TRENDS IN INDIANA'S WATER USE

1986–96

SPECIAL REPORT NO. 1

STATE OF INDIANA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER

IN COOPERATION WITH THE U.S. GEOLOGICAL SURVEY

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By Donald V. Arvin, U.S. Geological Survey, and

Ralph Spaeth, Indiana Department of Natural Resources

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CONTENTS

ILLUSTRATIONS

Trends in Indiana's Water Use, 1986–96

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SELECTED FINDINGS

The Indiana Department of Natural Resources (IDNR), Division of Water, has been conducting an inventory of the state's significant water withdrawal facilities (facilities capable of pumping 100,000 gallons or more per day) since 1985. The Division of Water, in cooperation with the U.S. Geological Survey, conducted an investigation that included a trend analysis using the 1986-96 water use data. The data are grouped into six major water use categories: Energy Production, Industry, Agriculture, Public Supply, Rural Use, and Miscellaneous. Some of the major findings of that investigation are presented below.

- Statewide, ground water withdrawals were much less than surface water withdrawals. By comparison, ground water withdrawals each year were less than 7 percent of the amount withdrawn from surface water sources.
- Total surface water withdrawals for the state showed neither an upward nor a downward trend over time, although relatively large fluctuations occurred from one year to the next. Total ground water withdrawals increased over time.
- Two water use categories, when combined, accounted for more than 94 percent of statewide surface water withdrawals each year. Energy Production accounted for 67 to 69 percent, and Industry accounted for 26 to 28 percent.
- The Public Supply category ranked highest in ground water withdrawals, accounting for 55 to 61 percent of all ground water withdrawals each year. The Industry category ranked second, accounting for 20 to 28 percent.
- From 1986 to 1996, there was more than a 45-percent increase in ground water withdrawal capacity. Nearly 65 percent of this increased ground water withdrawal capacity was associated with the Agriculture category, and nearly 20 percent of the increase was associated with the Public Supply category.
- Withdrawals for the Agriculture category, both surface water and ground water, increased over time.
- Annual ground water withdrawals for the Agriculture category tended to be larger during years when summer temperatures were higher. There seemed to be little to no correlation between summer temperatures and annual surface water withdrawals for this same category.
- Annual surface water withdrawals for the Public Supply category and annual ground water withdrawals for the Energy Production category tended to be largest during years when summer temperatures were highest.
- For the Public Supply category, surface water withdrawals neither increased nor decreased over time,

whereas ground water withdrawals increased over time. In 1996, for the first time, ground water withdrawals exceeded surface water withdrawals for this category.

INTRODUCTION

Water is one of Indiana's most valuable resources. The availability of water is linked directly to the well-being of our communities, our economy, and our future. An understanding of how we use our water is a key component in resolving the issues we face today and in planning for tomorrow.

The Water Resource Management Act (Indiana Code 14-25-7, previously 13-2-6.1), passed by the State Legislature in 1983, mandates that owners of all wells and surface water intakes register with the Division of Water if their pumping facilities have the capability of withdrawing 100,000 gallons or more of water per day (equivalent to about 70 gallons or more per minute). These facilities are identified as significant water withdrawal facilities. The law pertains to both stationary and portable pumps. Registration requirements are based on pump capacity, not actual water withdrawals. Beginning in 1996, by act of the legislature, landfill facilities were exempted from the requirement to register and report their withdrawals.

In accordance with the Water Resource Management Act, the Division of Water since 1985 has been conducting an inventory of the state's significant water withdrawal facilities. This inventory includes information on the numbers of significant water withdrawal facilities throughout the state, along with the numbers of registered ground water wells and surface water intakes, the amounts of water withdrawn, and the pump withdrawal capacities. Withdrawal capacity is the amount of water a pump is capable of pumping, whereas a withdrawal is the amount of water a pump actually withdrew from a surface or ground water source. Data in this water use inventory can be aggregated by category of use, and also by county and by Water Management Basin (figure 1).

The owner of a facility capable of withdrawing 100,000 gallons per day is required to register that facility with the Division of Water within 90 days of the time that the facility begins operation. A facility having a maximum withdrawal capability less than 100,000 gallons per day is not required to register. Most home owners, for example, who withdraw water from their own well for household needs typically have pumps with a maximum capability of less than 70 gallons per minute. Therefore, they are not required to register their well.

Every year, the Division of Water mails a reporting form to each registered facility. The facility owners ensure that the forms are completed and returned to the agency. The facility owner's best estimates of total monthly withdrawals for each pump are listed on the form. Reported withdrawals at some sites are based on flowmeter readings, although metering is not uniformly mandated for all facilities. Reported withdrawals at other sites are based on the pump capacity multiplied by the hours of pump operation. At still other sites alternative techniques are used to estimate the withdrawals. In 1996, withdrawal data were reported for 3,536 active registered facilities.

The purpose of this publication is to provide to resource managers, planners, the general public, and other interested parties the results of an investigation that involved a trend analysis on 1986-96 Indiana water use data. The conclusions presented in this report focus on trends by source (ground water or surface water) and by category at the state, county, and Water Management Basin level. This report does not attempt to present conclusions as to the specific economic, environmental, or other forces that influence the amounts of water withdrawn in Indiana and does not attempt to predict

Figure 1. Indiana counties and Water Management Basins.

the amounts of water that might be withdrawn in the future. Water use information for individual counties and basins can be found in the IDNR publication, "Water Use in Indiana, Graphs by County and Water Management Basin."

Information presented in this report was based primarily on water use data collected and maintained by the Division of Water. Other agencies, however, also made data available for use in this effort. The National Weather Service and the Midwestern Climate Center provided temperature and precipitation data. The Indiana Agricultural Statistics Service provided data on crop acreage. The U.S. Department of Commerce, Bureau of the Census, provided population data, irrigation acreage, housing data, and other information.

CATEGORIES OF WATER USE

Registered significant water withdrawal facilities have been divided into six general water use categories. The categories are described as follows:

Energy Production facilities include those that withdraw water for the primary purpose of power generation, including coal mining operations. A major component in this category is water used for the cooling of condensers at fossil fuel power plants.

Industrial facilities include those that withdraw water primarily for use in the manufacturing process, including sand and gravel operations.

Public Supply facilities include those that withdraw water for the primary purpose of distributing water for use by others and for use in public establishments. These facilities include water supply utilities and self-supplied mobile home parks and apartment complexes. These facilities also include self-supplied schools and other institutions that provide water for use by the general public.

Agricultural facilities include those that withdraw water for the primary purpose of irrigating crops or golf courses, dewatering farm sites and fields, and other similar agricultural practices.

Rural Use facilities include those that withdraw water for the primary purpose of watering livestock and operating fish hatcheries.

Miscellaneous facilities include those that withdraw water for a variety of other uses, including snow-making, operating fish and wildlife areas, lake-level maintenance, and construction dewatering. Landfills were included in this category through 1995, then were exempted from the registration and reporting requirement beginning in 1996.

METHODOLOGY

In analyzing the 1986-96 withdrawal data, one of the major goals was to determine if data for a selected category or source exhibited an upward or downward trend over time, or no change over time. Kendall's correlation coefficient (tau-b) was used to evaluate the possible occurrence of any trends. A correlation coefficient is a measure of the strength of association between two variables, such as water withdrawals and time. Kendall's coefficient evaluates the monotonic (where one variable generally increases or decreases as the second variable increases) rather than just the linear relation between two variables. Kendall's correlation coefficient falls in the range -1 to 1. Using withdrawals and time as example variables, negative coefficients indicate a decrease in water withdrawals over time, and positive coefficients indicate an increase in water withdrawals over time. Coefficients near zero indicate no relation exists between water withdrawals and time. The closer the coefficient is to -1 or 1, the stronger the relation between water withdrawals and time.

Correlation coefficients are only a measure of relation between two variables. They do not provide evidence that a change in one variable caused a change in the second variable.

Provided in this report, along with Kendall's tau-b, is the value p, which is the probability of obtaining the trend test result by chance when in fact there is no trend. The smaller the value p, the stronger the evidence that the trend test result was not obtained simply by chance.

It is important to note that the results of the analyses presented in this report represent only the 1986-96 period. The results should not be interpreted as predictions of water use in the coming years.

TRENDS IN STATEWIDE WATER USE

To manage water resources responsibly it is necessary to understand how people use water—and there are more people using water in Indiana today than ever before. The Bureau of the Census reported an increase in the population of Indiana from 3.24 million people in 1930 to more than 5.80 million people in 1995, a greater than 79-percent increase in 65 years.

Each year during the 1986-96 period, much larger amounts of water were withdrawn from surface water sources than ground water sources (figure 2). In comparing withdrawals from the two sources, total ground water withdrawals ranged from about 5.4 percent of total surface water withdrawals in 1990 to about 6.9 percent in 1991. More than 94 percent of the surface water withdrawn each year is accounted for by the sum of two water use categories, Energy Production and Industry. Most of the surface water withdrawn by these two categories is returned to the water bodies, making that water available again for use by the same facility or for use by others.

To place water use data in context with weather conditions, many illustrations in this report (such as figure 2) include graphs showing the departure from normal monthly mean temperature and normal monthly mean precipitation at Indianapolis. Weather data from Indianapolis were used because of the site's central geographic location. Normal monthly means are defined as the mean for the month for the 30-year period, 1961 through 1990.

Total surface water withdrawals, statewide, ranged from a low of about 2,882 billion gallons in 1992 to a high of about 3,213 billion gallons in 1989 (figure 2). There was no apparent upward or downward trend in total surface water withdrawals over time (Kendall's tau-b = 0.13, p = 0.59), although large variations occurred from one year to another. Total ground water withdrawals ranged from about 173 billion gallons in 1987 to about 211 billion gallons in 1996. Ground water withdrawals increased over time (Kendall's tau-b = 0.60, p = 0.010).

When considering surface water withdrawals for each category as a percentage of the total surface water withdrawals, the data indicate a high degree of consistency from year to year. For each year throughout the 1986-96 period, Energy Production accounted for about 67 to 69 percent of total surface water withdrawals. Industry accounted for 26 to 28 percent of all surface water withdrawals, with its smallest percentage occurring in 1988, which was a year noted for extended periods of warm temperatures and small amounts of precipitation. Public Supply accounted for 4 to 5 percent of total surface water withdrawals. Agriculture, Rural Use, and Miscellaneous withdrawals were each less than 1 percent of total surface water withdrawals for each year during the 1986-96 period.

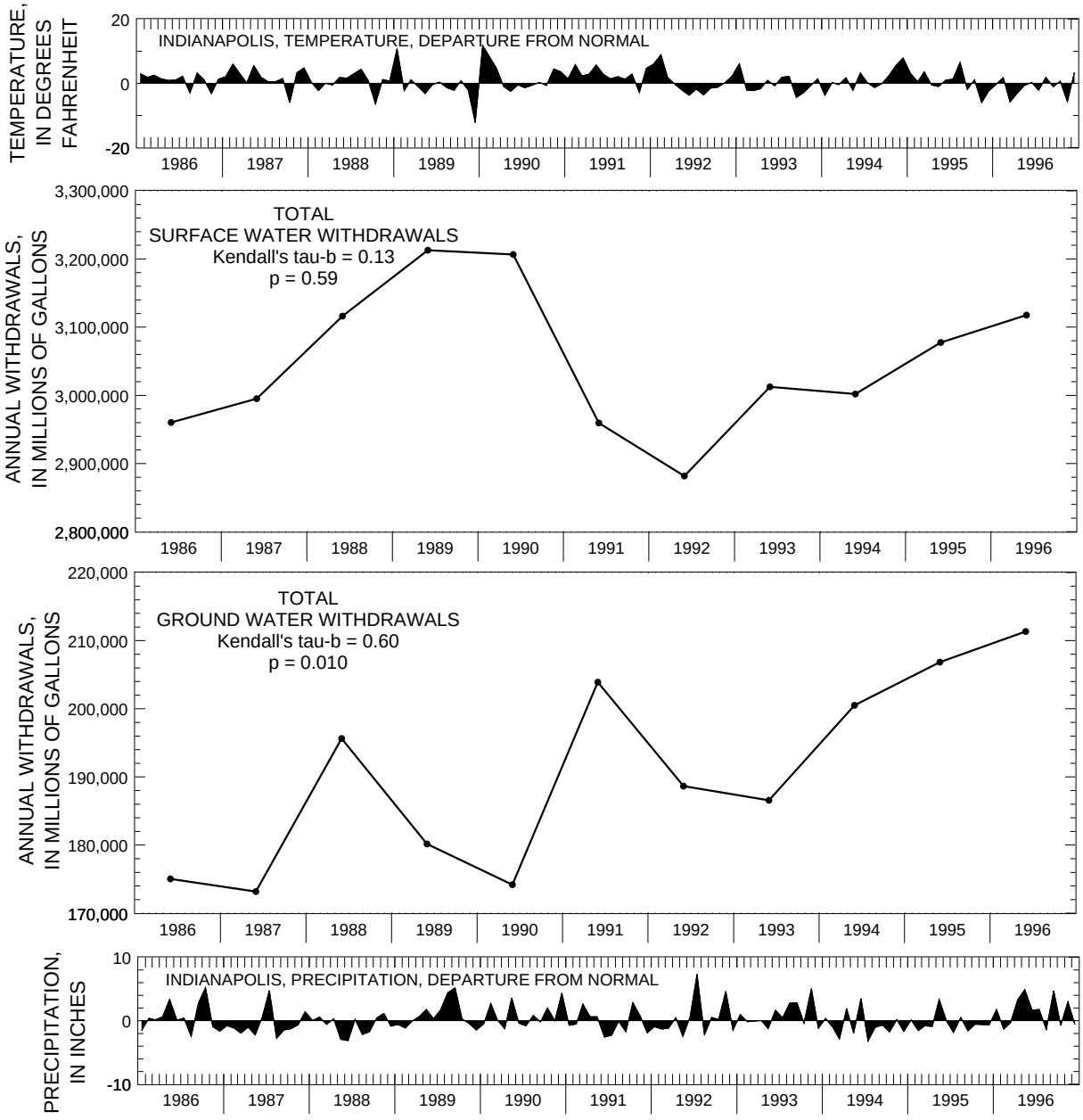

Figure 2. Statewide reported annual total surface water withdrawals and total ground water withdrawals, aligned with temperature and precipitation departures from normal at Indianapolis, 1986-96.

When considering ground water withdrawals for each category as a percentage of total ground water withdrawals, the data exhibited a wider range of change from year to year than was indicated by the surface water data. Public Supply accounted for 55 to 61 percent of total ground water withdrawals for each year during the 1986-96 period. Industry accounted for 20 to 28 percent of total ground water withdrawals, Agriculture accounted for 5 to 14 percent, and Energy Production accounted for 4 to 7 percent. Miscellaneous withdrawals were largest for its respective category in 1996, at 4 percent. Ground water withdrawals for Rural Use were less than 1 percent each year during the period. As a percentage of total ground water withdrawals, Public Supply withdrawals were at the category's smallest in 1988 and 1991 (even though these years represented increases from the previous years in ground water withdrawals for Public Supply). As a percentage, ground water withdrawals for Agriculture were at the category's largest during these same two years. The years 1988 and 1991 had sustained periods of warm temperatures and small amounts of precipitation.

The number of registered significant water withdrawal facilities increased from 2,482 in 1986 to a high of 3,585 in 1994 (figure 3). The increase reflected both the registration of previously existing facilities, particularly in the first few years of the program, and the start up of new facilities. The number of registered facilities decreased after 1994, falling to 3,536 in 1996. Eight landfills were included as registered facilities in 1995, but these landfills were exempted from the requirement to register and report their withdrawals beginning in 1996. Between 1986 and 1996, the number of newly registered ground water wells was more than triple that of newly registered surface water intakes.

From 1986 to 1990, there was about a 6-percent increase in surface water withdrawal capacity (figure 4) followed by 4 years of relatively little change. In 1995, the surface water withdrawal capacity declined by 2.6 percent from the previous year. The decline in 1995 was attributed largely to the shutdown of an Energy Production facility in Sullivan County. From 1986 to 1996, ground water withdrawal capacity increased more than 45 percent (figure 5). Nearly 65 percent of this increased ground water withdrawal capacity was associated with Agriculture, nearly 20 percent of the increase was associated with Public Supply, nearly 10 percent with Miscellaneous, and 4 percent with Industry.

The four categories that ranked highest in the amount of total withdrawals were Energy Production, Industry, Public Supply, and Irrigation. Annual withdrawal data for these four categories were compared with annual summer temperature data and annual summer precipitation data collected at the National Weather Service station at Indianapolis. Summer temperature values used in the analysis were the mean of the June, July, and August monthly mean temperatures. Summer precipitation values used in the analysis were the sums of the precipitation amounts for those same three months.

The data indicated that annual surface water withdrawals for Public Supply and annual ground water withdrawals for Energy Production exhibited strong correlations with summer temperature (Kendall's tau-b = 0.60, p = 0.010, for both categories). There was a moderate correlation between annual ground water withdrawals for Agriculture and summer temperature (Kendall's tau-b = 0.49, p = 0.036). The data indicated that annual withdrawals for these categories from these sources were largest during the years of the highest summer temperatures. In addition, the data indicated a moderate correlation between annual ground water withdrawals for Industry

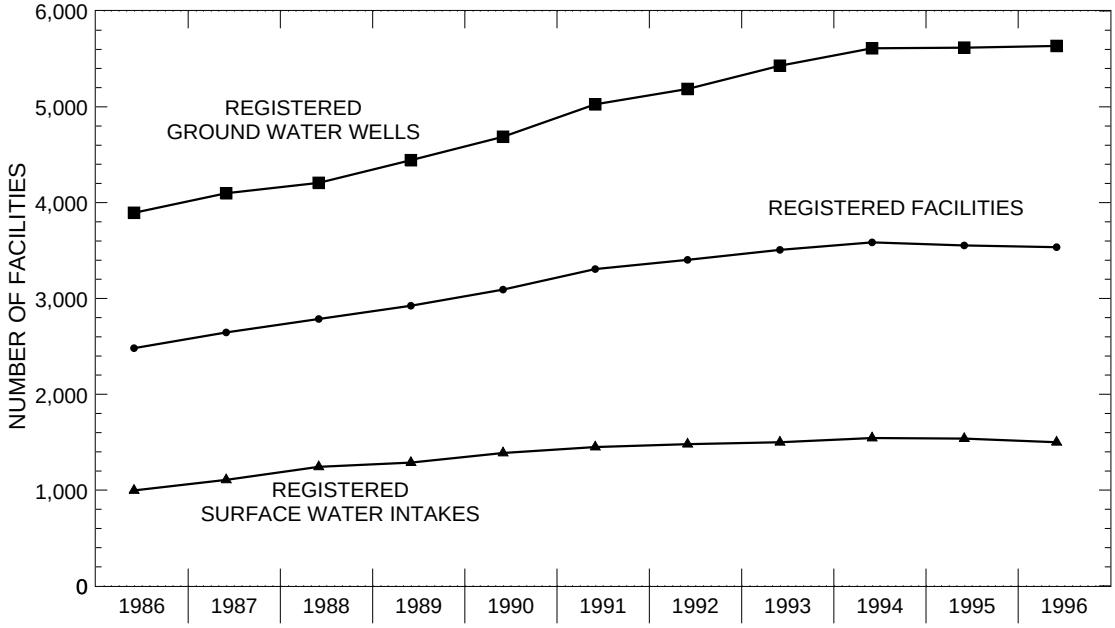

Figure 3. Numbers of registered significant water withdrawal facilities, ground water wells, and surface water intakes, 1986-96.

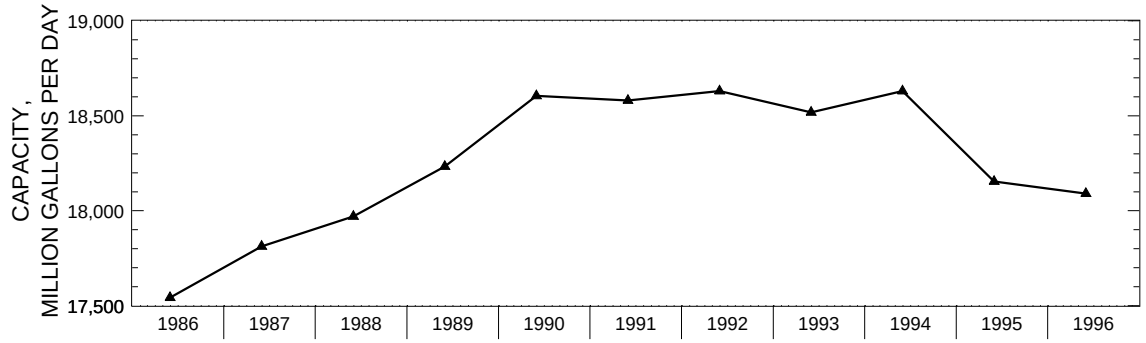

Figure 4. Total withdrawal capacity for registered surface water intakes, 1986-96.

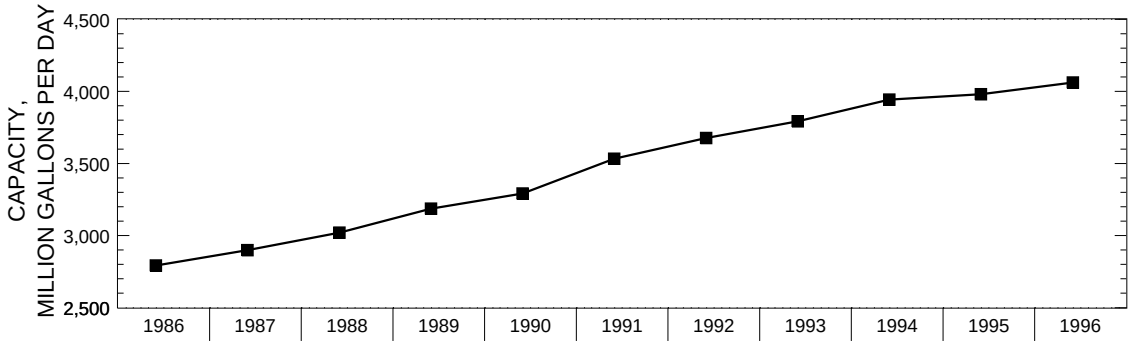

Figure 5. Total withdrawal capacity for registered ground water wells, 1986-96.

and summer temperature (Kendall's tau-b = -0.31, p = 0.19) and a moderate correlation between annual surface water withdrawals for Industry and summer temperature (Kendall's tau-b = -0.27, p = 0.24). The data indicated that annual ground water and surface water withdrawals for Industry generally were smallest during the years of highest summer temperatures. There was little correlation between summer temperatures and withdrawals for the remaining categories and sources.

The data indicated that annual surface water withdrawals for Public Supply and annual ground water withdrawals for Energy Production exhibited a moderate correlation with summer precipitation (Kendall's tau-b = -0.35, p = 0.14, for both categories). Annual ground water withdrawals for Agriculture also exhibited a moderate correlation with summer precipitation (Kendall's tau-b = -0.38, p = 0.10). Withdrawals for these categories and sources tended to be largest during years of the least summer precipitation. The data indicated little correlation between summer precipitation and withdrawals for the remaining categories and sources.

The relation between annual withdrawals for Energy Production and temperatures for seasonal periods other than summer months was further investigated. The data indicated a moderate correlation between annual surface water withdrawals for Energy Production and winter temperatures (Kendall's tau-b = -0.42, p = 0.073). Winter temperatures were defined as the mean of January, February, and December monthly mean temperatures. The data indicated that annual surface water withdrawals for Energy Production were largest during years when winter temperatures were coldest. It should be noted that annual surface water withdrawals for Energy Production for the Ohio River Water Management Basin ranked highest by a large margin in surface water withdrawals for this category, and the data from this basin strongly influenced statewide results. If the withdrawals for the Ohio River Water Management Basin are removed from the statewide total, the correlation between statewide surface water withdrawals for Energy Production and winter temperature decreases from the moderate level (Kendall's tau-b = -0.42, p = 0.073) to a level of little to no correlation (Kendall's tau-b = -0.09, p = 0.70).

There was a moderate correlation between statewide annual ground water withdrawals for Energy Production and winter temperatures (Kendall's tau-b = -0.27, p = 0.24). If the withdrawals for the Ohio River Water Management Basin were removed from the statewide total, the correlation between statewide ground water withdrawals for Energy Production and winter temperature remains at the moderate level (Kendall's tau-b -0.45, p = 0.052).

TRENDS IN WATER USE BY CATEGORY

Trends in water use by category are discussed in this section. For readers who are interested in trends for specific counties or basins, plots of yearly water withdrawals for each category for each of Indiana's 92 counties and 12 Water Management Basins are presented in the IDNR report, "Water Use in Indiana, Graphs by County and Water Management Basin."

ENERGY PRODUCTION

Energy Production facilities include those that withdraw water for the primary purpose of power generation, including oil recovery and coal mining operations. In 1996, there were 100 registered facilities in the Energy Production category. Electricity was generated at 34 of these facilities.

Of the six major water use categories in the Indiana water use data base, Energy Production facilities account for the largest amount of total water withdrawals. In 1996, Energy Production accounted for about 69 percent of the surface water

withdrawn in the state by significant water withdrawal facilities and about 4 percent of the ground water. In 1996, all but about 1 percent of the surface water withdrawn for Energy Production was used for cooling purposes at coal-fired thermoelectric power plants. It is estimated that less than 5 percent of the surface water withdrawn statewide for Energy Production is consumed in the cooling process and the remainder is returned to the water bodies for future use. Most of the water that is consumed in the cooling process is lost to evaporation. There are currently no thermonuclear power plants operating in the state.

Surface water withdrawals were largest for Energy Production in 1989, when about 2,194 billion gallons of water were withdrawn (figure 6). The least amount of surface water was withdrawn for this category in 1992 when 1,955 billion gallons were withdrawn. The 1986-96 data indicated little to no correlation between surface water withdrawals for Energy Production and time (Kendall's tau-b = 0.16, p = 0.48). There appeared to be no upward or downward trend, therefore, in surface water withdrawals for Energy Production over time.

Jefferson County ranked highest of all counties each year in surface water withdrawals for Energy Production, accounting for about 21 to 24 percent of all surface water withdrawals for this category each year during the 1986-96 period. The Ohio River Basin ranked highest of all Water Management Basins each year in surface water withdrawals for Energy Production. The Ohio River Basin's 984 billion gallons of surface water withdrawn for this category in 1996 was more than twice that of the Lake Michigan Basin, which ranked second with 367 billion gallons.

The 1986-96 data indicated little to no correlation between ground water withdrawals for Energy Production and time (Kendall's tau-b = -0.20, p = 0.39). There was no apparent upward or downward trend, therefore, in ground water withdrawals for Energy Production over time.

Whereas the primary use of surface water at Energy Production facilities was for cooling at coal-fired thermoelectric power plants, the uses of ground water at Energy Production facilities were more varied. Of the 100 registered Energy Production facilities in the state, 68 withdrew 9.46 billion gallons of ground water in 1996 (figure 6). Uses of ground water at these 68 facilities included cooling, drinking water and sanitation, dewatering, oil recovery, coal preparation and mineral extraction, heating and air conditioning, grounds irrigation, and fire protection. Of these 68 Energy Production facilities that withdrew ground water in 1996, 21 facilities were coal-fired thermoelectric power plants. These 21 facilities withdrew 3.25 billion gallons of ground water. The remainder of the 9.46 billion gallons of ground water withdrawals for Energy Production were at facilities not directly involved with the generation of electricity, such as at coal mines or at those facilities where water was used primarily for heating and air conditioning.

INDUSTRY

Industrial facilities include those that withdraw water primarily for the manufacturing process and include sand and gravel operations.

During the 1986-96 period, surface water withdrawals for Industry were largest in 1990 at about 878 billion gallons (figure 7). Surface water withdrawals for Industry were smallest in 1992 at 788.5 billion gallons. Each year during the 1986-96 period, surface water withdrawals for Industry accounted for 26 to 28 percent of all surface water withdrawals by significant water use facilities in Indiana, ranking second to Energy Production. The data indicated little to no relation between surface water withdrawals for Industry and time, so there was no apparent upward or downward trend in surface water withdrawals over time (figure 7, Kendall's tau-b = -0.13, p = 0.59).

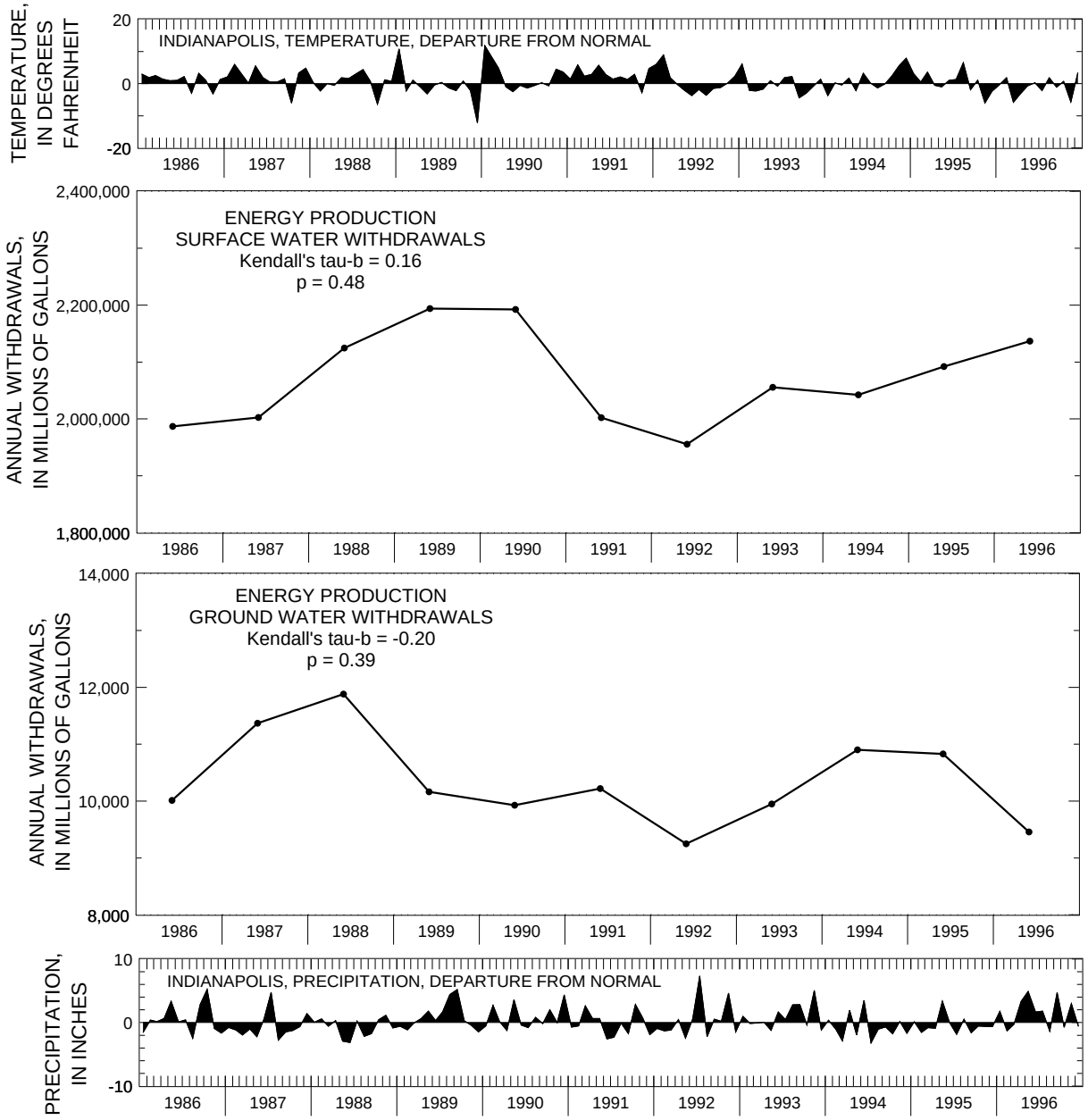

Figure 6. Statewide reported annual surface water withdrawals and ground water withdrawals for Energy Production, aligned with temperature and precipitation departures from normal at Indianapolis, 1986-96.

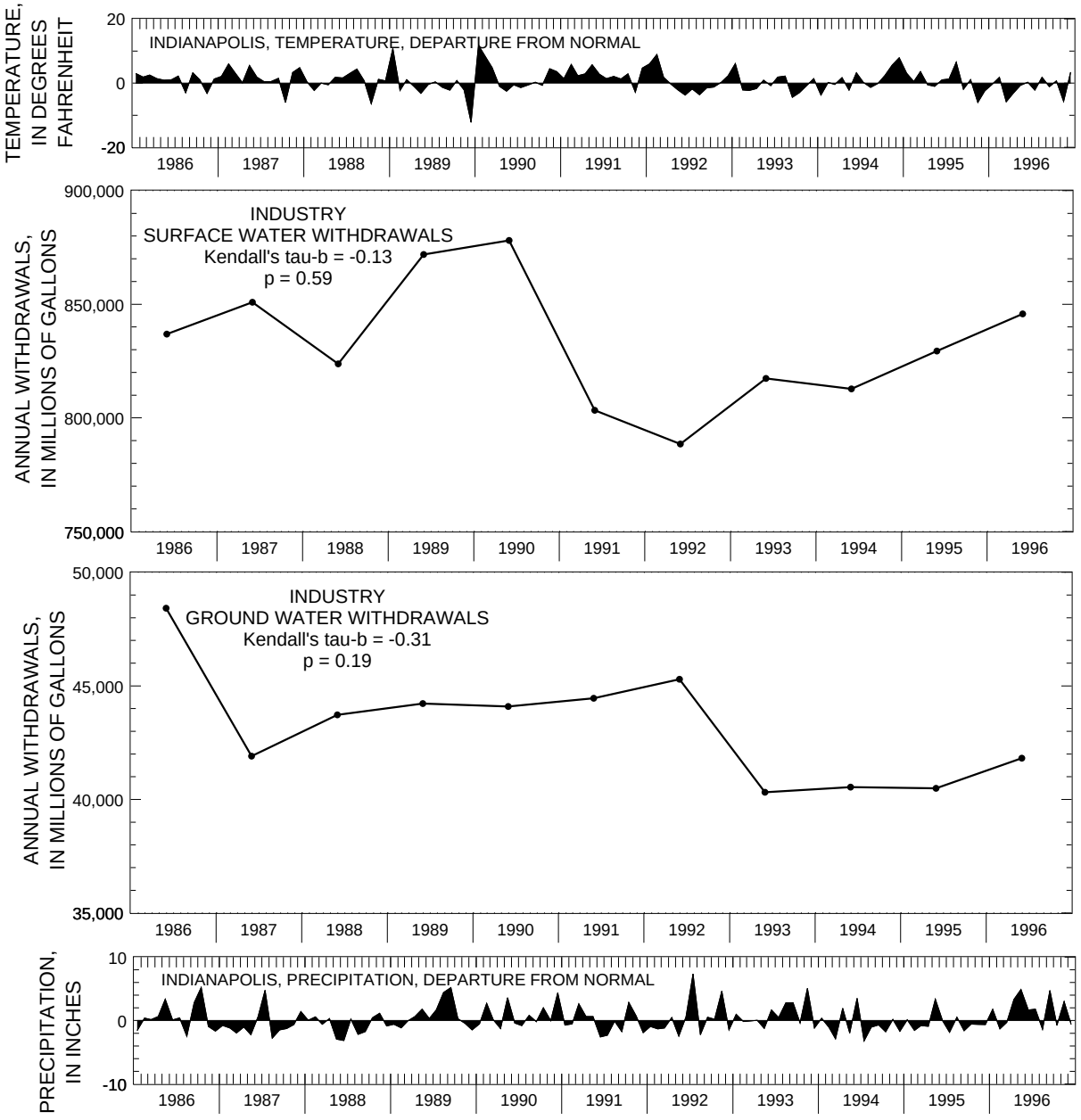

Figure 7. Statewide reported annual surface water withdrawals and ground water withdrawals for Industry, aligned with temperature and precipitation departures from normal at Indianapolis, 1986-96.

Each year, the Lake Michigan Basin ranked highest of the 12 Water Management Basins in surface water withdrawals for Industry. In 1996, surface water withdrawals for Industry in the Lake Michigan Basin were more than 3 times the amount withdrawn in the Ohio River Basin, which ranked second. Surface water withdrawals for Industry decreased over time in the Lake Michigan Basin (Kendall's tau-b = -0.60, p = 0.010) and increased over time in the Ohio River Basin (Kendall's tau-b = 0.78, p = 0.0008).

The data indicated a moderate relation between ground water withdrawals for Industry and time (Kendall's tau-b = -0.31, p = 0.19). Ground water withdrawals for Industry decreased over time. In addition, ground water withdrawals for Industry decreased over time in terms of the percentage of total ground water withdrawals for all six major categories, decreasing from about 28 percent of all ground water withdrawals in 1986 to about 20 percent in 1996. Industry consistently ranked second to Public Supply in total ground water withdrawals.

AGRICULTURE

Agricultural facilities include those that withdraw water for the primary purpose of irrigating crops or golf courses, dewatering farm sites and fields, and other similar agricultural practices.

A relatively small amount of acreage in Indiana is irrigated, but the amount of irrigated acreage has increased over time. According to the Bureau of the Census, there were about 11.8 million acres of harvested cropland in Indiana in 1992. About 2 percent of that area (nearly 241 thousand acres) was irrigated. The amount of land irrigated in 1992, however, was more than 7 times the land irrigated in 1974.

The 1986-96 data indicated that surface water withdrawals for Agriculture increased over time (figure 8, Kendall's tau-b = 0.45, p = 0.052), as did ground water withdrawals (Kendall's tau-b = 0.42, p = 0.073). The increase in surface water and ground water withdrawals over time was apparent despite the fact that two years with small amounts of summer precipitation, 1988 and 1991, occurred fairly early in the period of record.

Ground water and surface water withdrawal capacity for Agriculture also increased. From 1986 to 1996, ground water withdrawal capacity for Agriculture increased from 882 million gallons per day to 1,704 million gallons per day. During the same period, surface water withdrawal capacity for Agriculture increased from 1,110 million gallons per day to 1,792 million gallons per day, with the largest increases occurring from 1987 to 1989.

PUBLIC SUPPLY

Public Supply facilities are those that withdraw water for the primary purpose of distributing that water for use by others and for use in public establishments. These facilities include water supply utilities and self-supplied mobile home parks and apartment complexes. These facilities also include self-supplied schools and other institutions that provide water for use by the general public.

Most homes in Indiana rely on Public Supply facilities as their source of water. Household data made available by the Bureau of the Census indicated that of the nearly 2.25 million households in Indiana in 1990, more than 1.66 million households (nearly 74 percent) were connected to a public supply.

The 1986-96 withdrawal data indicated no upward or downward trend in surface water withdrawals for Public Supply over time (figure 9, Kendall's tau-b = -0.20, p = 0.39). The strong correlation between ground water withdrawals for

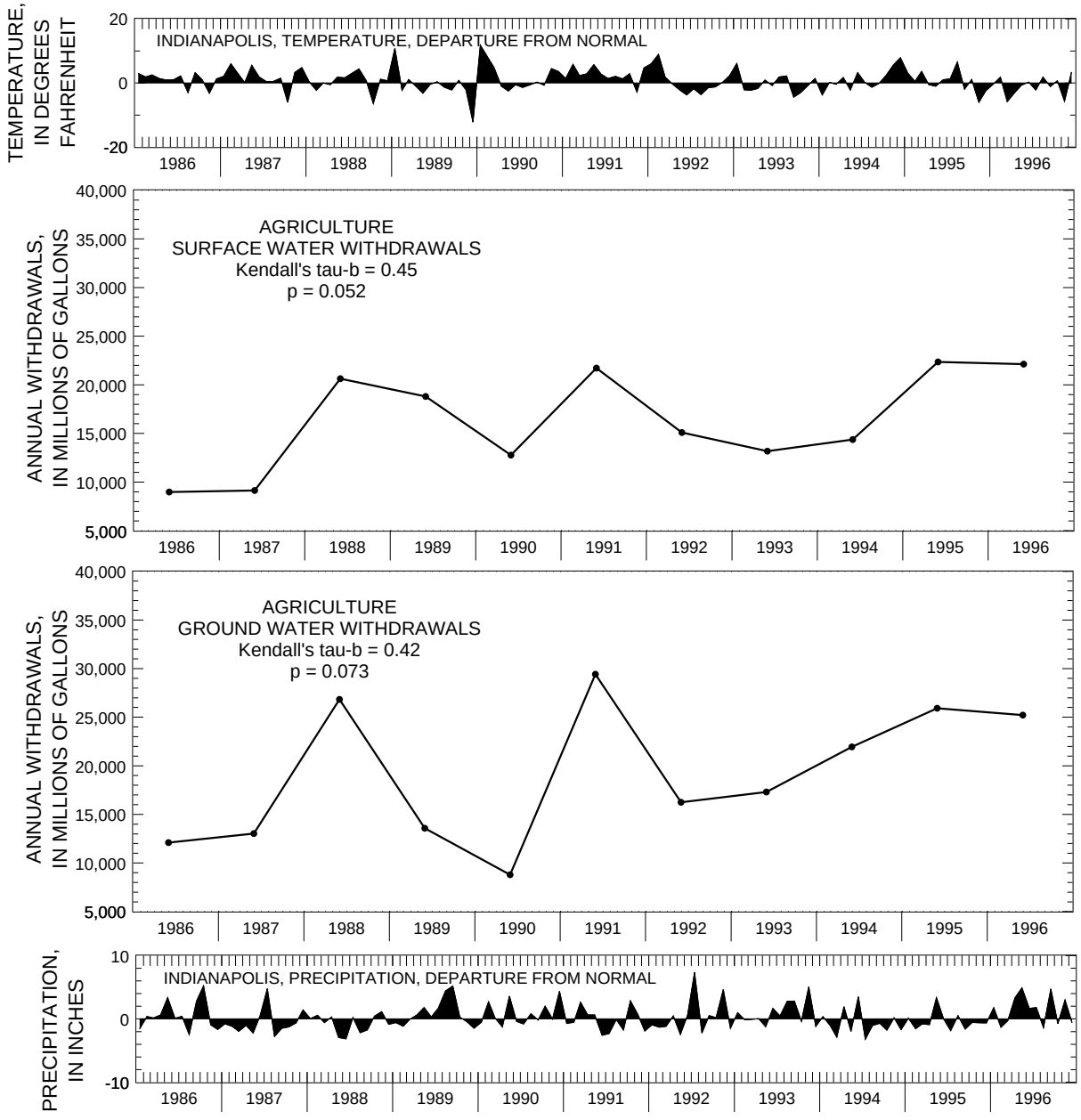

Figure 8. Statewide reported annual surface water withdrawals and ground water withdrawals for Agriculture, aligned with temperature and precipitation departures from normal at Indianapolis, 1986-96.

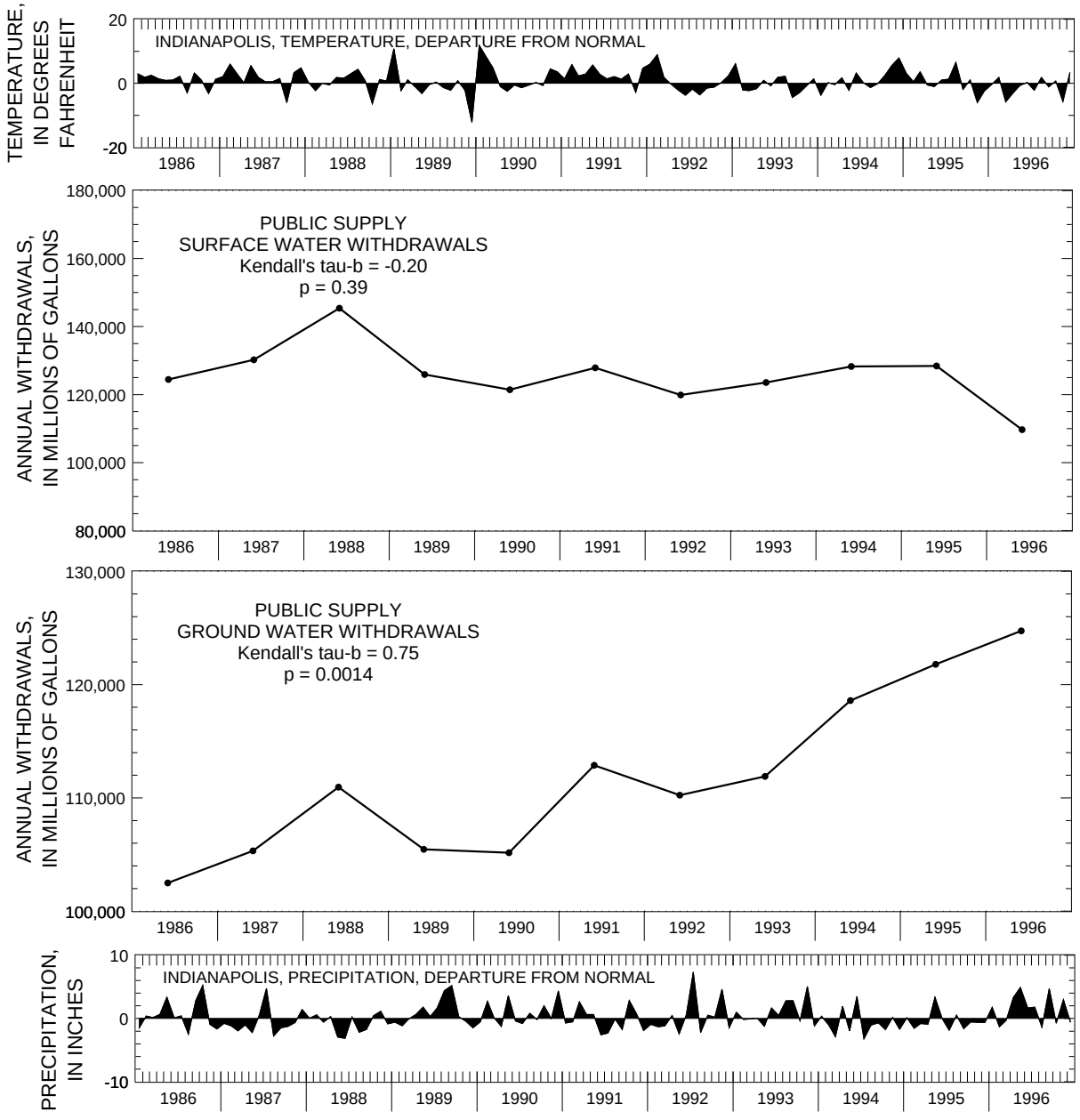

Figure 9. Statewide reported annual surface water withdrawals and ground water withdrawals for Public Supply, aligned with temperature and precipitation departures from normal at Indianapolis, 1986-96.

Public Supply and time (Kendall's tau-b = 0.75, p = 0.0014) indicated an upward trend. In 1996, for the first time, statewide ground water withdrawals for this category exceeded surface water withdrawals.

From 1986 to 1996, surface water withdrawal capacity for Public Supply decreased from 1,098 million gallons per day to 970 million gallons per day. During this same period, ground water withdrawal capacity for Public Supply increased from about 1,170 million gallons per day to about 1,420 million gallons per day, about a 21-percent increase. Ground water withdrawal capacity for Public Supply increased every year from 1986 through 1996, with the exception of 1990.

Marion County withdrew more surface water for Public Supply than any other county from 1986 through 1995; Lake County ranked second. In 1996, surface water withdrawals for Public Supply in Marion County decreased to an amount less than that of Lake County.

St. Joseph County withdrew more ground water for Public Supply than any other county throughout the 1986-96 period. Tippecanoe County ranked second in ground water withdrawals for Public Supply each year from 1986 through 1994; in 1995 and 1996, Marion County ranked second.

RURAL USE

Rural Use facilities are those that withdraw water for the primary purpose of watering livestock and operating fish hatcheries.

Withdrawals for Rural Use represent a small amount of the total water withdrawals in Indiana. Each year throughout the 1986-96 period, surface water withdrawals for Rural Use never exceeded 0.1 percent of total surface water withdrawals by significant water use facilities, and ground water withdrawals for Rural Use never exceeded 0.8 percent of total ground water withdrawals by significant water use facilities.

Although there were general increases over time in surface and ground water withdrawals for Rural Use, there were no large changes in the amounts of withdrawals for this category statewide during the 1986-96 period (figure 10).

By 1996, 31 facilities in the state were registered for this category. Surface water withdrawal capacity increased from less than 10 million gallons per day in 1989 to nearly 19 million gallons per day in 1992 and then remained relatively unchanged through 1996. Ground water withdrawal capacity increased from less than 16 million gallons per day in 1989 to more than 25 million gallons per day in 1996.

MISCELLANEOUS

Miscellaneous facilities are those that withdraw water for a variety of uses other than those included in the other five water-use categories. Miscellaneous facilities include those involved in snow-making, operating fish and wildlife areas, lake-level maintenance, and construction dewatering. Withdrawals at landfills were included in this category through 1995; beginning in 1996, landfills were exempted from the requirement to register their facilities and report their withdrawals.

Miscellaneous water withdrawals, as with the Rural Use category, represent a small amount of Indiana's total water use. Each year throughout the 1986-96 period, Miscellaneous facilities withdrew less than 0.2 percent of the total surface water withdrawals in Indiana and less than 5 percent of the total ground water withdrawals.

Although Miscellaneous withdrawals represented a small amount of water on a statewide basis, they were capable of creating a significant impact at the local level. Responding to the need

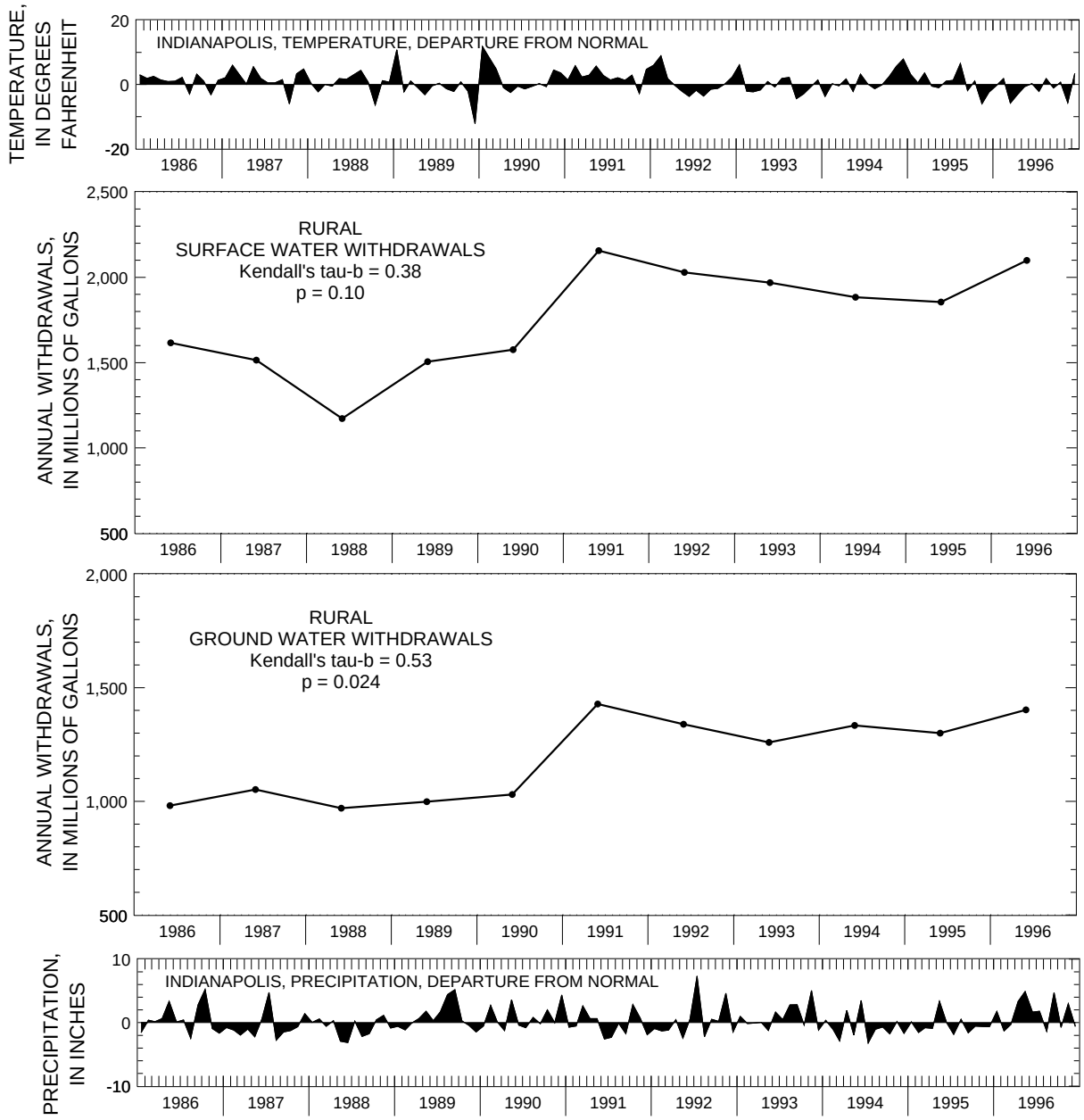

Figure 10. Statewide reported annual surface water withdrawals and ground water withdrawals for Rural Use, aligned with temperature and precipitation departures from normal at Indianapolis, 1986-96.

for information in these types of situations, in 1989, the Division of Water began registering temporary construction dewatering facilities. Reported Miscellaneous ground water withdrawals increased from less than 1.5 billion gallons in 1988 to almost 6 billion gallons in 1989 (figure 11). This apparent increase was largely the result of increased availability of information for this category, rather than an actual increase in withdrawals in the state.

SUMMARY

The Indiana Department of Natural Resources, Division of Water, has been conducting an inventory of the state's significant water withdrawal facilities since 1985. A trends analysis was performed on the 1986-96 water use data. The data indicated that, over the 1986-96 period, total ground water withdrawals increased over time, whereas total surface water withdrawals tended neither to increase nor decrease over time. Each year, total ground water withdrawals were less than 7 percent that of surface water withdrawals. The water use categories Energy Production and Industry, combined, accounted for more than 94 percent of statewide surface water withdrawals each year. Both ground water withdrawals and surface water withdrawals for Agriculture increased over time. Annual ground water withdrawals for Agriculture tended to be largest during years when summer temperatures were highest. There seemed to be little relation between annual surface water withdrawals for Agriculture and summer temperatures. The Public Supply category ranked highest in ground water withdrawals each year. Ground water withdrawals for Public Supply increased over time. Surface water withdrawals for Public Supply showed neither an upward nor downward trend over time.

Water use information for individual counties and basins can be found in the IDNR publication, "Water Use in Indiana, Graphs by County and Water Management Basin."

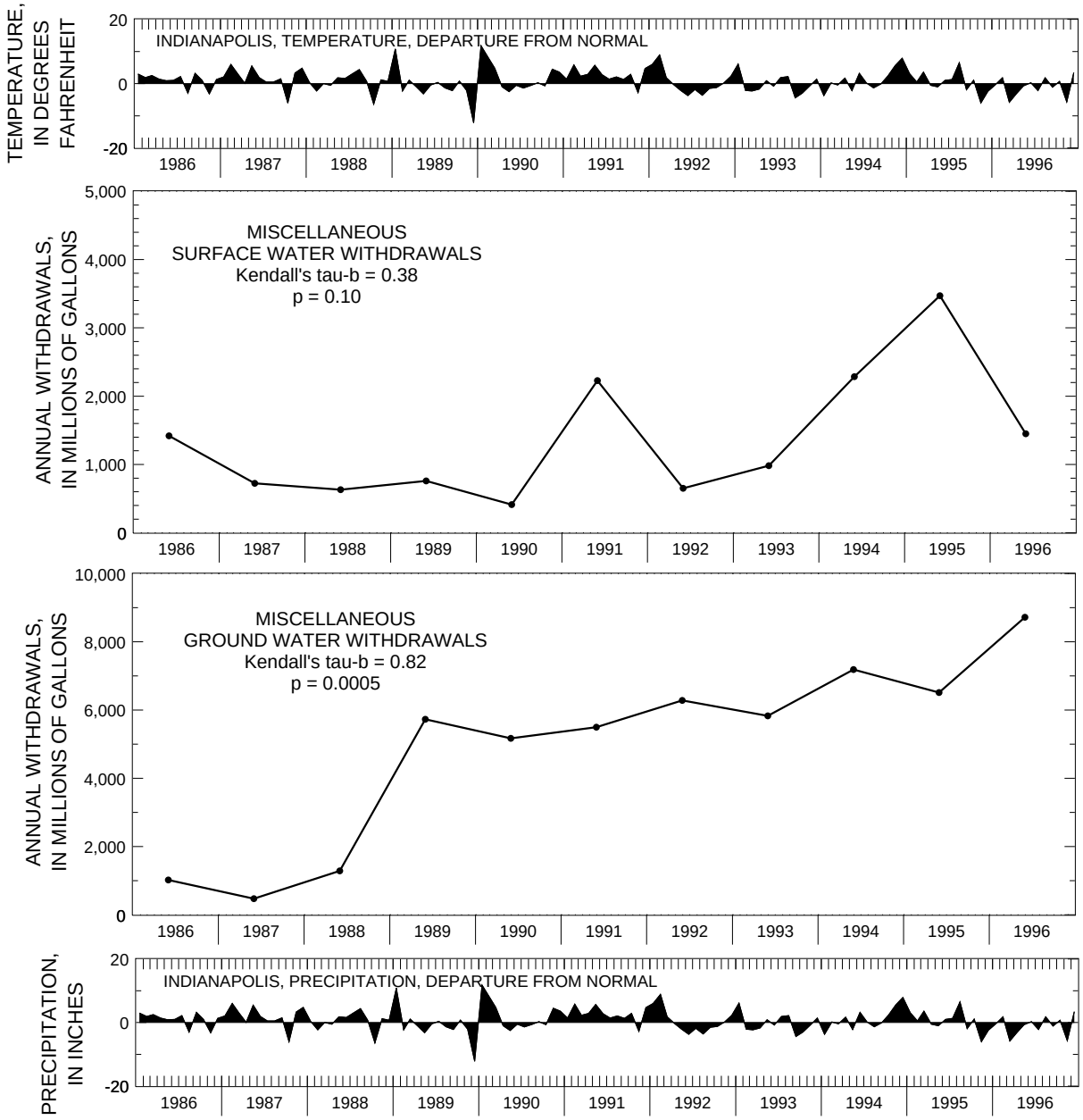

Figure 11. Statewide reported annual surface water withdrawals and ground water withdrawals for Miscellaneous, aligned with temperature and precipitation departures from normal at Indianapolis, 1986-96.