ILLINOIS
Floods and Droughts

Illinois is located in the northern temperate zone, where weather systems move predominantly from west to east. Winds bring warm, moist, maritime air north into the temperate zone where the moist airmass meets cool, dry, continental air, thus creating conditions favorable for precipitation.

Some flooding generally occurs in Illinois every year. In some years, the floods are minor; in other years, they are extensive and cause substantial loss of life and property. Flooding generally results from rain that continues to fall for several days or from intense rain and thunderstorms of relatively short duration. The largest flood of the Ohio River was during January–February 1937 and resulted from intense rain in the basin, as much as 20 inches in southern Illinois. The flood inundated large areas of Illinois adjacent to the Ohio River and the flood plain along much of the Saline River, Bay Creek, and the Cache River. The most widespread severe flood to affect Illinois was in May 1943.

Record drought occurred in Illinois from 1952 to 1957. That drought was followed only 5 years later (1962–67) by another of almost equal severity. Precipitation during the driest year of record in northern Illinois (1956) was 64 percent of average; during the driest year of record in southern Illinois (1953), precipitation was 58 percent of average.

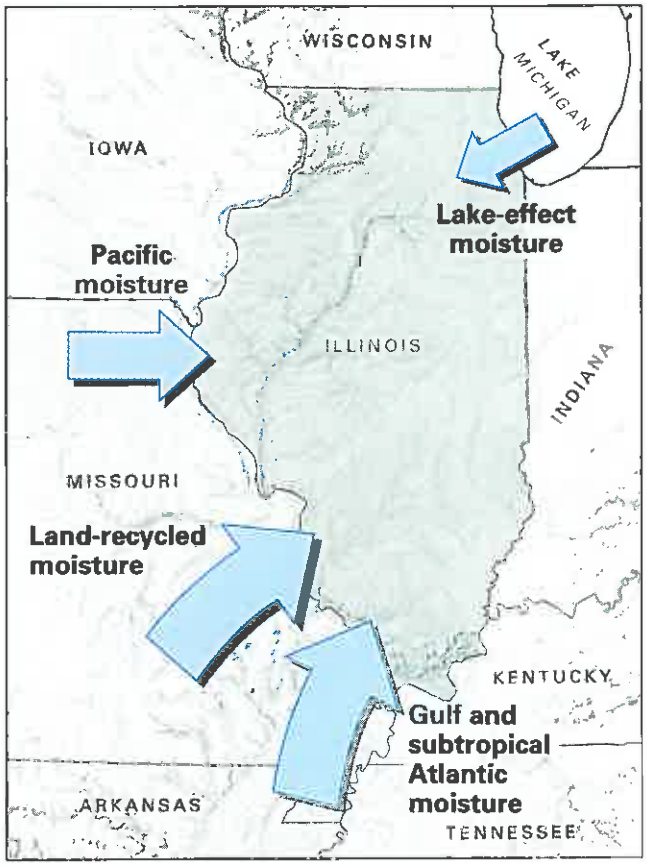


Figure 1. Principal sources and patterns of delivery of moisture into Illinois. Size of arrow implies relative contribution of moisture from source shown. (Source Data from Douglas R. Clark and Andrea Lage, Wisconsin Geological and Natural History Survey.)

Percolating water dissolves minerals from the soil and commonly transports them into streams. The result is increased mineral concentrations in stream water, especially in areas of surface mining. During floods, the concentrations decrease because the additional runoff dilutes the stream water. During droughts, the concentrations generally increase.

Flood-warning mechanisms in Illinois are limited mostly to flood-stage and weather reports provided by the National Weather Service (NWS). The Federal Emergency Management Agency administers a national flood-insurance program and assists local communities in establishing flood-plain-management regulations. The Illinois Department of Transportation, Division of Water Resources, has the authority to regulate the use of water from, and any construction on or adjacent to, the State's lakes and streams.

GENERAL CLIMATOLOGY

Because of its midlatitude and interior-continental location, Illinois' climate is affected by several types of airmasses that enter the State during the year (fig. 1). Warm maritime air from the Gulf of Mexico and the subtropical Atlantic Ocean is dominant for 5 or 6 months during the warm part of the year. This warm air is, by far, the most humid of airmasses that affect Illinois and provides most of the precipitation. Warm and dry tropical continental air from the Southwest desert reaches Illinois for only a few days every several years. Polar maritime air from the Pacific Ocean affects the State about 2 months each year. Although this air is moist while over the ocean, much of its moisture is lost in crossing the Rocky Mountains, and it arrives in Illinois relatively dry. Polar continental air that originates in northern Canada affects Illinois for about 1 month each winter. This is the driest and coldest of the airmasses. Airmasses that have been modified while passing over the High Plains and the Ohio River valley affect the State 3–4 months each year.

In extreme northeastern Illinois, marinelike airmasses can occur because of the effect of Lake Michigan. The effect of the lake is typified by a decrease in extreme temperatures and an increase in snowfall within a few miles of the lake. Snowfall is increased when the wind is from the northeast.

In addition to the oceans and Lake Michigan, important moisture sources include local and upwind land surfaces, as well as lakes and reservoirs, from which moisture evaporates into the atmosphere. Typically, as a moisture-laden ocean airmass moves inland, it is modified to include some water that has been recycled one or more times through the land-vegetation-air interface.

Illinois extends about 400 miles in a north-south direction. Because of this orientation, the northern part of the State is cooler and drier than the southern part. Daily maximum temperatures in July are about 85 °F (degrees Fahrenheit) in the north and about 88 °F in the south, whereas those in January are about 30 °F in the north and about 41 °F in the south. Daily minimum temperatures are about 20 °F less than maximum temperatures. The severity of weather in Illinois depends more on the duration of seasonal temperatures than on the extremes in temperature.

Annual precipitation is about 35 inches in the north and 46 inches in the south. During the warm part of the year, precipitation ranges from about 3–4 inches per month in the north to about 4–5 inches per month in the south. During the cold part of the year, precipitation ranges from about 2 inches per month in the north to about 3 inches per month in the south.

Snowfall ranges from about 32 inches in the north to about 14 inches in the south, but snowfall varies greatly from year to year. Ground frost in winter typically reaches a depth of about 35 inches in northern Illinois, whereas it is shallow and discontinuous in southern Illinois. The State averages about five severe winter storms per year, but the number has ranged from none in some years to 18 during the winter of 1977–78.

Precipitation is caused principally by (1) moisture from the Gulf of Mexico colliding with a frontal system over Illinois during cold weather, and (2) thunderstorms, primarily during warm weather. Hail, tornadoes, and severe thunderstorms are most frequent during the spring.

Floods during cold weather tend to be widespread and result from moderate precipitation that falls for several days. Some winter floods are intensified as rain falls on snow-covered, frozen ground and results in increased runoff. Other winter floods are caused by ice jams that force water to overflow the streambanks. Such floods have occurred on the Kankakee, Fox, and Rock Rivers, as well as many smaller streams in Illinois.

Floods during warm weather commonly result from intense thunderstorms covering small areas and from stalled frontal systems. Rainfall rates of more than 16 inches in 12 hours have been recorded in Illinois. A stalled frontal system was the cause of intense rain and flooding in August 1987, although this situation can occur anytime during the year. Flooding in the spring commonly is enhanced by frozen ground and rapidly melting snowpack.

Drought in Illinois begins when the conditions are not conducive to precipitation for an extended period. Precipitation becomes deficient when (1) the air is somewhat drier than normal because of unusual travel paths of airmasses from the Gulf of Mexico, and (2) frontal systems and unstable airmasses are less frequent than normal.

MAJOR FLOODS AND DROUGHTS

The most significant floods and droughts in Illinois are listed in table 1; rivers and cities are shown in figure 2. The areal extent and severity of the five most significant floods and five most significant droughts to affect Illinois in this century are shown in figures 3 and 4.

FLOODS

Despite flood-control projects, such as levees and reservoirs, flooding is a problem each year in Illinois. Although floods on major streams have caused considerable damage, numerous local floods on smaller streams have caused the greatest annual flood damage.

Five major floods of Illinois' history are depicted in figure 3. The floods occurred in 1937, 1943, 1961, 1982, and 1987. The areal extent and severity of the floods are based on records from more than 100 gaging stations throughout Illinois. Streamflow data are collected, stored, and reported by water year (a water year is the 12-month period from October 1 through September 30 and is identified by the calendar year in which it ends).

The location of six representative streamflow-gaging stations and the corresponding annual peak discharges are shown in figure 3. The six gaging stations were chosen because they are currently in operation, have long periods of continuous record (as long as 76 years), are not affected by reservoirs or other stream regulation, and are representative of the hydrologic conditions in the principal physiographic and geographic areas of the State. About 75 percent of Illinois is underlain by glacial till that has little physiographic relief. The Des Plaines River at Des Plaines (fig. 3, site 2), the Sangamon River at Monticello (site 4), the Spoon River at Seville (site 3), and the Skillet Fork at Wayne City (site 5) drain areas affected by glaciation. The Pecatonica River at Freeport (fig. 3, site 1) in northwestern Illinois and the Cache River at Forman (site 6) in southern Illinois drain unglaciated areas that have relatively large relief.

The January 22–February 1, 1937, Ohio River flood was the largest recorded for that river (U.S. Geological Survey, 1938, p. 2). The entire Ohio River, from Pittsburgh, Pa., to Cairo, Ill. (about 1,000 river miles), was above flood stage on January 22, 23, and 25–27. Precipitation from December 26, 1936, to January 25, 1937, averaged 12.8 inches in the Ohio River basin, which encompasses 204,000 square miles; the southeastern one-quarter of Illinois received as much as 20 inches. The river stage along southern Illinois rose continuously from early January to February 1 and exceeded all previously known maximum stages by 5.8 feet at Golconda, 6.4 feet at Metropolis, and 3.1 feet at Cairo. Floodwaters flowed up the Wabash River, across the drainage divide, and into the Saline River basin in southeastern Illinois. Large areas of southeastern Illinois were then flooded by the Saline River flowing back into the Ohio River at a point about 20 miles downstream from the Wabash River. On February 1, 1937, just downstream from Golconda and about 40 river miles downstream from the Saline River, floodwaters from the Ohio River flowed up Bay Creek at a rate of 70,000 ft^3/s (cubic feet per second). These floodwaters passed over a low divide and flowed

Figure 2. Selected geographic features, Illinois.

down the Cache River (fig. 3, site 6), following an ancient channel, to the Mississippi River upstream from Cairo. The flow of the Ohio River at Metropolis was 1,780,000 ft³/s at that time (U.S. Geological Survey, 1938, p. 17, 114, 115).

During the 1937 flood, the Saline River flooded towns and cities more than 20 miles from the Ohio River. Many people were forced to evacuate their homes. Coal mines were inundated, and large areas of agricultural land were flooded, causing great loss to property and livestock. Mound City, near Cairo, lost 371 of 780 buildings from a levee break along the Ohio River (U.S. Geological Survey, 1938, p. 22). The snow, ice, and sleet storm of January 22 hampered rescue work and added to the problems of the flood victims (U.S. Geological Survey, 1938, p. 82). The U.S. Weather Bureau reported 137 lives lost and flood damage of about $418 million (Hoyt and Langbein, 1955, p. 386).

The May 1943 flood resulted from a series of storms during May 6–24, 1943. The weather pattern was similar to that of the 1937 Ohio River flood, except that the storms were centered over Illinois. Early rains, May 6–10, in the Kaskaskia and Embarras River basins were followed by widespread rainfall throughout the State. As much as 7 inches of rain fell during May 16–19 in the lower Illinois, Sangamon, and Vermilion (tributary to the Wabash River) River basins. This rain was followed by additional rain between Quincy and Kankakee. Finally, intense local showers during May 23–24 added water to streams already at flood stage throughout central Illinois (Illinois Department of Public Works and Buildings, 1943, p. 15–17). Twenty-four gaging stations in Illinois recorded peak discharges of record in May 1943. Of these, six gaging stations recorded streamflow having recurrence intervals greater than 100 years (Curtis, 1987). Streamflows measured in 1943 at 12 gaging stations remain as the maximum of record. Floods having at least a 10-year recurrence interval resulting from the intense rains of May 1943 extended over most of central Illinois. Estimated property damage and crop loss was $31 million, and about 900,000 acres of cropland were affected (Illinois Department of Public Works and Buildings, 1943, p. 12–13).

As much as 7.2 inches of rain during May 5–8, 1961, in southern Illinois created record peak discharges on May 10 in three river basins. Peak discharge of the Skillet Fork at Wayne City (fig. 3, site 5) was more than 1.5 times the discharge having a 100-year recurrence interval. Peak discharge of the Big Muddy River at Plumfield, southwest of Wayne City, was more than 3 times the discharge having a 100-year recurrence interval (Curtis, 1987, p. 61). Peak discharge of the Little Wabash River at Carmi, southeast of Wayne City, had a recurrence interval of about 100 years (Curtis, 1987, p. 29).

Two deaths and many injuries were attributed to the 1961 flood in Illinois, along with $1 million in damage (The News-Gazette, Champaign, Ill., May 10, 1961, p. 1). Many highways and railroads were flooded. Water and sewer services were disrupted in many cities, according to newspapers. Nine counties were declared disaster areas.

The flood of December 3–7, 1982 (water year 1983), was caused by 3–5 inches of rainfall in the Illinois River basin between Quincy and Chicago on December 3. The maximum peak discharge for the Illinois River at Kingston Mines (40-year recurrence interval) occurred on December 7. A record peak discharge having a recurrence interval greater than 100 years was recorded on the Mackinaw River near Congerville. Much flooding was reported along the Mackinaw, Little Calumet, Illinois, and Vermilion (tributary to the Illinois River) Rivers and Salt Creek (tributary to the Sangamon River) and as far south as the Big Muddy River basin. An area of streamflows having a recurrence interval greater than 50 years was located between sites 2, 3, and 4 (fig. 3). Eight deaths and much property damage from flooding and tornadoes were reported. About 350 residents of Pontiac were evacuated from their homes along the Vermilion River (The News-Gazette, Champaign, Ill., December 6, 1982, p. 1).

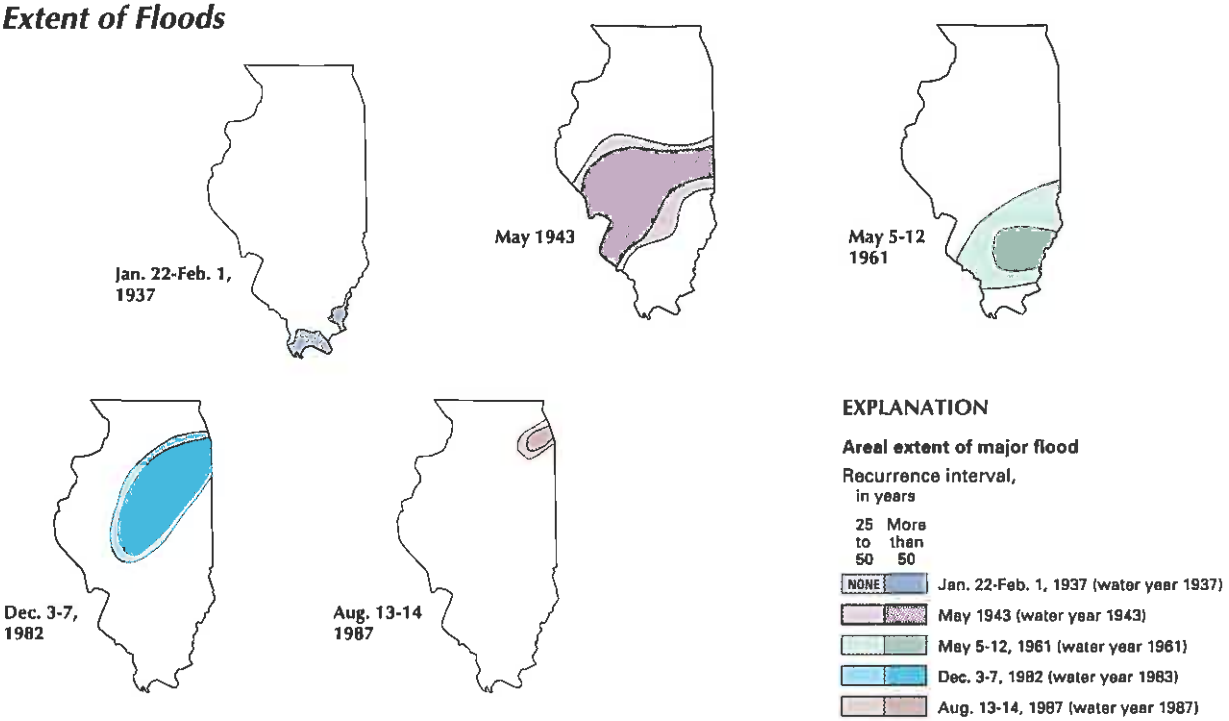
Intense rainfall on August 13–14, 1987, caused severe flooding in urban areas of Chicago. An all-time 24-hour rainfall record of 9.4 inches was reported at O'Hare International Airport, which is adjacent to Chicago's west side. Record rainfall also was recorded within a 10- to 15-mile radius of the airport (R.R. Waldman, National Weather Service, written commun., 1987). The storm was caused by the interaction of warm, moist air from the Gulf of Mexico and subtropical Atlantic Ocean with a cold front from the northwest; this

Table 1. Chronology of major and other memorable floods and droughts in Illinois, 1906–88

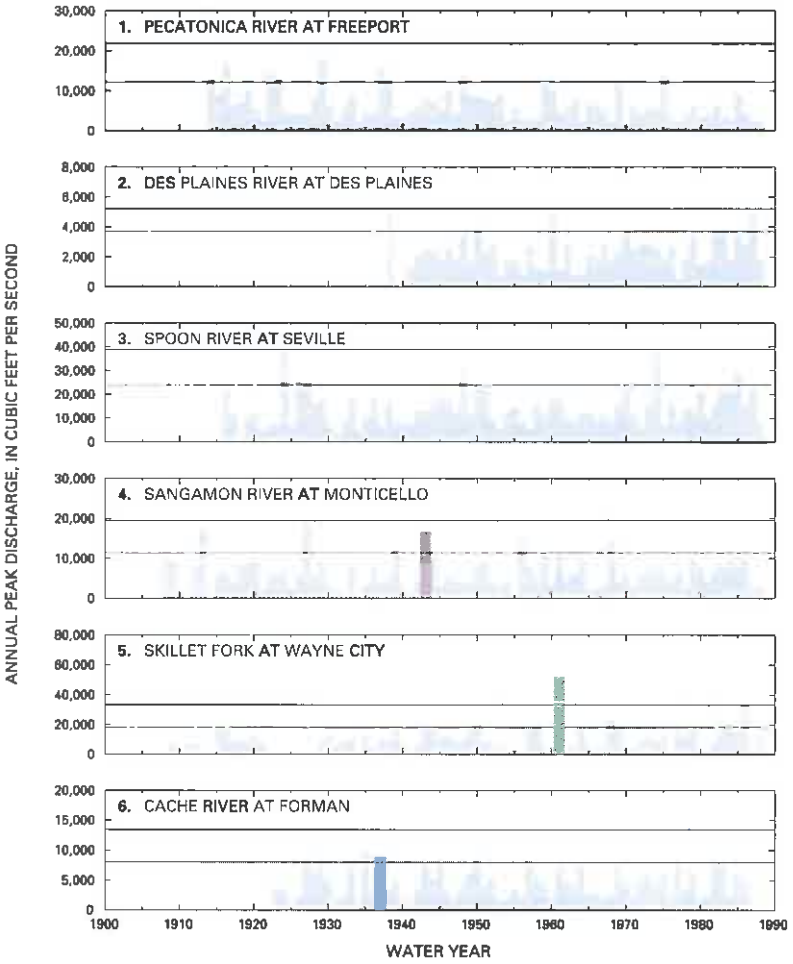
[Recurrence interval: The average interval of time within which streamflow will be greater than a particular value for floods or less than a particular value for droughts. Symbol: >, greater than. Sources: Recurrence intervals calculated from U.S. Geological Survey data, other information from U.S. Geological Survey, State and local reports, and newspapers]

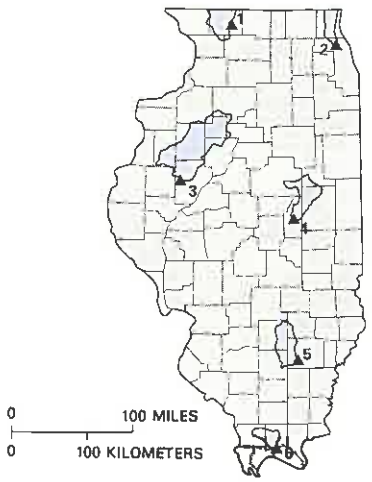
Flood or drought	Date	Area affected (fig. 2)	Recurrence interval (years)	Remarks
Flood	Jan. 24–Mar. 1906	Rock River, northwestern Illinois.	>50	Ice more than 10 feet thick filled Rock River for 20 miles for more than 1 month; many bridges damaged.
Drought	1922–26	Central and southern Illinois	10 to 25	Regional.
Flood	May 18–22, 1927	Central Illinois	50 to 100	Illinois River levee broke. Deaths, 210; homeless, 1 million.
Drought	1930–36	Statewide	60	Regional.
Flood	Jan. 22–Feb. 1, 1937	Ohio River basin.	>100	Precipitation of about 20 inches. Deaths, 137; damage, $418 million.
Drought	1939–41	Statewide	15 to 70	Regional.
Flood	May 1943	Central Illinois	>100	Intense rains May 6–24. Damage, $31 million.
Flood	Jan. 1950	East-central Illinois	>50	Locally intense rainfall inundated Villa Grove, St. Joseph, and thousands of acres. Damage, $500,000.
Drought	1952–57	Statewide	40 to 75	Regional.
Flood	May 1956	Central Illinois	>50	Local rainfall of 10.5 inches. Deaths, 1; extensive damage.
Flood	June 1957	Southwestern Illinois	>100	Local rainfall of 16.5 inches in 12 hours. Deaths, 4; damage, $2.7 million.
Flood	July 13, 1957	Northeastern Illinois	>100	Local rainfall of 6.2 inches. Deaths, 9; extensive damage.
Flood	May 5–12, 1961	Southern Illinois	>100	Local rainfall of 7.2 inches. Deaths, 2; damage, $1 million.
Drought	1962–67	Statewide	30 to 70	Regional.
Flood	May 16, 1968	Central Illinois	>100	Local rainfall of 5 inches in 2 hours; much local flooding.
Drought	1975–78	Statewide	10 to 25	Regional.
Flood	Dec. 3–7, 1982	Central Illinois	>100	Caused by local thunderstorms with 3–5 inches of rain. Deaths, 8.
Flood	Feb.–Mar. 1985	Northern one-half of Illinois	>100	Local rain on snow followed by second intense rainfall; 26 counties declared disaster areas. Damage, $10 million.
Flood	Sept. 20–Oct. 3, 1986	Northeastern Illinois	>100	Local rains during 2-week period. Deaths, 4; damage, $50 million.
Flood	Aug. 13–14, 1987	Greater Chicago area	>100	Local rainfall of 9.4 inches in 24 hours. Deaths, 4; damage, $77.6 million.

Areal Extent of Floods



Peak Discharge





U.S. Geological Survey streamflow-gaging stations and corresponding drainage basins — Numbers refer to graphs

Figure 3. Areal extent of major floods with a recurrence interval of 25 years or more in Illinois, and annual peak discharge for selected sites, water years 1908–88. (Source: Data from U.S. Geological Survey files.)

interaction created a stationary weather pattern over northeastern Illinois. An additional 2–3 inches of rain fell in the area during the next 2 days.

The August 13–14, 1987, storm produced record streamflows at 10 gaging stations on the Des Plaines River and its tributaries. The recurrence intervals for peak discharges at nine gages were greater than 100 years (Curtis, 1987). Flooding on the Des Plaines River was more severe downstream from the gaging station near Des Plaines (fig. 3, site 2) because of large inflow from tributaries. All suburban communities along the Des Plaines River and its tributaries south of O'Hare International Airport were affected by the flooding. Airport access roads near the center of the storm and the first floor of the NWS Forecast Office adjacent to the airport were covered by 3 feet of water the afternoon of August 14.

The 1987 flood resulted in at least four deaths and extensive property damage (Federal Emergency Management Agency, 1987). The flooded areas were declared major disaster areas by the President. Damage assessments indicate that about 16,400 buildings, including 11,540 homes, were affected by direct flooding or sewer backup. The Small Business Administration's estimate of damage to private property was $77.6 million (Federal Emergency Management Agency, 1987).

Chicago has a flood-control program officially named the "Tunnel and Reservoir Plan." The plan is designed to capture excess runoff from the combined stormwater and sanitary-sewer system and to process the sewage-laden stormwater runoff before it is released to rivers. The plan was about one-half complete in 1987. Newspapers reported that, according to the Metropolitan Sanitary District of Greater Chicago, all the combined sewer flow could have been captured for processing at a later time if the plan had been completed at the time of the flood.

Droughts

The streamflow records of 19 gaging stations throughout Illinois were studied for drought conditions. Annual departures from average streamflow for six of those stations are shown in figure 4. A negative annual departure indicates less than average streamflow for a particular year. If the negative departure continues for 2 years or more, it is herein referred to as a drought.

Droughts in Illinois have been observed during every decade from 1920 to 1980. Three droughts were severe statewide: 1930–36, 1952–57, and 1962–67; each had a recurrence interval greater than 25 years (fig. 4). Two less severe droughts in 1939–41 and 1975–78 also are shown in figure 4.

The most memorable drought in the Midwest—one that caused dust-bowl conditions—occurred in the 1930's. In Illinois, the drought lasted from 1930 to 1936. Short periods of increased streamflow (indicated by the positive annual departures in the hydrographs) can be seen within this period at most of the gaging stations (fig. 4, sites 2–6); however, the net streamflow deficit through this period indicates that the drought was continuous at all sites except Cache River at Forman (fig. 4, site 6). Streamflow records indicate that this drought had a recurrence interval of about 60 years and affected the entire State. Annual precipitation for this period was about 7 inches less than average in southwestern Illinois and about 2 inches less than average in northeastern Illinois.

A drought of almost uniform severity was continuous from 1939 to 1941. The recurrence interval ranged from about 15 to 25 years in northwestern and southeastern Illinois and about 30 to 70 years in the rest of the State. Annual precipitation during this period was about 3 inches less than average in southwestern Illinois and about 2 inches less than average in northeastern Illinois.

The drought of 1952–57 was the most severe in terms of deficient streamflow in Illinois. Streamflow records showed a continuous deficit from April 1952 to March 1957 at almost every gaging station analyzed (fig. 4). The recurrence interval of the drought across Illinois ranged from about 40 to 75 years. Annual precipitation for this period was about 7 inches less than average in southwestern Illinois and about 3 inches less than average in northeastern Illinois.

Only 5 years later, another drought began. The drought of 1962–67 had a recurrence interval ranging from about 30 to 70 years and affected the entire State. Annual precipitation for this period was about 3 inches less than average in southwestern Illinois and about 2 inches less than average in northeastern Illinois.

The drought of 1975–78 was the last significant drought observed statewide and the least severe. This drought had a recurrence interval ranging from about 10 to 25 years for the entire State, except for a small area along the Mississippi River in west-central Illinois, where the recurrence interval was less than 10 years. Annual precipitation during this period was about 1 inch less than average in southwestern Illinois and about 5 inches less than average in northeastern Illinois.

WATER MANAGEMENT

Flood-Plain Management.—The Illinois Department of Transportation, Division of Water Resources, has the authority to regulate the use of water from lakes and streams and to regulate any construction such as buildings, levees, and loading terminals on or adjacent to lakes and streams. Building permits are required for construction on the flood plains of any drainage area of more than 1 mi^2 in a city or more than 10 mi^2 in a rural area. The Division of Water Resources administers a dam-safety program and has the authority to order repairs to unsafe dams.

Cities and local authorities can administer more stringent management programs. The Federal Emergency Management Agency provides assistance for flood-hazard mapping and flood-plain regulation to communities. About 90 percent of the communities in Illinois have enacted local flood-plain-management regulations and participate in the National Flood Insurance Program.

Flood-Warning Systems.—The NWS is responsible for the preparation and issuance of flood and severe-weather warnings. The U.S. Army Corps of Engineers constructs and operates flood-control projects that include dams and levees on the Kaskaskia and Illinois Rivers. The U.S. Army Corps of Engineers also provides technical and emergency assistance to protect public health and safety during and after floods.

Water-Use Management During Droughts.—Water use in Illinois generally has not been restricted because ample water supplies are available. In 1985, 61 percent of the public-supplied population was served by surface-water sources (U.S. Geological Survey, 1990). Illinois is fortunate in having abundant freshwater resources within and along the State's boundaries, including the Illinois River through central Illinois, Lake Michigan to the northeast, and the Mississippi, Wabash, and Ohio Rivers along the western, eastern, and southern borders, respectively.

The Illinois Environmental Protection Agency continuously monitors public water supplies for quality and quantity, which can change substantially during floods or droughts. This agency works with other State agencies in attempting to resolve water-shortage problems during droughts (Illinois Department of Transportation, 1983, p. 8).

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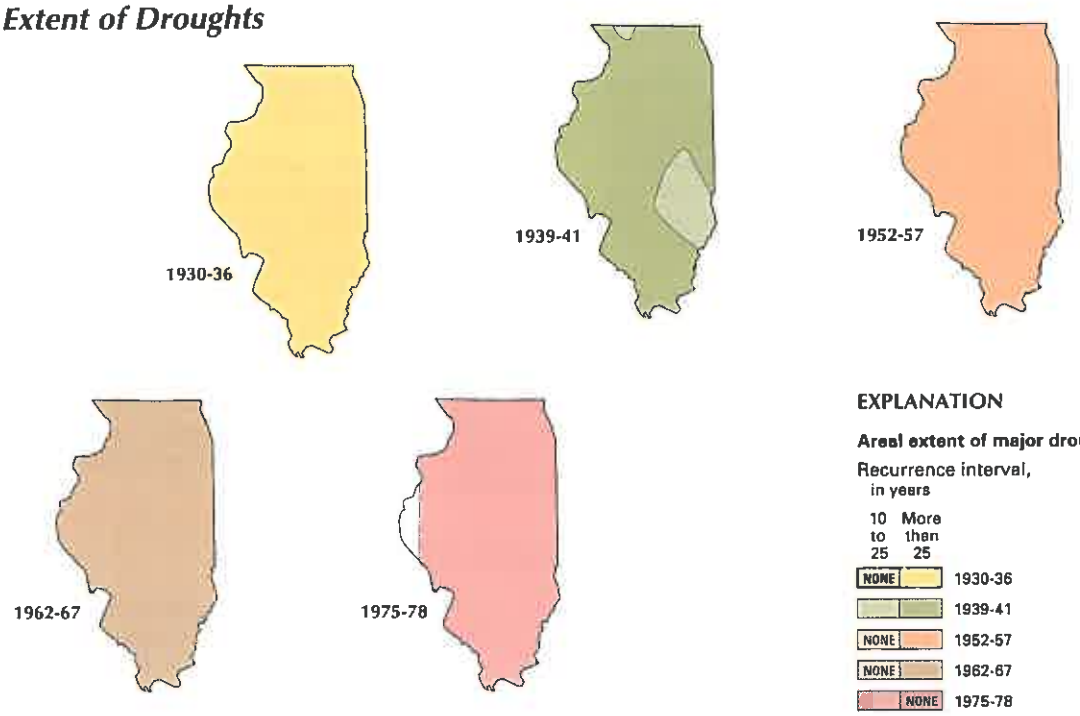
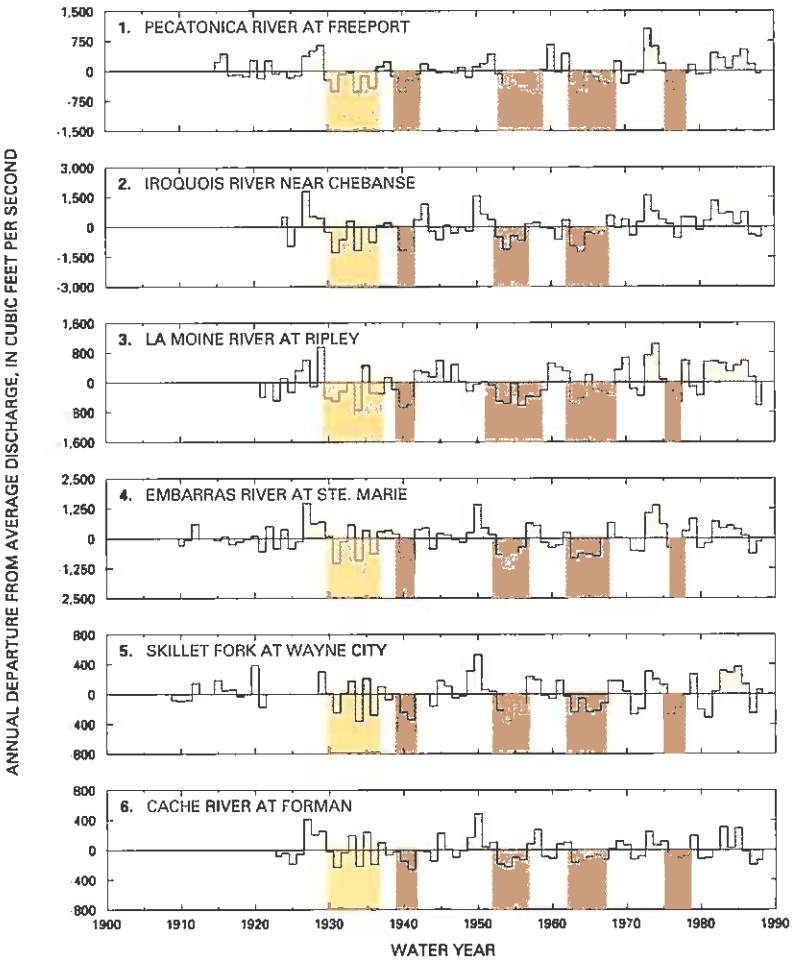
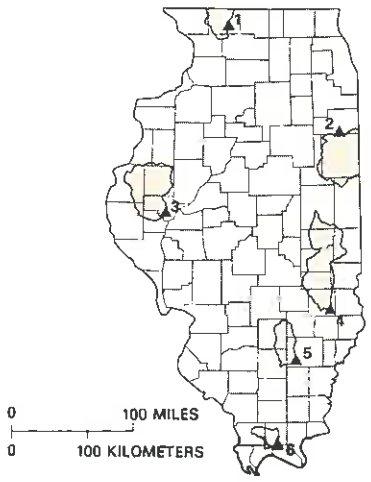
Areal Extent of Droughts



Annual Departure





U.S. Geological Survey streamflow-gaging stations and corresponding drainage basins — Numbers refer to graphs

Figure 4. Areal extent of major droughts with a recurrence interval of 10 years or more in Illinois, and annual departure from average stream discharge for selected sites, water years 1909–88. (Source. Data from U.S. Geological Survey files.)

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