

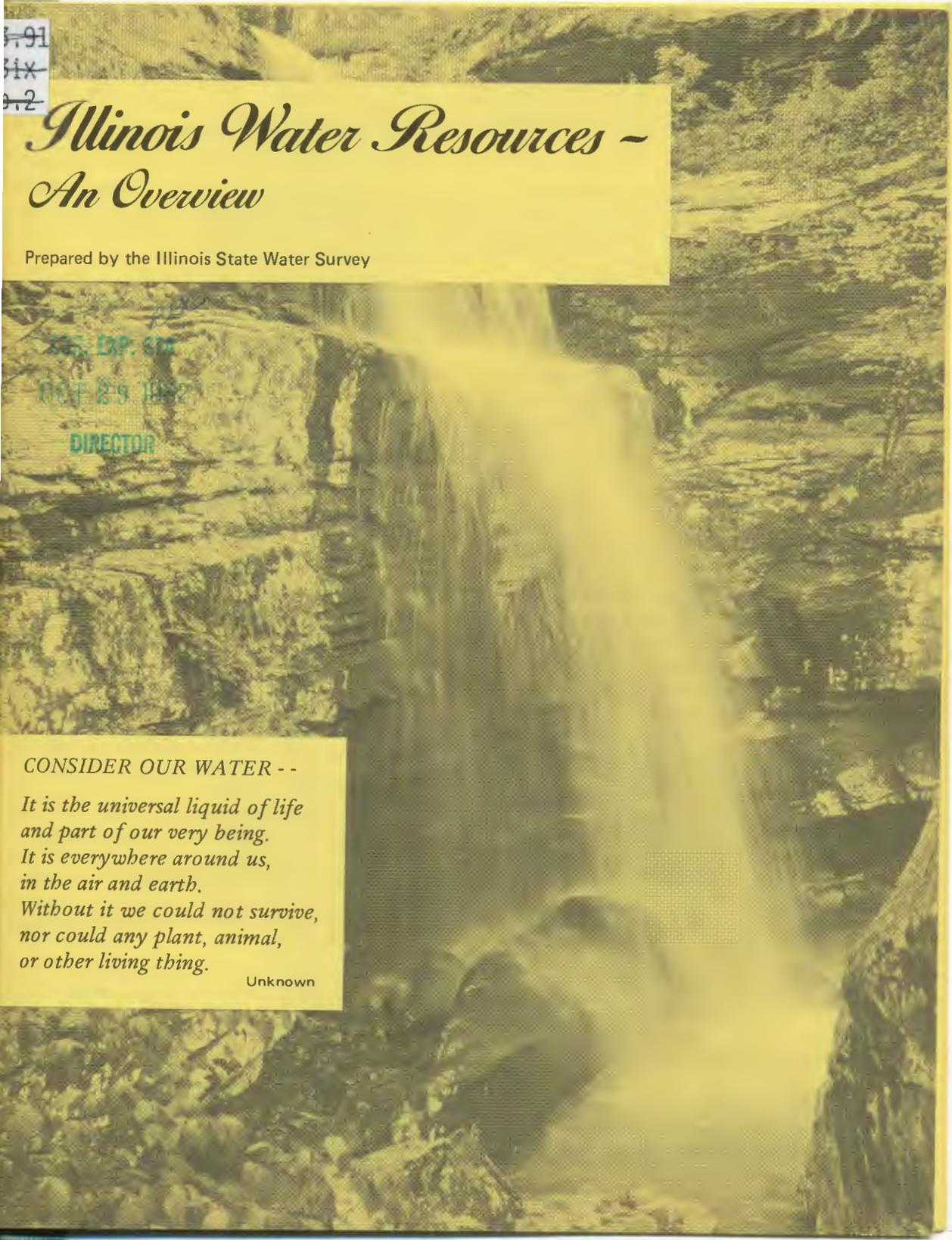
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Illinois Water Resources - An Overview

Prepared by the Illinois State Water Survey

225 EXP. 308
OCT 29 1982
DIRECTOR

CONSIDER OUR WATER - -
*It is the universal liquid of life
and part of our very being.
It is everywhere around us,
in the air and earth.
Without it we could not survive,
nor could any plant, animal,
or other living thing.*
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*The thirsty earth
soaks up the rain,
And drinks,
and gapes
for drink again.*

[A. Cowley 1618-1667]

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About Our Water Resources...

The waters of the earth move in an endless cycle from ocean to atmosphere and back to the ocean. The total never changes — in one of its forms as a liquid, vapor, or solid, the amount of water is the same today as it was thousands of years ago.

In its journey through the atmosphere some of the water vapor condenses and falls as precipitation over both water and land. The portion that falls over land masses is held for varying times in channels and lakes or in layers of the land crust before flowing back to the ocean. It is this small portion that becomes our "water resources." We know them as our rivers and streams, lakes and reservoirs, and underground aquifers.

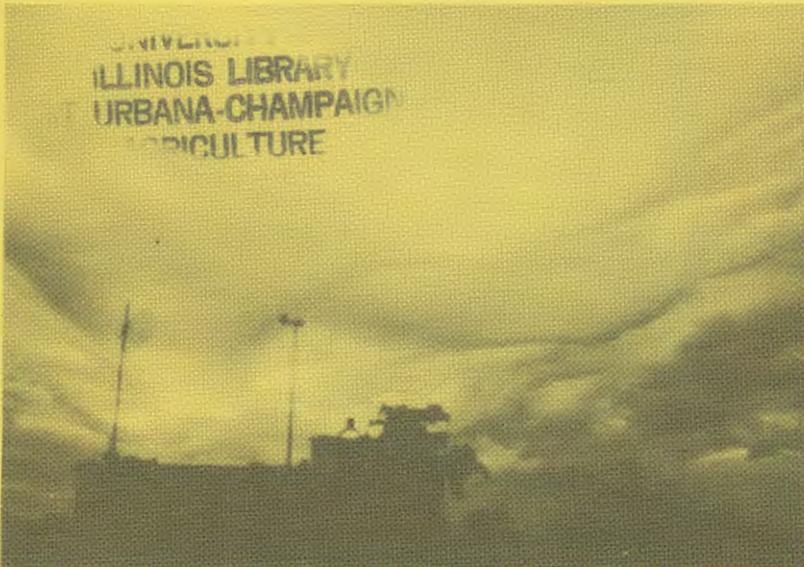
An average of 2,000 billion gallons of water vapor daily passes over Illinois. But, the processes of nature cause only about 5 percent of this moisture to fall over the state as precipitation, for an average of about 100 billion gallons a day. About three-fourths of this evaporates from the surface or is transpired by growing

plants back to the atmosphere. Nonetheless, this is generally abundant precipitation, producing a humid climate.

In addition, we share in the use of our surrounding fresh waters of the vast Mississippi and Ohio Rivers and Lake Michigan, which about doubles our total usable resource.

Although our total water resource for Illinois is large, its distribution in time, place, and quality is not uniform. Precipitation varies from place to place, by season, and from year to year. Our use of it is affected from time to time by the extremes of droughts and floods, and by pollution.

This brochure provides an overview of the extent of our various water resources, their location, and their many variations.



*Thou waterest her furrows,
thou sendest rain into the
little valleys thereof:
thou makest it soft
with the drops of rain,
and blessest the
increase of it.*

[Prayer Book 1662]

COVER: Burden Falls,
south of Harrisburg
in Pope County.

Rain or No Rain

Precipitation is the original source of water. It includes rain, snow, and sleet, though most of it occurs as rain. It produces about 10 percent of the precipitation in northern Illinois and 3 percent in southern Illinois.

Variability is the most significant feature of annual precipitation

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*The thirsty earth
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Rain or No Rain

Precipitation is the original source of all our water. It includes rain, snow, sleet, and hail, though most of it occurs as rain. Snow produces about 10 percent of the average annual precipitation in northern Illinois and only 2 to 3 percent in southern Illinois.

Variability is the most significant characteristic of annual precipitation in Illinois, which aver-

ages from about 32 inches near Lake Michigan to about 46 inches in the Shawnee Hills of southern Illinois (see map). Part of this variation from place to place is due to the north-south length of the state. This 385 miles of latitude has major differences in temperatures, storm tracks, and distance from the primary moisture source, which is the Gulf of Mexico.

Seasonal differences also exist. During the colder half of the year, October through March, precipitation ranges from about 12 inches in the north to 23 inches in the south. However, in summer there is much less difference, and precipitation for April through September ranges from 20 to 24 inches from north to south. February is the driest month throughout the state. But the wettest month is usually April in the south, May in south-central and eastern Illinois, and June in the remainder of the state.

Storm systems which bring widespread precipitation through Illinois occur mostly in the winter and spring. Summer storms cover a smaller area, but the heat and high moisture content of the atmosphere promote intense localized thunderstorm activity, which occasionally is accompanied by hail and windstorms, or even tornadoes. Thunderstorms, which are highly variable, produce more than 70 percent of our normal precipitation in the warm months.

The climate of Illinois is always changing. The last four years have shown a slow trend to cooler and wetter weather, with a tendency

to more extremes appearing in the 1970s. Cold winters with large numbers of severe snow and ice storms have prevailed, and in summers Illinois has had relatively cool temperatures, more rain events, and much more July and August rainfall.

Droughts

Droughts are difficult to define because critical precipitation deficits and durations vary for different water uses. What is a critical dry period for agriculture may not be critical for the well-designed municipal water supply.

On the other hand, deficient rainfall in winter or early spring that does not immediately affect agriculture may cause trouble for small water supply systems, especially if they are old and only marginally adequate for growing community water demands. This was the case at Eldorado in southeastern Illinois, where it was necessary to impose severe water use restrictions during the 1980-1981 drought.

Droughts have been observed in all sections of Illinois, but are most frequent in the southern



We have had a very remarkable dry summer there are streams 40 miles in length which have entirely stopped running — two thirds of the wells and springs have dried and the grass is not more than half its usual length.

[Gerhsam Flagg, Edwardsville, 1820]

I had never before had an impression of the power of water... in geological time nothing can resist such

[Flood on the Mississippi, Mr. Thompson, 1851]

and southwest regions, vary from 3 to 36 months.

Three of the four worst occurred from 1930 to 1953-1954, 1976-1977, the most severe in more than a month drought that ended 70 percent of normal rainfall in the state. The 12-month drought affected only portions of the state with 50 percent of normal rainfall in the central area had normal

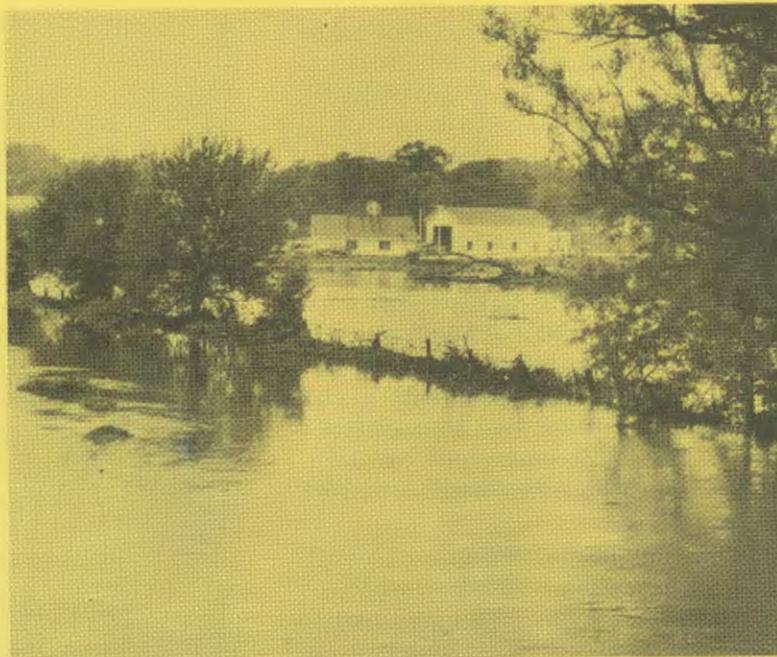
Floods

Floods cause extensive damage throughout Illinois. From the inundation of the Mississippi to the ponding of excess precipitation in the central area.

Although Illinois has experienced floods on its major rivers, a part of the annual flood season consists of numerous floods on small streams from small stream floods.

I had never before had such an impression of the power of water . . . in geological changes; nothing can resist such a flood.

[Flood on the Mississippi, a Mr. Thompson, 1851]



and southwest regions. Usual drought periods vary from 3 to 36 months.

Three of the four worst droughts of record occurred from 1930 to 1936. The droughts of 1953-1954, 1976-1977, and 1980-1981 were the most severe in more recent times. The 12-month drought that ended in July 1934 (50 to 70 percent of normal rainfall) affected the entire state. The 12-month drought that ended in 1954 affected only portions of south-central Illinois with 50 percent of normal rain, while the north-central area had normal or above normal rain.

Floods

Floods cause extensive and costly destruction throughout Illinois. Few areas are totally safe from the inundation caused by the overflow or ponding of excess precipitation runoff.

Although Illinois has had a number of devastating floods on its major streams, the greater part of the annual flood damage is the sum of numerous floods on small streams. The damage from small stream flooding has greatly increased

because of recent increased urbanization on floodplains of small streams and a shift to a wetter climate.

The greatest floods of record were those of 1979 on the Illinois River and its tributaries and the 1973 flood of the Mississippi River. The 1973 flood caused about \$50 million in damages in Illinois alone, and the 1979 flood damage was \$48 million.

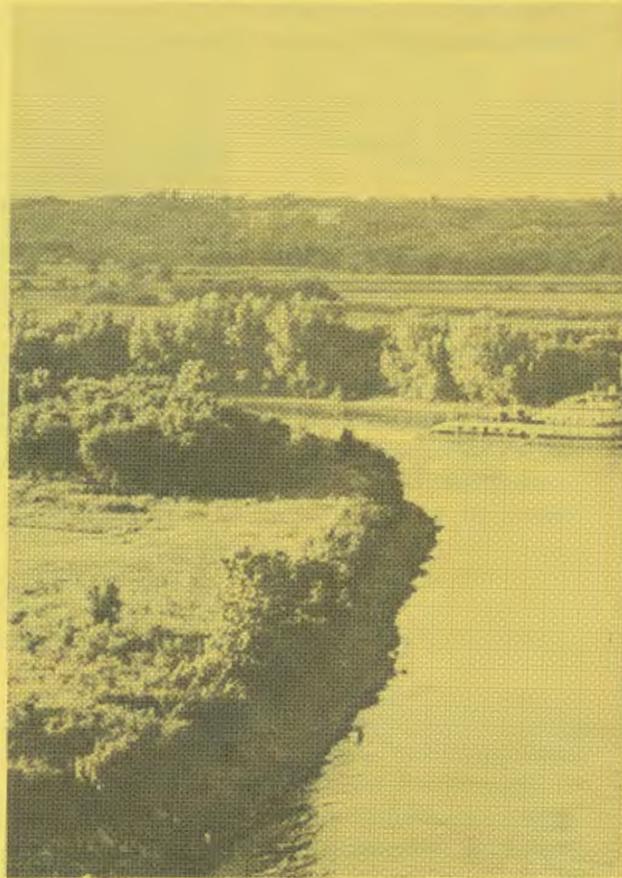
Heavy rainstorms that produce floods may occur at any time, but the frequency of floods is greatest from late spring to early fall. They are on an increase because of the climate shift that includes more rain events. Winter storms capable of floods are restricted mostly to the southern part of the state, but winter floods occur frequently elsewhere from rapid melting of heavy snow cover, particularly in recent years.

The storm of June 14-15, 1957, in southwestern Illinois was the most intense 12-hour storm period recorded during the 90 years from 1887 to 1978. At its center in St. Clair County, 16.5 inches of rain was recorded in that period.

Rivers and Streams

Illinois is almost an island, in a sense being nearly surrounded by fresh water. Along our western border flows the mighty Mississippi and to the south and east are the Ohio and Wabash. Lake Michigan lies to the northeast. This is far from all, for large amounts of water are readily available within the state from great rivers such as the Rock, Illinois, Kaskaskia, Embarras, and Big Muddy. In addition, there are numerous smaller streams. Altogether, Illinois has some 2,700 interior streams for more than 13,000 miles of water courses.

Within its boundaries, the state's only commercially navigable waters are the Illinois Waterway and a small portion of the lower Kaskaskia River. The Illinois Waterway, which includes the Calumet-Sag Channel and the Sanitary and Ship Canal in the Chicago area as well as the Illinois River, provides through-navigation from the Mississippi River near Alton to Lake Michigan with a minimum channel depth of 9 feet. The Kaskaskia has been made navigable from Fayetteville to its confluence with the Mississippi, about 36 miles.



Junction of the Calumet-Sag Channel and Des Plaines River

The situation of this Territory is good for trade having the advantage of Water carriage on all sides . . .

[Gresham Flagg, Pioneer Letters 1818]



In order to know how much water will be available for navigation, water supplies, recreation, or the carrying of treated wastes, we need to know how much water flows in Illinois streams at various times. Streamflow is recorded at about 150 locations in the state.

In Illinois runoff in the form of streamflow varies by area in much the same pattern as precipitation. The average annual discharge of streams in northern Illinois is equivalent to about 9 inches of water depth over the land surface and in southern Illinois is equal to about 15 inches. Streamflow is a major water resource because it can be taken directly from a stream and used, or it can be stored in a reservoir and used as needed.

Streams in northern Illinois generally flow year round, have fewer extremely high or extremely low flows, and therefore are more dependable than streams in southern Illinois. This is

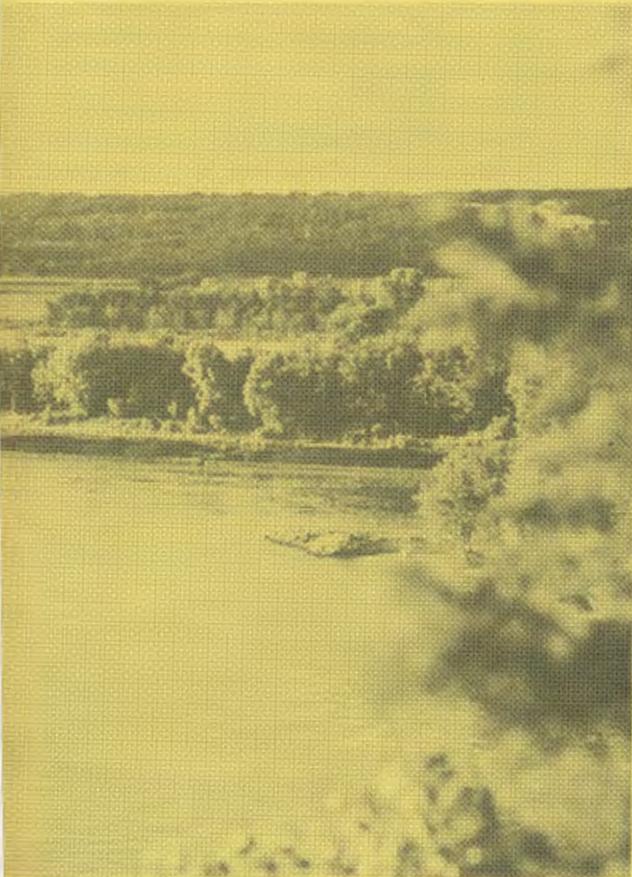
partly because under generally good, and groundwater. The summer or dry periods, but frequently flood in the south, coupled with itself to the development of dependable water supply.

The amount of streamflow at least part of the time, how much treated water.

Because of its constantly changing nature, Illinois is more consistent than happens 200-400 parts

Nature has been eminently bountiful to Illinois, in bestowing the means of internal navigation without the expense of cutting canals, perhaps nowhere else to be found in the world.

[Daniel Blowe 1820]



steady contribution of groundwater. In the south, water in streams becomes less hard (usually less than 200 parts per million), but is more variable in mineral content.

The many streams, large and small, throughout Illinois add up to about 13,202 miles of water courses providing a water surface area of about 256,574 acres.

partly because underground storage conditions in the north are generally good, and much of the streamflow is from stored groundwater. The southern streams may often go dry in summer or dry periods, but may carry large quantities of water and frequently flood in wet periods. However, the higher runoff in the south, coupled with more rolling or hilly land surface, lends itself to the development of impoundments which can provide dependable water supplies.

The amount of streamflow that is available at any one place, at least part of the time, is very important also in determining how much treated waste can be carried by the stream.

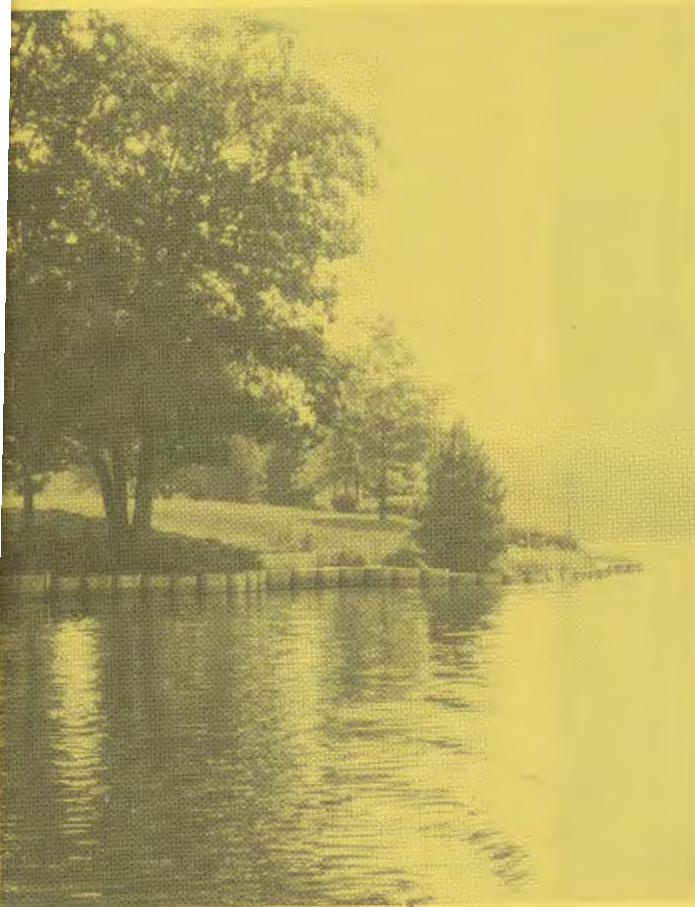
Because of its constant movement, the quality of streamflow is constantly changing. In general, streamflow in northern Illinois is more consistent in quality, but the water is harder (perhaps 200-400 parts per million of hardness) because of the



Lakes and Reservoirs

Big pond, little lake, the naming doesn't matter. It is water, fresh water cupped in a hollow among the green hills, cool haven from summer's heat and hurry, a priceless heritage.

[The Little Lakes (August 16),
Hal Borland's Twelve Moons of the
Year, 1979]



Lakes and reservoirs — whether natural or man-made — collect water for later use and thus represent an important means of conserving water, while also reducing floods, reducing the impact of droughts, and serving other purposes.

Natural lakes in Illinois are primarily in the northeastern part of the state and are the result of the last glacial periods. Most of these are in the Fox Chain of Lakes region in Lake and McHenry Counties. Other natural lakes occur along the Illinois River, or in limestone sink holes near the Mississippi in southwestern Illinois.

Artificial lakes and reservoirs have been developed throughout the state for various purposes, including flood control, water supply,

recreation, water quality control, and the largest ones also for navigation and fish and wildlife conservation.

The three largest man-made lakes, all constructed by the U.S. Army Corps of Engineers, are Carlyle Lake, Lake Shelbyville, and Rend Lake, which are located in the southern half of the state. Rend Lake is the source of water for communities in nine counties. There are numerous lakes of intermediate size such as Crab Orchard, Lake Decatur, and Lake Springfield. Many of these are used primarily for municipal water supply.

In all, Illinois has about 83,000 lakes and reservoirs, of which about 80,000 are small (less

than 6 acres) lakes and farm more than 350 lakes of 40 a more than 50 of these are m

The state also has more t additional man-made lakes c acres in size. If they were b create the water storage equi of 2.85 inches over the state about 0.5 inch of storage of However, for environmental reasons, the construction of come to a virtual halt.

A major problem occurring and lakes is an excessive rate from erosion on the watershed



Lake Lou Yeager, Litchfield

than 6 acres) lakes and farm ponds. There are more than 350 lakes of 40 acres or more, and more than 50 of these are more than 500 acres.

The state also has more than 800 sites for additional man-made lakes of more than 40 acres in size. If they were built, they would create the water storage equivalent of a depth of 2.85 inches over the state, compared with about 0.5 inch of storage of our existing lakes. However, for environmental, space, and other reasons, the construction of major lakes has come to a virtual halt.

A major problem occurring with reservoirs and lakes is an excessive rate of sedimentation from erosion on the watersheds. Sedimentation

reduces storage capacity and contributes to problems such as eutrophication, which is the over-enrichment of nutrients in water that gives rise to growth of algae and other aquatic weeds.

Lake Michigan. Lake Michigan is the single most important water body available to the state. About 7 percent of the lake is considered to be in Illinois. It supplies water to Chicago and numerous suburbs, as well as providing navigation and recreation. The Chicago Department of Water, which serves more than 4.5 million people, pumped 997 million gallons a day from Lake Michigan in 1980. However, the amount of water that Illinois can withdraw from Lake Michigan is limited by a U.S. Supreme Court decree.



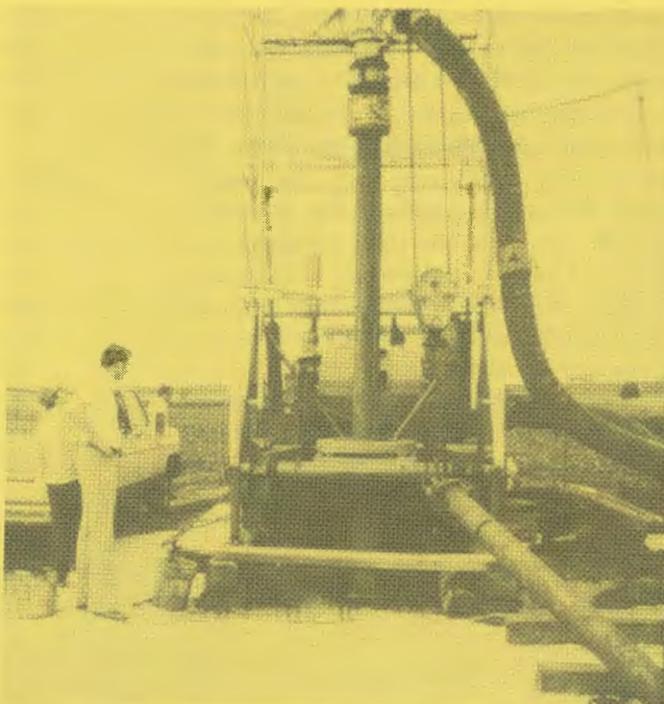
Lake Lou Yeager, Litchfield

Groundwater

The topography and the nature of earth and rock materials largely determine the availability of groundwater. The more permeable earth and rock formations serve as aquifers — formations that store and transmit water and allow it to flow into wells.

The northern third of Illinois is more fortunate than the rest of the state, having extensive aquifers of sand and gravel in the shallow glacial material and also more aquifers of sandstone and limestone in deeper rock formations.

In the rest of the state, the only aquifers of high potential water yield are sand and gravel deposits along the Mississippi, Illinois, Ohio, Wabash, Kaskaskia, and Embarras Rivers, as well as the buried Mahomet valley that partially crosses the state just north of Champaign. In other areas, only small yields are available to wells, but these may be adequate for domestic and livestock purposes and for small communities.



No water near, a well was of the first necessity. [George Flower, Edwards County English Settlement, 1817]

Groundwater is an extremely important resource in the state. Hundreds of municipal and industrial wells take large quantities from aquifers in the northern half. Groundwater also is the predominant source for medium and small communities and is virtually the exclusive source for rural supplies.

The potential for the development of groundwater supplies in Illinois is huge — in the order of 7 billion gallons per day compared with the approximate 1 billion gallons per day that was withdrawn in 1980. However, this potential is not always located where it is needed. In the Chicago region, for example, the rate of withdrawals from deep sandstone wells exceeds the rate of water recharge, which means that groundwater levels in these deep sandstone aquifers are declining at the rate of 10 feet or more a year.

Cost-effective means must be found to shift a portion of this Chicago-area demand to shallow aquifers, where additional supplies exist, or the state must seek further allocations from Lake Michigan. The possibility of artificially recharging aquifers in the Chicago region with treated waste water is also being studied.

A growing problem in many parts of the state is the threat of pollution of groundwater from surface contamination or buried toxic wastes.



Water Quality

The use of our water resources is affected by location, but also on quality and the use of the water. What are the differences and these differences are varied.

Natural water quality varies through. In Illinois, water contains amounts of iron, nitrates, and other substances that are easily treated.

Pollution — the quality of water is more diverse and often less

Water Survey scientists prepare to take samples from the bottom of the Illinois River for study of water quality.

cessive bacteria and viruses from inadequate treatment after human and animal use, to excessive organic material that decomposes to lower dissolved oxygen in streams and lakes. Toxic chemicals from agricultural and industrial discharges also are of concern. In addition, a major pollutant is excess sediment resulting from row-crop farming that places an added burden on streams and changes their natural system of taking care of wastes. Fortunately, regulations and considerable research are at work on these problems.



Water Quality

The use of our water resources depends not only on their amount and location, but also on quality. Quality varies by the resource — but also by the *use* of the water. What is good for one use may not be right for another, and these differences are very complex.

Natural water quality varies and changes by the soil and rock it flows through. In Illinois, water is generally hard and contains troublesome amounts of iron, nitrates, and sometimes methane gas. Most of these are easily treated.

Pollution — the quality problems caused by human activities — can be more diverse and often less easy to treat. These problems range from ex-



A Final Word

Illinois is indeed fortunate in its water resources. However, abundant water resources may not equate to an *adequate water supply*. Today we see our usable supply threatened by increasing water usage, increasing water pollution, an ever-changing climate, continued siltation of lakes, increasing age of water and sewer systems, and a general apathy ("water will always be cheap and plentiful") of the populace. Whether or not we have adequate resources becomes a matter of the uses of the water and how well we plan and manage the resource for those uses.

This is the sixth in a series of pamphlets describing in popular language our research findings about water resources and weather in Illinois and current issues concerning them.

September 1982

UNIVERSITY OF ILLINOIS-URBANA



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This brochure was prepared by the Illinois State Water Survey, in cooperation with the University of Illinois at Urbana-Champaign. It was prepared for the Illinois State Water Survey, Special Report 1 (1982), the Illinois Department of Conservation's 1978 Inventory of Illinois Surface Water Resources, and the Water Survey's Circular 152, "Water Withdrawals in Illinois, 1980." Technical review and encouragement were provided by Stanley A. Changnon, Jr., Chief of the Illinois State Water Survey and a member of the Water Plan Task Force.

The Illinois State Water Survey is the central data repository and research coordinator for Illinois in matters related to water resources and weather. Its research and service programs encompass assessment and evaluation of ground, surface, and atmospheric water resources as to quantity, quality, and use. The Water Survey was founded in 1895 and is now a division of the Department of Energy and Natural Resources.

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