

ESTIMATED WATER USE IN IOWA, 1980

by
Robert C. Buchmiller
and
Richard A. Karsten

Prepared by
U.S. GEOLOGICAL SURVEY
in cooperation with the
IOWA GEOLOGICAL SURVEY

INTRODUCTION

The quantity of water available for use within Iowa remains fairly constant from year to year. However, seasonal and geographical variations may affect short-term availability. The use of water in Iowa has been increasing yearly due to greater demands for irrigation, industrial, and municipal supplies. The ability of water managers and planners to effectively analyze the water needs of Iowa requires that detailed information concerning the water resources available and the water-use trends be collected and reported in an efficient manner.

This report presents a summary, by county, of total water use in Iowa for 1980. The total use is divided into five categories: Municipal, Rural-domestic and livestock, Industrial self-supplied, Irrigation, and Thermoelectric-power generation. The report describes water use in terms of quantities of water used for particular needs. A use is defined as the quantity of water taken from a stream, lake, aquifer, or other source. Water to generate hydroelectric power is not included in this report because its use is not considered a withdrawal from a source.

DATA COLLECTION

In 1979 the U.S. Geological Survey entered into a cooperative program with the State of Iowa called the National Water Use Data System. The purpose of this program was to establish a system for collecting, storing, and reporting water-use data. In addition to the national system, Iowa has developed the Iowa Water Resources Data System to catalog, store, index, process, and transfer water-resources data to meet various state data needs. This report represents a part of these two programs.

Municipal water-use data was collected from the files of the six regional offices of the Iowa Department of Water, Air and Waste Management (formerly the Iowa Department of Environmental Quality). Information was obtained or estimated for 764 cities and towns, serving a population of about 2,147,000. A linear regression was used to estimate withdrawals from unreported municipal supplies.

Rural-domestic water use includes water withdrawn by rural water associations and self-supplied rural water users. Persons not served by towns included in the Municipal water-use category are considered Rural-domestic water users in this report. Rural-domestic water use was estimated by adding the quantities of water used by rural water associations to the use of the remaining self-supplied rural populations. Eighty-five gallons was estimated to be the daily per-capita rural-domestic water use of the self-supplied population.

Livestock water-use rates were provided by Iowa State University (1976) and the Cooperative Extension Service, Iowa State University, (John B. Herrick, oral commun.,

1982) for the animals involved on a per-head basis. The 1980 census of cattle, hog, sheep, and chicken populations (Skow and Halley, 1981) and the 1978 census of horses and turkeys (U.S. Department of Commerce, 1981) were used to estimate the number of animals of each type. Daily-use estimates were made by multiplying the daily-use rate by the numbers of animals involved.

Estimates of Industrial self-supplied water use were based on a survey of more than 250 permitted users and information in files of the U.S. Geological Survey. Numerous small commercial and industrial users were not contacted by this survey and their contribution to the total Industrial self-supplied use is not known. The Iowa Natural Resources Council (1978) estimates that there are approximately 3,000 users not included in the present permitting system. It is the intent of the data presented here to represent the majority of the Industrial self-supplied use for 1980.

Methods for estimating water use for irrigation were obtained from the Cooperative Extension Service, Iowa State University (Stuart Melvin, oral commun., 1982). The use in this category is dependent upon seasonal climatic variations and the number of acres irrigated. For 1980, it is estimated that 85 percent of the total permitted acreage was irrigated with an average of 5 inches of water per acre.

Thermoelectric-power generation estimates were tabulated from responses to a survey of more than 135 electric-generation facilities.

TOTAL WATER USE

Total water use in Iowa for 1980 was 1,170,000 million gallons (1.17 trillion gallons) or about 3,200 Mgal/d (million gallons per day). This is approximately 1,100 gallons per day per capita for all uses combined. The distribution by county is shown in figure 1.

The distribution of the total water use among the five categories used in this report is shown in figure 2. The distribution of surfacewater use is shown in figure 3 and that for groundwater use in figure 4. Surfacewater sources accounted for about 72 percent of all water used.

The largest total use occurred in Woodbury County (812 Mgal/d) due to the large uses in the Industrial self-supplied and Thermoelectric-power generation categories. Other counties with large total uses were primarily those with large Thermoelectric-power generation use. Extraordinarily large quantities of water are used for once-through cooling in thermoelectric-generating stations in comparison to the other identified categories of water use in Iowa. When the Thermoelectric-power generation category is not included in the total-use estimates, the counties with the largest total water use are Clinton (124 Mgal/d), Woodbury (67 Mgal/d), Lee (66 Mgal/d), Polk (58 Mgal/d), Muscatine (56 Mgal/d), and Dubuque (50 Mgal/d).

MUNICIPAL

Municipal water use is defined for the purposes of this study as the water used by cities and towns. Some small towns in Iowa do not supply water for their residents or other users. These, and all other self-supplied domestic water users are included under the Rural-domestic and livestock water-use category.

Total municipal water use during 1980 was approximately 305 Mgal/d, or about 111,000 million gallons. Of this quantity about 82 percent or about 246 Mgal/d were from groundwater sources. Municipal water use by county is shown in figure 5. Municipal water systems supplied approximately 74 percent of Iowa's population with potable

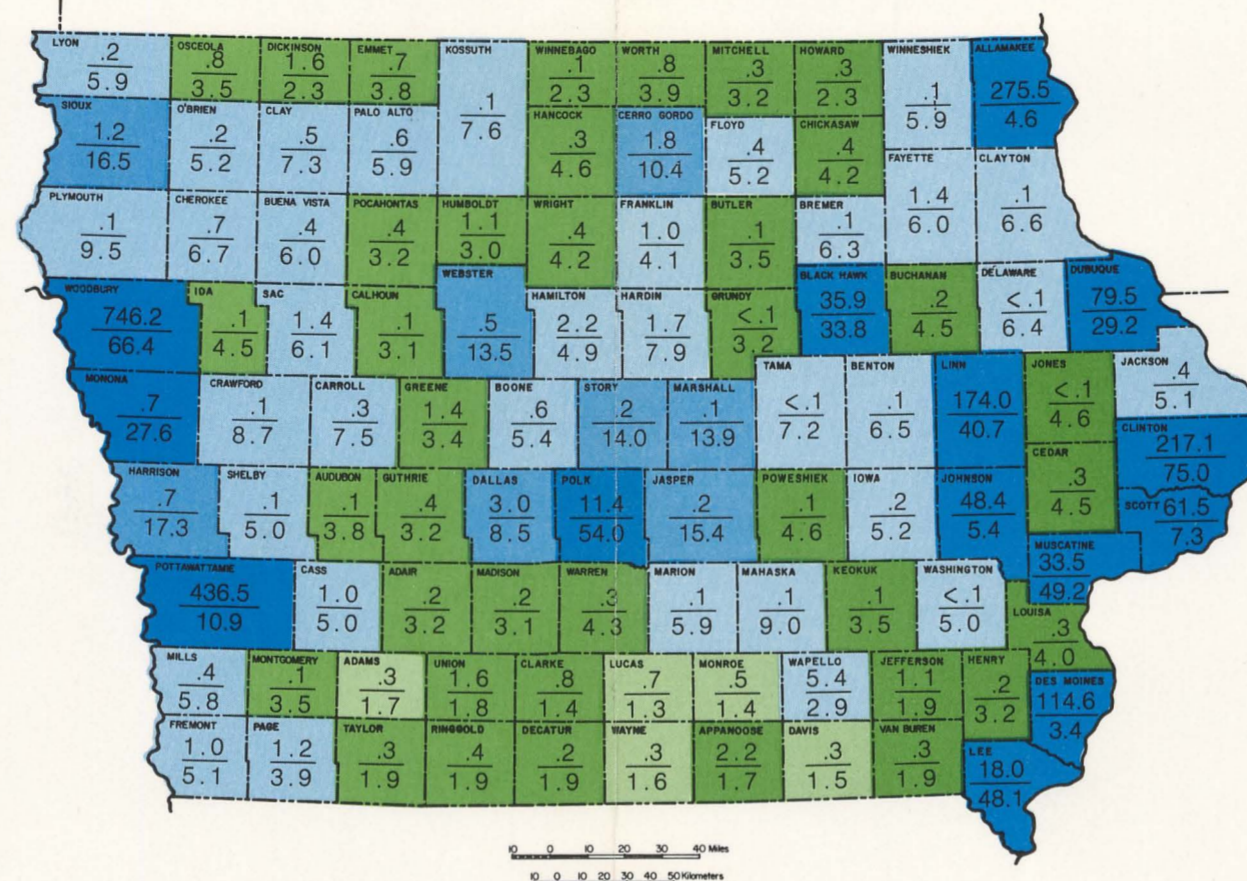


Figure 1. Total estimated water use. Upper number in each county is surfacewater use in Mgal/d; lower number is groundwater use in Mgal/d.

water. The average daily per capita water use during 1980 for all municipal water users in Iowa was about 140 gallons. Polk County had the largest municipal water use, about 42 Mgal/d. Linn County was second with 26.5 Mgal/d. The largest municipal water user during 1980 was the City of Des Moines in Polk County, which pumped 13,250 million gallons or about 36 Mgal/d. Davis County had the smallest municipal water use, less than 0.2 Mgal/d.

RURAL-DOMESTIC AND LIVESTOCK

The water needs of persons and livestock not served by the withdrawals identified in Municipal water use are included in the Rural-domestic and livestock water-use category. The Rural-domestic use represents a population of about 766,000 people, or 26 percent of the Iowa total of 2,913,387 (U.S. Department of Commerce, 1981).

In some areas of Iowa, particularly western and southern Iowa, water-availability and water-quality considerations have prompted the formation of rural water associations. These associations pool the financial resources of their members in order to obtain and distribute water of suitable quality and quantity. During 1980 there were 11 principal rural water associations operating in Iowa. These associations either purchased water from municipal suppliers or withdrew from surface or groundwater sources approximately 1,800 million gallons (5 Mgal/d) during 1980. About 53 percent of this total was from groundwater sources. Counties at least partly served by the major rural water associations are indicated by the striped pattern in figure 6.

The remainder of the Rural-domestic and livestock water use was considered to have been from self-supplied groundwater sources. However, in southern Iowa there are a number of rural residents using surfacewater sources for livestock watering or erosion control. During 1980 about 54,000 of these farm ponds were in use in Iowa. (V.H. Smith, U.S. Department of Agriculture, written commun.,

1982). These surfacewater uses are not known and cannot presently be accurately estimated.

Total Rural-domestic and livestock water use during 1980 was estimated to be about 260 Mgal/d. Distribution by county is shown in figure 6. Sioux County had the largest total Rural-domestic and livestock use (10 Mgal/d) with the majority (9 Mgal/d) for livestock watering. Winnebago and Worth Counties had the smallest Rural-domestic and livestock use with less than 1 Mgal/d each.

In the domestic portion of the Rural-domestic and livestock use category, Polk County had the largest water use, more than 2 Mgal/d. Other counties with large population centers also had a relatively large rural-domestic use. Wayne County had the smallest Rural-domestic use, less than 0.2 Mgal/d, which may be due to the population density and dependence on rural water associations with water-supply sources outside the county.

INDUSTRIAL SELF-SUPPLIED

The Industrial self-supplied category includes a variety of uses such as manufacturing, processing, washing, cooling, mining, housekeeping, and drinking water. Private power-generation facilities also are included in this category. It is not possible at this time to accurately predict the water use of small, unpermitted commercial and industrial users, and so, they have been omitted from this category.

The largest use of water by self-supplied industries was 114 Mgal/d in Clinton County (fig. 7). Other counties with large withdrawals were Lee (56 Mgal/d), Woodbury (37 Mgal/d), Dubuque (36 Mgal/d), Muscatine (35 Mgal/d), and Black Hawk (34 Mgal/d).

IRRIGATION

Of the 99 counties in Iowa, all but 14 have a record of irrigation permits. Groundwater sources account for about 83 percent of the irrigation water used. Much of this

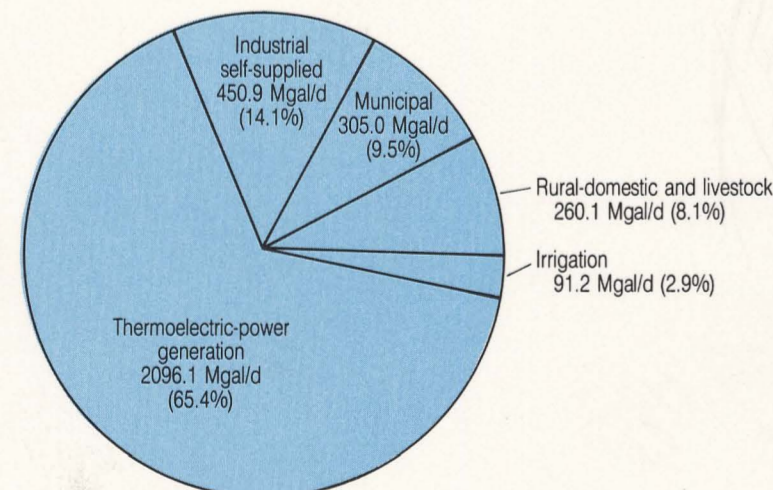


Figure 2. Total water use by category, in million gallons per day and percent.

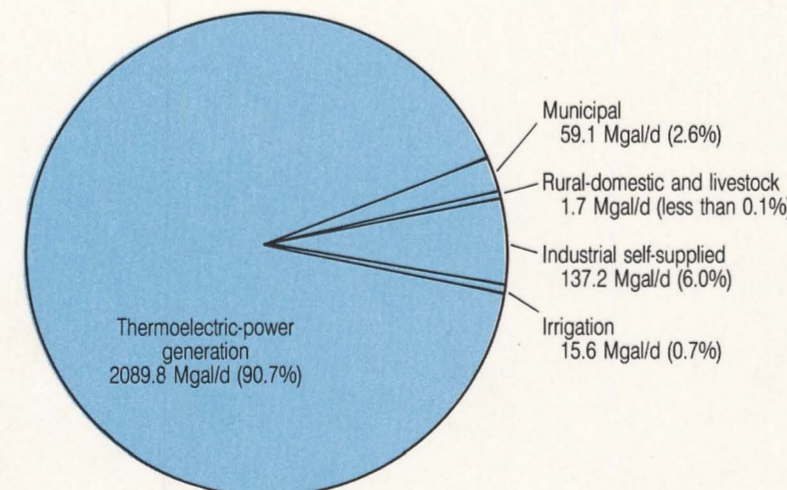


Figure 3. Surfacewater use by category, in million gallons per day and percent.

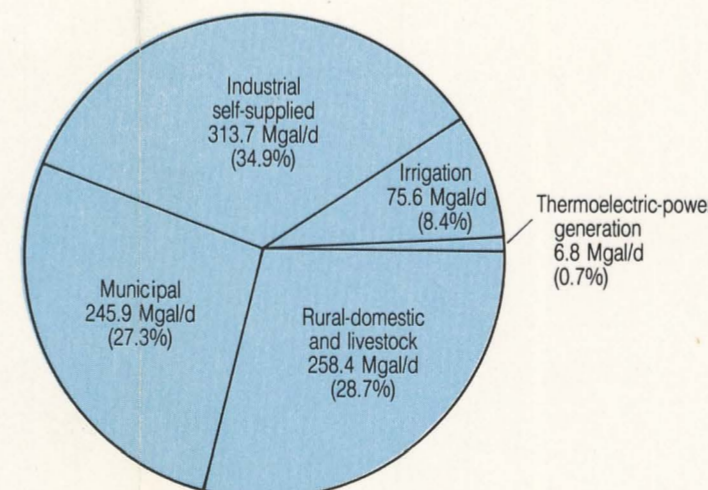


Figure 4. Groundwater use by category, in million gallons per day and percent.

EXPLANATION FOR MAPS
Water use in million gallons per day

- Less than 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 20.0
- Greater than 20.0
- No information available

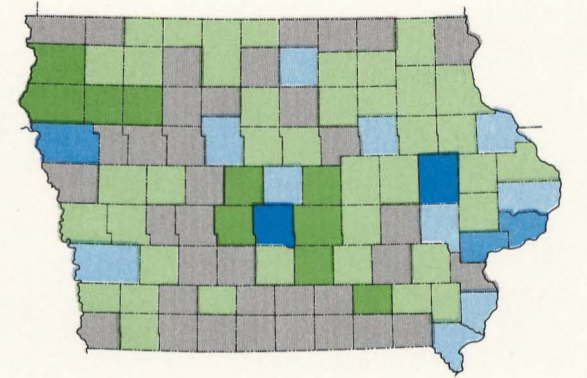


Figure 5. Municipal water use.

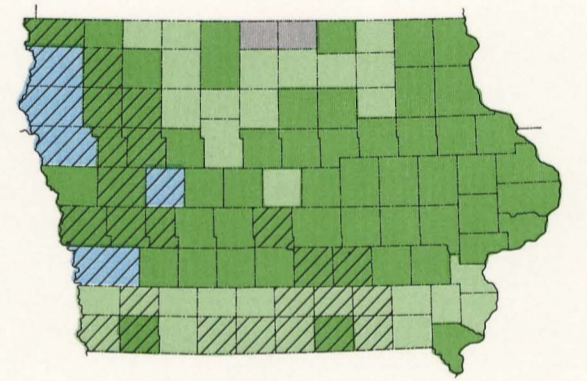


Figure 6. Rural-domestic and livestock water use. Striped areas indicate counties served by rural water associations.

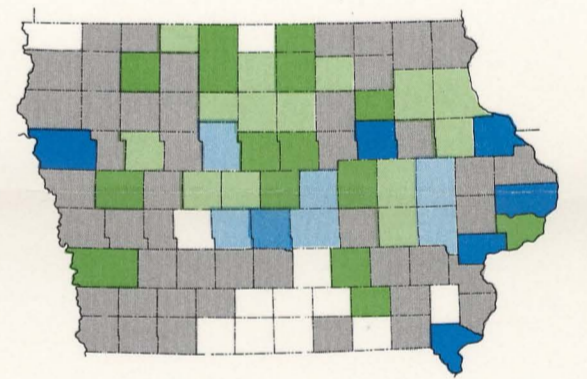


Figure 7. Industrial self-supplied water use.

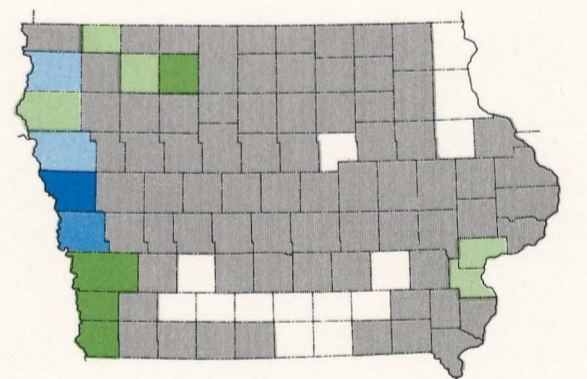


Figure 8. Irrigation water use.

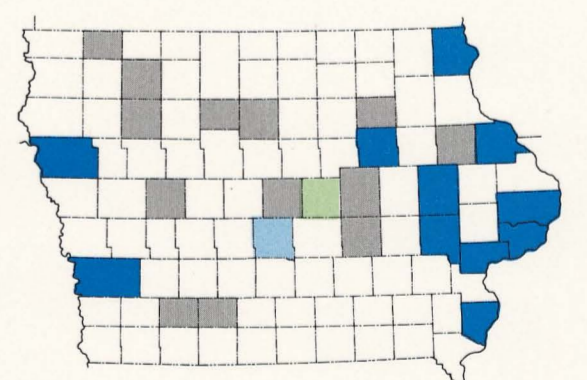


Figure 9. Thermoelectric-power generation water use.

comes from wells completed in the alluvium that underlies flood plains of major rivers. Irrigation water use, by county, is shown in figure 8.

Total irrigation use for 1980 was 33,200 million gallons or about 91 Mgal/d when computed on an annual basis. Because the withdrawals do not occur throughout the year, the relatively intense withdrawals during the growing season, especially during dry periods, may cause a significant impact on water sources. Irrigation was greatest in the western counties of Iowa, where annual precipitation usually is least. During 1980 Monona County had the largest total withdrawal, about 9,000 million gallons.

THERMOELECTRIC-POWER GENERATION

Most of the large thermoelectric-power generating stations in Iowa use fossil-fuel and are located on the Mississippi and the Missouri Rivers, which border Iowa to the east and west. Iowa has one nuclear-powered electric-generating station in Linn County. Its use is included in the Thermoelectric-power generation category.

The use of water in fossil-fuel generating stations is mainly for the production of steam and for cooling the boiler and associated power-generating equipment. Because the production of steam is in an air-tight closed system, only small losses occur and the need to replenish lost water is negligible. Water used for cooling can be very large since cooling water may pass through the facility only once or be recycled a number of times.

Total water use for thermoelectric-power generation stations was 765,000 million gallons or about 2100 Mgal/d during 1980. The distribution of use by county is shown in figure 9. The largest use was in Woodbury County (746 Mgal/d).

SELECTED REFERENCES

- Iowa Development Commission, 1982, 1981-82 directory of Iowa manufacturers: Des Moines, 351 p.
- Iowa Development Commission, 1982, 1982 statistical profile of Iowa: Des Moines, 118 p.
- Iowa Natural Resources Council, 1978, Iowa water plan '78 — Framework study — Main report: Des Moines, 207 p.
- Iowa State University, 1976, Water quality for livestock — Animal health fact sheet No. 8: Ames, Cooperative Extension Service, Iowa State University, 6 p.
- Skow, D.M. and Halley, C.R., 1981, Iowa agricultural statistics — 1981: Des Moines, Iowa Department of Agriculture, Iowa Crop and Livestock Reporting Service, 100 p.
- U.S. Department of Commerce, 1981, 1978 census of agriculture — Iowa: Washington, D.C., vol. 1, part 15, 696 p.
- U.S. Department of Commerce, 1981, 1980 census of population and housing — Iowa: Washington, D.C., PHC80-v-17, 48 p.