02	--	.02	.55	.12	.67	10	.12	10
Atascosa	45	--	45	7.2	--	7.2	6.3	--	6.3	1.2	--	1.2	.66	1.2	1.9	61	1.2	62
Austin	8.2	--	8.2	--	--	--	1.8	--	1.8	.04	--	.04	1.0	1.3	2.3	11	1.3	12
Bailey	176	--	176	--	--	--	.83	--	.83	.08	--	.08	1.2	.23	1.5	178	.23	178
Bandera	.12	.11	.23	--	--	--	.40	--	.40	.02	--	.02	1.0	.06	1.1	1.5	.17	1.7
Bastrop	.24	.24	.48	--	1.3	1.3	5.6	--	5.6	.03	.01	.04	.65	.78	1.4	6.6	2.3	8.8
Baylor	1.6	28	29	--	--	--	.86	1.2	2.1	.04	--	.04	.11	.77	.88	2.6	30	32
Bee	2.0	.03	2.0	--	--	--	2.2	--	2.2	.02	--	.02	1.5	.88	2.3	5.6	.91	6.6
Bell	.16	.41	.57	--	--	--	.97	38	38	.17	--	.17	.16	7.1	7.2	1.5	45	46
Bexar	23	11	34	.82	679	680	248	.32	248	8.7	.38	9.1	19	1.0	20	299	692	991
Total	5,590	2,900	8,490	54	7,070	7,130	1,260	1,830	3,090	240	787	1,020	236	146	382	7,390	12,700	20,100

Table 1. Estimated freshwater withdrawals in Texas, 1990, by county, use, and source--Continued

ESTIMATED FRESHWATER WITHDRAWALS IN TEXAS, 1990

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