INDIANA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER
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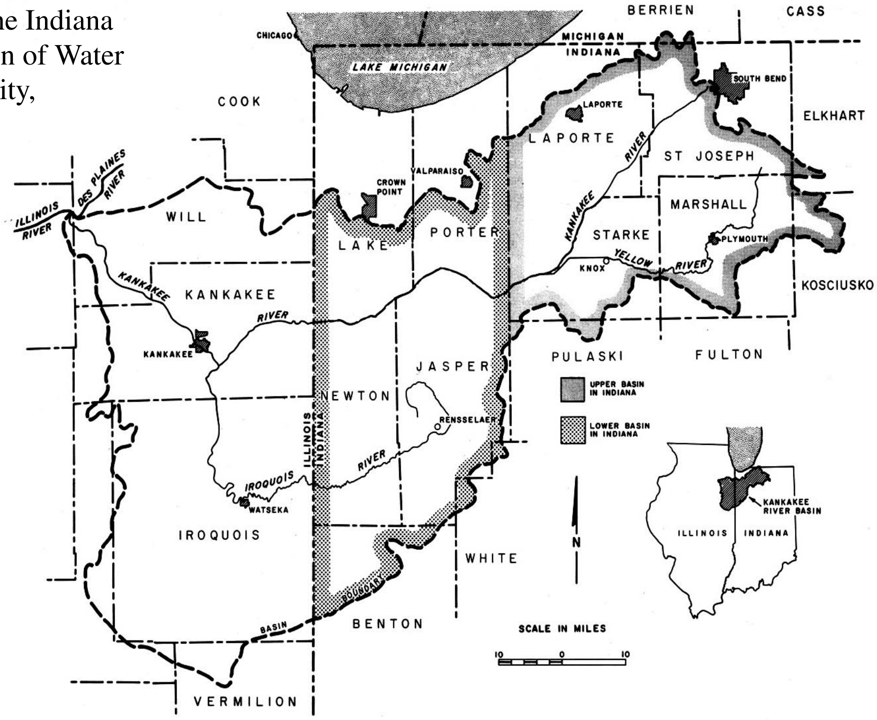
WATER RESOURCE AVAILABILITY IN THE KANKAKEE RIVER BASIN, INDIANA - EXECUTIVE SUMMARY

Figure 1. Location of the Kankakee River Basin



In response to legislative directives contained in the 1983 Water Resource Management Act, the Indiana Department of Natural Resources, Division of Water published a report describing the availability, distribution, quality, and use of surface water and ground water in the Kankakee River Basin, Indiana.* The third in a series of 12 regional watershed assessments, the report provides hydrologic data and related information for persons interested in the basin's water resource. The following is a summary of that report. The full report can be obtained from the Indiana Department of Natural Resources, Division of Water. For ordering information, please see the instructions printed at the end of this summary.

The Kankakee River Basin drains 2989 sq. mi. (square miles) in northwest Indiana, 2169 sq. mi. in northeast Illinois, and about 7 sq. mi. in southwest Lower Michigan (figure 1). The Kankakee River heads near South Bend, Indiana, then flows westward into Illinois, where it joins with the Des Plaines River to form the Illinois River. The area of Lake County which originally drained to Lake Michigan but now drains by means of artificial diversion to the Illinois River is not considered to be part of the Kankakee River Basin study region. Although the Kankakee River basin includes portions of Indiana, Illinois, and Michigan, the discussion below will focus on the Indiana portion of the basin.

SOCIOECONOMIC SETTING

Thirteen Indiana counties lie completely or partially within the Kankakee River Basin, but nine counties constitute more than 90 percent of the basin's land area in Indiana. For mapping and discussion purposes, the basin in Indiana is divided into an upper region (St. Joseph, LaPorte, Marshall, and Starke Counties) and a lower region (Porter, Lake, Jasper, Newton and Benton Counties).

In 1980, more than three-fourths of the basin's total population of 223,000 resided in rural areas. About one-fourth of the residents lived in urban areas, including the cities of LaPorte, Cedar Lake, Plymouth and Lowell.

Significant increases in population are expected in the basin portions of Lake and Porter Counties during the 1990s. Increasing trends in population are projected for most cities and towns in the basin, although decreases are anticipated in LaPorte, Knox and Westville.

Manufacturing, services, and wholesale and retail trade constitute the largest employment classes and account for

*Indiana Department of Natural Resources (Clendenon, C.J. and Beaty, J.E., eds.), 1987, Water resource availability in the Kankakee River Basin, Indiana: Division of Water, Water Resources, Assessment 90-3 the largest percentage of total earnings in most basin counties. In Benton County, however, agriculture is the leading source of county employment and earnings. In Jasper County, an electrical generating station provides the highest percentage of county earnings.

Cropland accounts for more than three-fourths of the basin's total land area. Corn and soybean production in the Kankakee River Basin is among the highest of any region in Indiana. Although sales of spearmint, peppermint, blueberries and orchard crops constitute only a small percentage of the basin's crop income, these crops are important to the local and regional farm economy. The production of mint for oil is significant on both a state and national level.

Forest land occurs primarily as small parcels scattered among cropland; however, some large tracts are found on the lower Kankakee River floodplain and on dunes and low sand ridges south of the river. Lakes and wetlands are most common in the morainal and outwash areas of the upper Kankakee and Yellow River watersheds. Urban or built-up land is concentrated in the basin's cities and towns and around some large lakes.

PHYSICAL ENVIRONMENT

The climate of the Kankakee River Basin is classified as temperate continental, which describes areas with warm summers, cool winters, and the absence of a pronounced dry season. The variability of climate in the basin is partially attributable to the proximity of Lake Michigan. Lake-effect processes in northern areas of the basin help to moderate extremes in temperature, thereby extending the length of the frost-free season by 2 to 3 weeks. The lake effect also causes more cloudiness, on average, and can produce frequent snows. In snow-belt areas of LaPorte and St. Joseph County, annual snowfall averages 70 inches, or about twice the normal amount received elsewhere in the basin (figure 2).

Annual evapotranspiration in the Kankakee River Basin consumes at least 25 inches (75 percent) of the 38 inches of normal annual precipitation. The theoretical average annual water surplus of 12 to 13 inches is considered adequate for the basin as a whole; however, the variability of rainfall and its uneven geographic distribution can occasionally limit crops.

The landscape of the Kankakee River Basin is primarily a product of the latest Wisconsinan glacial events of the Lake Michigan lobe. Major landscape elements include 1) the nearly level to gently rolling surfaces of ground moraine, eolian (sediments deposited by wind) plains, outwash-apron deposits, and the Kankakee River floodbasin; and 2) the more pronounced topography of

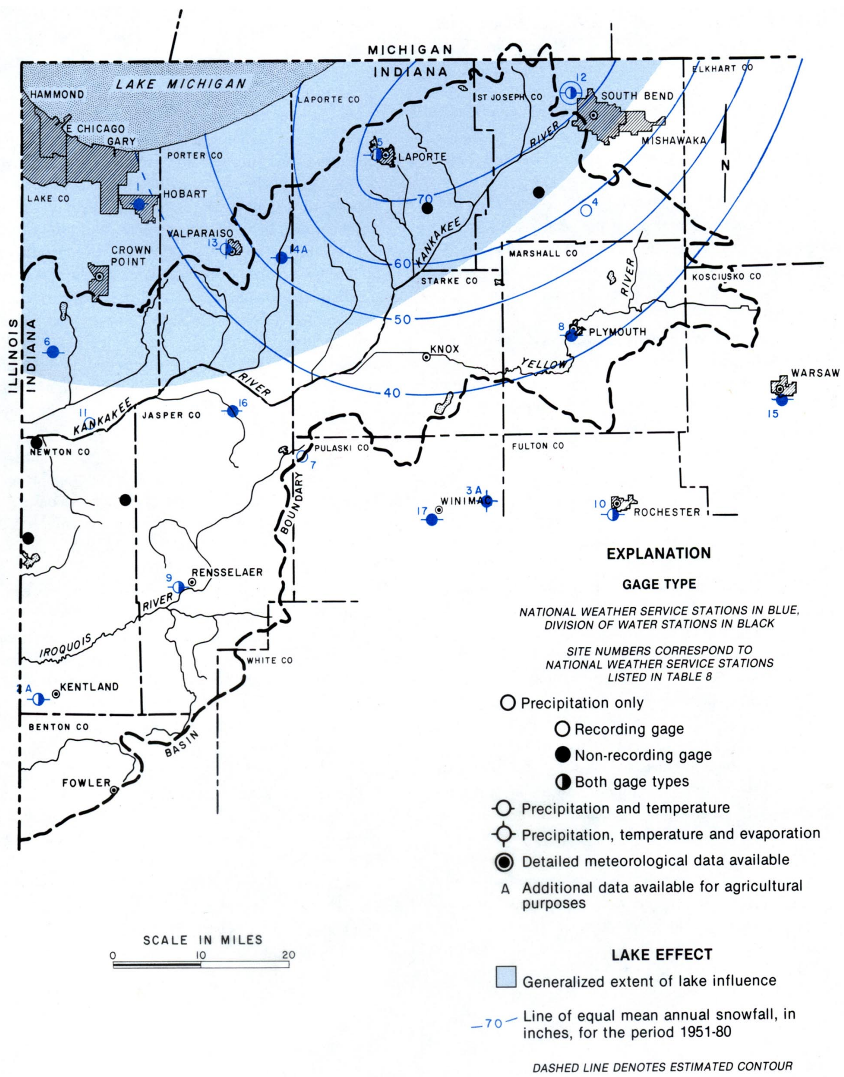


Figure 2. Location of climate stations, extent of lake effect, and mean annual snowfall in and near the Kankakee River Basin

end moraines. Local relief ranges from about 60 feet on the Iroquois Moraine to more than 100 feet along the crest and northern flank of the Valparaiso Moraine.

Outwash deposits occur in a broad northeast-to-southwest trending band through the basin's interior. Along and south of the Kankakee River floodplain, fine grained outwash sediments have been sorted by wind to form a broad eolian-sand sheet with scattered dunes and dune ridges. Lacustrine silts and clays underlie and are interbedded with outwash deposits in many parts of the basin.

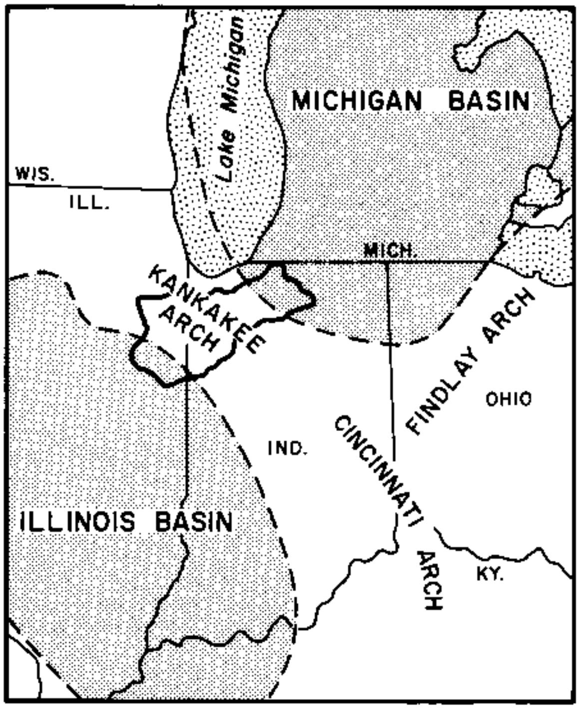


Figure 3. Regional bedrock structure

Fine-grained tills predominate in the basin's southwest portion and the elevated morainal areas in the east and northwest. Tills and stratified drift of chaotic form predominate in the Maxinkuckee Moraine.

The thickness of unconsolidated deposits generally ranges from 50 to 100 feet in the lower Kankakee River Basin, and from 100 to 250 feet in the upper basin. West of LaPorte where the Valparaiso Moraine forms a topographic high over a bedrock valley, unconsolidated thickness exceeds 350 feet.

The Kankakee River Basin lies across the crest of the Kankakee Arch, a major structural feature which separates the Michigan and Illinois Basins (figure 3). The bedrock surface in the upper Kankakee River Basin is composed primarily of Ellsworth and Antrim Shales of Devonian and Mississippian age. Silurian and Devonian limestones, dolomites and dolomitic limestones predominate in the lower basin.

Soils in and near the Kankakee River valley formed primarily in sandy and loamy lacustrine, outwash and eolian deposits. Soils that formed in loamy and clayey glacial till predominate in eastern and southwestern areas of the basin.

Soil losses by wind erosion are high where sandy and silty soils are dominant. The basin's overall erosion rate is low, however, because of the region's low relief, permeable soils and low runoff rates. Suspended-sediment yields in most basin streams also are low, although unstable ditch banks, poor agricultural practices and stream-related construction projects can lead to local sedimentation problems. Artificial drainage systems have been extensively employed in areas having a high water table and/or soils with inadequate natural drainage outlets.

SURFACE-WATER HYDROLOGY

The surface-water resources of the Kankakee River Basin include the mainstem Kankakee River; its principal tributaries, the Yellow and Iroquois Rivers; extensive networks of drainage ditches; and scattered zones of natural lakes and wetlands. Some small wetlands in the mainstem Kankakee River valley represent remnants of the former Grand Kankakee Marsh, a 625-square-mile marsh-swamp-dune complex which once occupied much of the valley.

Of the basin's streams, the Kankakee River supports the largest number of high-capacity withdrawals, primarily for irrigation purposes. The river's value as a water-supply source stems from its large drainage area and the presence of extensive outwash deposits which provide a high degree of base flow (more than 80 percent of total runoff) and consequently produce well-sustained stream flow.

The lower Yellow River has a moderate potential for water-supply development, and currently supports a few high-capacity withdrawals. Base flow constitutes about 65 percent of total runoff in the river's lower reaches, which traverse productive outwash deposits.

Major tributaries in outwash-dominated areas of the Kankakee and lower Yellow River Basins can yield significant quantities of water during much of the year. Many tributary ditches in the Kankakee-Yellow River system support high-capacity withdrawals, primarily for irrigation.

The Iroquois River and upper Yellow River have a limited potential for water-supply development, primarily

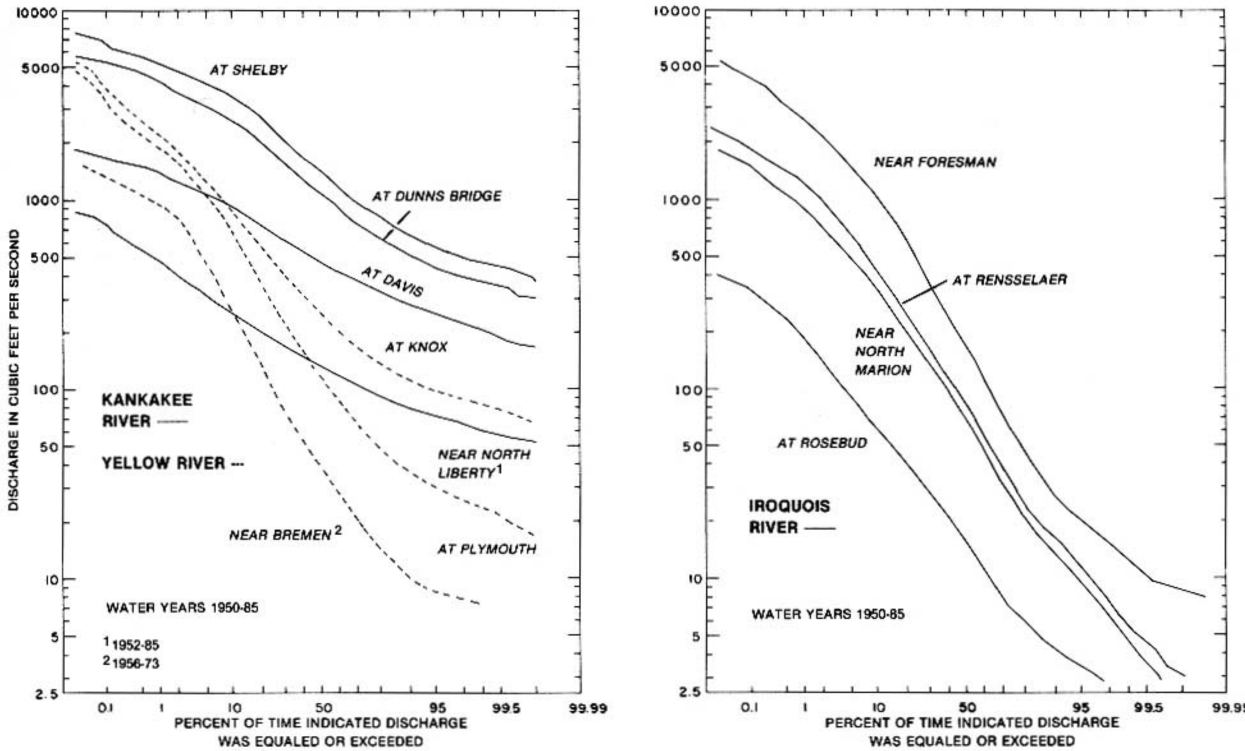


Figure 4. Duration curves of daily mean stream flow for gaging stations on the kankakee, Yellow and Iroquois Rivers

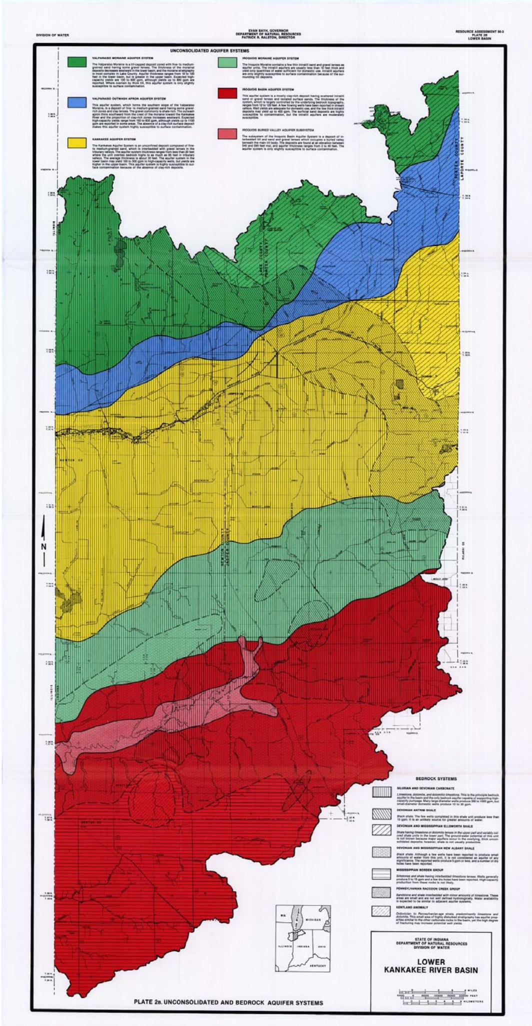
because of limited base flow from tills. Except for a few major ditches in sand-dominated upper reaches of the Iroquois River Basin, tributaries in these watersheds cannot support large withdrawal uses on a dependable basis because of poorly sustained flows. Upland (side-channel) reservoirs could provide additional water supply in the Iroquois River Basin, where soils and topography are suitable for reservoir construction. Flow duration curves for the Kankakee, Yellow, and Iroquois rivers are shown in figure 4.

Flood protection along the Kankakee River has been provided to some extent by spoil banks, levees and agricultural dikes; however, floods continue to plague low lying lands along the river and some of its major tributaries. A comprehensive plan recently developed by the Kankakee River Basin Commission contains a proposal for the development of a levee system along 60 miles of the Kankakee River. Unlike spoil banks and conventional levees, the proposed levees would be set back at varying distances from the river to allow storage of overbank floodwaters between the levees while providing flood protection, and improved drainage on adjacent lands. As of late 1990, the future of the proposed levee system remains uncertain.

SURFACE-WATER QUALITY

Water quality is generally good in the Kankakee, Yellow and Iroquois Rivers, although iron and manganese concentrations commonly are high and the rivers frequently are turbid. Available data for the Kankakee River show that concentrations of toxic substances in streambed sediment and fish tissue are negligible.

Violations of the bacterial standard for recreational uses sometimes occur on the Kankakee River and lower Yellow River. During the 1980s, frequent fish kills attributable to sewage related pollution were reported on the lower Yellow River. Stream reaches in the Travis Ditch, Crooked Creek, Cedar Creek, and Montgomery Ditch watersheds also have experienced chronic water quality problems from inadequately treated sewage. The number and frequency of water-quality impairments in these and other streams receiving wastewater discharges are expected to decrease in the 1990s as municipalities and industries continue to upgrade treatment facilities and improve opera-



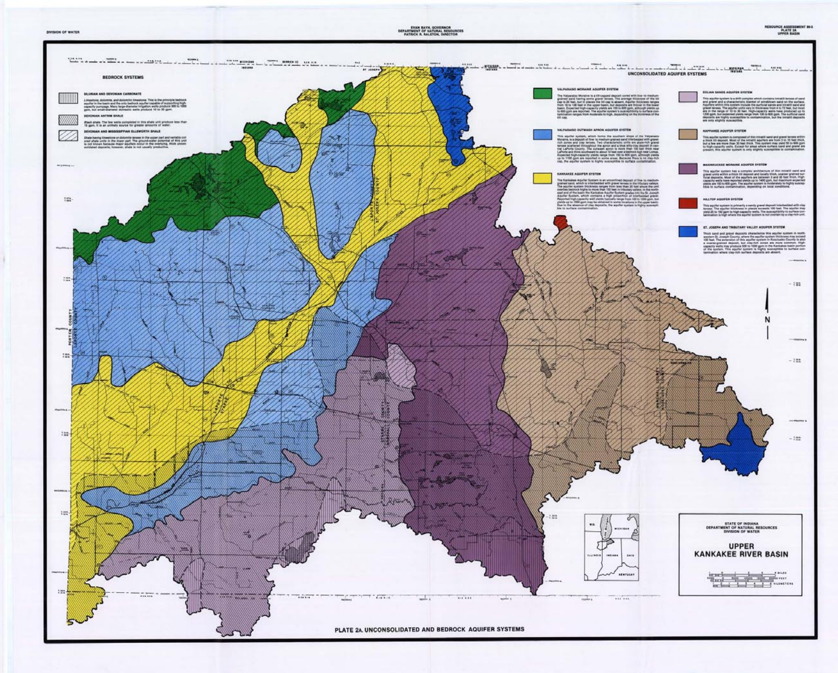


Figure 5. Aquifer systems maps **(click on map to enlarge)**

tions.

Recent lake surveys have revealed few water-quality problems. Of the basin's large natural lakes, only Cedar Lake and Koontz Lake have experienced documented problems attributable to accelerated eutrophication. J. C. Murphy Lake, an artificial impoundment, has undergone several fish eradication and selective restocking projects

GROUND-WATER HYDROLOGY

Ground-water availability in much of the Kankakee River Basin is considered moderate to excellent. Ten unconsolidated aquifer systems and one subsystem are defined according to hydrologic characteristics of the deposits and their environments of deposition. Seven bedrock aquifer systems are defined on the basis of hydrologic and lithologic characteristics (figure 5).

Extensive deposits of outwash sand and gravel characterize the Valparaiso Outwash Apron, St. Joseph and Tributary Valley, Kankakee, and eastern Valparaiso Moraine Aquifer Systems. Common thicknesses of these highly productive aquifer systems generally range from about 30 to 50 feet, but in some locations thicknesses exceed 100 feet. Domestic wells produce from less than 10 gpm to more than 50 gpm. Yields of up to 600 gpm generally can be expected from high capacity wells. Wells completed in the upper Kankakee Aquifer System and the St. Joseph and Tributary Valley Aquifer System may produce 1000 gpm or more.

The Maxinkuckee Moraine and the Eolian Sands Aquifer Systems are moderately productive unconsolidated aquifer systems. Although the systems are overlain by generally thick, permeable materials, ground-water production primarily is from deep wells completed in intratill sand and gravel lenses. Well yields for domestic supplies are more variable in the Maxinkuckee Moraine Aquifer System (4-80 gpm) than in the Eolian Sands Aquifer System (10-50 gpm). High capacity wells in these systems can produce 100 to 600 gpm.

Intratill sand and gravel lenses characterize the till-dominated Nappanee and Iroquois Basin Aquifer Systems. The Nappanee Aquifer System typically yields 5 to 50 gpm to domestic wells, and may yield 50 to 600 gpm to high-capacity wells. Domestic well yields in the Iroquois Basin Aquifer seldom exceed 10 to 25 gpm, and maximum production from high-capacity facilities is expected to be 50 to 100 gpm.

The Iroquois Buried Valley Aquifer Subsystem, part of the Iroquois Basin Aquifer System, consists of sand and gravel deposits in a buried valley overlain by till. Coarse-grained zones are more predominant in the buried valley than in overlying deposits. Yields of 10 to 40 gpm are common from domestic wells and production from high-capacity wells is expected to range from 100 to 400 gpm.

There are severe limitations to water resources in the Iroquois Moraine Aquifer System, which consists of isolated sand and gravel deposits encompassed within thick clays. Domestic wells may yield from 4 to 10 gpm. However, because the aquifers in this system are present only in small areas of the moraine, many wells pass through the unconsolidated deposits to obtain water from underlying bedrock.

Carbonate rocks of Silurian and Devonian age form the most productive bedrock aquifer system in the Kankakee River Basin. Development of joints, fractures, and solution cavities have considerably enhanced the secondary permeability of the upper part of these rocks, especially at the bedrock surface. Domestic wells commonly penetrate the upper 15 to 100 feet of bedrock and produce about 8 to 200 gpm. High-capacity wells typically penetrate 200 to 450 feet of rock and generally produce 300 to 1000 gpm.

Carbonate rocks of the Mississipian Borden Group are utilized as aquifers in northern Benton County. Wells generally penetrate less than 70 feet of bedrock to produce from limestone units. Wells also penetrate less productive shale and sandstone units, and some dry holes have been reported. Domestic wells yield about 5 to 15 gpm, and one high-capacity well reportedly produces 80 gpm; however, the development potential for high-capacity wells in this system is poor.

Shales of considerable areal extent are utilized as minor aquifers, primarily in the lower Kankakee River Basin. Wells are completed in the Antrim and new Albany Shale in areas where unconsolidated aquifers are rare or absent and where more productive carbonate aquifers are far beneath the bedrock surface. Wells are drilled as much as 62 feet into the Antrim Shale and as much as 102 feet into the New Albany Shale. Well yields can range up to 15 or 20 gpm. However, the occurrence of dry holes is likely in the Antrim Shale.

Devonian and Mississippian-age Ellsworth Shale forms a large area of the bedrock surface in the northern part of the basin. However, no wells are known to produce water from the bedrock because of the availability of ground water in unconsolidated deposits.

Sandstone units of the Pennsylvanian Raccoon Creek Group may be utilized as aquifers in small areas of the lower basin. Water-yielding capabilities of the sandstone units are not known, but may be similar to those of adjacent bedrock aquifers.

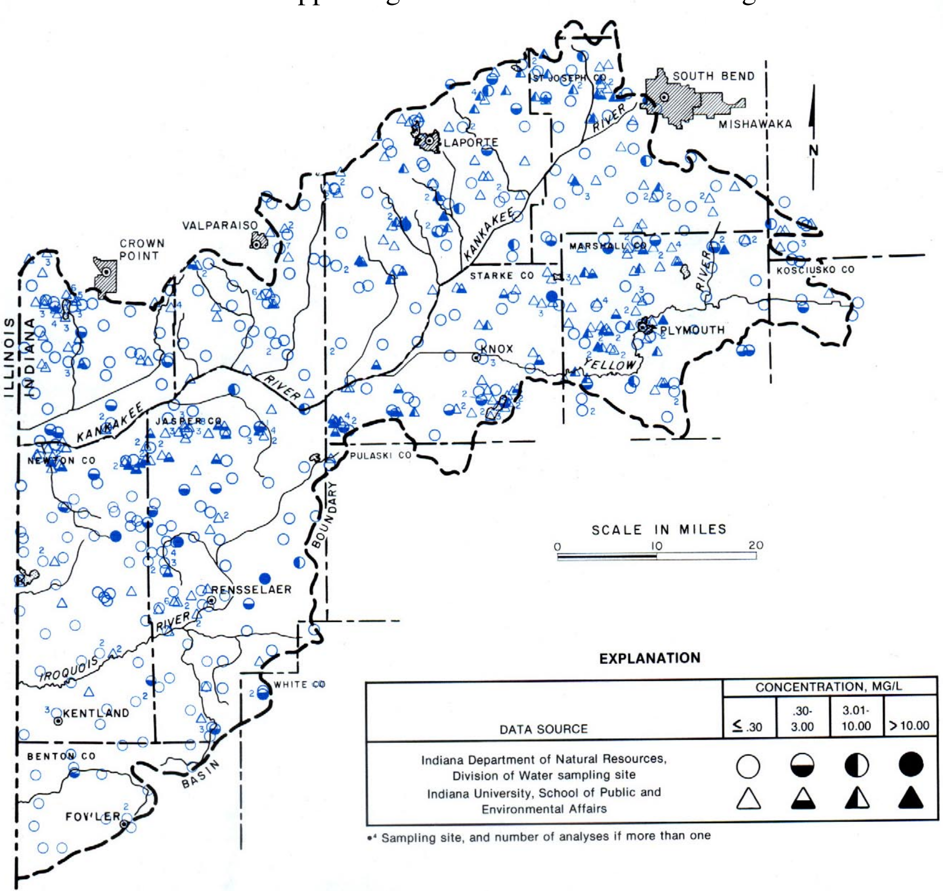


Figure 6. Distribution of nitrate-nitrogen concentrations for wells sampled in bedrock and unconsolidated deposits

GROUND-WATER QUALITY

Ground water in the Kankakee River Basin is hard, neutral to slightly alkaline, and dominated by calcium and bicarbonate. Ground water generally meets drinking-water standards, although iron commonly exceeds the Secondary Maximum Contaminant Level (SMCL). Other constituents that commonly exceed SMCLs include manganese and total dissolved solids. Chloride and sulfate concentrations can be variable and are sometimes high, but rarely exceed the SMCLs. Nitrate concentrations generally are at or near background levels, but water in a few wells scattered throughout the basin contains nitrate levels exceeding the 10 mg/L Maximum Contaminant Level (figure 6).

The Valparaiso Moraine Aquifer System, the most highly mineralized of the basin's unconsolidated systems, has ground water containing the highest median alkalinity and hardness, and the highest median concentrations of calcium, magnesium, iron and sulfate. In contrast, ground water of the Eolian Sands Aquifer System contains the lowest median concentrations of these constituents except for sulfate.

Bedrock aquifer water is similar in alkalinity to overlying recharge water, but commonly is softer and contains higher concentrations of sodium and potassium because of cation exchange occurring in overlying clays, tills or shales. Fluoride concentrations can be higher in ground water of the Silurian and Devonian carbonates than in other bedrock systems. Hydrogen sulfide gas most commonly has been detected in deep wells completed in Silurian and Devonian carbonates, where reducing conditions are most likely to occur.

Detectable levels of pesticides have been found in isolated cases in both unconsolidated and bedrock wells. Volatile organic compounds were not detected in private wells sampled in 1986 but have been present in the raw water of some public supplies in Newton, Jasper, Porter and Marshall Counties.

Unconsolidated aquifer systems that are highly susceptible to contamination from surface sources include the Kankakee, Valparaiso Outwash Apron, St. Joseph, Hilltop, and Maxinkuckee Moraine Aquifer Systems, and surficial deposits of the Eolian Sands Aquifer System. The Valparaiso Moraine Aquifer System can be susceptible where surficial clay layers are absent or discontinuous. The thick clay deposits overlying the intratill aquifers in the Eolian Sands, Nappanee, Iroquois Moraine and Iroquois Basin Aquifer Systems, and the Iroquois Buried Valley Subsystem afford some protection from surface contamination.

WATER USE AND PROJECTIONS

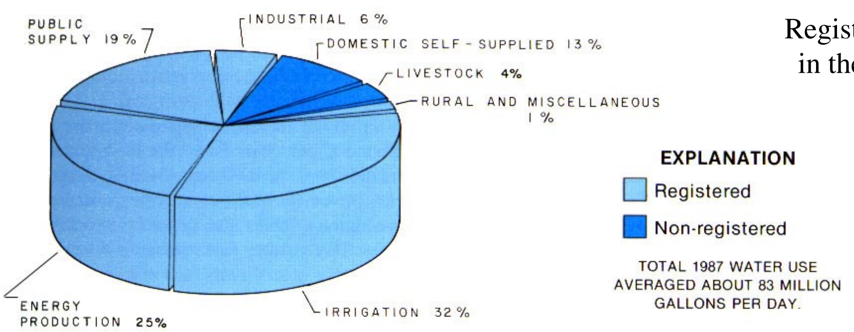


Figure 7. Percentage of water withdrawn by registered and non-registered facilities

Registered and non-registered water withdrawals in the Kankakee River Basin averaged 83 million gallons per day in 1987. About one-third of the withdrawals were for irrigation purposes, and another third were for public and domestic water supply. About one-fourth of the total withdrawals were related to energy production. The remaining withdrawals were by industries (primarily stone quarries and sand and gravel pits), a fish hatchery, livestock operations, and miscellaneous facilities (figure 7).

Nearly equal amounts of water are withdrawn from surface-water and ground-water sources throughout the basin as a whole; however, the major water source differs among counties and water-use categories. For example, most registered withdrawals in Jasper and Lake Counties are from streams and ditches, whereas withdrawals in LaPorte and Newton Counties are primarily from ground water. The Kankakee River is the major water source for withdrawals in the energy production category, whereas ground water is the major source for public and domestic supplies.

Irrigation in the Kankakee River Basin constituted more than 40 percent of Indiana's reported irrigation water withdrawals in 1987, and about one-third of the state's irrigated land. Although only 7 percent of the basin's farms and less than 5 percent of the total cropland are irrigated, seasonal withdrawals for irrigation far exceed other types of withdrawals. Irrigation facilities in the basin accounted for 84 percent of the 533 water-withdrawal facilities registered with the IDNR Division of Water in 1987.

The total number of irrigated acres in the eight county basin region is projected to increase from 67,000 acres in 1987 to nearly 109,000 acres by the year 2000. Variable increases in irrigation water withdrawals are expected.

Water withdrawals for energy production, public supply, industrial, domestic, self-supplied, and livestock watering purposes are expected to increase slightly as the basin's population continues to grow.

WATER RESOURCE DEVELOPMENT

Stream withdrawals are expected to remain high in areas along the lower Kankakee River and its major tributary ditches, where stream flow provides an adequate and dependable supply. Although water supplies in these areas should be sufficient for a variety of withdrawal and instream uses, the cumulative effects of irrigation withdrawals and seasonal declines in stream-flow availability may cause significant steam-flow reductions in dry years, particularly in water-courses with a limited storage capacity and large clusters of withdrawals. In Lake County, there is a high potential for water-use conflicts on Singleton Ditch and several of its tributaries, primarily because of the large number of seasonal withdrawals for irrigation.

During the periods of low stream flow, withdrawals from the Kankakee River for use at an electrical generating station may produce minor impacts on stream flow immediately downstream of the intake point. However, the degree of impact cannot be quantified because of data limitations.

Lakes and wetlands will continue to provide a wide range of recreational opportunities, fish and wildlife habitat, various hydrologic benefits, and, in a few cases, minor water supply sources. However, these systems are not considered as significant sources of supply because of their limited storage capacity, water-quality considerations, and regulatory, economic and environmental constraints.

Although ground-water supplies are abundant in much of the Kankakee River Basin, increasing demands may continue to create localized or short-term conflicts among ground-water users. In past years, water-use conflicts in the basin have occurred primarily in Jasper and Newton Counties as a result of seasonal ground-water pumpage for irrigation purposes. Most irrigation wells pump from carbonate rocks of Silurian and Devonian age, but some wells utilize the surficial sand aquifer designated as the Kankakee Aquifer System.

Between 1981 and 1989, IDNR staff investigated more than 225 complaints of water-supply problems in northern Jasper and Newton Counties. Most problems reported for shallow water wells were the result of seasonal water-table fluctuations in the sand aquifer, and generally were corrected by upgrading the wells. Losses of water supply in wells completed in the carbonate aquifer, however, frequently resulted from water-level declines induced by high-capacity irrigation pumpage from the bedrock.

Many of the domestic and livestock wells in Jasper and Newton Counties that were shown to be adversely affected by irrigation pumpage were voluntarily upgraded by area irrigators. In some cases, however, provisions of I. C. 13-2-2.5

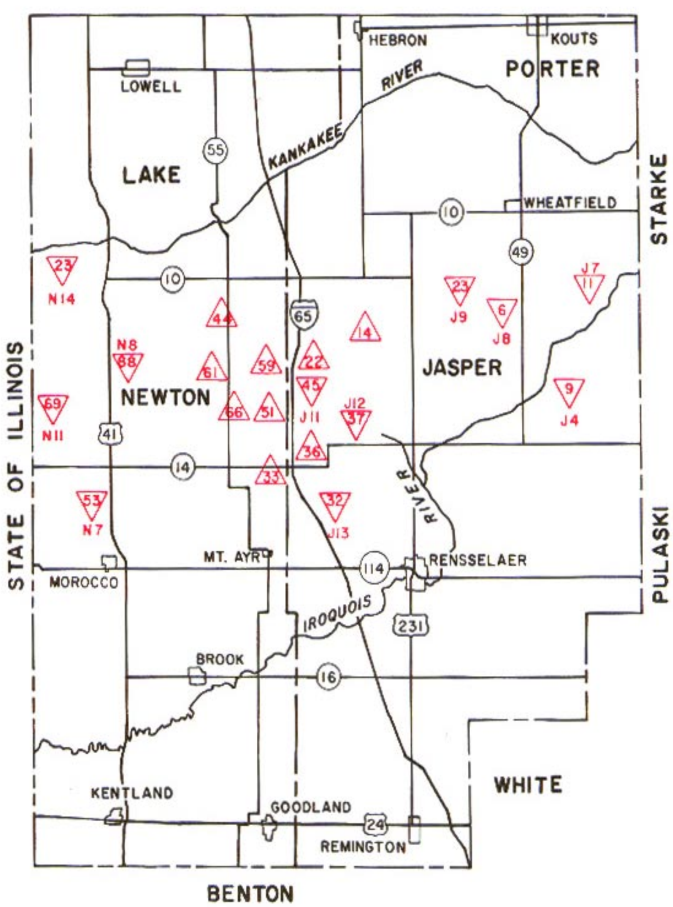


Figure 8. Water-level declines in selected bedrock wells in Jasper and Newton Counties during August 17-19, 1988

were invoked to provide an immediate temporary supply of potable water to owners of affected small-capacity wells. Each matter was subsequently brought before the Natural Resources Commission to determine timely and reasonable compensation as specified in I. C. 13-2-2.5.

During the drought conditions of 1988, record low ground-water levels were recorded in 19 of the 23 bedrock and unconsolidated observation wells in the Kankakee River Basin (figure 8). The greatest water-level declines were recorded in two bedrock wells in western Newton County, where maximum drawdowns were 88 and 71 feet. In the area monitored by these two wells, localized dewatering of the bedrock aquifer occurred during much of July and August, primarily as a result of hydorgeologic conditions, and heavy irrigation pumpage on either side of the Indiana-Illinois state line.

In response to recurring ground-water conflicts in Jasper and Newton Counties, the IDNR Division of Water has suggested several water-management alternatives in an attempt to alleviate the potential for future conflicts, particularly during the irrigation season and during periods of drought. The suggested alternatives call for 1) the additional development of the surficial sand aquifer as an alternative or complementary ground-water source for irrigation; 2) an examination of the need for localized restrictions on the drilling of new high-capacity bedrock wells; 3) the implementation of water-conservation practices in some irrigation areas; 4) the proper installation of small-capacity wells; and 5) continued coordination with the State of Illinois to manage irrigation development in the bi-state area where the carbonate aquifer is heavily pumped.

Existing provisions in Indiana law will continue to be a key factor in both developing and protecting the surface-water and ground-water resources of the Kankakee River Basin. As demands for water increase, additional steps may be needed to protect the resource.

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