WATER DEMANDS IN KANSAS, 1944-84

By Joan F. Kenny

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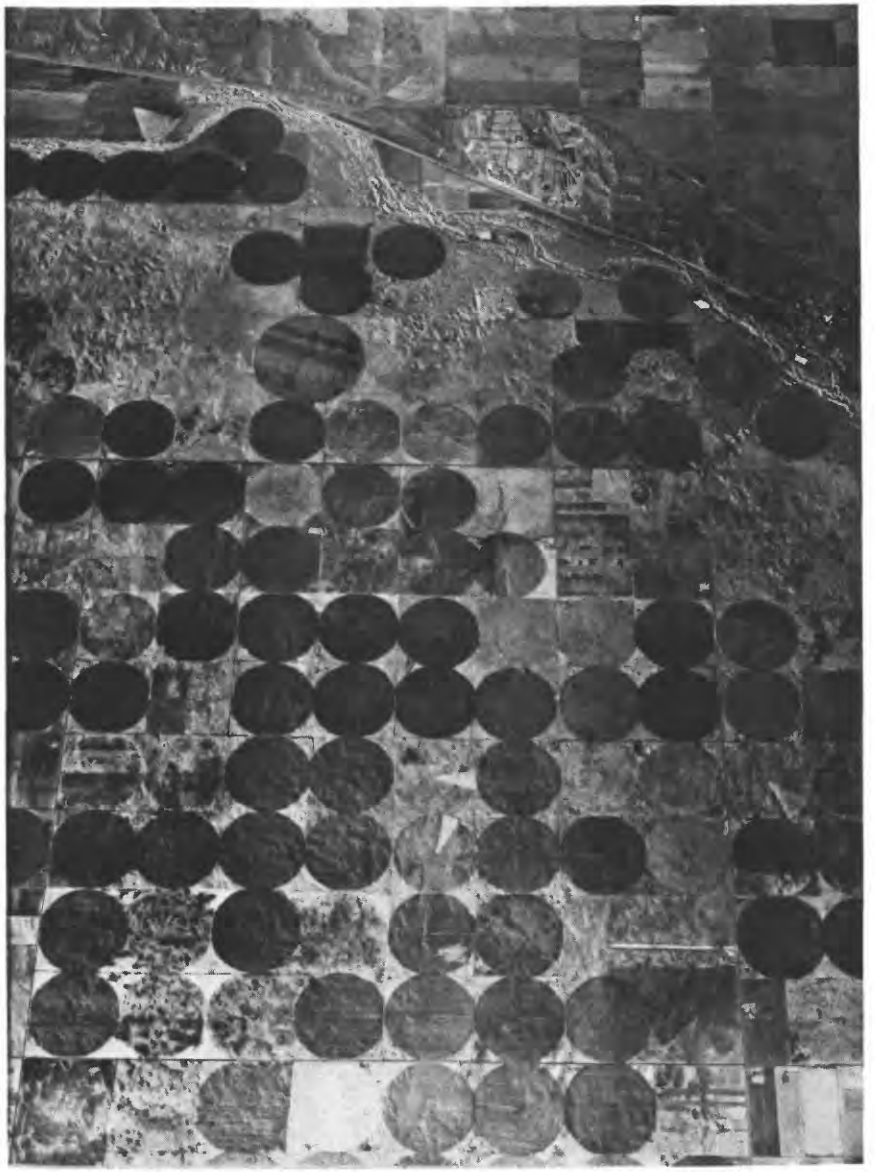
CONVERSION FACTORS

The following factors may be used to convert the inch-pound units published herein to the International System of Units (SI):

Multiply inch-pound unit	By	To obtain SI unit
inch	25.40	millimeter
mile	1.609	kilometer
square mile	2.590	square kilometer
acre	0.4047	hectare
gallon	0.003785	cubic meter
acre-foot	1,233	cubic meter
gallon per minute	0.06309	liter per second
cubic foot per second	28.32	liter per second
million gallons	3,785	cubic meter
million gallons per day (Mgal/d)	0.04381	cubic meter per second



Center-pivot irrigation systems, southeast of Garden City, 1978. Photograph courtesy of the Kansas Applied Remote Sensing Program, Lawrence, Kans.

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ABSTRACT

The State of Kansas has administered water rights according to an appropriations doctrine since 1945. Water rights are issued by the Kansas State Board of Agriculture, Division of Water Resources, for eight categories of beneficial use. Water-rights data and limited information on reported water use are stored on a computerized State data base; the U.S. Geological Survey cooperates with the State on maintenance of this system.

This report analyzes trends in appropriations from 1944-84 for surface and ground water for the three major categories of use--irrigation, public supply, and industry. Demands for water, represented by these appropriations, are compared for three geographic areas within the State. These areas correspond to general patterns of water availability, population, and enterprises.

As of 1984, 87 percent of the water appropriated for the three major types of use was for irrigation; most of this demand was for ground water in the western one-third of the State. Seventy-five percent of the water demands in the central one-third of Kansas were met by ground water; appropriations for irrigation represent the largest demand on water supplies in this area but must compete with appropriations for public supply and industry. Demands for surface water have increased substantially only in the eastern part of the State for industrial use and public supplies.

The most prominent trends in water-rights permit activity were related to climatic fluctuations, particularly the drought of the 1950's, legislative changes in the 1970's requiring permits, and growth of urban populations in the central and eastern areas of the State. Analysis of trends in water appropriations can be useful in understanding the water issues facing Kansas in the future.

INTRODUCTION

The water resources of Kansas are a subject of growing concern. Demands on finite supplies and competition among various types of use are increasing. For effective management of current and future water demands, government agencies, researchers, and local groups need credible information on where, how, and in what quantities water is being used. However, this information is limited at present. One alternative is to examine water appropriations instead of water use as an indication of demand. Analysis of trends in water appropriations can provide a perspective on historical, current, and future claims to water in Kansas. These appropriations are referred to collectively as demands.

Appropriation of water in Kansas is regulated by law and is a key element in the management of the State's resources. According to early common-law doctrine in the State, rights to surface water belonged to owners of land adjacent to or crossed by streams (riparian doctrine), and rights to ground water belonged to the landowner (doctrine of absolute ownership). This common-law doctrine was replaced by a prior-appropriations doctrine similar to those prevailing in other arid and semiarid Western States. With a prior-appropriations doctrine, more equitable distribution of water is achieved by allocating supplies on a "first-in-time, first-in-right" basis. In Kansas, the prior-appropriation doctrine was entered into law in 1945 with the passage of the Kansas Water Appropriation Act.

Recognizing that all water in the State is dedicated to the use of the people, subject to State control and regulation, the Water Appropriation Act established a system for the issuance of water rights by the Division of Water Resources, Kansas State Board of Agriculture. Rights to appropriate water for beneficial use are granted for eight categories--domestic, stock watering, public

supply, irrigation, industrial, recreation, water power, and artificial recharge. A permit obtained from the Chief Engineer of the Division of Water Resources is necessary to establish and protect one's right to a specified rate of diversion and annual quantity of water for a recognized beneficial use. Amendments to the Water Appropriations Act in 1978 made permits for all nondomestic use mandatory.

There are two basic types of water rights, applying to all surface and ground water in the State. Those persons using water prior to 1945 were given the opportunity until July 1, 1980, to present proof of their use to the Chief Engineer, who then issued a vested right to continue that use. Those filing an application to divert water after 1945 may secure an appropriation right if the application is approved. Vested rights are superior to any appropriation right; priority of appropriation rights is determined by the date of filing. Information required by the Division of Water Resources for both types of water rights includes the specific quantity, purpose, place of use, rate of diversion, source of the water appropriated, and number of diversion points. Amounts of water permitted on all water rights are referred to, hereafter, as water appropriations. Beneficial use of the appropriated water must be maintained, or a justifiable reason given for nonuse, such as conservation, unavailability of water at the time needed, or adequate precipitation. If no beneficial use is demonstrated for 3 consecutive years, the water right is subject to revocation unless the appropriator can justify his reason for nonuse of the water right in a public hearing. The Division of Water Resources also maintains the right to establish intensive ground-water-use control areas, where moratoriums on new well development may be declared, withdrawal rates may be restricted, and other management approaches may be implemented, as determined from an evaluation of the area by the Chief Engineer.

In 1958, the Division of Water Resources began issuing annual questionnaires to obtain information on amounts of water used by all water-right holders. Water-rights and water-use data are on file at the Division's office in Topeka, Kansas; all water-rights data, including vested and appropriations rights, and water-use data from the 1981 water season through the present (1986) are maintained on a computerized storage system. Appropriations and use data are retrievable by county, river basin, or permit number.

As part of the National Water Use Information Program in Kansas, the U.S. Geological Survey cooperates with the Division of Water Resources in maintenance of this water-rights/water-use data base. The Survey's responsibilities are principally to assure that data collected and stored by the Division are available to meet the needs of Federal and State agencies and to provide assistance in the design and evaluation of data-collection techniques and in quality control of data stored.

WATER DATA

The water-appropriation system administered by the Division of Water Resources, Kansas State Board of Agriculture, is one of the more comprehensive among the Western States and has potential value as a basis for estimating water use by various segments of the population. However, water-use data collected by the Division are not yet adequate for realistic appraisal of past and future trends in Kansas. These data are inadequate primarily because (1) an estimated 50 to 75 percent of all permit holders actually file annual water-use reports, making the data incomplete; (2) the probability that some of those who do file reports are over- or under-reporting allows possible error of unknown magnitude in the recorded amounts of water used; and (3) only water-use data collected after 1981 are stored in the computerized water-use storage and retrieval system of the Division of Water Resources, leaving but a few years of data for analysis. Also, the Division is continuously updating the water-use data for all years as water-use reports are received and processed; consequently the figures are constantly changing.

Information pertaining to vested rights issued for water use occurring prior to June 28, 1945, as well as to appropriation rights developed after that date under the Water Appropriation Act, is available on the State computer system. These records are part of a complex system of water-rights administration in which water rights are issued by the Chief Engineer after application is made to the Division of Water Resources. A water right includes a specific point of diversion, a designated place of use, and a specific rate of diversion and annual quantity allowable. Points of diversion and use may overlap, and until recently multiple diversions were sometimes included on a single permit. Additionally, there are 29 different codes for the status of a water right, depending on whether the permit has been deemed vested, active, inactive, pending, proposed, extended, partially completed, reinstated, denied, certified, or any of several combinations of the above.

A water-right owner has 5 years from the date of filing an application to "perfect" the water right. Perfection involves completing the diversion works and applying water to the proposed use in accordance with the approved application [Division of Water Resources Rules and Regulations 5-1-1(r)].

After perfection of the water right, an onsite inspection or audit is conducted by personnel employed or contracted by the Division of Water Resources to ascertain the maximum potential diversion rate. Extensions are possible if the owner feels that representative years have not occurred during this period; this is especially common with irrigation water rights that may not be fully utilized during wet years.

Certification is the final step in approval of a water right, in which the amount of water requested on the application is reviewed and finalized, and a certificate of appropriation is issued. As of 1985, the Division has approximately 9,000 uninspected diversions that remain to be certified (Boyd Allen, Division of Water Resources, oral commun., 1985). If State funding is continued at its current (1986) level, this "backlog" of inspections should be processed in 5 years. Despite this backlog, however, annual water-use reports are sent to holders of these uninspected diversions to obtain information on their annual water use.

There are differences between volumes of water appropriated and volumes of water reported or estimated to be used. Water-use figures reported (as of 1985) to the Division of Water Resources for 1983 are about 40 percent of the amount appropriated that year. Comparison of current appropriations with recent estimates of water use (Solley and others, 1983; Kansas Water Office, 1984) indicates that water used in Kansas is about 55 percent of the amount appropriated. Ratios of reported or estimated water use to appropriated amounts vary with the type of use, the source of water, the area of the State, and the year being analyzed.

Complexities aside, appropriations data are valuable for analysis of trends in Kansas water demands because (1) they comprise a historic record of maximum amounts of water allocated by the State for all uses except domestic; (2) the amounts of water permitted on water rights are not subject to fluctuations in recording as are annual water-use data; and (3) amounts of water appropriated, while much larger than amounts actually used, reflect changes in water demands with the demographic, climatic, and economic influences present during the past 40 years.

DATA ANALYSIS

The utility of the State water-rights/water-use data for study of trends in water demands varies with the category of use, geographic location, and time period. Data stored for the domestic-use category are not representative of the actual amounts used by self-supplied rural households for domestic and stock use because permits are not required for this type of use. The stock-water category pertains only to feedlot operations containing 1,000 head or more of livestock and thus does not indicate water demand for much of the livestock raised in Kansas. Appropriations for water power are small, as there are very few hydroelectric power-plants in the State. Recreational use and artificial recharge also represent a small percentage of total water demands in the State.

Primary uses of appropriated water in Kansas are for irrigation, public supply, and industry, which together constitute 97 percent of the total water appropriations administered during 1984. Public supplies include water appropriated for municipalities and rural water districts. Industrial water supplies that are derived from municipal water systems are included in the public-supply category. Water appropriations for industrial use apply to self-supplied industries and thermoelectric powerplants.

Water demands in Kansas vary with geographic area because of differences in population distribution, availability of water, and predominant types of water use. For purposes of data analysis, the State has been divided into western, central, and eastern areas (fig. 1), corresponding to general patterns of water sources, population, and enterprises. Aggregation of water data by large area rather than by county also tends to prevent erroneous conclusions regarding the location of water demands since the place(s) of use may be in a different county than the point(s) of diversion.

Areal differences in availability of water are illustrated in figures 2-4. Average annual precipitation increases from less than 16 inches in the western to more than 40 inches in the southeastern part of the State (fig. 2). The largest well yields are from major unconsolidated aquifers in the western and central areas; in contrast, very few areas in eastern Kansas have wells that yield more than 100 gallons of water per minute (fig. 3). Greater amounts of water are available from streams and associated alluvial aquifers in the eastern and central parts of Kansas than in the western part (fig. 4). In fact, river discharges in western Kansas during recent years have been consistently smaller than those indicated in figure 4.

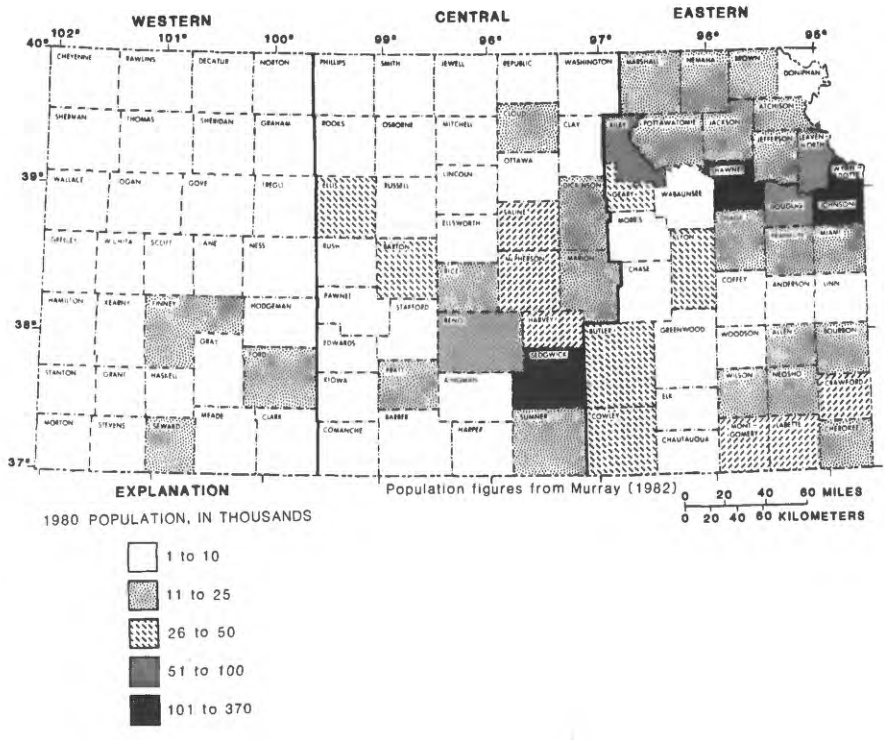


Figure 1.--Distribution of population in Kansas by county during 1980 and division of State into western, central, and eastern areas.

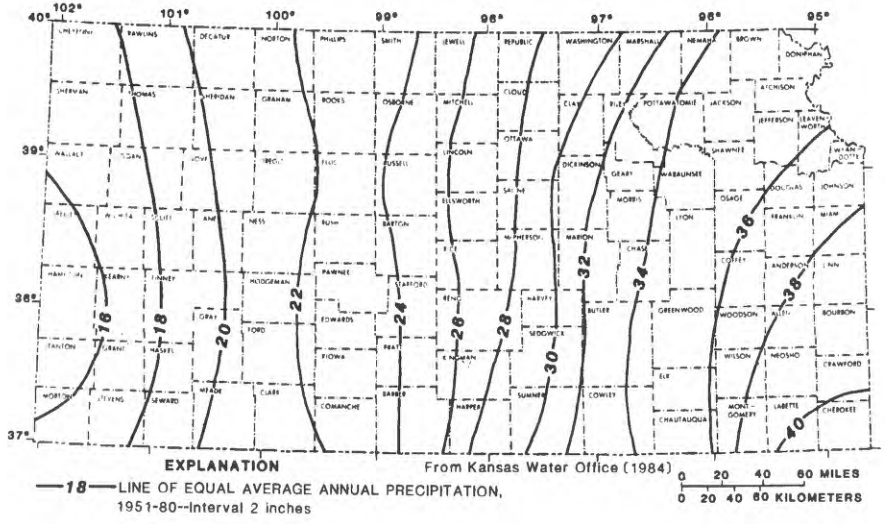
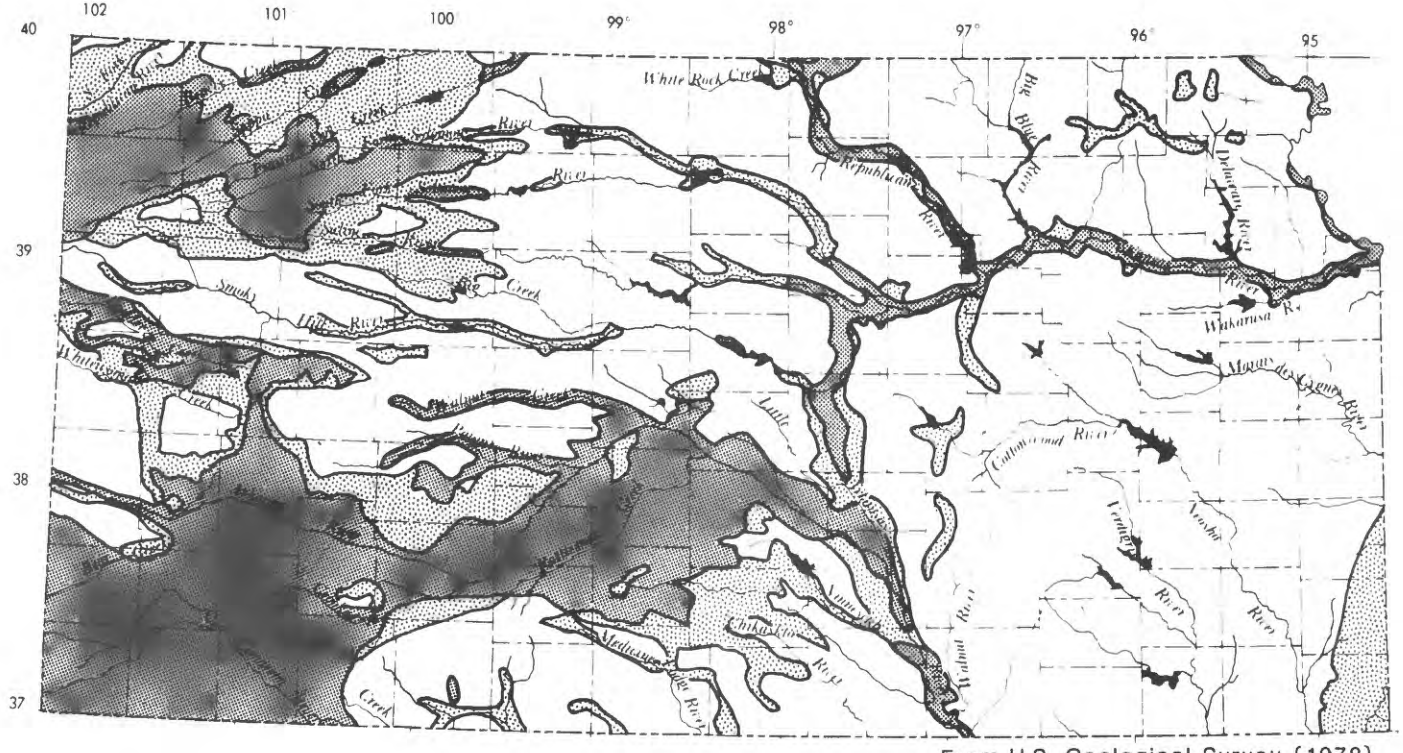
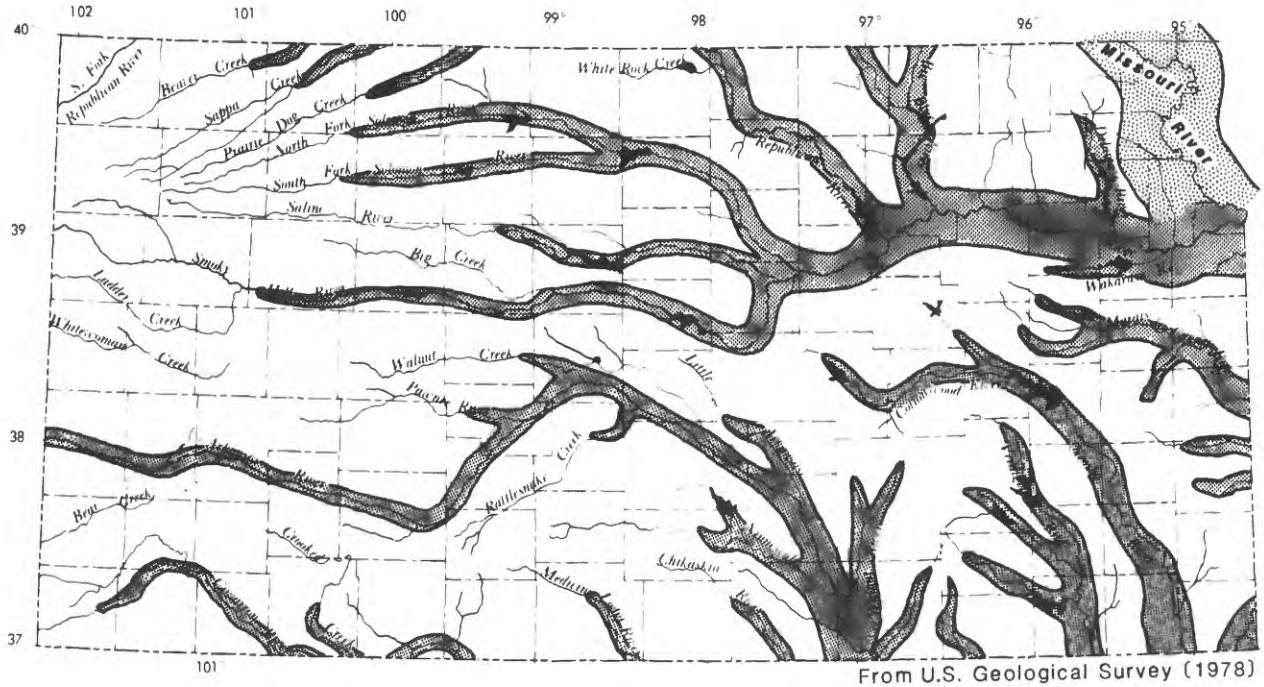


Figure 2.--Average annual precipitation, 1951-80.



From U.S. Geological Survey (1978)

Figure 3.--Availability of ground water.



From U.S. Geological Survey (1978)

EXPLANATION

WIDTH OF RIVER INDICATES AVERAGE DISCHARGE, IN CUBIC FEET PER SECOND

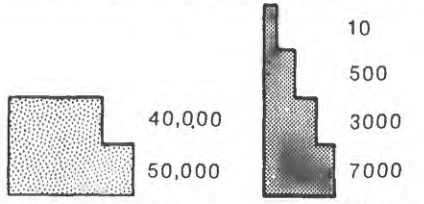


Figure 4.--Average discharge of principal rivers, based on available streamflow records through 1965.

Historic and current variability in water supplies and demands among the three areas of the State is illustrated in figures 5-7. Graphs of annual precipitation records from 1950 to 1983 indicate the variability of rainfall through time and its unequal distribution among geographic areas (fig. 5). Graphs of rural and urban population growth and decline in the three areas demonstrate the large differences in demographics, which in turn affect water demands (fig. 6). Pie diagrams showing proportions of water appropriations as of 1984 by category of use and source illustrate water-use priorities in the three areas (fig. 7).

The western one-third of the State includes 31 counties with generally sparse populations, the majority of which have always been rural. Irrigation is the primary use of water. Ground water available from major aquifer systems is used for virtually all needs, as streamflows and precipitation are neither abundant nor dependable in this part of the State.

The central one-third of Kansas comprises 35 counties, some predominately rural and some that include major population centers such as Wichita and Hutchinson. The greatest use of water in this area is for irrigation, followed by public supply and light industry. Ground water from major aquifer systems and alluvial areas supplies about 75 percent of these needs.

The eastern area consists of 39 counties, which in 1980 contained more than one-half of the States's population of 2,364,246, largely contained in the urban areas along the Kansas River from Topeka to Kansas City. The greatest water demands are for public supply and industrial use. Because of larger streamflows, higher precipitation, and generally poor yields from bedrock aquifers, surface water is used for approximately 70-percent of the water demands in this area.

Water-rights records of the Division of Water Resources from 1944 through 1984 were used in the following discussions of water use for irrigation, public supply, and industry. Permit activity and water appropriations are depicted for each of these three major type uses in the three areas of the State.

Water-appropriations data presented in this report were derived from annual appropriations data and are expressed as average daily quantities appropriated. Units of millon gallons per day (Mgal/d) are used to provide consistency with other U.S. Geological Survey reports (see Solley and others, 1983). However, the choice of these units in no way implies a rate, maximum or otherwise, at which appropriated water may be diverted. The comparisons of water appropriations for different types of use and in different areas of the State are of volume, not rate. Water withdrawals rarely occur

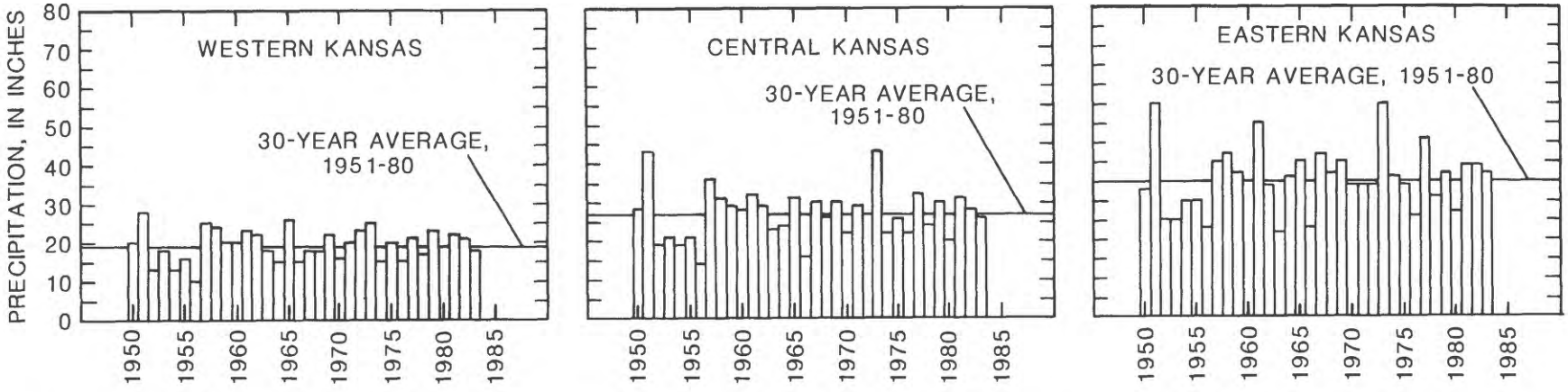


Figure 5.--Annual precipitation, 1950-83 (data from division averages in National Oceanic and Atmospheric Administration annual climatological summaries, 1950-83).

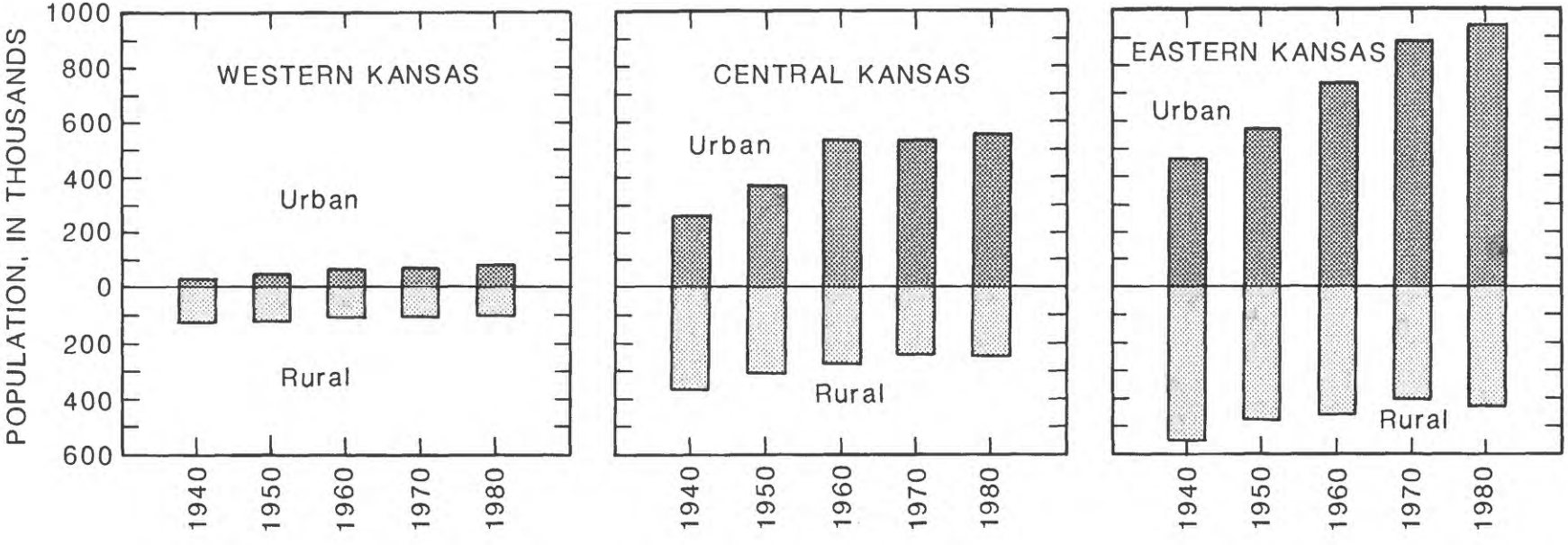


Figure 6.--Population trends, 1940-80 (data from U.S. Bureau of the Census, 1982).

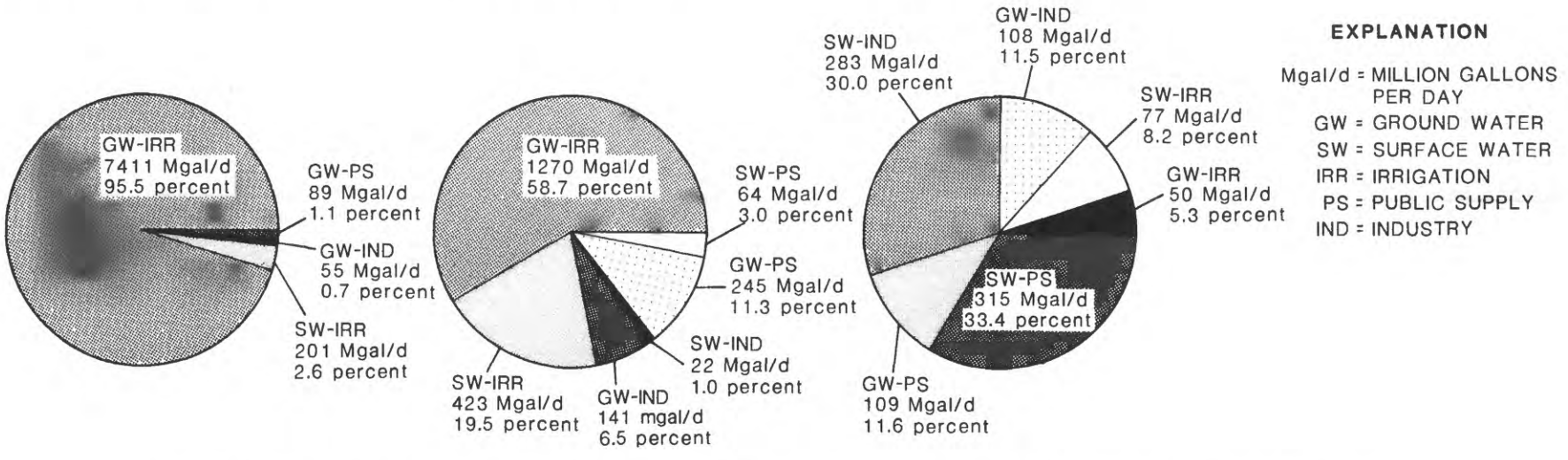


Figure 7.--Percentage and use of water appropriated during 1984 (data from Kansas State Board of Agriculture, Division of Water Resources, 1984).

at a constant rate; some, such as those for irrigation, are seasonal. Also, it is important when interpreting these data to understand that the total amounts of water appropriated on all active water rights include requested amounts that are in the pending or approved status and amounts allocated on temporary permits. Temporary permits have been issued since 1978 and are valid for a period of time ranging from 6 months to 1 year.

The number of permits issued for water used prior to June 28, 1945, represents the vested rights recognized when the Water Appropriations Act was passed. From that year on, the number of permits issued for water-appropriation rights each year is a net figure, reflecting the number of new permits granted minus the number of dismissed water rights. As of 1984, about 29,000 rights to appropriate water for irrigation, public supply, or industry were active; the amount appropriated by these permits totaled 10,863 Mgal/d, or about 12 million acre-feet.

WATER DEMANDS

Most of the water appropriated in Kansas for beneficial use is for irrigation, public supply, and industrial use. As defined by the Division of Water Resources [Water Appropriation Act Rules and Regulations 5-1-1 (0)] irrigation use comprises "the use of water for the growing of crops and the watering of lawns, golf courses, and parks." Public supply or municipal use, as defined by 5-1-1 (p), is "the various uses made of water delivered through a common distribution system operated by a municipality, a rural water district, public wholesale water supply district, a group of householders, mobile home parks, or any other similar entity distributing water to other water users for household purposes." Industrial use is defined by 5-1-1 (n) as "the use of water in connection with the manufacture, production, transport, or storage of products, or the use of water in connection with providing commercial services including water used in connection with steam electric power plants, secondary and tertiary oil recovery, air conditioning, heat pumps, restaurants, hotels and motels."

Irrigation

Of the three major categories of appropriated water in Kansas, irrigation has always comprised the largest proportion, increasing steadily from 47 percent in 1945 to 88 percent in 1980. In recent years, the percentage of total appropriations for major use categories that is represented by irrigation has dropped slightly, totalling 87 percent in 1984. This trend parallels the increase and levelling off of irrigated acres in Kansas, which are shown in figure 8 for the years 1940 through 1982 for each area of the State.

The vast majority of water appropriated during 1984 for irrigation was ground water in western Kansas, where the large amounts of water stored in the High Plains and other unconsolidated aquifers make large-scale irrigation possible. Irrigation is also the primary use of water in central Kansas; however, until 1970 surface-water sources provided the majority of water for irrigation in this area. Comparatively small amounts of water have been appropriated for irrigation in eastern Kansas, where there is less irrigable land and greater precipitation than in the rest of the State.

Graphs of water-rights permit activity and irrigation appropriations reflect several major trends in the past 40 years (figs. 9 and 10). Sharp rises in the number of permits issued in all three areas during the mid-1950's were associated with the devastating drought of 1952-56, which forced many irrigators to seek additional sources of water or to protect existing sources by obtaining legal water rights. Increases in permits issued to appropriate water for irrigation beginning in the mid-1960's, particularly in the

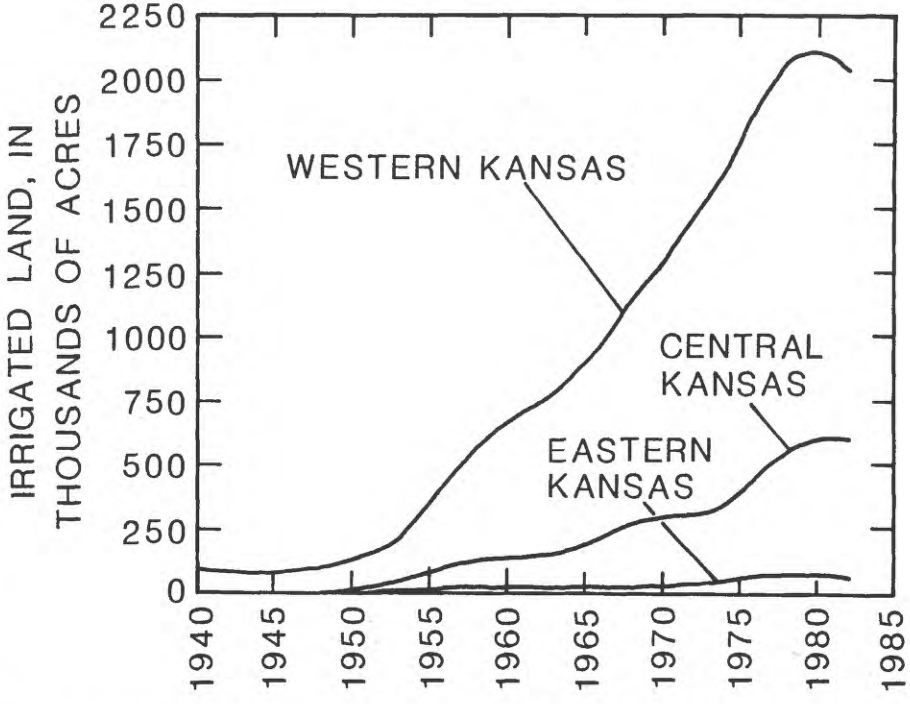


Figure 8.--Number of irrigated acres, 1940-82.

western and central areas of the State, coincide with the introduction of center-pivot irrigation systems and the subsequent development of vast acreages of farmland. In the sandhills area south of the Arkansas River in western Kansas, the number of center pivots increased from 1,084 during 1972 to 2,826 during 1975. In the Great Bend Prairie, south of the Arkansas River in central Kansas, the number of center pivots increased from 284 to 1,103 during the same period (Poracsky, 1977). The increases in use of ground water for irrigation has resulted in water-level declines in some aquifers; one study indicates that during 1977, average annual water-level declines of at least 0.5 foot were occurring beneath 65 percent of the total irrigated acres in Kansas (Sloggett and Mapp, 1984, p. 229).

Along with development of the technology to irrigate greater acreages came efforts to control the increasing use of finite ground-water resources. During 1972, the Kansas Legislature authorized the formation of ground-water management districts to direct ground-water development on a local basis. The five districts, three in western Kansas and two in south-central Kansas (fig. 11), have designed separate management policies to maximize the useful life of aquifers heavily pumped for irrigation. The ground-water management districts review each application to drill wells within their boundaries and make recommendations to the Chief Engineer, Division of Water Resources, regarding approval, modification, or denial. The effects of the management districts on irrigation-water appropriations in the western and central areas of the State during the mid-1970's have been both to encourage compliance with the permit system in order to protect one's right to divert water and to prevent the uncontrolled appropriation of ground-water resources.

The peak of permit activity, and correspondingly the greatest increases in amounts of water appropriated for irrigation, occurred during the mid- to late-1970's, due to the planning and eventual implementation of the law requiring permits to divert water for any purpose other than domestic use. Permit activity has decreased sharply during recent years in irrigation areas of western and central Kansas as the effects of resource management by ground-water management districts, rising energy prices, and the farm-economy slump limit the number of new applications filed and approved by the Chief Engineer. These areas may have reached their maximum development level, from both an economic and a technological standpoint: irrigation and farming costs have become prohibitive to many farmers, and water-rights appropriations are becoming more difficult to secure in certain areas because of water-level declines in aquifers pumped for irrigation.

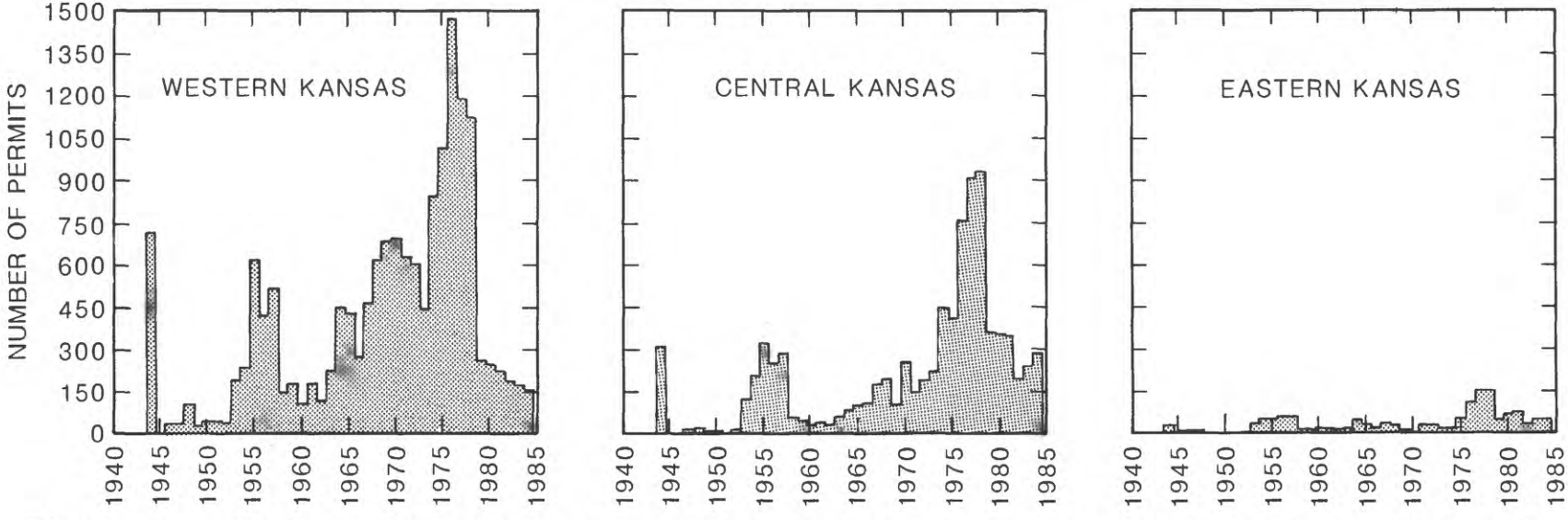


Figure 9.--Number of permits issued to appropriate water for irrigation, 1944-84.

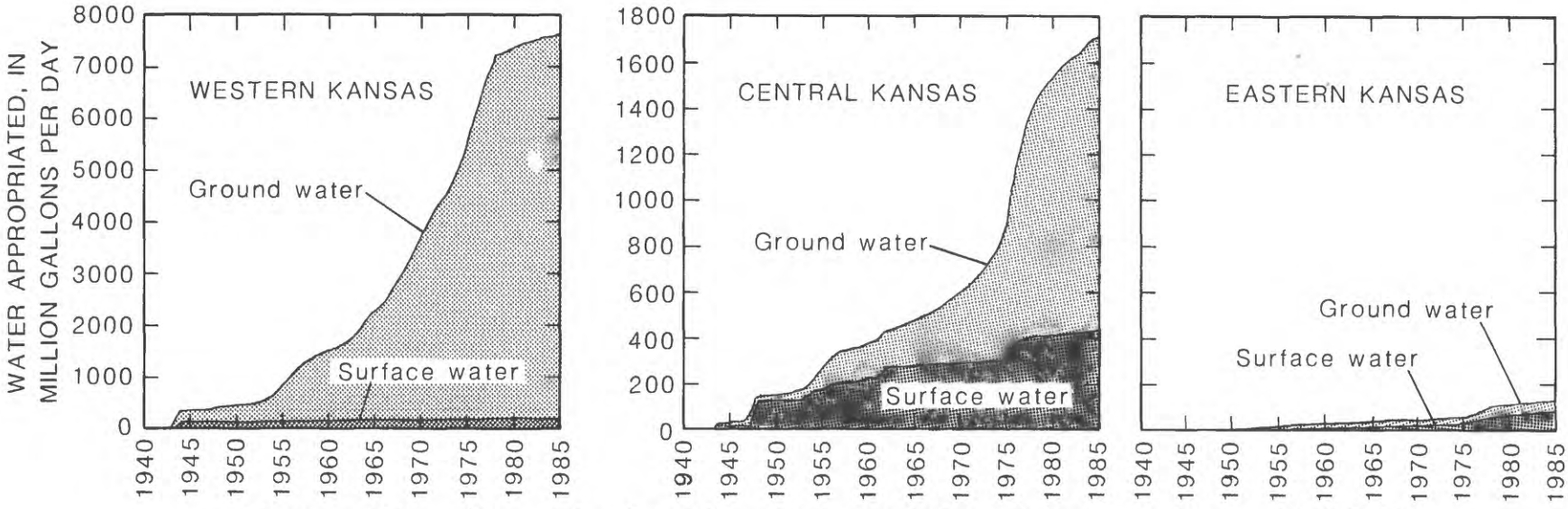


Figure 10.--Amount of water appropriated for irrigation, 1944-84.

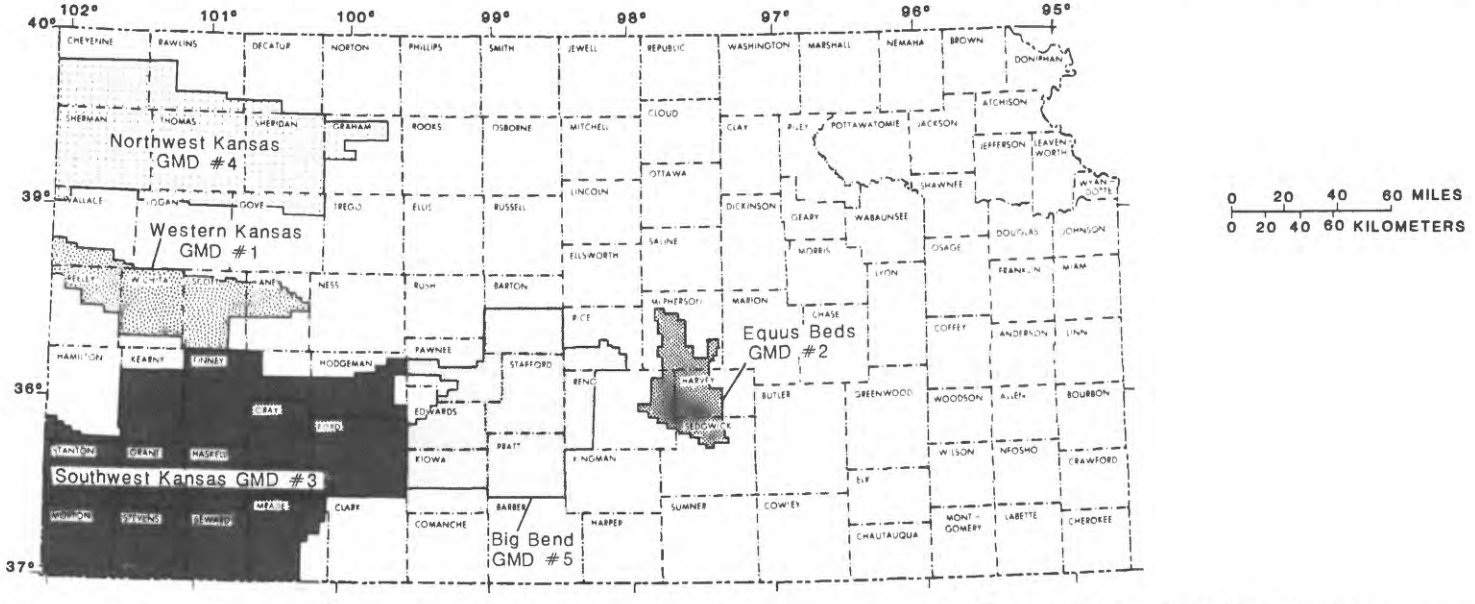


Figure 11.--Location of Groundwater Management Districts (GMD) in Kansas.

Public supply

Water appropriated for public supply includes that provided for urban domestic use, commercial operations, industries buying water from municipal systems, and rural water districts. The public-supply category comprised 7 percent of the total water appropriated during 1984 for the three major uses of water in Kansas. Statewide, 54 percent of the water appropriated during 1984 for public supplies was derived from ground-water sources.

Within the State, more than one-half of the total water appropriated as of 1984 for public supply was in eastern Kansas, the area with the largest population and number of industries within urban areas. Also, the majority of rural water districts in the State are located in this area, because of the general unavailability of adequate ground-water supplies for the rural sector. Within the eastern one-third of Kansas, public supply represents the greatest demand on water supplies, accounting for 45 percent of the water appropriated as of 1984. Public supply demands are smallest in western Kansas, where there has been relatively little change in both urban and rural populations since 1940. Rural water districts are rare in this area since ground water is usually available for self-supplied domestic use on individual farms.

Permit activity (fig. 12) and water appropriated (fig. 13) for public supply reflect demographic, climatic, and legislative trends. In eastern and central Kansas, the drought of the 1950's had a major impact on the number of communities applying for water rights during that decade. Increases in urban populations and formation of rural water districts in these two areas during the 1960's are reflected in steady increases in water appropriations. Permits to appropriate water for public supplies have been most numerous in the central one-third of the State. A rise in permit activity during the late 1970's due to changes in the Water Appropriations Act is apparent in all three areas.

The sources of water for public supply vary among the three areas of the State. The majority of water allocated for this category is derived from surface-water sources in eastern Kansas, while ground water is the dominant source in the central and western areas.

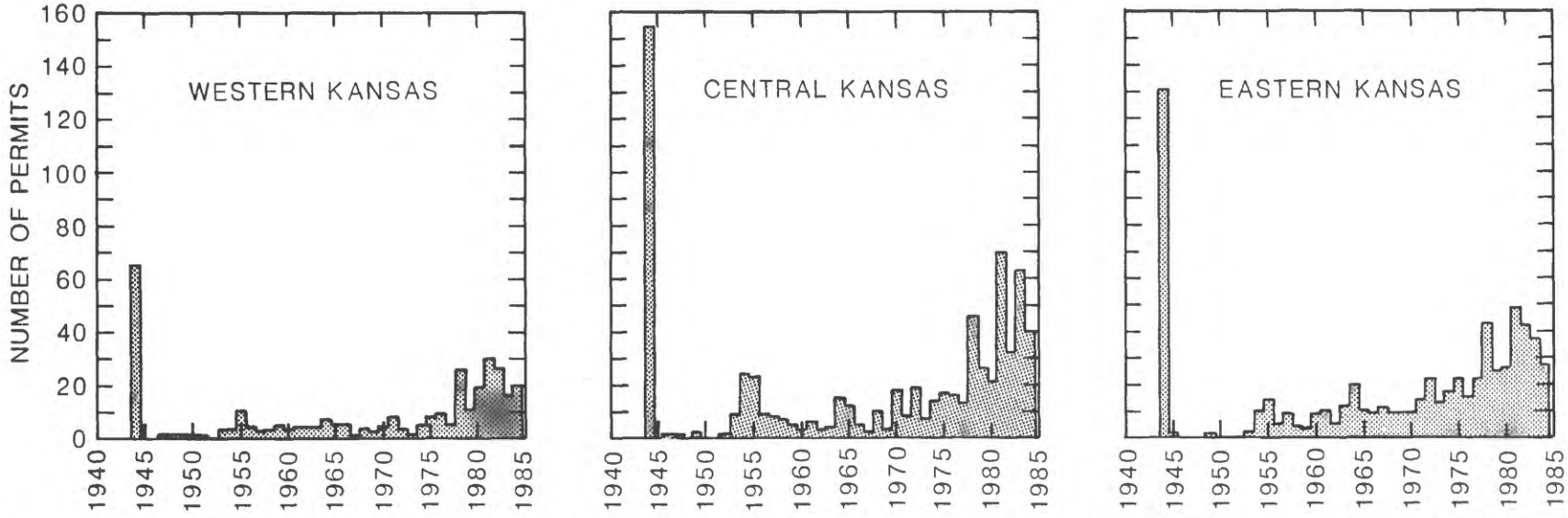


Figure 12.--Number of permits issued to appropriate water for public supply, 1944-84.

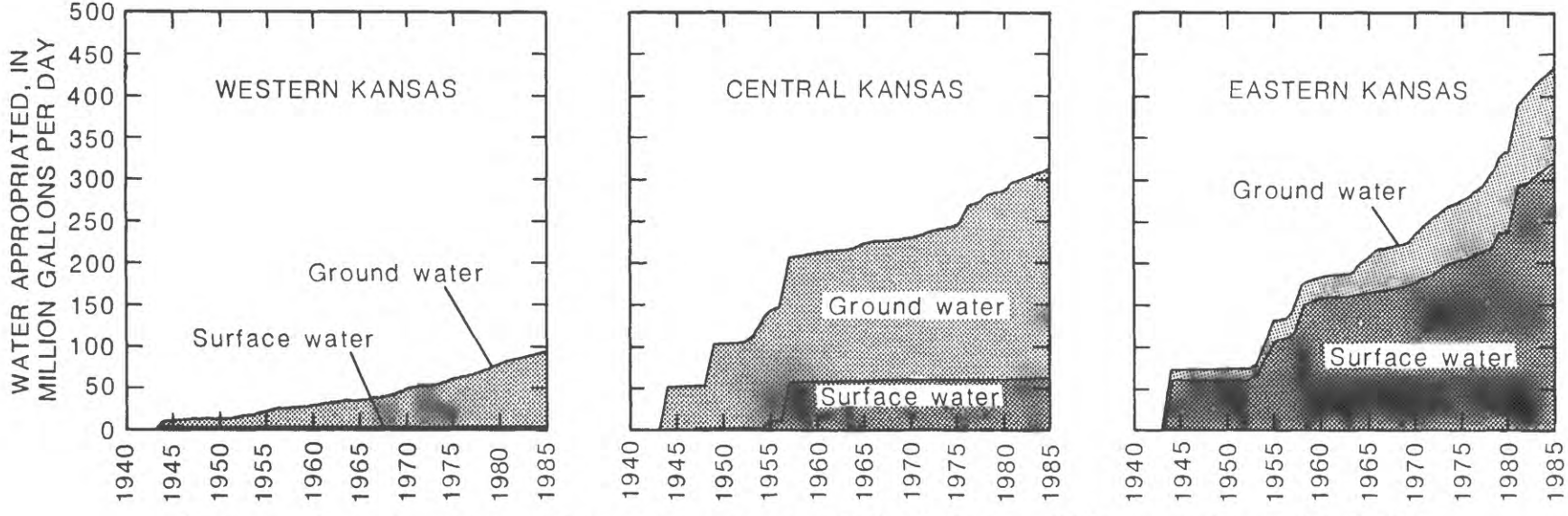


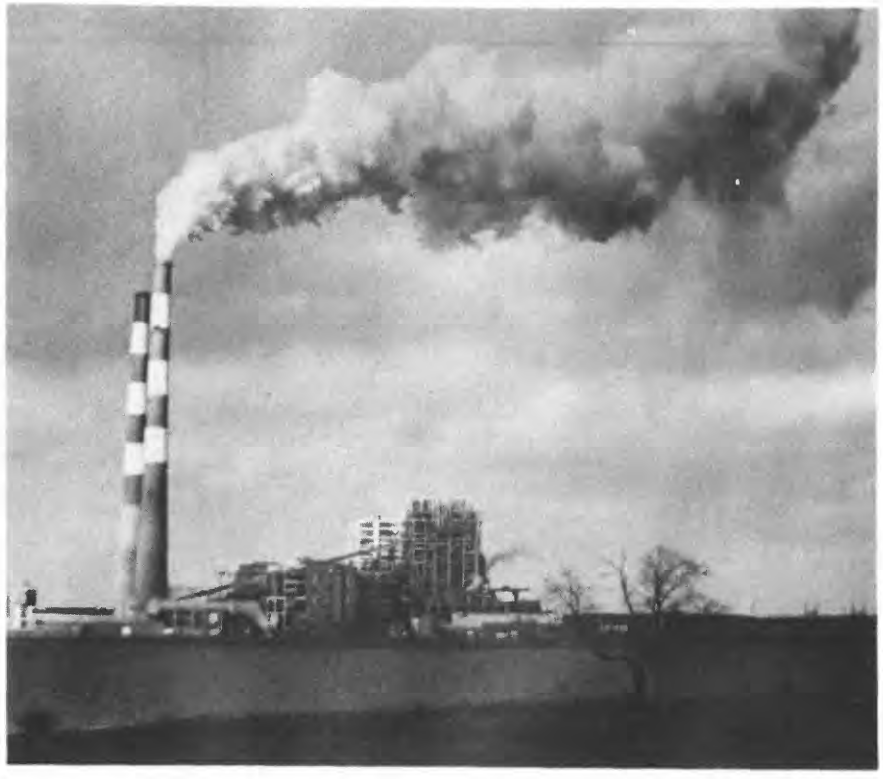
Figure 13.--Amount of water appropriated for public supply, 1944-84.

Industry

Industrial uses of water in Kansas include mining, manufacturing, petroleum production and refining, thermoelectric power generation, chemical production, and food processing. Industrial water demands and the sources sought to satisfy them are highly variable among industries and through time; many are served by municipal supplies. During 1984, water appropriated for self-supplied industries in Kansas comprised 6 percent of the amount appropriated for the three major categories of use. Nearly equal volumes of surface and ground water were appropriated for industrial use; however, as in all water-use categories, patterns of water demand vary geographically.

Most of the demand for industrial-water appropriations has been in the eastern and central areas of the State, where major population centers and industries that use large quantities of water are located. The greatest number of permits to appropriate water for industrial use have been issued in central Kansas (fig. 14), although approximately twice the volume of water has been appropriated for industrial use in eastern Kansas as in central Kansas (fig. 15). Because the average amount of water approved per permit is greatest in the eastern part of the State, increases in total appropriations tend to be prominent. Most of the water appropriated during the last 40 years in central Kansas has been for industries supplied by ground water due to its greater reliability. In eastern Kansas, where the availability and reliability of streamflows are greater, surface-water sources have supplied about 75 percent of the total demands.

Ground water is the source for virtually all self-supplied industrial water appropriated in western Kansas. While numbers of permits to appropriate water for this category are comparable to those in eastern Kansas, the volumes are smaller owing to differences in types of industry.



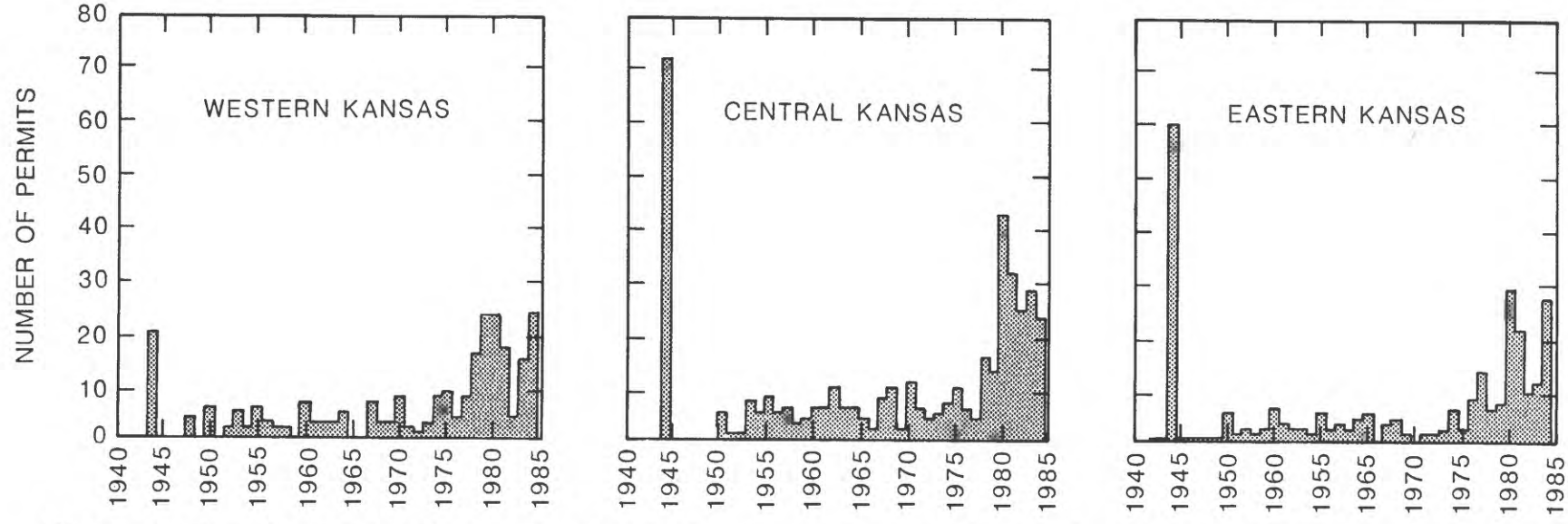


Figure 14.--Number of permits issued to appropriate water for industry, 1944-84.

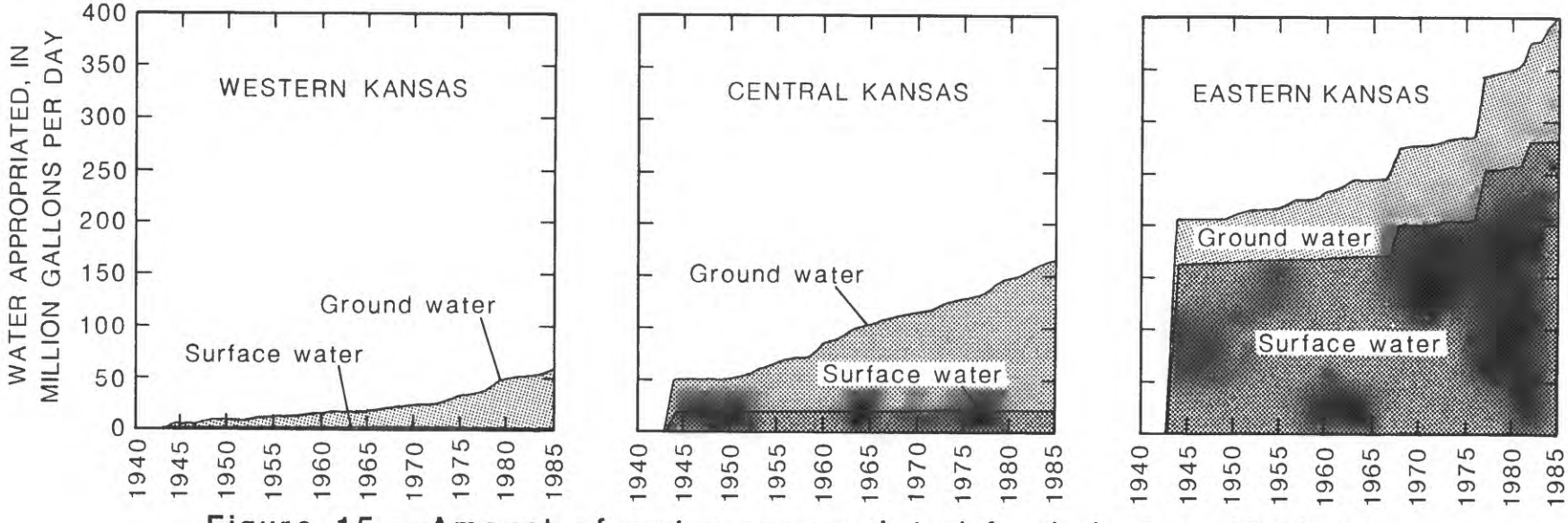


Figure 15.--Amount of water appropriated for industry, 1944-84.

WATER MANAGEMENT

Kansas is a state with large demands on finite supplies of good-quality water and limited information on what proportions of these demands are real: the maximum amounts of water that users may divert legally are known but not the amounts actually needed or used. The institution to administer water appropriations was established by the State of Kansas on the fundamental premises of beneficial use and legal water rights. As of 1984, 29,000 rights to appropriate water for irrigation, public supplies, and industry were recognized by the Division of Water Resources. A total of 10,863 Mgal/d were appropriated on these permits, a volume greater than either reported or estimated water used.

Water-use data are essential to many aspects of water-rights management. The direction of research into methods to obtain better data is indicated by analysis of past and current trends in water appropriations for primary use categories and their geographical distribution. In Kansas, the most imperative need for water data focuses on irrigation-water requirements and ground-water pumpage in the western and central areas of the State.

SUMMARY

The allocation of Kansas' water supplies is an issue of increasing importance as demands for water approach or exceed actual amounts available. Examination of patterns of water appropriations--during the 40 years that water rights have been issued, within three general areas of the State, and by category of use--indicates trends basic to an understanding of water issues facing Kansans today. To summarize:

(1) Kansas water law is grounded in the appropriations doctrine, whereby all waters belong to the people and are allocated by a water-rights system on a "first-in-time, first-in-right" basis to those who demonstrate beneficial use of the resource.

(2) Issuance and regulation of water rights, reasonably accurate reporting of actual water use, and efficient storage and dissemination of data are vital to the utility of the State water-use program.

(3) As of 1984, a total of 10,863 Mgal/d had been appropriated on 29,000 water rights for irrigation, public supply, and industrial use. Appropriated amounts of water are about 2 1/2 times as large as reported use, and about twice as large as estimated use. These ratios vary with the category of use and source of water. Fair and responsible allocation of water supplies involves acquisition of reasonably good information on the actual water needs of the State.

(4) With efforts to realistically evaluate present and future water use comes the recognition that demands are affected by many factors, including economics, climate, legislation, and demographics. Division of the State into western, central, and eastern areas is useful in analyzing the distribution of water needs and sources.

(5) Appropriations for irrigation water represent the largest demand on Kansas' water resources; most of this demand is for ground water in the western and central areas of the State. The importance of irrigation to a state that relies on declining groundwater reservoirs to supply a majority of its needs warrants further study to determine the amounts of water used, amounts actually needed, and amounts over-appropriated.

(6) Excluding water appropriated for irrigation, surface- and ground-water resources supply nearly equal amounts of water for major needs in Kansas. These demands, however, are distributed unevenly throughout the State. Demands for surface water have increased substantially only in the eastern part of Kansas for self-supplied industries and public supplies. Elsewhere and for other type uses, most of the water demands are met by ground water.

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