2-1983

An Inventory of Public, Industry, and Power-generating Water Use in Nebraska, 1979 and 1980

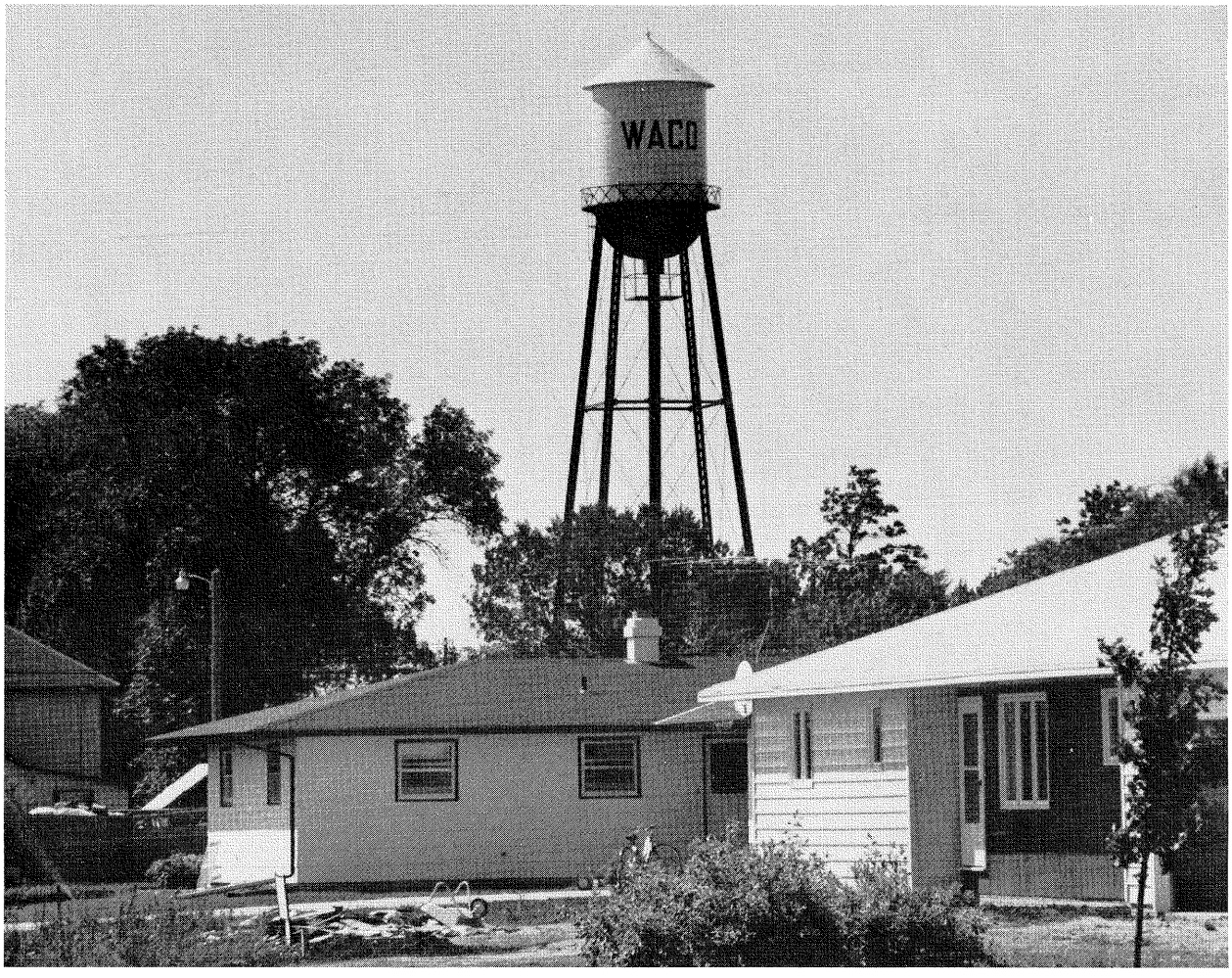
Dennis R. Lawton
University of Nebraska- Lincoln

Cynthia L. Veys
University of Nebraska-Lincoln

Owen Goodenkauf
University of Nebraska - Lincoln

An Inventory of Public, Industrial, and Power-generating Water Use in Nebraska, 1979 and 1980

DENNIS R. LAWTON
CYNTHIA L. VEYS
OWEN GOODENKAUF



Prepared in cooperation with the U.S. Geological Survey
NEBRASKA WATER SURVEY PAPER 54

An Inventory of Public, Industrial, and Power-generating Water Use in Nebraska, 1979 and 1980

Dennis R. Lawton
Cynthia L. Veys
CONSERVATION AND SURVEY DIVISION
Owen Goodenkauf
NEBRASKA DEPARTMENT OF HEALTH

Prepared in cooperation with the U.S. Geological Survey

NEBRASKA WATER SURVEY PAPER 54

Conservation and Survey Division

Institute of Agriculture and Natural Resources

The University of Nebraska–Lincoln

February 1983

CONTENTS

TABLES

FIGURES

Units of measurement in this report are those of the United States customary measurement system. To convert such units to those in the International System of Units, the following factors should be used:

United States System		Factor		International System
feet.....	X	0.304 8	=	meters
miles.....	X	1.609	=	kilometers
acres.....	X	0.404 7	=	hectares
acre-feet.....	X	1 233	=	cubic meters
gallons.....	X	3.785	=	liters
million gallons per day	X	43.81	=	liters per second

INTRODUCTION

This report presents data summarizing amounts of water withdrawn and used in Nebraska by public supplies, self-supplied industries, and power-generating facilities during the calendar years 1979 and 1980. The data were collected and compiled as part of a new water-use data collection program for Nebraska developed and coordinated by the Conservation and Survey Division in conjunction with the U.S. Geological Survey's National Water-Use Information Program.

The National Water-Use Information Program began in 1977 in an effort to obtain for all states accurate information on water withdrawal and use for various purposes. Previously, the U.S. Geological Survey prepared summaries of the nation's water use at five-year intervals, beginning in 1950. These summaries were published in U.S. Geological Survey Information Circulars entitled "Estimated Use of Water in the United States" (Mac Kichan, 1951 and 1957; Mac Kichan and Kammerer, 1961; Murray, 1968; Murray and Reeves, 1972 and 1977). Sources of information included in these reports were not always well documented and the methods for collecting and reporting the information were not the same for all states. Moreover, it may not be adequate for water planning and management purposes to have information available only for every fifth year. The main objective of the National Water-Use Information Program, therefore, is to obtain well documented data in a standardized format and on an annual basis. The data will be stored and maintained in a computer data base called the National Water-Use Data System (NWUDS). Decision makers can then use these data in planning the optimum utilization and management of the nation's water resources.

The Conservation and Survey Division prepared, in conjunction with the five-year reports of the U.S. Geological Survey, reports summarizing water use in Nebraska for 1965, 1970, and 1975. These reports were published as Nebraska Water Survey Papers entitled "Availability and Use of Water in Nebraska" (Shaffer, 1966 and 1972; Bentall and Shaffer, 1979). Many of the water-use data summarized in these reports were estimates similar to those used in the

national reports; consequently, the sources, accuracy, and reliability of the data are not well documented.

The objective of the new Nebraska Water-Use Data Program, which began in 1978, is to develop well documented methods and procedures for the continuous collection of the most accurate and reliable water-use data available. Although collection and compilation of data are planned for other categories of use in Nebraska (such as irrigation, mining, self-supplied commercial, and recreation), initial efforts were focused on the three categories presented in this report -- public supplies, self-supplied industries, and power-generating facilities. Whether current data-collection activities in Nebraska and development of data collection procedures for other use categories continue depends primarily on the availability of future funding for water-use data collection.

Attempts were made to coordinate data collection with existing programs of other state agencies. Unfortunately, Nebraska has few legal requirements for reporting water withdrawals and water use in the state. As a result, effective coordination was possible only in collection of public supply data which was coordinated with the Division of Environmental Engineering of the Nebraska Department of Health. In parts of the state designated as Groundwater Control Areas or Groundwater Management Areas, the local natural resources district can require reporting of groundwater withdrawals. Currently, there are three groundwater control areas in the state and all of them require, or will require, some reporting of groundwater withdrawals. The Nebraska Department of Water Resources administers two state regulatory programs pertaining to water withdrawals in the state. These are the registration of wells and issuance of stream appropriate permits. Although the Department of Water Resources does not require reporting of annual withdrawals by registered wells, it could -- if necessary for water rights administration -- require the measurement and reporting of stream diversion totals. At present, only some diversions for hydroelectric plants are reported by the department; whereas, stream diversions for public supply systems, self-supplied industries, and thermoelectric power-generating facilities are not.

The 1979 and 1980 water withdrawal totals summarized in this report were compiled by collecting data from individual public-supplies, self-supplied industries, and power-generating facilities. Such data from individual facilities are called site-specific data. The site-specific data were

aggregated to obtain state, county, and hydrologic unit totals for the respective use categories. So that aggregated totals could be most accurately determined, estimates were made for individual facilities not having data. For public supplies and self-supplied industries, only the aggregated totals are included in this report. Because there are so few power-generating facilities and because their use is in many cases quite large, site-specific data are presented for individual generating plants.

In addition to the 1979 and 1980 withdrawal and use estimates, published estimates of water use for earlier years and projected uses for 1980 (which projections were made in 1970) are given for comparative purposes. Water-use estimates for 1965, 1970, and 1975 are from reports of the Conservation and Survey Division (Shaffer, 1966; Shaffer, 1972; Bentall and Shaffer, 1979). Estimates for late 1960s and early 1970s and the projected estimates for 1980 are from the Nebraska State Water Plan Framework Study (Nebraska Soil and Water Conservation Commission, 1971). It should be noted that the compilations of water-use estimates for the 1965, 1970, and 1975 water-use reports were done with less available effort and funding than were the 1979 and 1980 estimates. Comments in this report related to the detail and accuracy of those previous estimates certainly recognize those limitations and are not meant to be critical. Comparison of the estimates for 1979 and 1980 to the estimates for the previous years is important in that the previous estimates most probably have been used extensively in water-resource planning studies.

So that readers can acquire a better perspective of total water withdrawal and use in Nebraska, data from this report for 1980 (for public-supplies, self-supplied industries, and power-generating facilities) and estimates of use during 1980 for irrigation and for rural domestic and livestock purposes are summarized in the table on the following page. The estimates for irrigation use and rural domestic and livestock use were made by the U.S. Geological Survey to be included in its 1980 national summary. Not included in the table are uses by self-supplied commercial facilities, such as restaurants, gas stations, recreations areas, and campgrounds; mining facilities, including sand and gravel operations and secondary oil recovery operations; and other miscellaneous using facilities. The use categories that are included in the table are the same categories for which water-use estimates were reported in the 1965, 1970, and 1975 water-use reports (Shaffer, 1966; Shaffer, 1972; Bentall and Shaffer, 1979). However, the reader is cautioned

about comparing the values for 1980 to values reported for the previous years without first reviewing the remainder of this report, which includes detailed discussions about such comparisons. The comparisons are made only for the three use categories addressed in detail in this report.

	1980 Water Use (Millions of gallons per day)		
	Surface Water	Groundwater	Total
Public supply	67.3	237.4	304.7
Self-supplied industrial	7.2	41.2	48.4
Thermoelectric power generation	2,527.7	25.2	2,552.9
Rural domestic and livestock	23.2	142.5	165.7
Irrigation	2,578.5	6,714.2	9,292.7
	5,203.9	7,160.5	12,364.4
Hydroelectric power generation	5,949.2		5,949.2

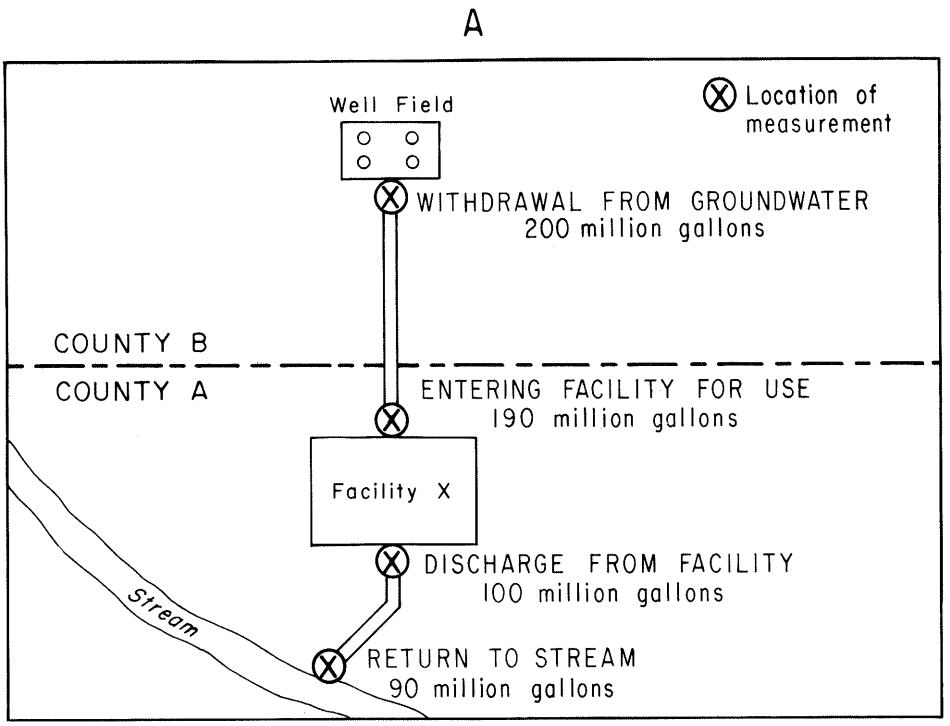
Water use for the three use categories included in this report accounts for about one-quarter of the total estimated water use in the state during 1980 (not including hydroelectric power generation). Irrigators withdraw by far the largest amount of water for any single use in Nebraska. Because this use is so large and there are tens of thousands of individual users, establishment of a comprehensive statewide data collection program is difficult. Future emphasis of water-use data collection activities most likely will be focused on withdrawals for irrigation.

The cooperation and efforts of many persons were necessary to collect and compile the 1979 and 1980 water-use data. Cooperation of the water users in supplying the requested information is greatly appreciated, especially considering that any new data collection program is subject to skepticism and close scrutiny. Those persons supplying data included many municipal officials and employees, and many manufacturing and power industry officials and representatives. The efforts of the Department of Health (Division of Environmental Engineering) field personnel in collecting public supply data is gratefully acknowledged. Also deserving mention are Eileen Reno and Doug Gilg, who aided in collecting and compiling much of the data, and Melba Stemm, who prepared the many tables.

TERMINOLOGY

Proper definition of terminology used to summarize information about water withdrawal and water use is important. Inadequate definition of such terms as water use, which may differ among publications, can result in erroneous comparison of data. Also, the relations between the withdrawal, transmission, and use of water are sometimes complex and difficult to describe accurately in summary reports.

A schematic diagram of a hypothetical water withdrawal and use scenario is shown in figure 1a. The diagram is an aid in defining the terminology used in this report. Facility X, which is located in County A, withdraws 200 million gallons of water from a well field located in County B. Ten million gallons of water is lost during transmission from the point of withdrawal to the point of use. Thus, only 190 million gallons actually are available for use. Discharge from facility X, after use, amounts to 100 million gallons, 10 million of which is lost during transmission to the point of return to the stream. The difference between the 190 million gallons entering the facility and the 100 million gallons leaving the facility often is considered to be consumptive use, or water that is incorporated in a product or lost to evaporation and, thus, not immediately returned to the hydrologic system. To summarize the hypothetical situation, 200 million gallons were withdrawn, 190 million gallons were used, 90 million gallons were consumptively used, 90 million gallons were returned, and 20 million gallons were lost in transmission. If measurements were available only at the point of withdrawal and the point of return, the 20 million gallons of transmission losses would be counted as consumptive use. In some cases, withdrawals or returns may occur at the same location as the use; thus, there are no transmission losses. Also, if facility X is a town rather than an industry, some of the 90 million gallons of consumptive use actually may be transmission losses within the distribution system. This lost water might be considered a return, rather than a consumptive use. Whether transmission



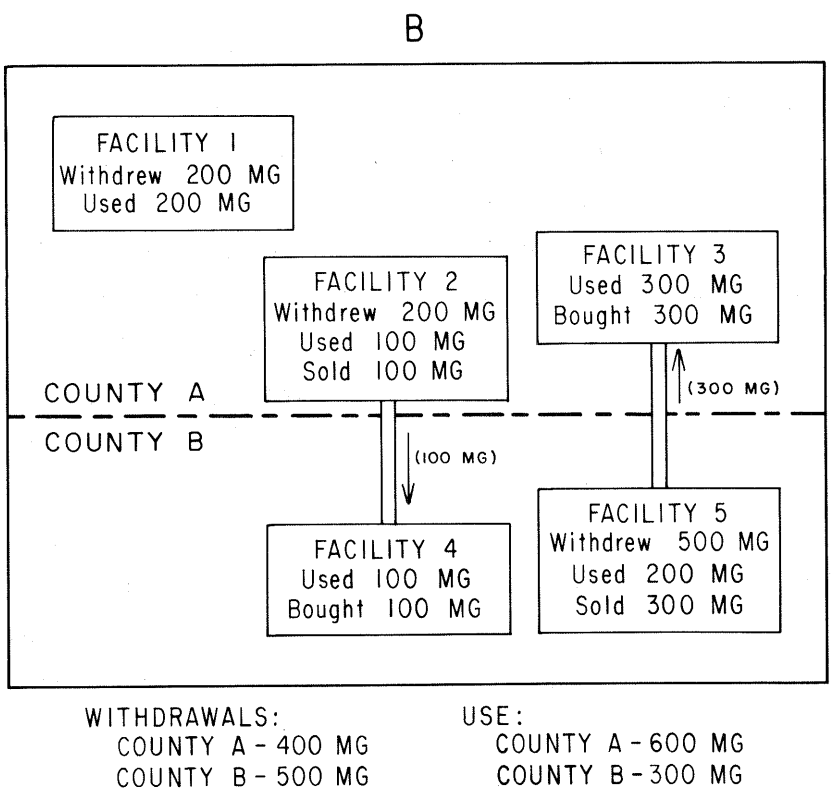


Fig. 1. Hypothetical water withdrawal and use scenarios

losses are considered returns or consumptive use depends on whether the water is considered to be returned to the hydrologic system for future use.

So that a detailed accounting of water withdrawal and use can be made, as shown in figure 1a, measurements must be available for all locations indicated. Unfortunately, such measurements rarely are available. The basic data collected as part of the Nebraska Water-Use Data Program for inclusion in this report are amounts of water withdrawn, either from wells or from streams and canals. Information about transmission losses or consumptive use, for the most part, is not available and could not be summarized. Except in the case of certain power-generating facilities, the terms withdrawal and use are essentially synonymous; that is, all water withdrawn is considered to be used. The only place in the report where different values are given for withdrawal and use is in the tables of county totals for public supplies. The different values for withdrawal and use take into account the withdrawal of water from one county and its use in another county. An example of the distinction between withdrawal and use is shown in figure 1b. State totals for withdrawal and use are not the same because one town withdraws water in Nebraska and sells it in Iowa and another town withdraws water in Kansas and uses it in Nebraska. Population distributions for towns included in more than one hydrologic unit are difficult to determine; therefore, distinction between use and withdrawal was not made for hydrologic units. All self-supplied industries used water in the same county or hydrologic unit from which they withdrew it; thus, withdrawal and use totals are the same for self-supplied industries.

The distinction between the terms withdrawal and use for hydroelectric power-generating plants is somewhat different. At on-stream plants, water passes through the turbines without being removed from the stream. Essentially no consumptive use occurs and the water generally is not considered to be withdrawn from the stream. At off-stream plants, an initial diversion, or withdrawal, is made from a stream into a canal. The generating plants generally are located on the canal and do not withdraw any water from it. In some cases the canal water is used at more than one hydroelectric plant along a canal and in some cases it is used for other purposes, either before or after its use for hydroelectric generation. In this report, all water that is discharged through the turbines at both off-stream and on-stream plants is considered to be use. A value for withdrawal of water by hydroelectric plants is not specified so that confusion with diversions for off-stream plants can

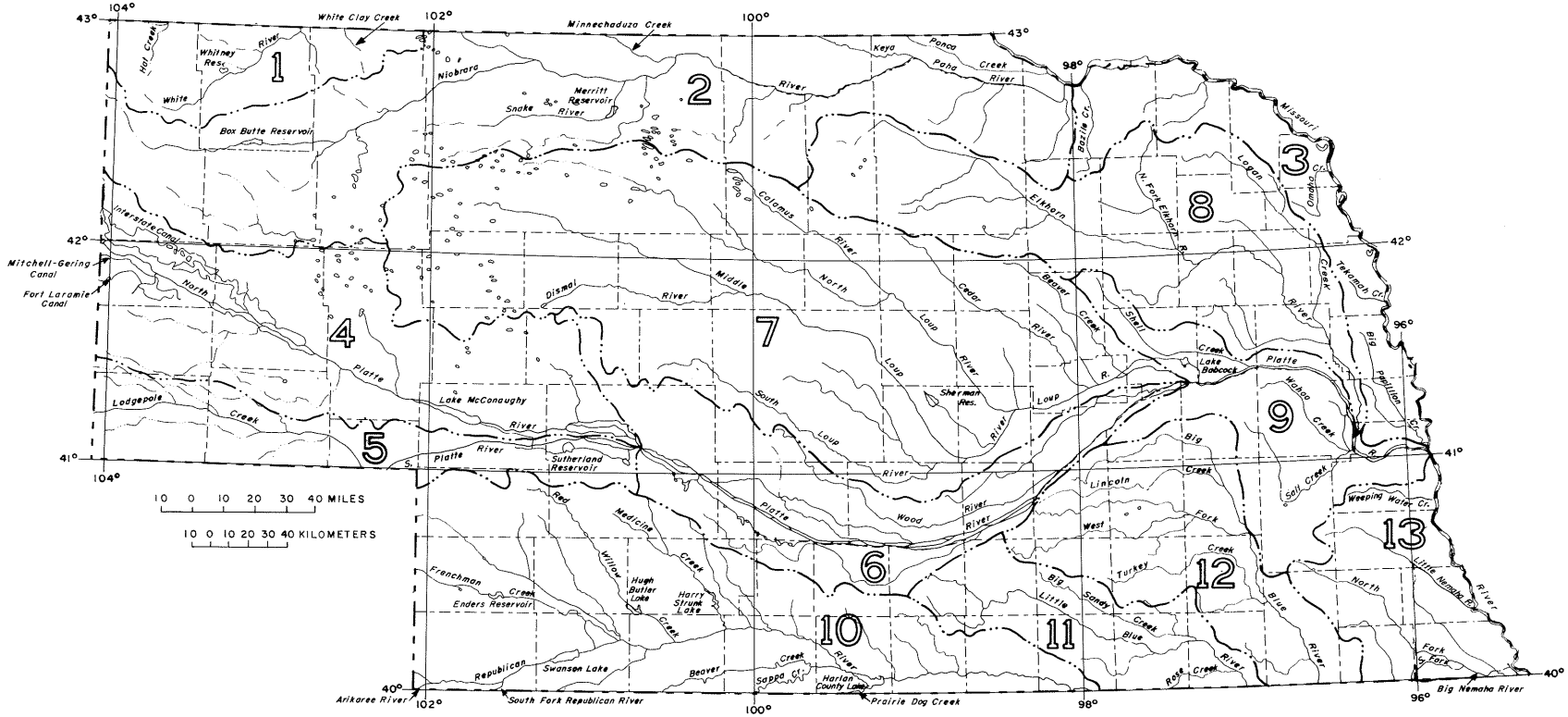
be avoided. However, the corresponding stream diversions for each off-stream plant are listed in the tables.

Two thermoelectric power-generating-plants withdraw water from canals that divert water for hydroelectric generation and for irrigation. The withdrawal amounts listed for those plants are the withdrawal from the canal, apart from any consideration of the original diversion into the canals.

Throughout the text and in the figure titles, we attempted to be consistent in applying the terms use and withdrawal as explained. Consequently, some tables are titled use, some withdrawal, and some withdrawal and use. Although not presented in the report, quantification of amounts of consumptive use and transmission losses is important for a complete understanding of a hydrologic system. Future emphasis should indeed be put on acquiring good data for these parameters.

The water withdrawal and use totals occurring in the various tables within the report are expressed in either millions of gallons, millions of gallons per day, or acre-feet. Except for hydroelectric plants, most original data were reported in millions of gallons. County totals for public supply and self-supplied industrial withdrawal and use are presented in millions of gallons. For hydrologic units, all totals were calculated in millions of gallons and then converted to millions of gallons per day. The data are presented in millions of gallons per day because this unit commonly has been used in similar tables in previous state and national reports. However, it should be noted that millions of gallons per day is a rate term that indicates an average daily rate of withdrawal or use for a year. If withdrawal and use do not occur every day of the year, the actual daily rates may be much greater than the total annual use expressed in millions of gallons per day. For hydroelectric plants, totals are expressed in both acre-feet, the unit in which the data are commonly reported, and millions of gallons per day. For quick reference in state summary tables, totals are presented in millions of gallons, millions of gallons per day, and acre-feet.

Boundaries of the 13 hydrologic units, for which water withdrawal and use totals are summarized, are shown in figure 2. The hydrologic units are the same as the 13 subregions used in the 1970 and 1975 Nebraska water-use reports (Shaffer, 1972; Bentall and Shaffer, 1979). Most hydrologic-unit boundaries correspond to hydrologic subregion (4-digit code) boundaries, which are part of the classification used by the U.S. Geological Survey for indexing



Hydrologic Unit (River Drainage Basin)	Corresponding U.S. Geological Survey Hydrologic Unit code
1. Hat Creek-White River-White Clay Creek	subregions 1012 and 1014
2. Niobrara River and Ponca Creek	subregion 1015
3. Missouri River tributaries	subregions 1017 and 1023
4. North Platte River	subregion 1018
5. South Platte River	subregion 1019
6. Middle Platte River	accounting unit 102001
7. Loup River	subregion 1021
8. Elkhorn River	subregion 1022
9. Lower Platte River	accounting unit 102002
10. Republican River	subregion 1025
11. Little Blue River	cataloging unit 10270206
12. Big Blue River	subregion 1027 (except cataloging unit 10270206)
13. Weeping Water Creek-Little Nemaha River-Big Nemaha River	subregion 1024

Fig. 2. Hydrologic units in Nebraska

all hydrologic data, including data in the National Water-Use Data System. Exceptions are: the Hat-White-White Clay hydrologic unit, which includes two subregions; the Middle Platte and Lower Platte hydrologic units, which correspond to accounting-unit (6-digit code) boundaries; and the Little Blue hydrologic unit, which corresponds to a cataloging-unit (8-digit code) boundary. The corresponding subregion, accounting unit, and cataloging unit code numbers and the commonly used name for each of the hydrologic units are included in figure 2. The code numbers are presented to enhance familiarity with the nationally standardized classification. Within the text, however, hydrologic units are referred to by their common names.

PUBLIC SUPPLIES

A public water-supply system, as defined by the National Interim Primary Drinking Water Regulations (EPA, 1976), serves at least 15 service connections or serves an average of 25 or more individuals daily for a minimum of 60 days. A community system is defined as serving the above stated connections or residents on a year-round basis; all other public supply systems are considered to be noncommunity systems. As part of its responsibility for enforcing the Federal Safe Drinking Water Act, the Nebraska Department of Health regulates the operation of all public water-supply systems in the state. The Department of Health has the regulatory authority under the Nebraska Safe Drinking Water Act to require reporting of water withdrawals by public supply systems.

Prior to the 1979 and 1980 inventories, few public water-supply systems reported their annual water withdrawals. Twenty-nine municipalities annually report their average daily and maximum daily withdrawal to the Nebraska Department of Water Resources as a condition for maintaining a permit under the City, Village, and Municipal Corporation Ground Water Permit Act. Acquisition of such a permit, however, is not required. In addition, 43 municipal systems that fluoridate their water supply (including some systems that report to the Department of Water Resources) are required to provide monthly pumpage reports to the Department of Health.

Data Collection

The master file of public water-supply systems maintained by the Department of Health was used as the official list of public water supplies. Community systems were categorized as either municipal or nonmunicipal. Municipal systems include villages, cities, and rural water districts. Nonmunicipal systems include mobile-home parks, subdivisions, institutions, and all other community water systems. Most noncommunity public water-supply

systems are included in the self-supplied commercial use category, which is not included in this report.

The 1979 inventory of public water-supply systems was conducted by the field personnel of the Department of Health in cooperation with the Conservation and Survey Division. Most of the data were collected through personal visits, but some were collected by telephone or mail. A total of 473 municipal systems (including 16 rural water districts) and 229 nonmunicipal systems were inventoried. The systems provided either metered withdrawal data or estimates made by water system operators, or they were not able to provide any withdrawal information. To make estimates, they most frequently added individual customer meter readings or made calculations based on power consumption of well pumps. Other general information collected as part of the inventory included storage capacity, type of treatment, water rates, population served, and amounts of water purchased from or sold to other water systems.

For the 1979 inventory, 182 of the 473 municipal systems provided metered data and 68 systems provided estimates. Systems having metered data accounted for about 88 percent of the total population served by municipal systems and systems providing estimates accounted for an additional 3 percent. The 223 municipal systems that did not provide any water withdrawal information accounted for only 9 percent of the population served by municipal systems. Only 26 of the 229 nonmunicipal systems provided either metered data or estimates. So that aggregated water withdrawal totals could be compiled for counties and hydrologic units, general estimates were made for facilities not having data. For municipal systems, the population served was multiplied by an average per capita use that was computed from systems having metered data. Use values of 233 gpcd (gallons per capita per day) and 201 gpcd were used for towns having populations of less than 2,000 or more than 2,000, respectively. A similar approach was used for nonmunicipal systems; however, populations first were estimated for some systems. An average of 175 gpcd was used for nonmunicipal systems. Population estimates for trailer parks and subdivisions were based on three persons per dwelling and 40 dwellings per system; whereas, estimates for institutions were based on 25 persons per building and 15 buildings per facility.

For the 1980 inventory, a survey form was mailed to all systems having meters and reliable records. Department of Health field personnel visited most systems having meters but inadequate records. These personnel, in

addition to collecting available data for 1980, aided the systems in establishing adequate record-keeping procedures. So that the general water system information could be updated, survey forms were sent to towns that had no meters and had a population greater than 500. Nonmunicipal systems and towns not having meters or reliable records and having populations less than 500 were not inventoried.

During 1980 a total of 475 municipal systems were in operation. The 237 systems that provided either metered or estimated data accounted for about 92 percent of the population served by municipal systems. For 54 systems that provided metered or estimated data in 1979 but did not provide data in 1980, the reported withdrawal was increased by 10 percent to obtain a 1980 estimated withdrawal. The 10 percent increase corresponds to the average calculated increase from 1979 to 1980 for systems that provided metered data. Withdrawals for the 184 systems not providing data for 1980 were estimated by the same method used in making the estimates for 1979. All systems for which 1980 estimates were made had populations less than 1,800; therefore, the estimates were based on an average use of 264 gpcd for all systems. Since nonmunicipal systems were not inventoried in 1980, their 1979 withdrawal values were increased by 10 percent to obtain estimates for 1980.

Inventory Results

Total estimated water withdrawals by public water-supply systems during 1979 and 1980 were 271.3 and 304.7 mgd (million gallons per day), respectively (table 1). These systems served approximately 80 percent of the state's total population. The increase in withdrawals from 1979 to 1980 does not necessarily indicate a trend of increasing water use. The average state precipitation was 31 percent less in 1980 than in 1979 and was 26 percent less during April-September when water use for irrigating lawns and gardens was greatest (NOAA, 1979 and 1980). In addition, the average temperature for the state was 3 degrees Fahrenheit higher in 1980 than in 1979 (NOAA, 1979 and 1980). The greater water withdrawals in 1980 resulted possibly from increased use related to lesser precipitation and higher temperatures.

Aggregated totals by counties and hydrologic units are shown, respectively, in tables 2 and 3. Also included in the tables are population data and information about the total number of systems within each county or hydrologic unit and the total number of systems that provided metered or estimated data.

Groundwater accounted for approximately 78 percent of the total water withdrawn by public supplies in both 1979 and 1980 (table 1). The Lincoln water system, which withdrew 36 mgd in 1980, was the largest municipal system to rely solely upon groundwater. The Metropolitan Utilities District (M.U.D.), which serves the Omaha area, used a combination of surface water and groundwater. M.U.D.'s groundwater pumpage for 1980 was 39 mgd, which accounted for about 40 percent of its supply. Lincoln's and most of M.U.D.'s groundwater withdrawals were in the Lower Platte hydrologic unit which had the largest withdrawal of groundwater for public supplies of any hydrologic unit. Although M.U.D.'s withdrawal is in the Lower Platte hydrologic unit, almost all the water is used in the Missouri tributaries hydrologic unit. Lincoln transports its water about 23 miles, but uses it within the same hydrologic unit from which it is withdrawn.

Chadron, Crawford, and M.U.D. were the only municipal systems withdrawing surface water in 1979 and 1980. Crawford relied on water from the White River and Dead Man Creek as its source of supply. Chadron, which used a combination of surface water and groundwater, depended on Chadron Creek for its surface-water supply. M.U.D., which pumped 66 mgd in 1980 from the Missouri River, accounted for approximately 98 percent of the total surface water withdrawn for public supplies within the state.

Nonmunicipal systems accounted for about 3 percent of the total water withdrawn for public supplies in both years. Beaver Lake, in Cass County, was the only nonmunicipal system that used surface water.

Withdrawals by rural water districts accounted for about 1 percent of the total withdrawals by public supplies in both 1979 and 1980. In addition to the 2.1 mgd the rural water districts withdrew in 1980, they bought 1.1 mgd from towns. The rural water districts, on the other hand, sold 0.5 mgd to towns while delivering 2.7 mgd to rural customers in 1980.

Statewide water use, based on reported withdrawal data, averaged 215 gpcd (gallons per capita per day) in 1979 and 239 gpcd in 1980. Per capita use differed greatly from place to place within the state, the extremes not being

confined to any particular area. The lowest reported per capita use for the two-year period was 67 gpd (gallons per day) for a town that purchased its entire supply from a rural water district. The highest reported per capita use was 989 gpd for a town having no meters on individual service connections and a flat monthly water rate (a set charge not dependent on consumption). Shown below is an analysis of 1979 per capita water use for 230 towns that had either metered data or reliable estimates.

Range in average use (gpcd)	Number of towns	Number of towns having flat rates	Number of towns having metered rates	Percent of towns having metered rates
50-100	23	3	20	87
101-150	41	6	35	85
151-200	47	5	42	89
201-250	39	12	27	69
251-300	32	15	17	53
301-350	20	10	10	50
351-400	5	4	1	20
401-450	3	1	2	67
451-500	4	4	0	0
>500	16	14	2	12
Total	230	74	156	68

The effect of metered rates on per capita consumption is pronounced. More than 85 percent of the towns in the three lowest use ranges had metered rates, whereas only 17 percent of the towns in the three highest use ranges had metered rates. Many of the towns having low per capita use bought their water from rural water districts, which had high metered rates. Likewise, most towns having high per capita use had low monthly flat rates.

Estimates for Earlier Years and Projections for 1980

Published estimates of public supply water use for 1965, 1969, 1970, and 1975, the 1979 and 1980 estimated use, and a previously published projection of use for 1980 are given in table 4. The 1969 estimate, from the State Water Plan Framework Study, was based on an inventory by the U.S. Department of Health, Education, and Welfare in 1963 (HEW, 1964). However, details of how

the 1969 estimates were derived are not documented. The projections for 1980, also from the State Water Plan Framework Study, are based on projected population estimates and estimated per capita consumption. Specific sources of the 1965, 1970, and 1975 estimates, published by the Conservation and Survey Division, are not documented. The 1965 estimates include water use at municipal thermoelectric power plants, whereas the 1969, 1970, and 1975 estimates apparently do not. It appears that the 1975 estimates may have been obtained by interpolation between the 1969 or 1970 estimates and the projections for 1980. As mentioned previously, the 1979 and 1980 figures are aggregations of site-specific data, both metered or estimated, for each facility. The earlier estimates were all reported as use, not as withdrawal. The difference between use and withdrawal because of M.U.D.'s transfer of water across hydrologic unit boundaries was published in the 1975 water use report. Similar calculations are included for 1970 (table 4) based on M.U.D.'s reported withdrawals (M.U.D., 1981). For comparative purposes, the 1979 and 1980 withdrawal values in table 4 were changed to account for M.U.D.'s withdrawal and transfer. Transfers of water among other hydrologic units are not accounted for but they are assumed to be small.

Because the sources of data for estimates for the previous years are not well documented and partly because annual variations cannot adequately be evaluated when data are available for five-year intervals only, it is difficult to predict possible trends in water use by evaluating the data in table 4. Most likely, total public supply use has increased over the last 10 to 15 years because of increased population, increased per capita use, and an increased number of public water-supply systems. However, the actual rate of increase in water use cannot be determined with confidence from the data presented in table 4. Also, differences in water use from year to year may be related more to climatic conditions rather than to a change in the number of persons served or a general long-term trend of changing water-use habits. As mentioned previously, this may have been the case for the increased use from 1979 to 1980. The projected total use of 341.6 mgd for 1980, which was published in 1971, appears to be high, even if possible annual variations are taken into account. The 1975 estimates also may have been too high if they are interpolated values based on the 1980 projections. The reason for the difference between the 1969 and 1970 estimates is not known, but it may occur because of different methods used in preparing the respective estimates.

In summary, trends in water use for public supply cannot be determined accurately from data for every fifth year only. Without data for intermediate years, one cannot tell whether the year being evaluated represents low, normal, or high usage. Also important is the need to document sources of data or methods used in compiling estimates. Only by annual collection of reliable data can water withdrawals and use by public supplies be documented precisely.

Table 1

Water withdrawal for public supply in Nebraska, 1979 and 1980

	1979			1980		
	Millions of gallons	Acre-feet	Millions of gallons per day	Millions of gallons	Acre-feet	Millions of gallons per day
Total	99,030[2]	303,910	271.3	111,516[3]	342,230	304.7
Municipal[1]	96,461	296,030	264.3	108,690	333,560	297.0
Nonmunicipal	2,569	7,880	7.0	2,826	8,670	7.7
Groundwater	78,275	240,220	214.4	86,892	266,660	237.4
Surface water	20,755	63,700	56.9	24,624	75,570	67.3

1. Municipal includes rural water districts.

2. In 1979, 139.4 million gallons of municipal surface water withdrawn in Nebraska were used in Iowa, and 17.5 million gallons of municipal groundwater were withdrawn in Kansas and used in Nebraska.

3. In 1980, 145.2 million gallons of municipal surface water withdrawn in Nebraska were used in Iowa and 21.1 million gallons of municipal groundwater were withdrawn in Kansas and used in Nebraska.

Table 2a

Municipal public supply withdrawal and use by county, 1979 and 1980

[Differences between water withdrawn and water used are due to water being withdrawn in one county and used in a different county; transmission losses are not accounted for. Ratio of reporting systems to total systems: Upper number in ratio is the number of systems providing metered or estimated data and lower number is the total number of systems in the county. Withdrawal systems: Systems that withdraw water in the county. Use systems: Systems that use water in the county.]

County	1979					1980				
	Water withdrawn (millions of gallons)	Water used (millions of gallons)	Population served	Ratio of reporting systems to total systems: withdrawal systems	Ratio of reporting systems to total systems: use systems	Water withdrawn (millions of gallons)	Water used (millions of gallons)	Population served	Ratio of reporting systems to total systems: withdrawal systems	Ratio of reporting systems to total systems: use systems
Adams	2,470.6	2,439.7	25,073	4/6	3/5	2,830.5	2,779.7	25,092	4/6	3/5
Antelope	386.5	355.3	4,607	2/8	2/8	429.3	409.2	4,645	2/8	2/8
Arthur	0.0	0.0	0	0/0	0/0	0.0	0.0	0	0/0	0/0
Banner	0.0	0.0	0	0/0	0/0	0.0	0.0	0	0/0	0/0
Blaine	15.5	15.5	182	0/1	0/1	17.5	17.5	182	0/1	0/1
Boone	315.7	315.7	3,840	3/5	3/5	348.0	348.0	3,940	5/5	5/5
Box Butte	927.1	927.1	10,880	2/2	2/2	1,153.2	1,153.2	10,888	2/2	2/2
Boyd	56.3	125.6	2,393	3/4	6/7	60.4	145.7	2,273	1/4	4/7
Brown	192.4	192.4	2,753	2/2	2/2	213.9	213.9	2,753	2/2	2/2
Buffalo	2,010.9	2,010.9	26,643	4/8	4/8	2,528.9	2,528.9	26,650	6/8	6/8
Burt	314.1	314.1	5,450	5/5	5/5	366.3	366.3	5,458	5/5	5/5
Butler	306.7	306.7	4,321	1/8	1/8	341.5	341.5	4,321	1/8	1/8
Cass	7,621.5	837.8	15,727	5/11	9/15	7,387.2	871.1	15,712	6/11	10/15
Cedar	370.0	370.0	5,167	7/9	7/9	411.7	411.7	5,227	4/9	4/9
Chase	287.3	287.3	2,681	1/2	1/2	339.3	339.3	2,681	2/2	2/2
Cherry	271.7	271.7	3,412	2/6	2/6	351.5	351.5	3,424	3/6	3/6
Cheyenne	803.4	803.4	7,339	3/5	3/5	894.8	894.8	7,389	2/5	2/5
Clay	277.8	405.2	4,681	0/7	1/8	407.3	548.5	5,593	1/7	2/8
Colfax	410.7	410.7	6,654	3/5	3/5	477.9	477.9	6,654	3/5	3/5
Cuming	487.6	487.6	7,088	4/5	4/5	624.4	624.4	8,292	4/5	4/5
Custer	992.8	992.8	7,902	6/10	6/10	1,104.7	1,104.7	7,960	2/10	2/10
Dakota	816.0	827.4	11,818	2/5	3/6	1,049.4	1,059.3	13,009	1/5	3/7
Dawes-GW	210.1	210.1	3,238	2/2	3/3	138.5	138.5	2,270	1/2	2/3
Dawes-SW	200.6	347.6	4,297	1/1	2/2	251.2	404.4	5,253	1/1	2/2
Dawson	1,799.4	1,799.4	15,718	3/5	3/5	2,245.7	2,245.7	15,871	5/5	5/5
Deuel	169.6	169.6	1,591	1/2	1/2	262.0	262.0	1,626	1/2	1/2
Dixon	331.3	308.6	3,803	3/9	3/9	352.5	332.6	3,894	7/9	7/9
Dodge	1,387.5	1,790.1	28,902	5/8	5/8	1,649.6	2,131.8	29,905	5/8	5/8
Douglas-GW	1,158.8	9,289.0	116,146	6/7	4/5	1,391.4	8,999.1	103,303	6/7	4/5
Douglas-SW	20,353.5	20,214.0	252,000	1/1	1/1	24,160.0	24,004.6	273,000	1/1	1/1

Table 2a (continued)

County	1979 Water withdrawn (millions of gallons)	1979 Water used (millions of gallons)	1979 Population served	1979 Ratio of reporting systems to total systems: withdrawal systems	1979 Ratio of reporting systems to total systems: use systems	1980 Water withdrawn (millions of gallons)	1980 Water used (millions of gallons)	1980 Population served	1980 Ratio of reporting systems to total systems: withdrawal systems	1980 Ratio of reporting systems to total systems: use systems
Dundy	102.6	102.6	1,452	1/2	1/2	173.9	173.9	1,468	1/2	1/2
Fillmore	909.5	782.2	5,027	2/8	1/7	1,082.4	941.2	5,061	2/8	1/7
Franklin	231.5	231.5	2,698	0/7	0/7	260.0	260.0	2,698	0/7	0/7
Frontier	192.4	192.4	1,892	3/5	3/5	179.2	179.2	1,896	3/5	3/5
Furnas	308.3	440.3	4,608	2/6	2/7	314.2	489.8	4,579	3/6	4/7
Gage	1,628.8	1,630.2	17,183	5/9	7/11	1,762.9	1,764.4	17,183	3/9	5/11
Garden	100.9	100.9	1,060	1/1	1/1	100.9	100.9	1,060	1/1	1/1
Garfield	117.5	117.5	1,382	0/1	0/1	120.8	120.8	1,382	1/1	1/1
Gosper	66.7	66.7	784	0/2	0/2	77.7	77.7	806	0/2	
Grant	28.4	28.4	334	0/1	0/1	32.2	32.2	334	0/1	0/1
Greeley	186.3	186.3	1,891	4/4	4/4	224.0	224.0	1,897	3/4	3/4
Hall	2,822.6	2,822.6	36,520	2/5	2/5	3,457.4	3,457.4	36,535	3/5	3/5
Hamilton	483.1	483.1	5,316	2/6	2/6	477.7	477.7	5,316	2/6	2/6
Harlan	319.6	249.3	2,676	1/6	1/6	443.3	339.2	2,676	3/6	3/6
Hayes	19.6	19.6	231	0/1	0/1	25.1	25.1	260	0/1	0/1
Hitchcock	221.5	221.5	2,461	1/4	1/4	307.7	307.7	2,464	2/4	2/4
Holt	677.0	607.7	7,247	5/7	4/6	838.8	753.6	7,247	3/7	2/6
Hooker	163.3	163.3	712	1/1	1/1	179.6	179.6	712	0/1	0/1
Howard	274.7	274.7	3,045	2/5	2/5	307.9	307.9	3,051	2/5	2/5
Jefferson	616.2	610.8	7,154	5/9	6/10	632.6	626.3	7,039	2/9	3/10
Johnson	513.1	416.2	4,280	5/6	5/6	545.4	443.9	4,334	4/6	4/6
Kearney	307.5	307.5	3,877	2/3	2/3	342.8	342.8	3,877	2/3	2/3
Keith	558.0	558.0	6,634	1/3	1/3	608.0	608.0	6,634	1/3	1/3
Keya Paha	23.0	23.0	319	1/1	1/1	25.3	25.3	319	0/1	0/1
Kimball	322.7	322.7	3,574	1/3	1/3	424.1	424.1	3,628	2/3	2/3
Knox	503.9	503.9	6,085	6/11	10/11	603.1	603.1	6,117	4/11	4/11
Lancaster	412.9	12,582.8	178,355	10/15	10/15	637.6	13,604.9	178,829	8/15	8/15
Lincoln	2,127.8	2,127.8	27,074	2/5	2/5	2,514.2	2,514.2	27,073	2/5	2/5
Logan	28.9	28.9	340	0/1	0/1	32.8	32.8	340	0/1	0/1
Loup	0.0	0.0	0	0/0	0/0	0.0	0.0	0	0/0	0/0
McPherson	0.0	0.0	0	0/0	0/0	0.0	0.0	0	0/0	0/0
Madison	1,387.9	1,419.1	24,068	5/6	5/6	1,540.0	1,560.1	23,880	5/6	5/6
Merrick	348.6	348.6	4,512	1/4	1/4	391.1	391.1	4,515	2/4	2/4
Morrill	364.1	364.1	3,294	2/3	2/3	394.7	394.7	3,294	2/3	2/3
Nance	234.2	234.2	2,793	2/3	2/3	253.6	253.6	2,793	1/3	1/3
Nemaha	386.0	372.3	7,553	5/10	4/9	442.3	427.2	6,213	5/10	4/9
Nuckolls	416.6	416.6	4,065	3/5	3/5	435.3	435.3	4,369	3/5	3/5
Otoe	1,060.0	1,024.9	14,359	6/9	10/13	1,244.6	1,202.6	14,508	4/9	8/13
Pawnee	72.2	155.6	3,825	2/2	7/7	80.4	165.0	3,549	2/2	7/7
Perkins	325.3	325.3	1,914	2/4	2/4	270.3	270.3	1,960	2/4	2/4

Table 2a (continued)

County	1979 Water withdrawn (millions of gallons)	1979 Water used (millions of gallons)	1979 Population served	1979 Ratio of reporting systems to total systems: withdrawal systems	1979 Ratio of reporting systems to total systems: use systems	1980 Water withdrawn (millions of gallons)	1980 Water used (millions of gallons)	1980 Population served	1980 Ratio of reporting systems to total systems: withdrawal systems	1980 Ratio of reporting systems to total systems: use systems
Phelps	702.6	702.6	7,086	1/5	1/5	819.9	819.9	7,135	1/5	1/5
Pierce	314.5	314.5	3,945	2/4	2/4	343.4	343.4	3,945	1/4	1/4
Platte	1,279.7	1,279.7	19,776	4/7	4/7	1,396.9	1,396.9	19,839	2/7	2/7
Polk	281.2	281.2	3,442	1/4	1/4	324.2	324.2	3,456	1/4	1/4
Red Willow	1,195.0	1,133.3	9,801	1/6	1/5	1,340.8	1,269.4	9,801	3/6	2/5
Richardson	472.1	485.8	9,714	4/7	7/10	449.7	464.8	9,464	4/7	7/10
Rock	116.9	116.9	1,128	2/2	2/2	142.5	142.5	1,142	1/2	1/2
Saline	620.0	620.0	9,323	3/8	3/8	535.9	535.9	9,411	2/8	2/8
Sarpy	7,993.5	5,645.1	78,759	5/5	5/5	7,870.3	5,609.6	75,231	5/5	5/5
Saunders	12,851.8	663.4	9,990	7/14	6/13	13,728.5	736.6	10,470	7/14	6/13
Scotts Bluff	2,464.3	2,464.3	27,167	3/8	3/8	3,209.0	3,209.0	28,031	4/8	4/8
Seward	701.0	701.0	10,249	8/10	8/10	798.6	798.6	10,428	5/10	5/10
Sheridan	341.0	341.0	4,200	2/3	2/3	360.7	360.7	4,333	3/3	3/3
Sherman	207.1	207.1	1,891	1/3	1/3	284.6	284.6	1,891	1/3	1/3
Sioux-GW	31.3	31.3	368	0/1	0/1	35.5	35.5	368	0/1	0/1
Sioux-SW	147.1	0.0	0	1/1	0/0	153.3	0.0	0	1/1	0/0
Stanton	133.2	133.2	2,002	1/2	1/2	136.3	136.3	2,002	1/2	1/2
Thayer	419.4	442.2	5,180	4/9	6/11	485.1	512.6	5,161	3/9	5/11
Thomas	26.6	26.6	313	0/1	0/1	30.2	30.2	313	0/1	0/1
Thurston	359.5	370.8	3,650	3/5	4/6	388.2	398.1	3,650	2/5	3/6
Valley	321.0	321.0	3,478	2/3	2/3	400.2	400.2	3,478	1/3	1/3
Washington-GW	436.1	436.1	8,864	4/5	4/5	425.7	425.7	8,598	3/5	3/5
Washington-SW	0.0	0.0	0	0/0	0/0	0.0	10.1	366	0/0	2/2
Wayne	344.5	344.5	6,114	3/5	3/5	385.4	385.4	6,114	2/5	2/5
Webster	174.9	205.8	2,483	2/3	2/3	219.0	269.8	2,595	2/3	2/3
Wheeler	34.1	34.1	275	1/2	1/2	38.0	38.0	275	0/2	0/2
York	684.0	684.0	9,926	1/6	1/6	816.5	816.5	9,926	1/6	1/6
Groundwater (GW)	75,760.3	75,112.7	967,727	229/450	251/472	84,126.0	83,378.4	955,965	210/450	233/473
Surface water (SW)	20,701.1	20,561.7	256,297	3/3	3/3	24,564.4	24,419.2	278,619	3/3	5/5
Total[1]	96,461.4	95,674.4	1,224,024	230/451	252/473	108,690.4	107,797.6	1,234,584	211/451	235/475

1. Columns may not add to totals because of independent rounding.

Table 2b

Nonmunicipal public supply withdrawal and use by county, 1979 and 1980

[No distinction made between withdrawal and use (except for Sarpy County) because all the systems use water in the same county from which it is withdrawn. Ratio of reporting systems to total systems: Upper number in ratio is the number of systems providing metered or estimated data and the lower number is the total number of systems in the county. An asterisk indicates that additional persons are served seasonally.]

County	Water withdrawn and used (millions of gallons) 1979	1980	Population served	Ratio of reporting systems to total systems	County	Water withdrawn and used (millions of gallons) 1979	1980	Population served	Ratio of reporting systems to total systems
Adams	241.1	265.2	2,402	2/2	Lancaster	145.1	159.6	2,763	2/8
Antelope	3.8	4.2	60	0/1	Lincoln	20.9	23.0	327	0/7
Arthur	0.0	0.0	0	0/0	Logan	0.0	0.0	0	0/0
Banner	0.0	0.0	0	0/0	Loup	0.0	0.0	0	0/0
Blaine	0.0	0.0	0	0/0	McPherson	0.0	0.0	0	0/0
Boone	0.0	0.0	0	0/0	Madison	108.3	119.1	1,695	0/12
Box Butte	4.8	5.3	75	0/3	Merrick	1.1	1.2	16	0/2
Boyd	0.0	0.0	0	0/0	Morrill	0.0	0.0	0	0/0
Brown	0.0	0.0	0	0/0	Nance	0.0	0.0	0	0/0
Buffalo	74.9	82.4	1,173	0/12	Nemaha	0.0	0.0	0	0/0
Burt	0.0	0.0	0	0/0	Nuckolls	24.0	26.3	375	0/1
Butler	7.7	8.4	120	0/1	Otoe	0.0	0.0	0	0/0
Cass-GW	46.1	50.7	1,529	1/8	Pawnee	0.0	0.0	0	0/0
Cass-SW	54.2	59.6	795	1/1	Perkins	0.0	0.0	0	0/0
Cedar	7.7	8.4	120	0/1	Phelps	0.0	0.0	0	0/0
Chase	1.2	1.3	18	0/1	Pierce	15.3	16.9	240	0/2
Cherry	31.9	35.1	115	1/1	Platte	90.1	99.1	1,410	0/10
Cheyenne	15.1	16.6	520	1/2	Polk	0.0	0.0	0	0/0
Clay	0.0	0.0	0	0/0	Red Willow	3.8	4.2	60	0/1
Colfax	0.0	0.0	0	0/0	Richardson	0.0	0.0	0	0/0
Cuming	1.0	1.1	15	0/1	Rock	3.1	3.4	48	0/1
Custer	8.3	9.1	13	0/1	Saline	0.0	0.0	0	0/0
Dakota	17.3	19.0	255	0/5	Sarpy				
Dawes	33.4	36.7	523	0/5	(withdrawn)	83.0	91.3	-	1/12
Dawson	35.0	38.5	370*	0/11	(used)	748.0	859.9	7,616	3/14

Table 2b (continued)

Deuel	0.0	0.0	0	0/0
Dixon	0.0	0.0	0	0/0
Dodge	88.8	97.7	1,041	1/8
Douglas	471.7	518.8	6,221	9/22
Dundy	0.0	0.0	0	0/0
Fillmore	9.1	10.0	100	1/1
Franklin	0.0	0.0	0	0/0
Frontier	6.7	7.4	0*	0/1
Furnas	0.0	0.0	0	0/0
Gage	0.0	0.0	0	0/0
Garden	1.9	2.1	0*	0/1
Garfield	0.0	0.0	0	0/0
Gosper	19.6	21.6	135*	0/13
Grant	0.0	0.0	0	0/0
Greeley	0.0	0.0	0	0/0
Hall	134.7	148.1	2,098	1/7
Hamilton	0.0	0.0	0	0/0
Harlan	18.4	20.2	167*	1/4
Hayes	0.0	0.0	0	0/0
Hitchcock	6.7	7.3	0*	0/1
Holt	15.3	16.9	270	0/3
Hooker	0.0	0.0	0	0/0
Howard	7.7	8.4	120	0/1
Jefferson	0.0	0.0	0	0/0
Johnson	0.0	0.0	0	0/0
Kearney	11.2	12.3	470	1/2
Keith	53.8	59.1	277	0/12
Keya Paha	0.0	0.0	0	0/0
Kimball	5.7	6.3	90	0/2
Knox	15.3	16.9	240	0/2
Saunders	21.8	24.0	342	0/4
Scotts Bluff	46.2	50.8	857	0/11
Seward	17.5	19.3	274	0/4
Sheridan	3.1	3.4	48	0/2
Sherman	31.9	35.1	500	0/1
Sioux	0.0	0.0	0	0/0
Stanton	7.7	8.4	120	0/1
Thayer	0.0	0.0	0	0/0
Thomas	0.0	0.0	0	0/0
Thurston	42.4	46.7	670	0/3
Valley	0.0	0.0	0	0/0
Washington	38.9	42.8	747	1/4
Wayne	0.0	0.0	0	0/0
Webster	1.6	1.8	25	0/1
Wheeler	0.0	0.0	0	0/0
York	413.1	454.5	418	1/3
Groundwater(GW) withdrawn	2,514.7	2,766.2	-	24/226
Groundwater(GW) used	3,179.8	3,534.9	37,088	26/228
Surface water (SW)	54.2	59.6	795	1/1
Total[2] withdrawn	2,568.9	2,825.8	-	25/227
Total[2] used	3,234.0	3,594.5	37,883	27/229

1. Metropolitan Utilities District, which is a municipal system, sells water to Capehart and Offut Air Force Base, which are nonmunicipal systems. This accounts for the different withdrawn and use values.

2. Columns may not add to totals because of independent rounding.

Table 2c

Total public supply withdrawal and use by county, 1979 and 1980

[Differences between water withdrawn and water used are due to water being withdrawn in one county and used in a different county; transmission losses are not accounted for. Ratio of reporting systems to total systems: Upper number of ratio is the number of systems providing metered or estimated data and lower number is the total number of systems in the county; ratios were not computed for 1980 because nonmunicipal systems were not inventoried. Withdrawal systems: Systems that withdraw water in the county. Use systems: Systems that use water in the county.]

County	1979					1980		
	Water withdrawn (millions of gallons)	Water used (millions of gallons)	Population served	Ratio of reporting systems to total systems: withdrawal systems	Ratio of reporting systems to total systems: use systems	Water withdrawn (millions of gallons)	Water used (millions of gallons)	Population served
Adams	2,711.8	2,680.8	27,475	6/8	5/7	3,095.6	3,044.9	27,494
Antelope	390.4	359.2	4,667	2/9	2/9	433.5	413.4	4,705
Arthur	0.0	0.0	0	0/0	0/0	0.0	0.0	0
Banner	0.0	0.0	0	0/0	0/0	0.0	0.0	0
Blaine	15.5	15.5	182	0/1	0/1	17.5	17.5	182
Boone	315.7	315.7	3,840	3/5	3/5	348.0	348.0	3,940
Box Butte	931.9	931.9	10,955	2/5	2/5	1,158.5	1,158.5	10,963
Boyd	56.3	125.6	2,393	3/4	6/7	60.4	145.7	2,273
Brown	192.4	192.4	2,753	2/2	2/2	213.9	213.9	2,753
Buffalo	2,085.8	2,085.8	27,816	4/20	4/20	2,611.3	2,611.3	27,823
Burt	314.1	314.1	5,450	5/5	5/5	366.3	366.3	5,458
Butler	314.4	314.4	4,441	1/9	1/9	349.8	349.8	4,441
Cass-GW	7,667.6	883.9	17,256	7/20	11/24	7,437.9	921.8	17,241
Cass-SW	54.2	54.2	795	1/1	1/1	59.6	59.6	795
Cedar	377.7	377.7	5,287	7/10	7/10	420.1	420.1	5,347
Chase	288.4	288.4	2,699	1/3	1/3	340.6	340.6	2,699
Cherry	303.7	303.7	3,527	3/7	3/7	386.6	386.6	3,539
Cheyenne	818.5	818.5	7,859	4/7	4/7	911.4	911.4	7,909
Clay	277.8	405.2	4,681	0/7	1/8	407.3	548.5	5,593
Colfax	410.7	410.7	6,654	3/5	3/5	477.9	477.9	6,654
Cuming	488.5	488.5	7,103	4/6	4/6	625.5	625.5	8,307
Custer	1,001.1	1,001.1	7,915	6/11	6/11	1,113.8	1,113.8	7,973
Dakota	833.3	844.7	12,073	2/10	3/11	1,068.4	1,078.3	13,264
Dawes-GW	243.5	243.5	3,761	2/7	3/8	175.2	175.2	2,793
Dawes-SW	200.6	347.6	4,297	1/1	2/2	251.2	404.4	5,253
Dawson	1,834.4	1,834.4	16,088	3/16	3/16	2,284.2	2,284.2	16,241
Deuel	169.6	169.6	1,591	1/2	1/2	262.0	262.0	1,626
Dixon	331.3	308.6	3,803	3/9	3/9	352.5	332.6	3,894
Dodge	1,476.3	1,878.9	29,943	6/16	6/16	1,747.3	2,229.5	30,946
Douglas-GW	1,630.4	9,760.0	122,367	15/29	13/27	1,910.2	9,518.0	109,524
Douglas-SW	20,353.5	20,214.0	252,000	1/1	1/1	24,160.0	24,004.6	273,000
Dundy	102.6	102.6	1,452	1/2	1/2	173.9	173.9	1,468
Fillmore	918.6	791.3	5,127	3/9	2/8	1,092.4	951.2	5,161
Franklin	231.5	231.4	2,698	0/7	0/7	260.0	260.0	2,698
Frontier	199.2	199.2	1,892	3/6	3/6	186.6	186.6	1,896
Furnas	308.3	440.3	4,608	2/6	2/7	314.2	489.8	4,579
Gage	1,628.8	1,630.2	17,183	5/9	7/11	1,762.9	1,764.4	17,183
Garden	102.8	102.8	1,060	1/2	1/2	103.0	103.0	1,060
Garfield	117.5	117.5	1,382	0/1	0/1	120.8	120.8	1,382
Gosper	86.3	86.3	919	0/15	0/15	99.3	99.3	941
Grant	28.4	28.4	334	0/1	0/1	32.2	32.2	334
Greeley	186.3	186.3	1,891	4/4	4/4	224.0	224.0	1,897
Hall	2,957.3	2,957.3	38,618	3/12	3/12	3,605.5	3,605.5	38,633
Hamilton	483.1	483.1	5,316	2/6	2/6	477.7	477.7	5,316
Harlan	338.0	267.7	2,843	2/10	2/10	463.5	359.4	2,843
Hayes	19.6	19.6	231	0/1	0/1	25.0	25.0	260
Hitchcock	228.2	228.2	2,461	1/5	1/5	315.0	315.0	2,464
Holt	692.3	623.0	7,517	5/10	4/9	855.7	770.5	7,517
Hooker	163.3	163.3	712	1/1	1/1	179.6	179.6	712
Howard	282.4	282.4	3,165	2/6	2/6	316.3	316.3	3,171
Jefferson	616.2	610.8	7,154	5/9	6/10	632.6	626.3	7,039

Table 2c (continued)

County	1979 Water withdrawn (millions of gallons)	1979 Water used (millions of gallons)	1979 Population served	1979 Ratio of reporting systems to total systems: withdrawal systems	1979 Ratio of reporting systems to total systems: use systems	1980 Water withdrawn (millions of gallons)	1980 Water used (millions of gallons)	1980 Population served
Johnson	513.1	416.2	4,280	5/6	5/6	545.4	443.9	4,334
Kearney	318.8	318.8	4,347	3/5	3/5	355.1	355.1	4,347
Keith	611.8	611.8	6,911	1/16	1/16	667.1	667.1	6,911
Keya Paha	23.0	23.0	319	1/1	1/1	25.3	25.3	319
Kimball	328.4	328.4	3,664	1/5	1/5	430.4	430.4	3,718
Knox	519.2	519.2	6,325	6/13	6/13	620.0	620.0	6,357
Lancaster	558.0	12,727.8	181,118	12/23	12/23	797.2	13,764.5	181,592
Lincoln	2,148.7	2,148.7	27,401	2/12	2/12	2,537.2	2,537.2	27,400
Logan	28.9	28.9	340	0/1	0/1	32.8	32.8	340
Loup	0.0	0.0	0	0/0	0/0	0.0	0.0	0
McPherson	0.0	0.0	0	0/0	0/0	0.0	0.0	0
Madison	1,496.1	1,527.3	25,763	5/18	5/18	1,659.1	1,679.1	25,575
Merrick	349.7	349.7	4,528	1/6	1/6	392.3	392.3	4,531
Morrill	364.1	364.1	3,294	2/3	2/3	394.6	394.6	3,294
Nance	234.2	234.2	2,793	2/3	2/3	253.6	253.6	2,793
Nemaha	386.0	372.3	7,553	5/10	4/9	442.3	427.2	6,213
Nuckolls	440.6	440.6	4,440	3/6	3/6	461.6	461.6	4,744
Otoe	1,060.0	1,024.9	14,359	6/9	10/13	1,244.6	1,202.6	14,508
Pawnee	72.2	155.6	3,825	2/2	7/7	80.4	165.0	3,549
Perkins	325.3	325.3	1,914	2/4	2/4	270.3	270.3	1,960
Phelps	702.6	702.6	7,086	1/5	1/5	819.9	819.9	7,135
Pierce	329.8	329.8	4,185	2/6	2/6	360.3	360.3	4,185
Platte	1,369.8	1,369.8	21,186	4/17	4/17	1,496.0	1,496.0	21,249
Polk	281.2	281.2	3,442	1/4	1/4	324.2	324.2	3,456
Red Willow	1,198.8	1,137.2	9,861	1/7	1/6	1,345.0	1,273.6	9,861
Richardson	472.1	485.8	9,714	4/7	7/10	449.7	464.8	9,464
Rock	120.0	120.0	1,176	2/3	2/3	145.9	145.9	1,190
Saline	620.0	620.0	9,323	3/8	3/8	535.9	535.9	9,411
Sarpy	8,076.4	6,393.2	86,375	6/17	8/19	7,961.6	6,469.6	82,847
Saunders	12,873.7	685.2	10,332	7/18	6/17	13,752.5	760.6	10,812
Scotts Bluff	2,510.4	2,510.4	28,024	3/19	3/19	3,259.8	3,259.8	28,888
Seward	718.5	718.4	10,523	8/14	8/14	817.9	817.9	10,702
Sheridan	344.1	344.1	4,248	2/5	2/5	364.1	364.1	4,381
Sherman	239.1	239.1	2,391	1/4	1/4	319.7	319.7	2,391
Sioux-GW	31.3	31.3	368	0/1	0/1	35.5	35.5	368
Sioux-SW	147.1	0.0	0	1/1	0/0	153.3	0.0	0
Stanton	140.8	140.8	2,122	1/3	1/3	144.7	144.7	2,122
Thayer	419.4	442.2	5,180	4/9	6/11	485.1	512.6	5,161
Thomas	26.6	26.6	313	0/1	0/1	30.2	30.2	313
Thurston	401.9	413.3	4,320	3/8	4/9	434.9	444.8	4,320
Valley	321.0	321.0	3,478	2/3	2/3	400.2	400.2	3,478
Washington-GW	475.1	475.0	9,611	5/9	5/9	468.5	468.5	9,345
Washington-SW	0.0	0.0	0	0/0	0/0	0.0	10.1	366
Wayne	344.5	344.5	6,114	3/5	3/5	385.4	385.4	6,114
Webster	176.5	207.4	2,508	2/4	2/4	220.8	271.6	2,620
Wheeler	34.1	34.1	275	1/2	1/2	38.0	38.0	275
York	1,097.2	1,097.2	10,344	2/9	2/9	1,270.9	1,270.9	10,344
Ground-water (GW)	78,275.0	78,292.5	1,004,815	253/676	277/700	86,892.2	86,913.3	993,053
Surface water (SW)	20,755.3	20,615.9	257,092	4/4	4/4	24,624.1	24,478.8	279,414
Total[1]	99,030.4	98,908.4	1,261,907	255/678	279/702	111,516.2	111,392.1	1,272,467

1. Columns may not add to totals because of independent rounding.

Table 3

Public supply withdrawal by hydrologic unit, 1979 and 1980
(millions of gallons per day)

[Water withdrawn: Values in parentheses indicate portion of the total that is surface water.]

Hydrologic unit	1979					1980			
	Municipal		Non-Municipal		Total	Municipal		Non-Municipal	Total
	Water withdrawn	Number of facilities	Water withdrawn	Number of systems	Water withdrawn	Water withdrawn	Number of systems	Water withdrawn	Water withdrawn
Hat-White-White Clay	0.98 (0.95)	3	0.09	5	1.07 (0.95)	1.13 (1.11)	3	0.10	1.24 (1.11)
Niobrara-Ponca	6.14	26	0.11	6	6.25	7.01	26	0.12	7.13
Missouri tributaries	64.65 (55.76)	37	1.78	43	66.43 (55.76)	76.34 (66.01)	37	1.95	78.29 (66.01)
North Platte	13.47	15	0.26	27	13.73	16.55	15	0.29	16.84
South Platte	5.30	13	0.12	8	5.42	6.23	13	0.13	6.36
Middle Platte	19.34	29	0.76	47	20.10	23.94	29	0.83	24.77
Loup	11.35	45	0.14	5	11.49	12.63	45	0.15	12.78
Elkhorn	16.82	65	0.71	31	17.53	19.50	65	0.78	20.27
Lower Platte[1]	79.99	47	0.78	28	80.77	82.16	47	0.85	83.01
Republican	11.66	48	0.11	9	11.77	13.27	48	0.12	13.38
Little Blue	7.72	36	0.07	1	7.79	8.62	36	0.07	8.69
Big Blue	18.97	58	1.89	11	20.85	21.05	58	2.07	23.12
Weeping Water-Little Nemaha-Big Nemaha	7.89	44	0.23 (0.15)	6	8.13 (0.15)	8.55	44	0.26 (0.16)	8.80 (0.16)
Total[2]	264.28 (56.72)	451[3]	7.04 (0.15)	227[3]	271.32 (56.86)	296.97 (67.12)	451[3]	7.72 (0.16)	304.69 (67.28)

1. The Metropolitan Utilities District withdrew 38.57 mgd of groundwater in 1979 and 37.16 mgd of groundwater in 1980 from the Lower Platte hydrologic unit; this water was used in the Missouri tributaries hydrologic unit.

2. Columns may not add to totals because of independent rounding.

3. Numbers do not add to total because some systems withdraw water from more than one hydrologic unit and thus are counted in each unit. The total represents the actual number of systems withdrawing water.

Table 4

Public-supply water use, 1979 and 1980,
estimates for previous years, and projection for 1980
(millions of gallons per day)

Hydrologic unit	1965 (Water Use Report[1])	1969 (Water Plan[2])	1970 (Water Use Report[3])	1975 (Water Use Report[4])	1979 (Inventory)	1980 (Inventory)	1980 Projected Use (Water Plan[5])
Hat-White-White Clay	-	1.41	1.1	1.5	1.07	1.24	2.2
Niobrara-Ponca	-	3.88	3.8	5.1	6.25	7.13	5.6
Missouri tributaries[6]	-	64.83	69.5 (40.8)*	130.2 (104.6)	105.00 (66.43)	115.45 (78.29)	157.7
North Platte	-	8.39	8.3	12.6	13.73	16.84	14.3
South Platte	-	3.50	5.4	4.5	5.42	6.36	4.9
Middle Platte	-	11.76	20.2	25.6	20.10	24.77	24.5
Loup	-	5.26	4.6	5.2	11.49	12.78	9.2
Elkhorn	-	11.51	14.3	20.1	17.53	20.27	23.7
Lower Platte[6]	-	23.94	30.5 (59.2)*	38.6 (64.2)	42.20 (80.77)	45.85 (83.01)	51.4
Republican	-	7.13	7.1	9.8	11.77	13.38	11.1
Little Blue	-	2.90	6.1	8.9	7.79	8.69	4.2
Big Blue	-	14.00	11.1	16.1	20.85	23.12	23.9
Weeping Water-Little Nemaha-Big Nemaha	-	4.93	5.9	7.8	8.13	8.80	8.9
Total	175.47[7]	163.44	187.9	286.0	271.32[8]	304.69[8]	341.6

1. From Shaffer, 1966, p. 28.

2. From Nebraska Soil and Water Conservation Commission, 1971, p. 8.

3. From Shaffer, 1972, p. 62.

4. From Bentall and Shaffer, 1979, p. 86.

5. From Nebraska Soil and Water Conservation Commission, 1971, p. 15.

6. Values in parentheses indicate amounts of water withdrawn within the respective hydrologic units. This takes into account that most groundwater used by M.U.D. in the Missouri tributaries hydrologic unit is withdrawn in the Lower Platte hydrologic unit. Other similar occurrences of smaller amounts are not indicated. Values in parentheses with asterisk are unpublished calculations of water withdrawn based on reports from M.U.D. for those years.

7. Value includes cooling water at fuel-electric plants in Lincoln, Grand Island, Hastings, Fremont, Scottsbluff, Nebraska City, part of water used at two similar plants in Omaha, and several other smaller towns.

8. Columns may not add to total because of independent rounding.

SELF-SUPPLIED INDUSTRIES

Self-supplied industries include manufacturers whose processing operations are served entirely or in part by a private water supply. Industries having private supplies for only sanitary purposes or lawn irrigation are not included, even though part of the withdrawal by included industries may be for those uses. Water use for power generation, secondary recovery of oil, and sand and gravel operations are not included in the self-supplied industrial use category.

Currently, reporting of water withdrawals and use by self-supplied industries is not required by any state agency. In 1981, the Nebraska Legislature passed the Industrial Groundwater Regulatory Act (LB 56), which requires that any industry (an individual facility) intending to withdraw 3,000 acre-feet or more of groundwater per year must obtain a permit from the Department of Water Resources. Although the bill was introduced because of concern about potential large withdrawals for cooling at power-generating plants, it pertains to all industrial and commercial use. Industries currently withdrawing 3,000 acre-feet or more are not required to obtain a permit. Industries that obtain permits will be required to record and report their annual use to the Department of Water Resources. During 1979 and 1980, only three industries, excluding power plants, withdrew more than 3,000 acre-feet of groundwater. Another five industries withdrew between 1,000 and 3,000 acre-feet of groundwater and five industries (including two that withdrew between 1,000 and 3,000 acre-feet of groundwater) withdrew between 1,000 and 3,000 acre-feet of surface water.

The only previously reported comprehensive inventory of industrial water use was a wastewater survey conducted by the Nebraska Department of Health in 1968 as part of a water pollution control program. Data were obtained for 461 industries, 130 of which had a private water supply. These data were used to prepare summary tables for the State Water Plan Framework Study (Nebraska Soil and Water Conservation Commission, 1971). However, no formal documentation of the inventory is available.

Data Collection

The Directory of Nebraska Manufacturers (Nebraska Department of Economic Development, 1979) was used as the base list to identify all industrial facilities within Nebraska. Included in the directory are manufacturers having Standard Industrial Classification (SIC) codes 2011 through 3999 (U.S. Office of Management and Budget, 1972). Potential self-supplied facilities then were identified for the 1979 inventory by using (1) industrial well registration and surface water appropriation permit information from the Nebraska Department of Water Resources, (2) the master list of noncommunity public water-supply systems from the Nebraska Department of Health, (3) National Pollutant Discharge Elimination System (NPDES) industrial discharge records from the Nebraska Department of Environmental Control, and (4) unpublished file data from the Nebraska Natural Resources Commission regarding the 1968 wastewater survey conducted by the Department of Health. Of the 154 industries originally identified from the above sources, 102 were self-supplied.

Data for both the 1979 and 1980 inventory were collected primarily by mail. Several follow-ups and some initial contacts were made by phone. About two-thirds of the industries provided either metered data or an estimate of their water use. Most estimates made by the industries were based on average well capacities and time of operation. So that state, county, hydrologic unit, and SIC category totals could be compiled, general estimates were made for industries that did not provide metered data or their own estimates. Such general estimates were based on available information for similar industries having similar numbers of employees. A summary of data availability for 1979 for industries within different ranges of water use is listed below:

Range in water use (mgd)	Number of industries providing metered data	Number of industries providing estimated data	Total industries providing data	Percent of total water use represented by industries providing data	Number of industries for which general estimates were made
>0.5	9	8	17	86	0
0.1-0.5	7	13	20	11	6
<0.1	7	25	32	1	27
Total	23	46	69	98	33

Since industries that provided metered or estimated data and used more than 0.1 mgd accounted for 97 percent of the total estimated water use in 1979, only 46 industries that used close to or greater than 0.1 mgd were inventoried for 1980. In addition, nine new industries were inventoried, of which four were self-supplied. In order to compile the 1980 aggregated totals, water use by industries not inventoried was assumed to be the same as that recorded for 1979. The 43 industries that provided metered or estimated data accounted for almost 98 percent of the total estimated use for 1980.

Inventory Results

Aggregated state totals of self-supplied industrial water withdrawal and use for 1979 and 1980 are shown in table 5. Aggregated totals for counties and hydrologic units are shown in tables 6 and 7, respectively. It should be noted that all water withdrawn by self-supplied industries is used in the same county or hydrologic unit from which it is withdrawn; thus, totals for withdrawal and use are the same for all counties and hydrologic units.

A detailed breakdown of water use by SIC category is listed in table 8. The largest water users, in descending order of amount used, were fertilizer processors, meat processors, and sugar beet processors. Other moderately large users during 1979 and 1980 were cement processors and one petroleum refiner. Water use for secondary recovery of oil, which previously had been reported as self-supplied industrial use, is estimated to be about 1.7 mgd and 1.6 mgd for 1979 and 1980, respectively. These estimates were made based on injection records obtained from the Nebraska Oil and Gas Commission. Water used in secondary recovery of oil will be included in the mining use category instead of the self-supplied industrial use category. This is done to conform with the use categories of the National Water-Use Information Program.

Estimates for Earlier Years and Projections for 1980

Shown in table 9 are previously published estimates of water use for self-supplied industries for 1965, 1968, 1970, and 1975; the 1979 and 1980 estimated use; and a previously published projection for 1980. Both the 1979 and 1980 estimated uses of 50.4 and 48.4 mgd, respectively, are

considerably less than the 1968, 1970, and 1975 respective estimates of 79.3, 101.3, and 124.3 mgd. The 1979 and 1980 estimates compare most favorably with the 1968 estimates, if consideration is given to known changes in use at specific plants and the exclusion from the 1979 and 1980 totals of the use for secondary recovery of oil. Major changes were a reduction in use between 1968 and 1979-1980 of about 9 mgd for sugar beet processing in the North Platte hydrologic unit, and a reduction of about 10 mgd for the Mason-Hanger ammunitions plant in the Middle Platte hydrologic unit. Minor changes in water use occurred because of the closings of some plants, the opening of new plants, and increases and reductions in water use by individual industries. The apparent decreased use in the Elkhorn hydrologic unit and increased use in the Lower Platte hydrologic unit most probably occurs because use by the Hormel Company of Fremont was included in the Elkhorn hydrologic unit in 1968 and in the Lower Platte hydrologic unit in 1979 and 1980. Use for secondary recovery of oil in the North Platte, South Platte, and Republican hydrologic units was estimated to be about 10.7 mgd in 1968.

The 1970 estimates of water use by self-supplied industries appear to have been based primarily on the 1968 inventory, since values for those two years closely agree in all hydrologic units except the Lower Platte. It appears that the use by Allied Chemical (about 21 mgd), already accounted for in the Missouri tributaries hydrologic unit, was included also in the Lower Platte hydrologic unit. This apparent double accounting may have occurred because Allied Chemical's wells are very near the boundary of the two hydrologic units. For 1979 and 1980, all of Allied Chemical's use was included in the Missouri tributaries hydrologic unit.

The 1975 estimates were computed by interpolation between the estimated 1968 use and projected use for 1980 made for the State Water Plan Framework Study (Nebraska Soil and Water Conservation Commission, 1971). The 43.0 mgd estimated use for the Lower Platte hydrologic unit in 1975 again appears to result from the double accounting of Allied Chemical's use; however, the increase from 25.4 to 43.0 mgd is neither documented nor explainable. The disparity between values listed in the table and those appearing in the text of the 1975 report (Bentall and Shaffer, 1979) suggests that a transposing error may have occurred. The estimated 1975 use is listed as 124.3 mgd in the table (sum of individual hydrologic unit totals), whereas in the text the listed uses total only 94.9 mgd.

Given below are water-use amounts for major product categories listed in the 1968, 1970, and 1975 reports and compiled for 1979 and 1980:

Product category	1968 (mgd)	1970 (mgd)	1975 (mgd)	1979 (mgd)	1980 (mgd)
Fertilizer processing	24.1	21.0	20.4	19.4	18.8
Sugar processing	17.0	16.0	10.2	7.5	7.7
Secondary oil recovery	10.7	7.4	7.4	(1.7)	(1.6)
Meat processing	9.8	-	-	12.1	12.0
State institutions	-	1.7	1.7	-	-
Other	17.7	55.2	55.2 (84.6)	11.3	9.9

The value of 55.2 for other in 1975 is the value listed in the text of the 1975 report (Bentall and Shaffer, 1979, p. 80). The value of 84.6, in parenthesis, is the difference between the sum of values listed in the text of the 1975 report (except for other) and the total value of 124.3 mgd listed in the summary table of the 1975 report (Bentall and Shaffer, 1979, p. 89). The reason for this discrepancy is not known. Use for meat processing is included as other in 1970 and 1975 and use for state institutions was not determined for 1968, 1979, and 1980. Estimated use for secondary recovery of oil for 1979 and 1980 is included for comparison purposes.

In summary, the 1979 and 1980 inventories appear to account for most of the self-supplied industrial water use within Nebraska. The differences between self-supplied industrial water use inventoried in 1979 and 1980, and the estimates published for previous years can be explained by a decrease in the number of self-supplied industries, by significant reductions in use by some industries, and possibly by accounting errors. Also of interest is the projected 1980 use of 90.16 mgd made for the State Water Plan Framework Study (Nebraska Soil and Water Conservation Commission, 1971), compared to the 1980 inventoried use of 48.4 mgd (plus 1.6 mgd for secondary recovery of oil). Since a complete inventory of all industries listed in the Directory of Nebraska Manufacturers was not conducted, some self-supplied industries may not have been included in the 1979 and 1980 inventories; however, most major water using industries probably were included.

Table 5

Water withdrawal and use for self-supplied industry in Nebraska, 1979 and 1980

	1979			1980		
	Millions of gallons	Acre-feet	Millions of gallons per day	Millions of gallons	Acre-feet	Millions of gallons per day
Total	18,392	56,443	50.4	17,719	54,378	48.4
Groundwater	15,543	47,700	42.6	15,088	46,303	41.2
Surface water	2,849	8,743	7.8	2,631	8,074	7.2

Table 6

Self-supplied industrial withdrawal and use by county, 1979 and 1980

[No distinction between withdrawal and use, since all water is used in the same county from which it is withdrawn. Ratio of reporting facilities to total facilities: Upper number in ratio is the number of facilities providing metered or estimated data and lower number is the total number of facilities in the county.]

County	1979		1980		County	1979		1980	
	Millions of gallons	Ratio of reporting facilities to total facilities	Millions of gallons	Ratio of reporting facilities to total facilities		Millions of gallons	Ratio of reporting facilities to total facilities	Millions of gallons	Ratio of reporting facilities to total facilities
Adams	305.6	1/2	310.1	1/2	Lancaster	13.0	4/4	13.3	4/5
Antelope	0.0	0/0	0.0	0/0	Lincoln	59.9	1/1	64.4	1/1
Arthur	0.0	0/0	0.0	0/0	Logan	0.0	0/0	0.0	0/0
Banner	0.0	0/0	0.0	0/0	Loup	0.0	0/0	0.0	0/0
Blaine	0.0	0/0	0.0	0/0	McPherson	0.0	0/0	0.0	0/0
Boone	0.0	0/0	0.0	0/0	Madison	508.5	8/13	685.4	9/14
Box Butte	0.1	1/1	0.1	1/1	Merrick	0.0	0/0	0.0	0/0
Boyd	0.0	0/0	0.0	0/0	Morrill-GW	65.5	2/2	65.5	2/2
Brown	7.3	0/2	7.3	0/2	Morrill-SW	580.0	1/1	620.0	1/1
Buffalo	301.6	4/5	299.1	4/5	Nance	0.0	0/0	0.0	0/0
Burt	0.0	0/0	0.0	0/0	Nemaha	0.0	0/0	0.0	0/0
Butler	0.0	0/0	0.0	0/0	Nuckolls-GW	4.5	1/1	7.6	1/1
Cass-GW	475.0	1/1	361.0	1/1	Nuckolls-SW	71.0	1/1	60.3	1/1
Cass-SW	568.0	1/1	300.0	1/1	Otoe	0.0	0/0	0.0	0/0
Cedar	40.2	0/2	40.2	0/2	Pawnee	0.0	0/0	0.0	0/0
Chase	0.0	0/0	0.0	0/0	Perkins	0.0	0/0	0.0	0/0
Cherry	0.0	0/0	0.0	0/0	Phelps	0.0	0/0	0.0	0/0
Cheyenne	0.0	0/0	1.6	1/1	Pierce	0.5	1/1	0.5	1/1
Clay	0.0	0/0	0.0	0/0	Platte	80.0	4/6	22.0	4/6
Colfax	773.9	1/2	539.0	1/2	Polk	0.0	0/0	0.0	0/0
Cuming	356.7	2/2	326.4	2/2	Red Willow	157.7	1/1	157.7	1/1
Custer	5.5	1/2	5.5	1/2	Richardson	0.0	0/0	0.0	0/0
Dakota	1,192.1	1/1	1,141.7	1/1	Rock	0.0	0/0	0.0	0/0
Dawes	0.0	0/0	0.0	0/0	Saline	347.0	2/4	376.7	2/4
Dawson	690.2	5/9	726.6	5/9	Sarpy	6,412.5	2/2	6,161.3	2/2

Table 6 (continued)

Deuel	0.0	0/0	0.0	0/0
Dixon	0.0	0/0	0.0	0/0
Dodge	808.8	4/4	891.3	4/4
Douglas	401.8	4/6	394.8	4/6
Dundy	0.0	0/0	0.0	0/0
Fillmore	0.0	0/0	0.0	0/0
Franklin	0.0	0/0	0.0	0/0
Frontier	0.0	0/0	0.0	0/0
Furnas	0.0	0/0	0.0	0/0
Gage	0.0	0/0	0.0	0/0
Garden	0.0	0/0	0.0	0/0
Garfield	0.0	0/0	0.0	0/0
Gosper	0.0	0/0	0.0	0/0
Grant	0.0	0/0	0.0	0/0
Greeley	0.0	0/0	0.0	0/0
Hall	264.2	4/7	275.4	5/8
Hamilton	293.0	3/3	296.0	3/3
Harlan	0.0	0/0	0.0	0/0
Hayes	0.0	0/0	0.0	0/0
Hitchcock	0.0	0/0	0.0	0/0
Holt	0.0	0/0	0.0	0/0
Hooker	0.0	0/0	0.0	0/0
Howard	0.0	0/0	0.0	0/0
Jefferson	119.2	2/2	119.2	2/2
Johnson	0.0	0/0	0.0	0/0
Kearney	103.4	1/1	105.3	1/1
Keith	0.0	0/0	0.0	0/0
Keya Paha	0.0	0/0	0.0	0/0
Kimball	0.0	0/0	0.0	0/0
Knox	0.0	0/0	0.0	0/0
Saunders	34.5	1/2	34.5	1/2
Scotts Bluff-GW	1,527.3	4/6	1,451.3	4/6
Scotts Bluff-SW	1,630.0	3/3	1,650.3	3/3
Seward	0.0	0/0	0.0	0/0
Sheridan	11.0	0/3	11.0	0/3
Sherman	0.0	0/0	0.0	0/0
Sioux	0.0	0/0	0.0	0/0
Stanton	124.7	1/2	135.8	1/2
Thayer	0.0	0/0	0.0	0/0
Thomas	0.0	0/0	0.0	0/0
Thurston	0.0	0/0	0.0	0/0
Valley	0.0	0/0	0.0	0/0
Washington	4.3	1/1	4.3	1/1
Wayne	0.0	0/0	0.0	0/0
Webster	0.0	0/0	0.0	0/0
Wheeler	0.0	0/0	0.0	0/0
York	53.7	1/1	56.0	1/1
Groundwater(GW)	15,543.1	69/102	15,088.0	70/106
Surface water(SW)	2,849.0	6/6[1]	2,630.6	6/6
Total[2]	18,392.1	69/102	17,718.6	70/106

1. The six facilities using surface water also used groundwater.

2. Columns may not add to totals because of independent rounding.

Table 7

Self-supplied industrial withdrawal and use by hydrologic unit, 1979 and 1980
(millions of gallons per day)

Hydrologic unit	1979			1980		
	Ground-water	Surface water	Number of industries	Ground-water	Surface water	Number of industries
Hat-White-White Clay	0.00	0.00	0	0.00	0.00	0
Niobrara-Ponca	0.05	0.00	6	0.05	0.00	6
Missouri tributaries	21.76	0.00	9	20.83	0.00	9
North Platte	4.53	6.05	9	4.32	6.20	10
South Platte	0.00	0.00	0	0.00	0.00	0
Middle Platte	3.33	0.00	19	3.45	0.00	20
Loup	0.12	0.00	4	0.12	0.00	4
Elkhorn	2.98	0.00	22	3.42	0.00	23
Lower Platte	6.02	1.56	18	5.13	0.82	19
Republican	0.44	0.19	2	0.45	0.16	2
Little Blue	0.62	0.00	4	0.62	0.00	4
Big Blue	2.73	0.00	9	2.83	0.00	9
Weeping Water-Little Nemaha-Big Nemaha	0.00	0.00	0	0.00	0.00	0
Total[1]	42.58	7.80	102	41.22	7.19	106

1. Columns may not add to totals because of independent rounding.

Table 8

Self-supplied industrial water withdrawal and use
by Standard Industrial Classification (SIC) category, 1979 and 1980

Major group	Minor group	Type	1979 Number of plants	1979 Millions of gallons per day	1980 Number of plants	1980 Millions of gallons per day
20 (Food and kindred products)	2011	Meat packing plants	21	11.586	21	11.298
	2013	Sausage and prepared meats	2	0.151	2	0.157
	2017	Poultry and egg processing	3	0.368	3	0.537
	2023	Condensed and evaporated milk	4	0.300	4	0.301
	2026	Fluid milk	1	0.100	1	0.100
	2035	Sauces, seasonings, and salad dressings	1	0.002	1	0.002
	2038	Frozen onion rings and diced onions	1	0.010	1	0.010
	2047	Pet food	5	0.294	5	0.306
	2048	Prepared feed and feed ingredients	7	0.015	7	0.015
	2063	Beet sugar	4	7.517	4	7.700
	2077	Animal and marine fats and oils	7	0.264	7	0.263
	2086	Bottled and canned soft drinks	3	0.030	3	0.030
	2099	Potato chips	1	0.010	1	0.010
		Subtotal	60	20.647	60	20.729
24 (Lumber and wood products)	2451	Mobile homes	1	0.100	1	0.100
		Subtotal	1	0.100	1	0.100
28 (Chemicals and allied products)	2819	Industrial inorganic chemicals	4	19.088	4	18.401
	2841	Toilet bar soap	1	0.621	1	0.574
	2873	Nitrogenous fertilizers	2	0.359	2	0.342
		Subtotal	7	20.068	7	19.317
29 (Petroleum refining and related industries)	2911	Petroleum refining	1	2.880	1	2.626
		Subtotal	1	2.880	1	2.626
30 (Rubber and miscellaneous plastics	3041	Rubber and plastic hose and belting	1	0.432	2	0.498
	3069	Fabricated rubber products	1	0.568	1	0.567
	3079	Miscellaneous plastic products	1	0.411	1	0.426
		Subtotal	3	1.411	4	1.491
32 (Stone, clay, glass and concrete products)	3241	Cement, hydraulic	2	3.065	2	1.991
	3251	Brick and clay tile	1	0.007	1	0.007
	3272	Concrete products	2	0.002	2	0.002
	3273	Ready-mix concrete	1	0.002	2	0.004
		Subtotal	6	3.076	7	2.004

Table 8 (continued)

Major group	Minor group	Type		1979 Number of plants	1979 Millions of gallons per day	1980 Number of plants	1980 Millions of gallons per day
33 (Primary metal industries)	3312	Blast furnaces, steel works		1	0.332	1	0.361
	3353	Aluminum sheet, plate, and foil		1	0.012	1	0.012
			Subtotal	2	0.344	2	0.373
34 (Fabricated metal products)	3448	Prefabricated metal buildings		1	0.193	1	0.034
	3482	Small arms ammunition		1	0.010	1	0.010
	3483	Ammunition		1	0.157	1	0.170
	3494	Valves and pipe fittings		2	0.075	2	0.075
			Subtotal	5	0.435	5	0.289
35 (Machinery, except electrical)	3523	Farm machinery and equipment		3	0.295	5	0.338
	3525	Irrigation equipment		2	0.295	2	0.320
	3531	Construction machinery and equipment		1	0.000	1	0.000
	3561	Pumps and pumping equipment		1	0.005	1	0.005
			Subtotal	7	0.595	9	0.663
36 (Electrical machinery)	3661	Telephone and telegraph		1	0.172	1	0.171
	3662	Radio and television transmitting equipment		1	0.001	1	0.001
	3674	Miniature transistor assemblies		1	0.005	1	0.005
	3679	Electric components		1	0.077	1	0.077
			Subtotal	4	0.255	4	0.254
37 (Transportation equipment)	3714	Motor vehicle parts and accessories		3	0.511	3	0.502
	3743	Railroad equipment		1	0.000	1	0.000
	3799	Transportation equipment		1	0.018	1	0.108
			Subtotal	5	0.529	5	0.520
38 (Measuring, analyzing, and controlling ingredients; photographic, medical, and optical goods; watches and clocks)	3841	Surgical and medical instruments		1	0.049	1	0.049
			Subtotal	1	0.049	1	0.049
Total				102	50.389	106	48.415

Table 9

Self-supplied industrial water use, 1979 and 1980, estimates for previous years, and projection for 1980 (millions of gallons per day)

Hydrologic unit	1965 (Water Use Report[1])	1968 (Water Plan[2])	1970 (Water Use Report[3,6]) (groundwater only)	1975 (Water Use Report[4,6]) (groundwater only)	1979 (Inventory)	1980 (Inventory)	1980 Projected Use (Water Plan[5])
Hat-White-White Clay	-	0.00	0.0	0.0	0.00	0.00	0.00
Niobrara-Ponca	-	0.05	0.0	0.0	0.05	0.05	0.08
Missouri tributaries	-	22.91	22.7	25.3	21.76	20.83	26.96
North Platte	-	22.44	22.4	22.6	10.58	10.52	22.68
South Platte	-	6.35	6.3	6.5	0.00	0.00	6.58
Middle Platte	-	12.62	12.7	13.0	3.33	3.45	13.19
Loup	-	0.37	0.3	0.5	0.12	0.12	0.54
Elkhorn	-	5.86	5.9	6.9	2.98	3.42	7.63
Lower Platte	-	3.37	25.4[7]	43.0[7]	7.58	5.95	5.12
Republican	-	0.20	0.2	0.4	0.63	0.61	0.48
Little Blue	-	1.26	1.5	1.6	0.62	0.62	1.90
Big Blue	-	3.84	3.9	4.5	2.73	2.83	5.00
Weeping Water-Little Nemaha-Big Nemaha	-	0.00	0.0	0.0	0.00	0.00	0.00
Total	39.7[8]	79.27	101.3	124.3	50.39[9]	48.41[9]	90.16

1. From Shaffer, 1966, p. 28.
2. From Nebraska Soil and Water Conservation Commission, 1971, p. 19. Values include a total of 10.7 mgd used for injection in secondary recovery of oil, in the North Platte, South Platte, and Republican hydrologic units.
3. From Shaffer, 1972, p. 63.
4. From Bentall and Shaffer, 1979, p. 89.
5. From Nebraska Soil and Water Conservation Commission, 1971, p. 21.
6. Values include a total of 7.4 mgd used for injection in secondary recovery of oil, in the North Platte, South Platte, and Republican hydrologic units.
7. Value includes use of 1.7 mgd by state institutions.
8. Value includes 5.7 mgd used for injection in secondary recovery of oil, and 1.7 mgd used by state institutions.
9. Water used for injection in secondary recovery of oil is not included in 1979 and 1980 values, but amounted to approximately 1.7 mgd in 1979, and 1.6 mgd in 1980. Columns do not add to total because of independent rounding.

POWER-GENERATING FACILITIES

Power-generating facilities in Nebraska include hydroelectric plants, in which water is the source of energy being converted to electricity, and nuclear and fossil-fuel thermoelectric plants, in which water is used primarily for cooling of stream condensers. Although numerous small diesel plants and some gas turbine plants are situated throughout the state, they produce power primarily for peak demand and they have minimal water use.

Hydroelectric facilities include both on-stream and off-stream plants. At on-stream plants, all or some of the natural streamflow passes through the turbines and returns to the river; virtually no water is used consumptively. The amount of power generated at on-stream plants is limited by the available streamflow, the amount of head drop, and the capacity of the turbines to use the available flow. At off-stream plants, water is diverted from a stream and transported via canal to the plant site, with some attendant evaporation and seepage losses from canals and associated reservoirs. In most instances, water diverted for use at off-stream plants is used at more than one hydroelectric plant or is used for other purposes, such as for irrigation or for cooling at thermoelectric plants. An advantage off-stream plants often have over on-stream plants is that greater head drops can be developed, which in turn results in a greater generating capacity for a given volume of water.

In addition to cooling of condensers at thermoelectric plants, water is used for service (such as equipment cooling or ash sluicing), boiler make-up, and sanitary purposes. Commonly, large amounts of untreated surface water are used for once-through condenser cooling at large plants. Plants with once-through cooling consume only a small fraction of the water withdrawn; thus, most of the water is returned to the source (Jury et al., 1979). A smaller amount of treated water normally is used for boiler make-up, service, and sanitary purposes. The treated water may be from the same source as the cooling water or may be from another source such as groundwater or a public supply system. Plants using surface water also use water for screen backwash,

warm-water recirculation in the winter to prevent ice buildup at the intakes, and surface sluicing to keep debris away from the intake structures. Water for screen backwash and surface sluicing essentially is recirculated within the intake areas without entering the plant. Discharged condenser cooling water usually is used for warm-water recirculation. Plants having cooling towers instead of once-through cooling require smaller amounts of water and commonly may use groundwater as a source. However, consumptive use at plants having cooling towers is greater than at plants having once-through cooling.

How water is used specifically within power plants is quite complex and often difficult to describe in detail. Many internal reuses of water occur in addition to the use of discharged cooling water for warm-water recirculation and the apparent recirculation of water for screen backwash and surface sluicing. Because of these complexities in both uses and withdrawals, care must be taken when comparing water-use values for power generation.

Currently, no state agency requires reporting of annual water withdrawals or use by power plants. As part of its function in administering water rights, the Nebraska Department of Water Resources measures canal diversions for some of the off-stream hydroelectric plants and in some cases also measures return flows to streams. New thermoelectric plants built after passage of the Industrial Groundwater Regulatory Act (LB 56) in 1981, will be required to obtain a permit if they intend to withdraw 3,000 acre-feet (2.68 mgd) or more of groundwater annually. Plants obtaining permits will be required to report their annual withdrawals to the Department of Water Resources. The Nebraska Department of Environmental Control, as part of permit requirements for the National Pollutant Discharge Elimination System (NPDES), requires monthly reports of water discharged to streams from thermoelectric plants. In many cases, discharge amounts reported to the Department of Environmental Control are based on water withdrawals calculated from pump capacities and operating time.

Data Collection

Measurements of stream diversions for use at off-stream hydroelectric plants were obtained from published reports of the Nebraska Department of Water Resources and the U.S. Geological Survey. Measurements of return flows,

which for some plants are the same as those of turbine discharge, were obtained from the Department of Water Resources. Other measurements of turbine discharge were obtained from power districts. Since turbine discharge measurements were not available for some off-stream plants, estimates were made based on stream diversion measurements and on arbitrarily assumed canal loss. For some on-stream plants, estimates of turbine discharge were based on the amount of power generated.

Data for the major thermoelectric plants were collected through personal visits and by mail and telephone contacts with power district representatives. Most withdrawal amounts were computed from design pump capacities and station logs of pump operation times. For some plants, data were compiled from NPDES records obtained from the Nebraska Department of Environmental Control. Municipal generating plants were inventoried by mail but some telephone follow-ups and visits to selected plants were necessary.

Inventory Results

Totals of water withdrawn and used for power generation in the state in 1979 and 1980 are given in table 10. Values listed for hydroelectric use include only amounts discharged through turbines; they are not amounts of initial diversions for use at off-stream plants. Turbine discharge at the Gavins Point hydroelectric plant on the Missouri River is not included in the state total. Values listed for thermoelectric power generation are for withdrawals only and do not include amounts of water reused within plants. Withdrawals by the Grand Island, Hastings, Fremont, and Schuyler municipal power plants, which are accounted for separately from withdrawals for other public supply uses in those towns, are included in the state total. Water used by the small municipal thermoelectric power plants that obtain water from public supplies is included in the totals for public supplies and not in the totals for power generation. These small plants used about 1.5 mgd in both 1979 and 1980. Water used by the small diesel generating plants situated throughout the state also is included in the public supplies totals. Use at these plants is estimated to be less than 1 mgd during both 1979 and 1980.

Amounts of water used at individual hydroelectric power plants are given in tables 11 and 12. In addition to amounts discharged through the turbines,

the tables present stream diversion amounts, power generation amounts, and other descriptive information. For off-stream plants, the total diversion of about 3.2 million acre-feet in 1979 and 3.4 million acre-feet in 1980 accounted for total turbine discharges of about 5.1 and 5.8 million acre-feet, respectively. This is because water diverted into the Tri-County Supply Canal was used to generate power at three plants, and water diverted into the Loup River Power Canal was used to generate power at two plants. In addition, water diverted into the Sutherland Canal was used at the Gentleman thermoelectric plant prior to being used at the North Platte hydroelectric plant. Also, water diverted into the Tri-County Supply Canal was used by the Canaday thermoelectric plant and by irrigators after being used at the three hydroelectric plants. Except for the Spencer hydroelectric plant, the amount of power generated at on-stream plants within the state is relatively small. The Gavins Point hydroelectric plant, which is on the Missouri River along the Nebraska-South Dakota border, discharges through its turbines greater than three times more water than do all the other hydroelectric plants in Nebraska (on-stream and off-stream) generating one-and-one-half to two times more power.

Water withdrawals for use at individual thermoelectric plants are shown in tables 13 and 14. The tables include total water withdrawals for condenser cooling, service, screen backwash, surface sluicing, and sanitary purposes. The quantities of water used for specific purposes was recorded for each plant whenever an adequate breakdown of data was available. However, because such breakdowns were not available for all plants and because the types of breakdowns were not consistent from one plant to another, quantities used for specific purposes within the plants could not be summarized in the table.

Withdrawals of surface water for use at thermoelectric power-generating plants is 60 times greater than groundwater withdrawals for thermoelectric plants. Between 85 and 90 percent of the surface water withdrawn is from the Missouri River for use at the Cooper, Kramer, Fort Calhoun, North Omaha, Jones Street, and Nebraska City plants. Since the Nebraska City plant began operation on May 31, 1979, its total withdrawal in 1979 was understandably less than in 1980. The Jones Street plant withdrew more water in 1980 than in 1979, even though generation decreased. This resulted from a problem of silt buildup in the intake tunnels, which required water to be circulated periodically through the plant even though power was not being generated. Withdrawal differences from 1979 to 1980 for the other plants were due to variations in the amount of

power generated. Changes in demand and shutdowns of plants for maintenance caused these variations. The other two major plants that use surface water, Gentleman and Canaday, withdrew water from canals that divert water from the Platte River system. The Gentleman plant began operation of its first unit in February of 1979 and began operation of its second unit in 1981.

Use of groundwater at thermoelectric plants was less in 1980 than in 1979. The Scottsbluff plant of the Nebraska Public Power District, which utilizes once-through cooling, decreased its use by half because of decreased power generation. Likewise, the Sheldon Plant decreased its use because of a decrease in generation. Use at the Lon D. Wright municipal plant of Fremont decreased because a newly constructed unit with cooling towers began operation in late 1980. Hastings and Grand Island have constructed new generating units that have cooling towers, which should result in decreased future use at those plants. The Hastings unit began operation in early 1981 and the Grand Island unit began operation in late 1982. Other municipal thermoelectric plants used minor amounts of water because they were used primarily for standby generation.

Estimates for Earlier Years and Projections for 1980

Water used by thermoelectric plants in 1979 and 1980, together with published estimates for previous years and a published projection for 1980, are shown in table 15. The 1970 estimate from the Nebraska State Water Plan Framework Study (Nebraska Soil and Water Conservation Commission, 1971) was based on design water-use rates for plants operating at that time; actual water use for 1970 by specific plants was not determined. The 1980 projection, also made for the Framework Study in 1970, took into account new plants that were planned for operation as well as possible shutdown and reduced generation for existing plants. Specific sources of data for the estimates published in the 1965, 1970, and 1975 water-use reports (Shaffer, 1966 and 1972; Bentall and Shaffer, 1979) are not documented.

An obvious inconsistency in table 15 is the high estimates for groundwater use published in the 1970 and 1975 water-use reports compared to the estimates in the 1965 report and to the 1979 and 1980 use. It appears that the high estimates for 1970 and 1975 include total condenser cooling water requirements, rather than just total withdrawals, for plants that have cooling towers. At

such plants, the necessary rate of withdrawal for make-up to the cooling towers is much less than the required rate of flow through the condensers because water continuously is recycled through the cooling towers. Both the condenser cooling water requirements and the total withdrawal requirements were estimated and reported in the State Water Plan Framework Study. This possibly explains how values for cooling water requirements were included in the 1970 and 1975 published estimates. Both values are listed in table 15, the cooling water requirements being in parentheses. The 1965 estimates include only total withdrawals, as do the 1979 and 1980 values.

For the 1980 projections, power generation and water use at the Scottsbluff and Sheldon plants was assumed to decrease, and use at the three large municipal plants (Grand Island, Hastings, and Fremont) also was assumed to decrease because of a decrease in generation and installation of more efficient cooling towers. Also assumed for the 1980 projection was that a new plant having cooling towers and using groundwater would be built near Grand Island. The Scottsbluff and Sheldon plants did decrease their use. Although the three municipal plants are in the process of converting to generating units that have cooling towers, they did not decrease their total annual generation. The new plant near Grand Island was not built. It appears that future use of groundwater will be primarily for plants having cooling towers; therefore, the use of groundwater for power generation likely will not be large.

The increase in surface-water use between 1975 and 1980 is because of the construction of the Cooper, Fort Calhoun, Gentleman, and Nebraska City plants and the greater use at the North Omaha plant. The 1980 projections considered construction of all these plants except the one at Nebraska City. Exclusion of the Nebraska City plant and the greater use at the North Omaha plant account for most of the difference between the 1980 projections and the actual 1980 estimated surface-water use.

Listed below are total discharges through turbines (in thousands of acre-feet) at hydroelectric plants for 1965, 1970, 1975, 1979, and 1980.

1965	1970	1975	1979	1980
9,064[1]	8,686[2]	7,339[3]	6,114	6,682

1. From Shaffer, 1966
2. From Shaffer, 1972
3. From Bentall and Shaffer, 1979

Some of the decrease in water use at hydroelectric plants between 1965 and 1980 occurred because of the decommissioning of several small plants. However, annual turbine discharge can vary considerably from year to year because of variations in streamflow, diversions, and storage amounts. If one considers the minimum and maximum discharge in each of the five years for the twelve plants operating in 1980, a possible maximum discharge of about 8,600 acre-feet and a minimum discharge of about 5,400 acre-feet are calculated. Evaluation of intermediate years might well reveal even a greater range in values. Because of the potential annual variability in this use, care must be taken when predicting trends from data for individual years five years apart.

Table 10

Water withdrawal and use for power generation in Nebraska, 1979 and 1980

	1979			1980		
	Millions of gallons	Acre-feet	Millions of gallons per day	Millions of gallons	Acre-feet	Millions of gallons per day
Hydroelectric[1,2]	-	6,114,940	5,459.1	-	6,682,262	5,949.2
Thermoelectric[3,4,5]						
Groundwater	14,282	43,830	39.1	9,237	28,347	25.2
Surface water	871,471	2,674,444	2,387.6	925,132	2,839,122	2,527.7

1. Includes only amounts discharged through the turbines and not amount of diversion for use at off-stream plants.
2. Does not include Gavins Point plant on Missouri River.
3. Does not include amounts from municipal supplies that are included in public supply totals.
4. Includes total withdrawals; does not include reuse within plants.
5. Includes withdrawals from canals for the Gentleman and Canaday plants and does not attribute any of the original diversion canal loss to the power plants.

Table 11

Water use by hydroelectric generating plants in Nebraska, 1979

Plant name	County	Owner	Feet of head	Generation, Mega-watt hours	Discharge through turbines, Millions of gallons per day	Discharge through turbines, Acre-feet	Amount diverted, Acre-feet	Source of supply
OFF-STREAM								
North Platte	Lincoln	NPPD	205	82,005	484.9	543,160	752,500[4]	South Platte and North Platte Rivers via Sutherland Canal
Kearney	Buffalo	NPPD	54	1,078	87.5	97,990	111,580	Platte River via Kearney Canal
Jeffrey	Lincoln	CNPPID	116	88,248	857.1	960,080		
Johnson #1	Gosper	CNPPID	116	53,401	511.9	573,350	1,052,490[5]	Platte River via Tri-County Canal
Johnson #2	Gosper	CNPPID	146	57,717	505.0	565,650[1]		
Monroe	Platte	LPD	32	29,131	1,102.0	1,234,380[1]	1,299,350	Loup River via Loup Power Canal
Columbus	Platte	LPD	112	111,462	1,044.0	1,169,420[2]		
Subtotal - Off-stream				423,041	4,592.4	5,144,030	3,215,920	
ON-STREAM								
Spencer	Holt-Boyd	NPPD	21	11,336	768.2	860,520[3]		Niobrara River
Minnechaduza	Cherry	NPPD	29	483	17.5	19,630[3]		Minnechaduza Creek
Niobrara	Cherry	NPPD	13	513	41.5	46,520[3]		Niobrara River
Blue Springs	Gage	NPPD	11	205	19.6	21,960[3]		Big Blue River
Spalding	Greeley	Spalding	16	302	19.9	22,280[3]		Cedar River
Subtotal - On-stream				12,839	866.7	970,910		
Total				435,880	5,459.1	6,114,940		
Gavins Point	Cedar	COE	42-50	818,202	18,854.7	21,120,000		Missouri River

1. Estimated as 95 percent of diversion.
2. Estimated as 90 percent of diversion.
3. Calculation based on power production.
4. Also used for cooling at Gentleman Steam Plant
5. Also used for cooling at Canaday Steam Plant and for irrigation.

NPPD - Nebraska Public Power District

CNPPID - Central Nebraska Public Power and Irrigation District

LPD - Loup Power District

COE - Corps of Engineers (U.S. Army)

Table 12

Water use by hydroelectric generating plants in Nebraska, 1980

Plant name	County	Owner	Feet of head	Generation, Mega-watt hours	Discharge through turbines: Millions of gallons per day	Discharge through turbines: Acre-feet	Amount diverted, Acre-feet	Source of supply
OFF-STREAM								
North Platte	Lincoln	NPPD	205	132,633	748.8	840,900	991,020[4]	South Platte and North Platte Rivers via Sutherland Canal
Kearney	Buffalo	NPPD	54	1,172	94.4	105,990	113,240	Platte River via Kearney Canal
Jeffrey	Lincoln	CNPPID	116	114,560	1,101.7	1,237,290		
Johnson #1	Gosper	CNPPID	116	79,381	756.8	849,900	1,296,530[5]	Platte River via Tri-County
Johnson #2	Gosper	CNPPID	146	101,067	745.4	837,160[1]		Canal
Monroe	Platte	LPD	32	22,967	886.9	996,020[1]	1,048,440	Loup River via Loup Power
Columbus	Platte	LPD	112	89,854	840.2	943,600[2]		Canal
Subtotal - Off-stream				541,634	5,174.2	5,810,860	3,449,230	
ON-STREAM								
Spencer	Holt-Boyd	NPPD	21	10,568	713.8	801,680[3]		Niobrara River
Minnechaduza	Cherry	NPPD	29	411	14.9	16,730[3]		Minnechaduza Creek
Niobrara	Cherry	NPPD	13	2	0.1	160[3]		Niobrara River
Blue Springs	Gage	NPPD	11	81	7.8	8,720[3]		Big Blue River
Spalding	Greeley	Spalding	16	598	39.3	44,110[3]		Cedar River
Subtotal - On-stream				11,660	775.9	871,400		
Total				553,294	5,949.2	6,682,260		
Gavins Point	Cedar	COE	42-50	792,914	17,723.3	19,904,000		Missouri River

1. Estimated as 95 percent of diversion.
2. Estimated as 90 percent of diversion.
3. Calculation based on power production.
4. Also used for cooling at Gentleman Steam Plant.
5. Also used for cooling at Canaday Steam Plant and for irrigation.

NPPD - Nebraska Public Power District.

CNPPID - Central Nebraska Public Power and Irrigation District.

LPD - Loup Power District.

COE - Corps of Engineers (U.S. Army).

Table 13

Water withdrawal and use for thermoelectric generating plants, 1979
(All values in millions of gallons per day except as indicated)

[Public supply: Asterisk indicates small, unmeasured amount used.]

Plant Name	County	Owner	Generating capacity (Mega-watts)	Generation (Mega-watt hours)	Ground-water	Surface water	Public supply	Cooling type
Cooper	Nemaha	NPPD	778	4,994,938	0.08	777.08	-	Once-Through
Gentleman	Lincoln	NPPD	500	1,395,181	0.33	198.30	-	Once-Through
Sheldon	Lancaster	NPPD	225	826,180	3.02	-	-	Cooling Tower
Kramer	Sarpy	NPPD	114	401,400	-	81.64	-	Once-Through
Scottsbluff	Scotts Bluff	NPPD	44	171,678	18.21	-	0.01	Once-Through
Ogallala	Keith	NPPD	9	32,405	0.10	-	-	Cooling Tower
Fort Calhoun	Washington	OPPD	457	3,663,501	-	504.50	-	Once-Through
North Omaha	Douglas	OPPD	632	2,239,130	-	555.96	0.65	Once-Through
Jones Street	Douglas	OPPD	84	4,298	-	3.54	*	Once-Through
Nebraska City	Otoe	OPPD	579	1,089,300	-	182.36	-	Once-Through
Canaday	Gosper	CNPPID	100	559,909	0.14	82.40	-	Once-Through
Alliance	Box Butte	Alliance	7.5	14,992	-	-	0.01	Once-Through
Fairbury	Jefferson	Fairbury	19	8,846	-	1.81	0.05	Once-Through
Lon D. Wright	Dodge	Fremont	136	398,575	10.78	-	*	Once-Through
C.W. Burdick	Hall	Grand Island	107.3	283,380	3.83	-	-	Once-Through Cooling Tower
Pine Street	Hall	Grand Island	12.5	261	0.05	-	-	Once-Through
North Denver	Adams	Hastings	39.2	138,045	2.56	-	0.58	Once-Through Cooling Tower
Lincoln	Lancaster	Lincoln	21	1,894	-	-	0.02	Cooling Tower
UNL-City Campus	Lancaster	U. of Nebraska	6	12,538	-	-	0.17	Cooling Tower
Schuyler	Colfax	Schuyler	7.5	2,696	0.03	-	*	Once-Through
Total				16,239,147	39.13	2,387.59	1.49	

NPPD - Nebraska Public Power District

OPPD - Omaha Public Power District

CNPPID - Central Nebraska Public Power and Irrigation District

Table 14

Water withdrawal and use for thermoelectric generating plants, 1980
(All values in millions of gallons per day except as indicated)

[Public supply: Asterisk indicates small, unmeasured amount used.]

Plant Name	County	Owner	Generating capacity (Mega-watts)	Generation (Mega-watt hours)	Ground-water	Surface water	Public supply	Cooling type
Cooper	Nemaha	NPPD	778	3,788,053	0.08	682.45	-	Once-Through
Gentleman	Lincoln	NPPD	500	2,313,734	0.33	253.34	-	Once-Through
Sheldon	Lancaster	NPPD	225	751,222	1.92	-	-	Cooling Tower
Kramer	Sarpy	NPPD	114	259,697	-	67.36	-	Once-Through
Scottsbluff	Scotts Bluff	NPPD	44	69,415	8.76	-	0.01	Once-Through
Ogallala	Keith	NPPD	9	2,322	0.01	-	-	Cooling Tower
Fort Calhoun	Washington	OPPD	457	2,006,395	-	457.91	-	Once-Through
North Omaha	Douglas	OPPD	632	2,612,064	-	601.07	0.61	Once-Through
Jones St.	Douglas	OPPD	84	3,209	-	21.82	*	Once-Through
Nebraska City	Otoe	OPPD	579	1,980,007	-	358.07	-	Once-Through
Canaday	Gosper	CNPPID	100	482,817	0.14	85.16	-	Once-Through
Alliance	Box Butte	Alliance	7.5	3,548	-	-	0.04	Once-Through
Fairbury	Jefferson	Fairbury	19	3,060	-	0.50	0.01	Once-Through
Lon D. Wright	Dodge	Fremont	136	326,734	6.35	-	*	Cooling Tower Once-Through
C.W. Burdick	Hall	Grand Island	107.3	224,007	3.77	-	-	Once-Through Cooling Tower
Pine Street	Hall	Grand Island	12.5	37	0.02	-	-	Once-Through
North Denver	Adams	Hastings	39.2	142,409	3.84	-	0.63	Once-Through Cooling Tower
Lincoln	Lancaster	Lincoln	21	1,371	-	-	0.02	Cooling Tower
UNL-City Campus	Lancaster	U. of Nebraska	6	12,494	-	-	0.19	Cooling Tower
Schuyler	Colfax	Schuyler	7.5	1,667	0.02	-	*	Once-Through
Total				14,984,262	25.24	2,527.68	1.51	

NPPD - Nebraska Public Power District

OPPD - Omaha Public Power District

CNPPID - Central Nebraska Public Power and Irrigation District

Table 15

Thermoelectric power generation water use, 1979 and 1980, estimates for previous years, and projection for 1980 (millions of gallons per day)

[GW: Groundwater; SW: Surface water]

Hydrologic unit	1965 (Water use Report[1])		1970 (Water Plan[2])		1970 (Water use Report[3])		1975 (Water use Report[4])		1979 (Inventory)		1980 (Inventory)		1980 Projected Use (Water Plan[2])	
	GW	SW	GW	SW	GW	SW	GW	SW	GW	SW	GW	SW	GW	SW
Hat-White-White Clay	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Niobrara-Ponca	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Missouri tributaries	-	-	0.17 (9.2)	415.5	9.2	526.9	9.2	536.1	0.0	1,145.6	0.0	1,148.2	0.10 (6.4)	747.1
North Platte	-	-	24.8	0.0	24.8	0.0	45.9	0.0	18.2	0.0	8.8	0.0	11.6	0.0
South Platte	-	-	0.06 (3.9)	0.0	3.9	0.0	10.3	0.0	0.4	198.3	0.3	253.3	0.02 (1.2)	302.5
Middle Platte	-	-	31.3	74.1	31.2	74.0	31.9	85.4	4.0	82.4	4.0	85.2	7.14 (213.5)	35.9
Loup	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Elkhorn	-	-	0.51 (30.7)	0.0	0.0	0.0	52.6	0.0	10.8	0.0	6.4	0.0	0.02 (1.63)	0.0
Lower Platte	-	-	2.1 (146.7)	0.0	177.2	0.0	165.9	0.0	3.0	0.0	1.9	0.0	0.9 (59.6)	0.0
Republican	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Little Blue	-	-	0.0	6.4	0.0	6.4	0.0	6.4	0.0	1.8	0.0	0.5	0.0	0.9
Big Blue	-	-	0.31 (20.8)	0.0	20.8	0.0	20.8	0.0	3.1	0.0	4.5	0.0	0.07 (4.48)	0.0
Weeping Water-Big Nemaha-Little Nemaha	-	-	0.0	0.0	4.1	0.0	4.1	0.0	0.1	959.5	0.1	1,040.5	0.0	667.1
Total	54.5	637.6	59.3 (267.4)	496.1	271.2	607.3	340.7	627.9	39.1	2,387.6	25.2	2,527.7	19.9 (298.7)	1,753.5

1. From Shaffer, 1966, p. 28.

2. From unpublished file notes used to compile data published in Nebraska Soil and Water Conservation Commission, 1971, pp. 89 and 90. Values were aggregated into hydrologic unit totals based on file notes. Values in parentheses include total condenser cooling water requirements for plants with cooling towers. Total withdrawals for use at these plants are much less than actual flow through condensers because of recirculation of water through cooling towers.

3. From Shaffer, 1972, p. 62.

4. From Bentall and Shaffer, 1979, p. 88.

SUMMARY

The establishment of a new water-use data collection program for Nebraska resulted in the collection of detailed water-use information for 1979 and 1980 for public supplies, self-supplied industries, and power-generating facilities. These three water-use categories account for an estimated one-quarter of the total water withdrawn in Nebraska for those years. The 1980 withdrawals and use for each use category are summarized by county in figures 3, 4, and 5. Irrigation is by far the largest water user in Nebraska; however, collection of detailed and accurate irrigation water-use data for the entire state is difficult and was not done as an initial part of the new program.

Water withdrawal for use by public supplies totaled 271.3 mgd in 1979 and 304.7 mgd in 1980. Slightly less than 80 percent of the total public supply withdrawal for both years was from groundwater. Only three municipal systems withdrew surface water. The largest was the Metropolitan Utilities District (serving the Omaha area), which accounted for about 98 percent of the total surface-water withdrawal. Public supply systems served about 80 percent of the state's total population. The average per capita water withdrawal was 215 gpd in 1979 and 239 gpd in 1980. The increase in withdrawals from 1979 to 1980 most likely occurred because of lesser precipitation and higher temperatures in 1980 than in 1979.

Self-supplied industries withdrew 50.4 mgd of water in 1979 and 48.4 mgd in 1980. Surface water accounted for only 7.8 mgd and 7.2 mgd of the total withdrawals in 1979 and 1980, respectively. The largest self-supplied industrial water users in 1979 and 1980 were fertilizer processors, meat processors, and sugar beet processors. Twenty-nine plants in these three categories withdrew slightly more than 75 percent of the total water withdrawn by self-supplied industries in 1979 and 1980.

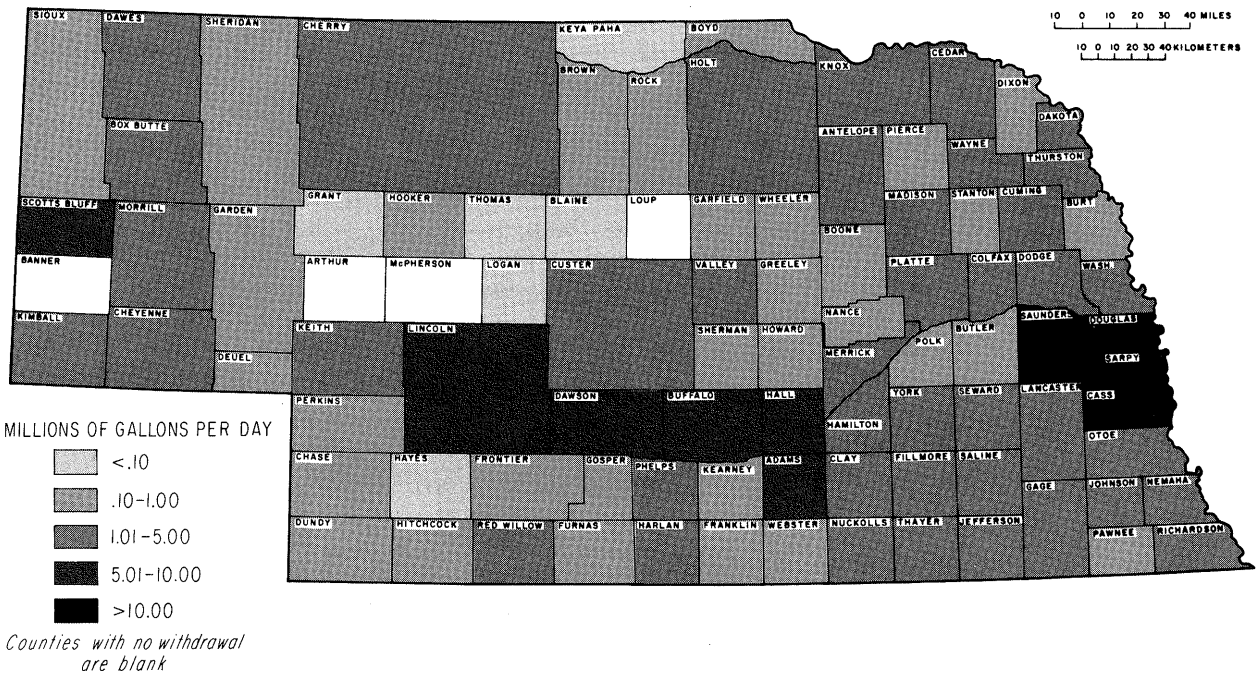
Withdrawals from surface water for use at thermoelectric power plants totaled 2,387.6 mgd in 1979 and 2,527.7 mgd in 1980. Most of the surface water is used for once-through cooling of condensers at large-capacity generating

plants. Only a small amount of this water is consumptively used; therefore, most of it is returned to its original source. Of the surface-water withdrawals, about 87 percent is from the Missouri River.

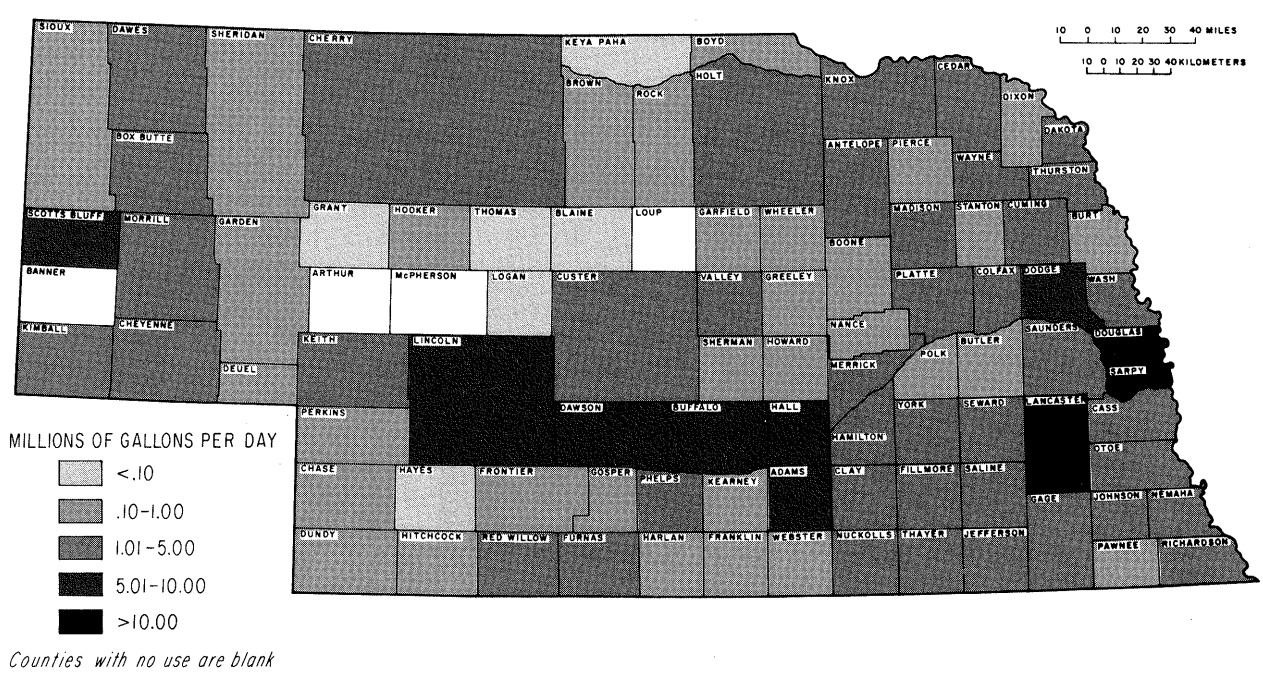
Groundwater withdrawals for use at thermoelectric plants were 39.1 mgd in 1979 and 25.2 mgd in 1980. Most of the total withdrawal was for five plants, three of which are owned by municipalities. The decrease in withdrawal from 1979 to 1980 occurred because the two plants not owned by municipalities decreased their generation and one of the municipal plants began operation of a new unit that has a cooling tower rather than the once-through condenser cooling. The other two municipal plants also recently began operation of new units that have cooling towers; thus, future groundwater use at those plants will decrease.

The flow of water through turbines at hydroelectric power generating plants (both on-stream and off-stream plants) was 5,459.1 mgd (6,114,940 acre-feet) in 1979 and 5,949.2 mgd (6,682,262 acre-feet) in 1980. For the seven off-stream plants, the total diversion of about 3.2 million acre-feet in 1979 and 3.4 million acre-feet in 1980 accounted for total turbine discharges of about 5.1 and 5.8 million acre-feet, respectively. This occurred because in one case the diverted water was used at two plants and in another case the diverted water was used at three plants.

Comparison of water-use estimates for 1979 and 1980 to estimates made for previous years, in order to evaluate possible trends in water use, is difficult because data collection and compilation methods are not the same for all years. Also, having data available for only every fifth year limits such an evaluation. The development of standardized methods and the collection of detailed data at more frequent intervals will make it possible to evaluate recent trends in water use more accurately and to predict possible future trends.



Withdrawal



Use

Fig. 3. Public supply water withdrawal and use, 1980

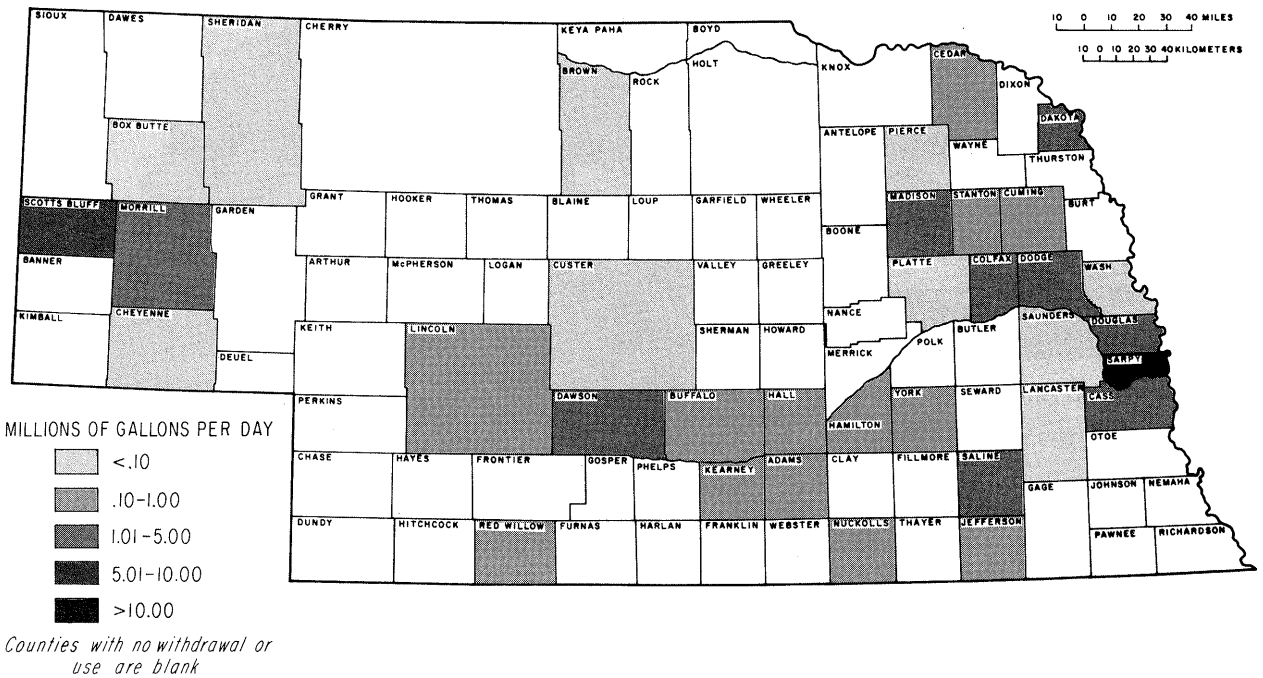


Fig. 4. Self-supplied industrial water withdrawal and use, 1980

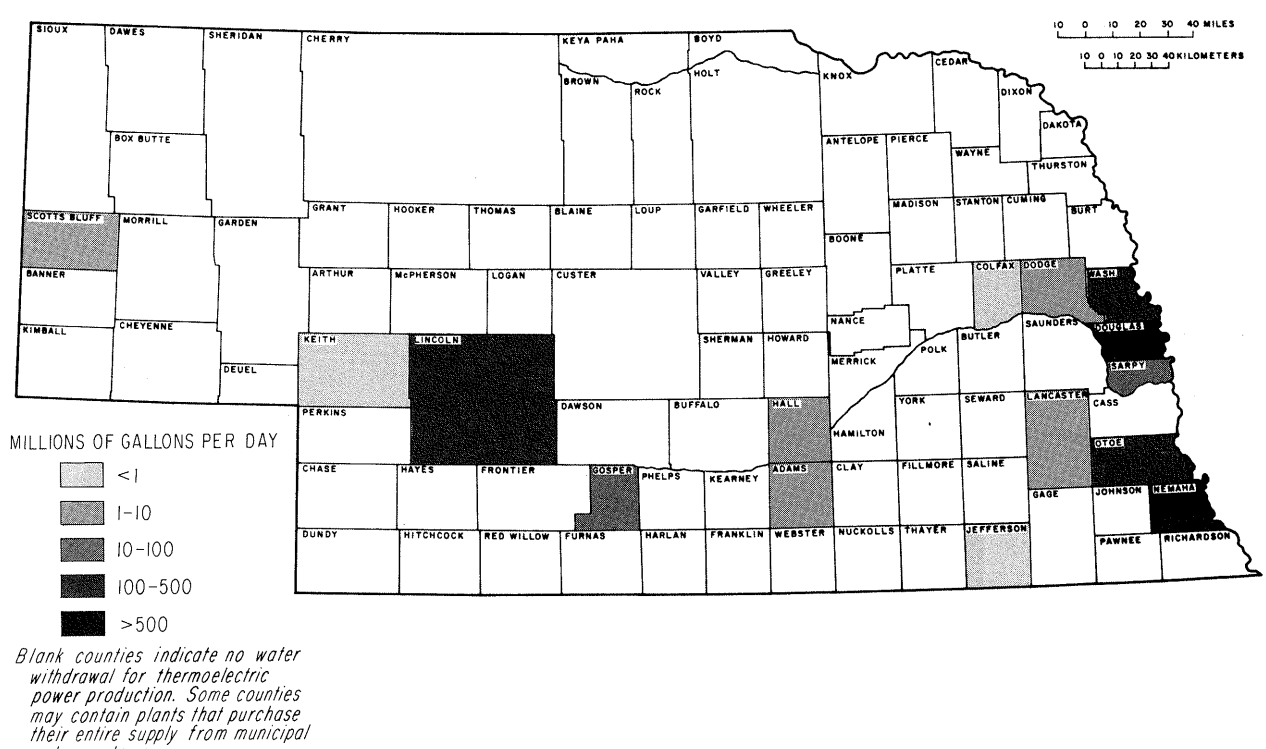


Fig. 5. Thermoelectric power generation water withdrawal and use, 1980

REFERENCES

Bentall, R.; and Shaffer, F. B. 1979. Availability and Use of Water in Nebraska, 1975. Conservation and Survey Division, University of Nebraska: Nebraska Water Survey Paper 48. 121 pp.

Jury, W. B.; Sinai, G.; and Stolzy, L. H. 1979. Future Sources of Cooling Water for Power Plants in Arid Regions: Water Resources Bulletin 15/5:1444-58.

Mac Kichan, K. A. 1951. Estimated Use of Water in the United States, 1950: U.S. Geological Survey Circular 115. 13 pp.

Mac Kichan, K. A. 1957. Estimated Use of Water in the United States, 1955: U.S. Geological Survey Circular 398. 18 pp.

Max Kichan, K. A.; and Kammerer, J. C. 1961. Estimated Use of Water in the United States, 1960: U.S. Geological Survey Circular 456. 26 pp.

M.U.D. (Metropolitan Utilities District). 1981. Annual Report of Water System Operations, 1980: Metropolitan Utilities District Department of Water Operations. Omaha, Nebraska. 51 pp.

Murray, C. R. 1968. Estimated Use of Water in the United States, 1965: U.S. Geological Survey Circular 556. 53 pp.

Murray, C. R.; and Reeves, E. B. 1972. Estimated Use of Water in the United States, 1970: U.S. Geological Survey Circular 676. 37 pp.

Murray, C. R.; and Reeves, E. B. 1977. Estimated Use of Water in the United States, 1975: U.S. Geological Survey Circular 765. 39 pp.

Nebraska Department of Economic Development. 1981. Directory of Nebraska Manufacturers, 1980-81. 195 pp.

Nebraska Soil and Water Conservation Commission. 1971. Report on the Framework Study, Appendix C, Land and Water Resources Problems and Needs: Nebraska State Water Plan Publication 101C. 133 pp.

NOAA (National Oceanic and Atmospheric Administration). 1980. Climatological Data Annual Summary--Nebraska, 1979: Climatological Data Annual Summary 84/13:1-16.

NOAA (National Oceanic and Atmospheric Administration). 1981. Climatological Data Annual Summary--Nebraska, 1980: Climatological Data Annual Summary 85/13:1-19.

Shaffer, F. B. 1966. Availability and Use of Water in Nebraska. Conservation and Survey Division, University of Nebraska: Nebraska Water Survey Paper 19. 33 pp.

Shaffer, F. B. 1972. Availability and Use of Water in Nebraska. Conservation and Survey Division, University of Nebraska: Nebraska Water Survey Paper 31. 33 p.

U.S. Department of Health, Education, and Welfare. 1964. Municipal Water Facilities, 1963 Inventory: Public Health Service Publication 775 (revised), Volume 6. 140 pp.

U.S. Office of Management and Budget. 1972. Standard Industrial Classification Mannual. Statistical Policy Division: Washington, D.C., U.S. Government Printing Office.