National Summary of Hydrologic Conditions and Water—Related Events—Water Year 1992

U.S. GEOLOGICAL SURVEY

Open-File Report 96-107

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National Summary of Hydrologic Conditions and Water-Related Events—Water Year 1992

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By Gregory J. McCabe,[1] Jr., Michael Crowe,[2] William O. Brown,[2] and Judy D. Fretwell[1]

Abstract

Surface-water conditions and many water-related events are controlled primarily by atmospheric factors. Because of this, the following annual and seasonal summaries of hydrologic conditions for water year 1992 (October 1991–September 1992) are described within a climatic context. The maps showing streamflow, precipitation, and temperature and the text provide an overview of the hydrologic conditions across the country for the water year as a whole and for each of the seasons. In addition, significant hydrologic and water-related events are described and plotted in figure 6.

The data used in preparing these summaries were taken from the following publications: the National Oceanic and Atmospheric Administration's "Climate Impact Assessment, United States," "Daily Weather Maps, Weekly Series," "Monthly and Seasonal Weather Outlook," "Storm Data," and "Weekly Weather and Crop Bulletin" (the last publication is prepared and published jointly with the U.S. Department of Agriculture) and the U.S. Geological Survey's (USGS) monthly "National Water Conditions." Geographic designations in this article generally conform to those used in the "Weekly Weather and Crop Bulletin" (fig. 1).

Figure 1. Geographic regions of the United States.

[1] U.S. Geological Survey.
[2] National Oceanic and Atmospheric Administration, National Climatic Data Center.

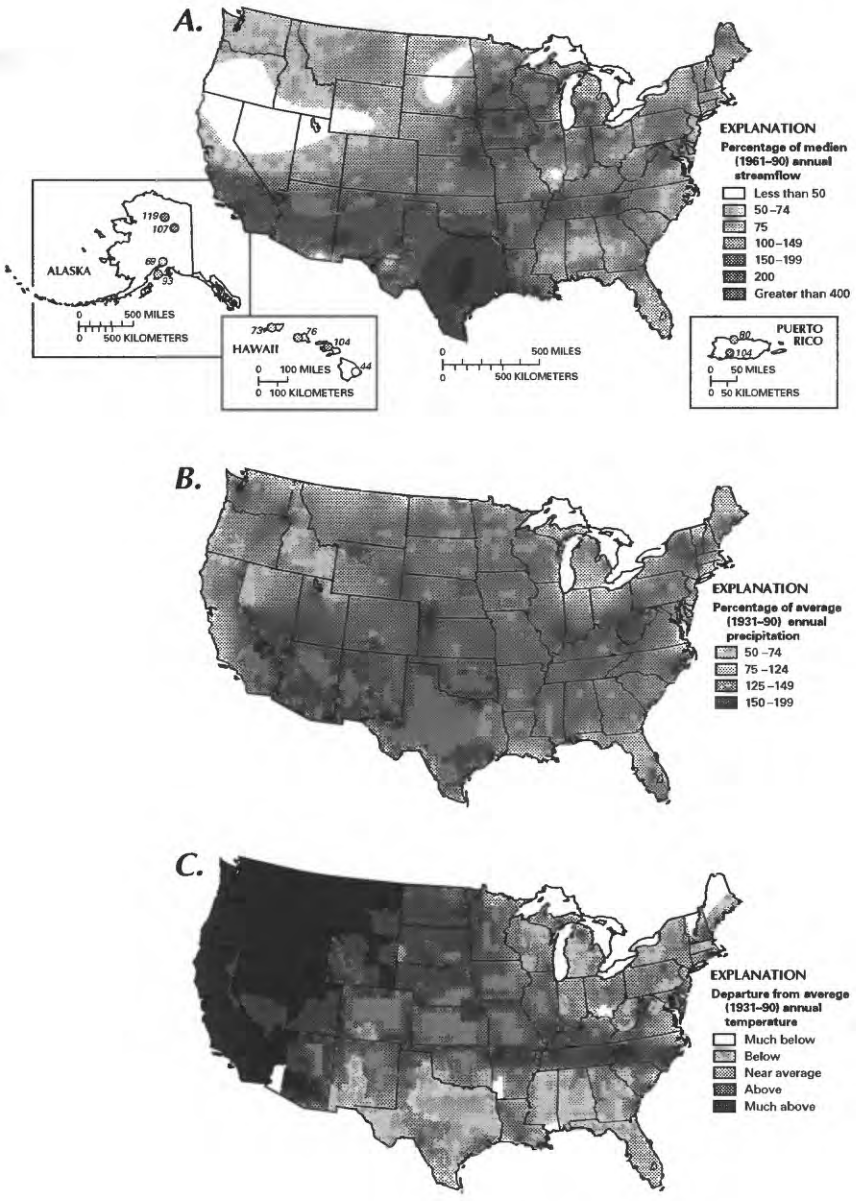


Figure 2. Hydrologic conditions during water year 1992. ***A***, Streamflow in the United States and Puerto Rico; ***B***, Precipitation in the conterminous United States; and ***C***, Temperature in the conterminous United States. Streamflow is shown as a percentage of median streamflow, precipitation is shown as a percentage of average precipitation, and temperature is shown as a departure from average annual conditions (much below, at least 1.28 standard deviations below the average; below, between 0.52 and 1.28 standard deviations below the average; near average, between -0.52 and 0.52 standard deviations from the average; above, between 0.52 and 1.28 standard deviations above the average; and much above, at least 1.28 standard deviations above the average) (Sources: Streamflow data from U.S. Geological Survey files; precipitation data from the National Oceanic and Atmospheric Administration, National Climatic Data Center.)

Streamflow during water year 1992 was below median[1] for most of the Western United States and in sections of the Ohio Valley, the Atlantic Coast States, and the lower Mississippi Valley (fig. 2*A*). It was above median in the southern Pacific Coast, much of the Southwest, parts of the Great Plains, the west Gulf Coast, and much of the Great Lakes region.

The below-median streamflow in the Western United States reflects the drought that persisted there throughout the year. The core area of below-median streamflow included southern Oregon, southern Idaho, southwestern Wyoming, northwestern Utah, northern Nevada, and northern California. For Washington, Oregon, and Idaho, January through September was the sixth driest such period on record, and water year 1992 was the eighth driest since 1895. Five of the prior six years had been drier than normal for these three States.

In contrast to the dry conditions of the northwestern part of the country, many areas had extreme precipitation events and flooding. Above-median streamflow was recorded consistently in central and eastern Texas. Flooding was severe in Hawaii (event 14 in the chronology section of this article), Puerto Rico (event 22), south-central Iowa (event 96), and south-central and southwestern Wisconsin (event 97).

Three major tropical storms affected the United States from mid-August to mid-September. Hurricane Andrew hit south Florida on August 24 and Louisiana 2 days later and caused 49 deaths and $22.4 billion in damages (event 86). Andrew was, at that time, the most costly natural disaster in the history of the United States. On August 27, Typhoon Omar hit Guam in the western Pacific Ocean (event 88). On September 11, Hurricane Iniki devastated Kauai, Hawaii (event 95). Most of the damage caused by these storms was attributed to winds.

Total precipitation for water year 1992 was below average[2] in the northern and central Rocky Mountains, the Great Basin, northern California, western Oregon, and north-central North Dakota, and it was above average in southern California eastward to the Gulf Coast of Texas, including central and southern Oklahoma (fig. 2*B*). Overall, about one-fifth of the country received much-above-average annual precipitation, whereas only 4 percent received much-below-average annual precipitation.

Annual temperatures were above average in much of the Western United States and near average in much of the central part of the country. Below average temperatures were found mostly in southern and northeastern states (fig. 2*C*).

The regional and local patterns of hydrologic conditions can be seen in the graphs of monthly discharges for selected rivers (fig. 3) and month-end storage of selected reservoirs (fig. 4) in the conterminous United States. For example, the persistent drought in much of the Western United States is reflected in the below-median monthly flows observed at the Willamette River at Salem, Oreg. [fig. 3 (1)]. Also, storage in the Clair Engle Lake reservoir near Lewiston, Calif. [fig. 4 (1)], was below the long-term average month-end values during the entire water year.

Some areas in the United States had normal or above-normal precipitation and streamflow. For example, observed monthly discharges of the Washita

[1]Median is the value that represents the point where as many values exist above the point as exist below the point, and average is the value determined by dividing the sum total of a set of values by the number of values.

[2]Average is the value determined by dividing the sum of the values by the number of values.

River near Dickson, Okla., were above the long-term median values for all months of water year 1992 [fig. 3 (4)]. Similarly, month-end reservoir storage in the International Falcon Reservoir in Texas [fig. 4 (5)] was above the median for all months of the water year.

During 1992 water year, many significant water-related natural and human-induced events took place. The events (fig.6) represent a culling of hundreds of these hydrologic occurrences and generally omit; floods in which the recurrence interval is less than 10 years, toxic spills that involve less than 2,500 gallons, and fishkills of fewer than 5,000 fish. The selection of events for inclusion in this list was affected, to some extent, by the degree of media coverage, including National Weather Service and USGS periodicals, and by communications from USGS field offices. Toxic-spill data were provided by the U.S. Coast Guard National Response Center. Reporting of weather-related events and damage estimates is subjective; therefore, the list might be inconsistent with other national compilations of hydrologic events, such as the annual flood-damage report to Congress by the U.S. Army Corps of Engineers (1992). Weather-related events (excluding drought, storm surges, and coastal flooding) were estimated to have caused damages in excess of $30 billion. Of this amount, flood damage was about $0.8 billion (U.S. Army Corps of Engineers, 1992).

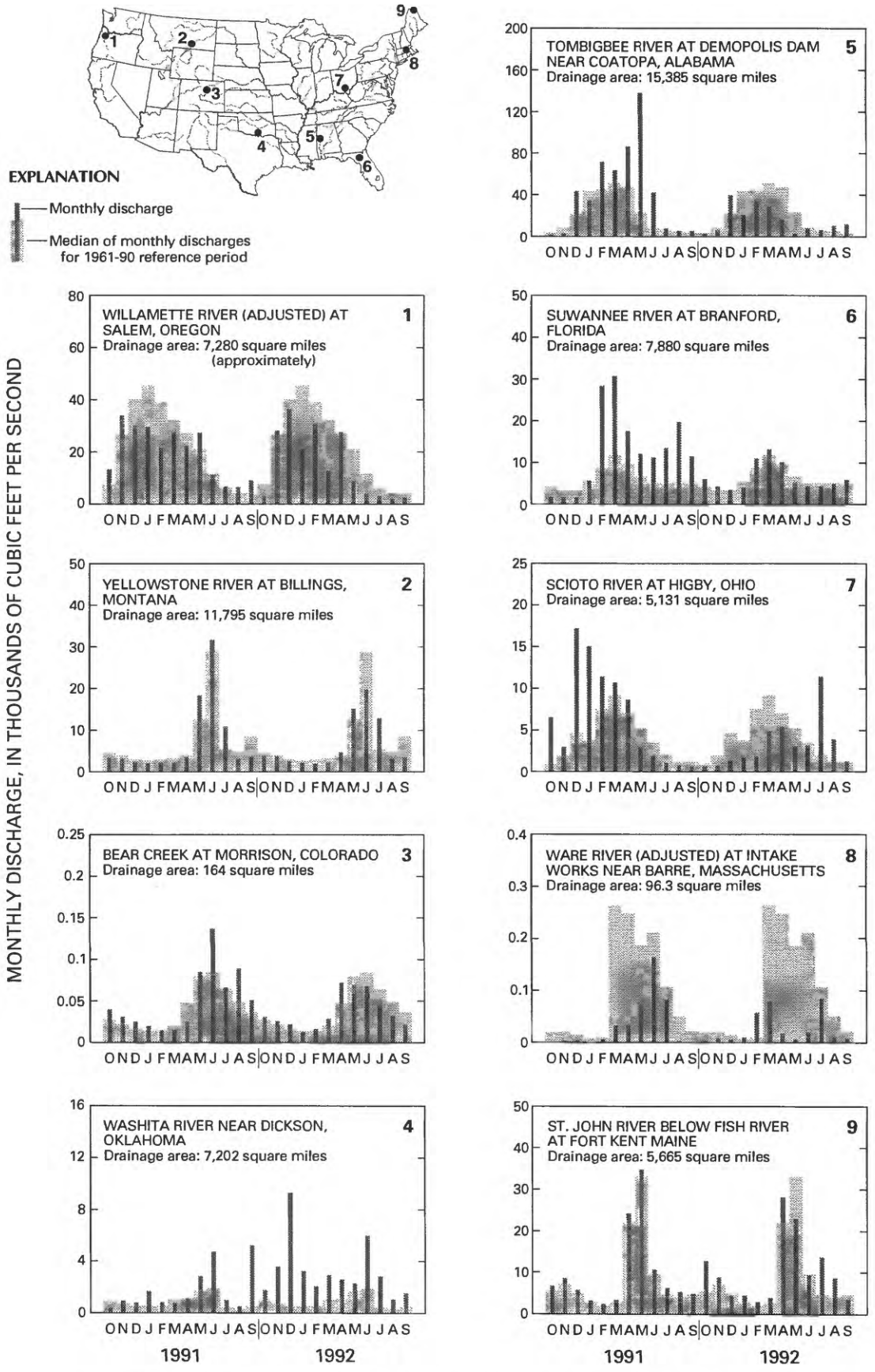


Figure 3. Monthly discharges for selected major rivers of the conterminous United States for water years 1991 and 1992 compared with monthly median discharges for the reference period water years 1961 to 1990.[a] The locations of individual discharge points are shown on the map.

[a] To obtain square kilometers, multiply the number of square miles by 2.59.

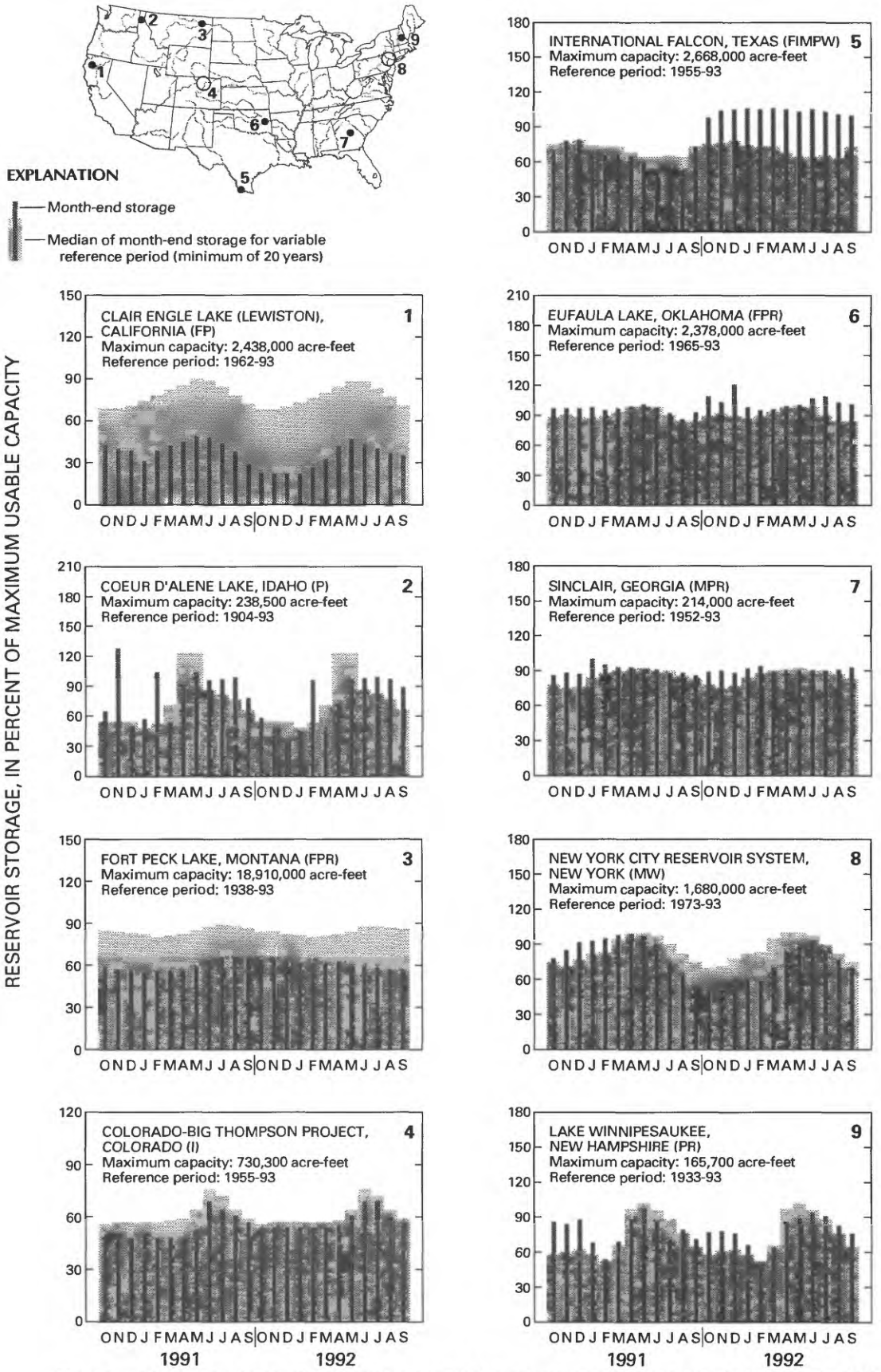


Figure 4. Month-end storage of selected reservoirs in the conterminous United States for water years 1991 and 1992 compared with median month-end storage for the reference period. The reference period, which varies but is a minimum of 20 years for each reservoir or reservoir system, is shown on the graph. The locations of individual reservoirs are shown on the map by black dots; the location of general reservoir systems (multireserves) are shown by open circles. Principal reservoir and water uses are shown in parentheses—F, flood control; I, irrigation; M, municipal; P, power; R, recreation; and W, industrial.[b] (Source: Data from USGS files.)

[b] To obtain cubic meters, multiply the number of acre-feet by 1,233.

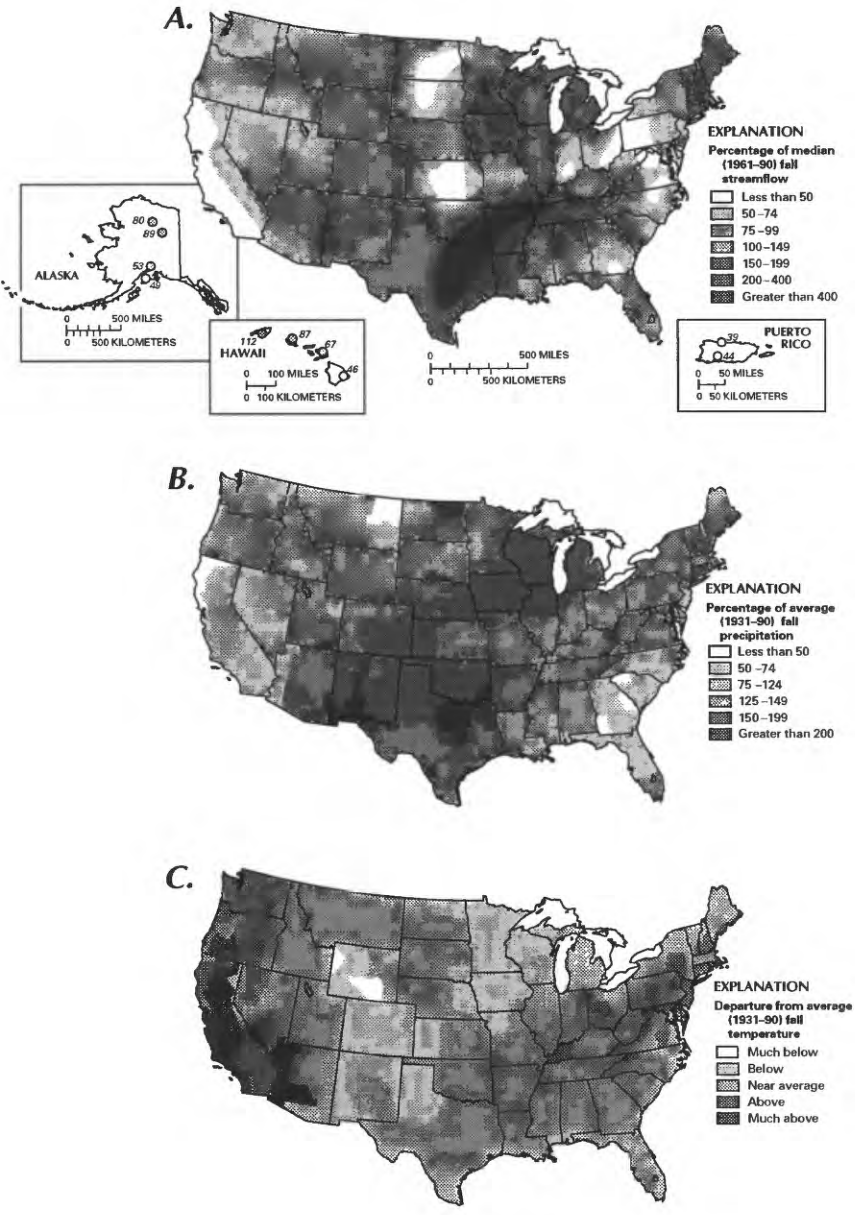


Figure 5. Hydrologic conditions—Fall, water year 1992. *A*, Streamflow in the United States and Puerto Rico; *B*, Precipitation in the conterminous United States; and *C*, Temperature in the conterminous United States. Streamflow is shown as a percentage of median streamflow, precipitation is shown as a percentage of average precipitation, and temperature is shown as a departure from average annual conditions (much below, at least 1.28 standard deviations below the average; below, between 0.52 and 1.28 standard deviations below the average; near average, between -0.52 and 0.52 standard deviations from the average; above, between 0.52 and 1.28 standard deviations above the average; and much above, at least 1.28 standard deviations above the average) (Sources: Streamflow data from U.S. Geological Survey files; precipitation data from the National Oceanic and Atmospheric Administration, National Climatic Data Center.)

Streamflow from October through December 1991 was above median for the upper and lower parts of the Mississippi Valley, the Great Lakes region, and the southern Great Plains. It was below median for the Pacific Coast; in parts of the Pacific Northwest, the central Rocky Mountains, the Great Basin, and the Ohio Valley; and throughout many of the Atlantic Coast States (fig. 5*A*). Drought conditions that existed during summer persisted. Contents of the New York City Reservoir System remained below average throughout the period and ranged from 48 percent of normal usable capacity in October to 57 percent in December [fig. 4 (8)]. By late December, the combined storage of six large index reservoirs in California was only 31 percent of normal.

From early October to early November, several severe storms affected many parts of the country, including southern Florida, Puerto Rico, from South Carolina to Maine, and Kodiak Island, Alaska. Intense rainfall events began in late November and continued into December in the Southeastern United States, south-central Tennessee, northeastern Mississippi, northern Alabama, and much of Texas. In addition, extreme precipitation events led to flooding in Hawaii during December 1991.

In the Western United States, precipitation was generally below average (fig. 5*B*) because of an anomalous high-pressure ridge in the eastern North Pacific Ocean. This anomalous high-pressure ridge blocked onshore storm movement from the eastern North Pacific Ocean into the Western United States. From early September through mid-October, practically no precipitation fell in Washington, Oregon, or California and caused a delayed fall rainy season for the sixth consecutive year.

Although precipitation was extreme in the Southeastern United States, most areas in the Southeast received near- or below-average precipitation (fig. 5*B*). Parts of the North and Middle Atlantic Coast States also received near-average amounts. In contrast, the middle one-third of the country from Arizona north and eastward to Michigan was inundated. In fact, nearly 20 percent of the country experienced much-above-average precipitation.

During late October and early November, a trough of low pressure extended from Canada to the southern Great Plains, and a strong blocking ridge of high pressure formed in the eastern North Pacific Ocean. These combined to produce Arctic airflow into the Central United States, which resulted in unprecedented low temperatures in much of the country. The northern Great Plains and the upper Mississippi Valley were especially affected by the severe cold (fig. 5*C*) and record snowfalls. In the Western United States, temperatures were above average because of the persistent anomalous high-pressure ridge in the eastern North Pacific Ocean. Average temperatures for most of the conterminous United States were near normal (fig. 5*C*).

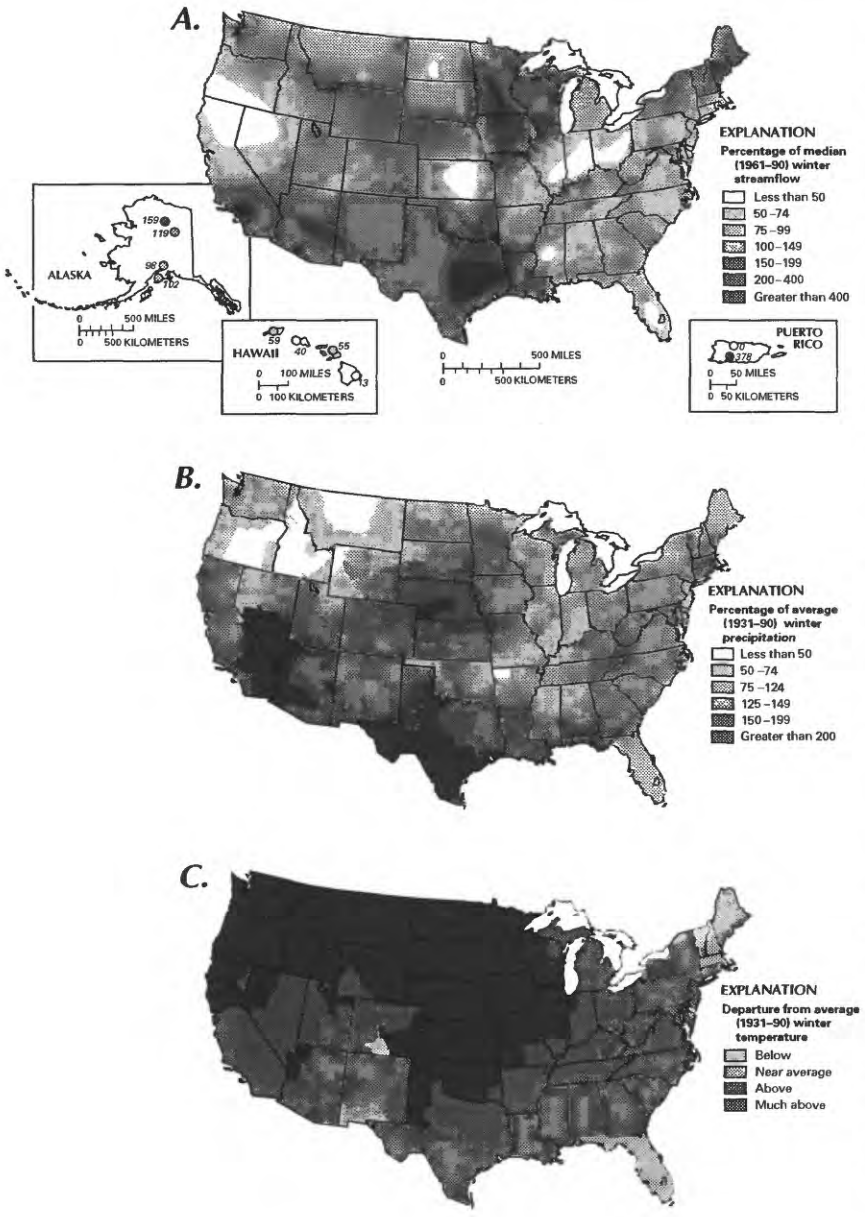


Figure 6. Hydrologic conditions—Winter, water year 1992. *A*, Streamflow in the United States and Puerto Rico; *B*, Precipitation in the conterminous United States; and *C*, Temperature in the conterminous United States.. Streamflow is shown as a percentage of median streamflow, precipitation is shown as a percentage of average precipitation, and temperature is shown as a departure from average annual conditions (much below, at least 1.28 standard deviations below the average; below, between 0.52 and 1.28 standard deviations below the average; near average, between -0.52 and 0.52 standard deviations from the average; above, between 0.52 and 1.28 standard deviations above the average; and much above, at least 1.28 standard deviations above the average) (Sources: Streamflow data from U.S. Geological Survey files; precipitation data from the National Oceanic and Atmospheric Administration, National Climatic Data Center.)

Streamflow from January thriugh March 1992 was above median in areas of the western Gulf Coast and southern Great Plains, parts of the Southwest, southern California, and the upper Mississippi Valley (fig. 5*A*). Streamflow was below median for most of the Pacific Northwest, northern California, Nevada, parts of the northern and central Rocky Mountains, the central Great Plains, the Ohio Valley, parts of the lower Mississippi Valley, parts of the Middle Atlantic States, most of southern Florida, and Hawaii.

The below-median streamflows in the Pacific Northwest, northern California, and Nevada were indicators of the drought that persisted in these areas. The Pacific Northwest had the second warmest and seventh driest winter on record. Two reservoirs in the drought-stricken area—at Lake Tahoe, which straddles California and Nevada, and at Rye Patch, Nev.—contained less than 10 percent of normal usable capacity. As a result of the dry conditions, 22 of the 36 Oregon counties (including all counties east of the Cascades) were declared drought emergencies. Drought also continued in areas of the Eastern United States, as indicated by the contents of the New York City reservoirs, which were 26 percent below the long-term end-of-March average (fig. 4).

In contrast to the drought-stricken areas, several extreme precipitation events were recorded during January in Puerto Rico, Colorado, Utah, Wyoming, Louisiana, and Mississippi (fig. 5*B*). Thunderstorms also produced intense rainfall and flooding in parts of the Southern United States, especially southeastern Texas, during early February. A series of strong storms during the middle of February in southern California produced the worst flooding in 50 years in that part of the State. During March, heavy rain fell again in southeastern Texas and southern California, as well as in western Arizona and southern Nevada.

Precipitation was well below average for the Pacific Northwest and the northern Rocky Mountain States (fig. 5*B*). Other areas having below-average precipitation were along the western Ohio River Valley into southern Missouri, some Middle Atlantic States, and northern Mississippi and Alabama. Above- to much-above-average precipitation fell along the entire southern tier of the United States. Above-average precipitation continued from the fall season in the central Missouri River Valley in the central Great Plains. Much of the eastern one-third of the country received near-average precipitation.

Temperatures were above average for almost 90 percent of the country (fig. 5*C*). The above-average temperatures were the result of a northward shift in the jet stream and a persistent ridge of high pressure centered over the northern Rocky Mountains, which kept polar air from intruding into the United States. The temperatures were particularly high in the Pacific Northwest, the northern Rocky Mountains, and the northern and central Great Plains. Nationally, March was the 10th warmest March on record. Because of the warmer-than-average temperatures, snow accumulations were below average for most areas of the country. One exception was an above-average snowfall during January in the Southern United States (6–8 inches from Texas to Georgia). This snowfall was the result of 1 of the 10 largest snowstorms of this century for this part of the country.

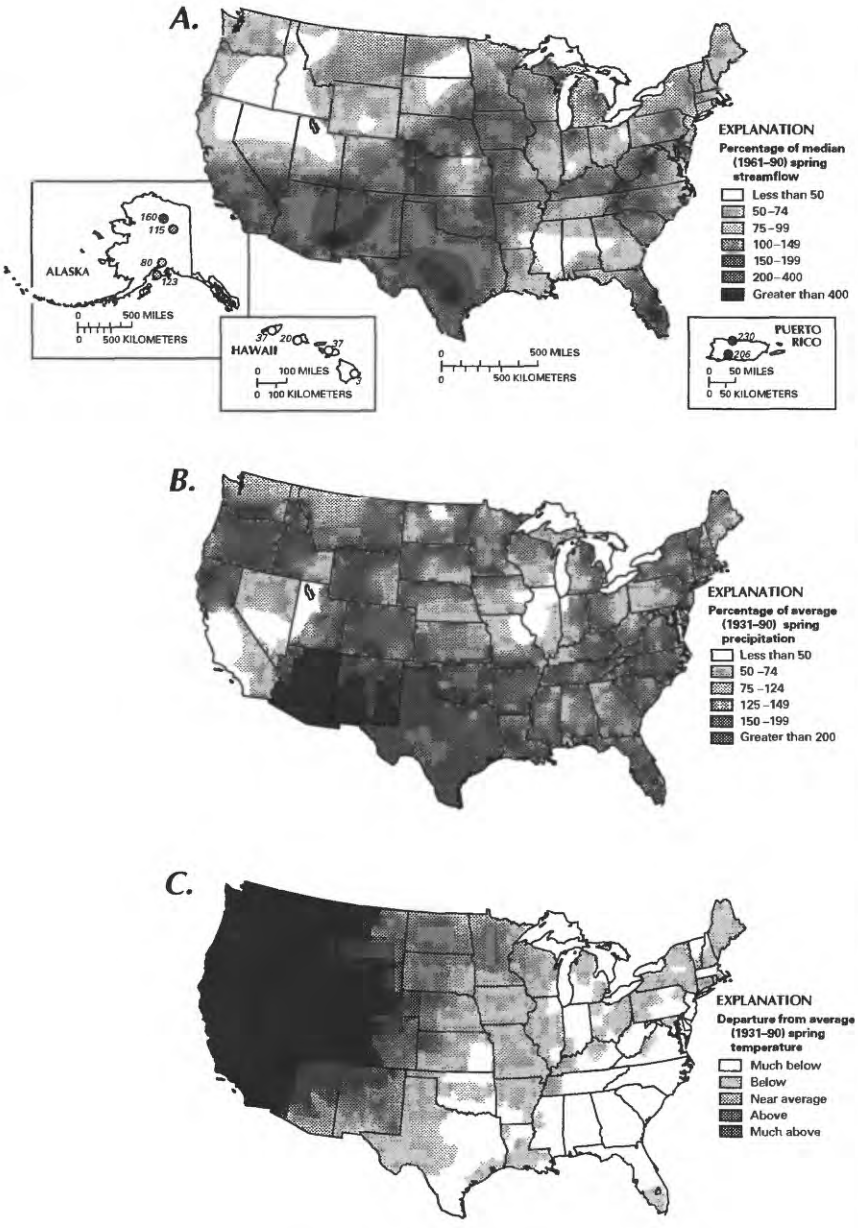


Figure 7. Hydrologic conditions—Spring, water year 1992.
A, Streamflow in the United States and Puerto Rico;
B, Precipitation in the conterminous United States; and
C, Temperature in the conterminous United States. Streamflow is shown as a percentage of median streamflow, precipitation is shown as a percentage of average precipitation, and temperature is shown as a departure from average annual conditions (much below, at least 1.28 standard deviations below the average; below, between 0.52 and 1.28 standard deviations below the average; near average, between -0.52 and 0.52 standard deviations from the average; above, between 0.52 and 1.28 standard deviations above the average; and much above, at least 1.28 standard deviations above the average) (Sources: Streamflow data from U.S. Geological Survey files; precipitation data from the National Oceanic and Atmospheric Administration, National Climatic Data Center.)

Streamflow from April through June of 1992 was below median for a large part of the United States, including the Pacific Northwest, northern Nevada and California, the northern and central Rocky Mountains, the northern High Plains and the Great Plains, the central Gulf Coast, the lower Mississippi Valley, parts of the Ohio Valley, much of the Atlantic Coast, and Hawaii (fig. 5*A*). Streamflow was above median only in parts of the southern High Plains and the Great Plains, parts of the Southwest and southwestern California, and in southern Florida.

April precipitation was less than one-half of average from the northern and central Great Plains westward to parts of Nevada and California (fig. 5*B*). In addition, abnormally dry weather was widespread across the central Mississippi Valley and the lower Ohio Valley, through much of the Southeastern United States, and along the Atlantic Coast from North Carolina to Maine. Hawaii and most of Alaska also reported drier-than-normal conditions during April.

During May, below-average temperatures and above-normal storm frequency produced record May snowfalls for parts of the southern Appalachian Mountains. Snow was reported in the higher mountains of South Carolina for the first time in May since recordkeeping began. In addition, May was an abnormally wet month in New Mexico and Alaska, and during June, a few intense rainfall events took place throughout the United States, including in south and south-central Connecticut and west-central Florida.

For the season as a whole, precipitation was much above average throughout the Southwest, central Florida, and parts of the northern Rocky Mountains (fig. 5*B*). The area from southern California through the Great Basin into the central Rocky Mountains was quite dry. Below-average precipitation also extended from the central Great Plains through the middle Mississippi Valley eastward into the Ohio Valley. Drought persisted in California, Nevada, and parts of the Pacific Northwest.

This season was characterized by a very warm western one-quarter of the Nation from the Rocky Mountains to the Pacific Coast and a distinctly cooler-than-average eastern two-thirds (fig. 5*C*). Slightly more than 20 percent of the conterminous United States experienced temperatures that were much below average as a result of atmospheric circulation, which was characterized by an anomalous ridge of high pressure over the Western United States and an anomalous trough of low pressure over the Eastern United States. The ridge over the Western United States enhanced warming of the air; the trough over the Eastern United States permitted the intrusion of cold air from Canada into the Eastern United States.

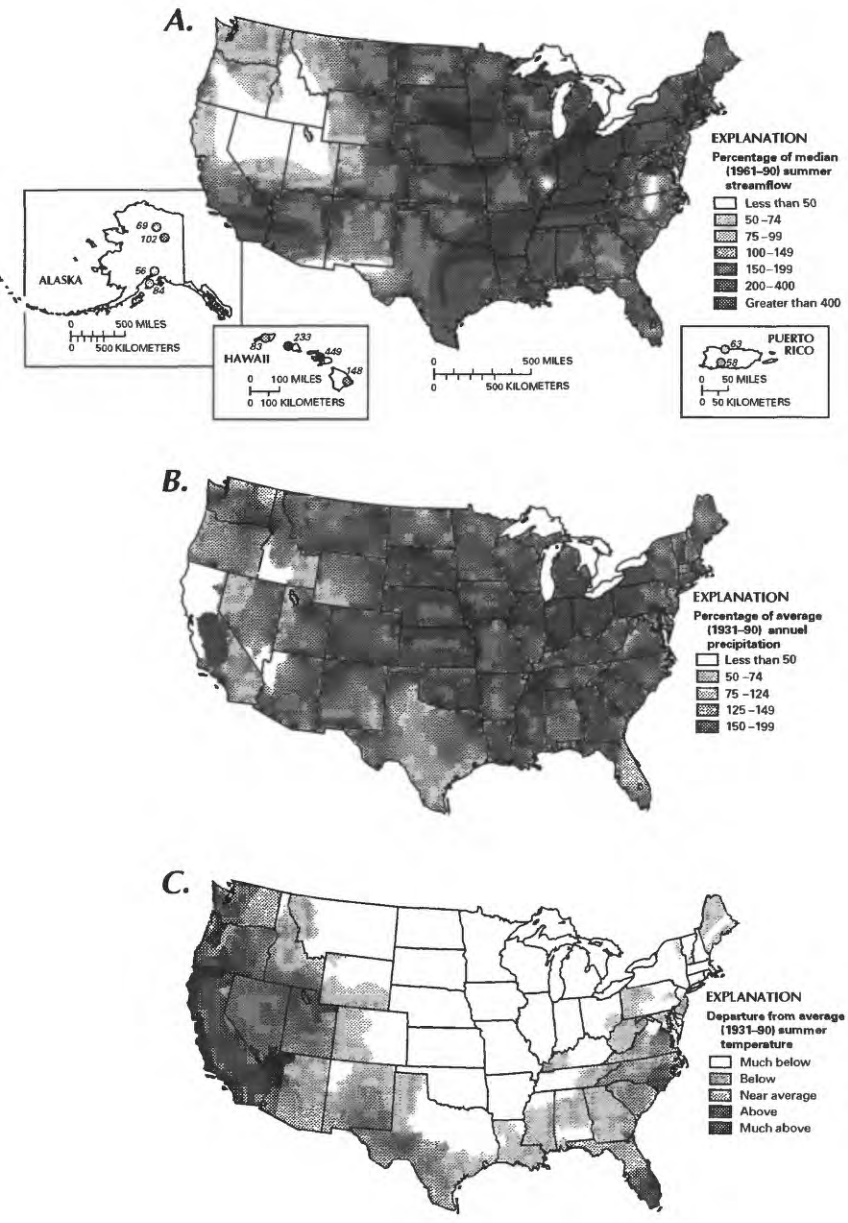


Figure 8. Hydrologic conditions—Summer, water year 1992. ***A***, Streamflow in the United States and Puerto Rico; ***B***, Precipitation in the conterminous United States; and ***C***, Temperature in the conterminous United States. Streamflow is shown as a percentage of median streamflow, precipitation is shown as a percentage of average precipitation, and temperature is shown as a departure from average annual conditions (much below, at least 1.28 standard deviations below the average; below, between 0.52 and 1.28 standard deviations below the average; near average, between -0.52 and 0.52 standard deviations from the average; above, between 0.52 and 1.28 standard deviations above the average; and much above, at least 1.28 standard deviations above the average) (Sources: Streamflow data from U.S. Geological Survey files; precipitation data from the National Oceanic and Atmospheric Administration, National Climatic Data Center.)

Streamflow fromJuly through September 1992 was below median in the Northwestern United States, the southern parts of Arizona and New Mexico, the westernmost part of Texas, and parts of the Middle Atlantic States, the northern Great Plains, and the middle Mississippi Valley (fig. 5*A*). Summer streamflow was above median for many areas east of the Mississippi River, for much of the Great Plains, for southern California, and for west-central Arizona.

The below-median streamflow in the Northwestern United States was indicative of the continued drought in that area. In California, the combined flow at six index streamflow stations indicated that the drought conditions in California were the worst since World War II. At the end of the season, the Lake Tahoe Reservoir continued to have no usable storage for the 24th consecutive month, and the Rye Patch Reservoir in Nevada continued to have no usable storage for the 5th consecutive month. Parts of the Rocky Mountains, the High Plains, and the southern Great Plains also were abnormally dry.

Rainfall and flooding were extreme in other parts of the country. Extreme rainfall was recorded in July in Indiana and Kentucky, and during August, intense storms caused widespread flooding in eastern North Carolina. In general, extreme precipitation events contributed to greater-than-normal summer precipitation extending from the central Great Plains through the northern Ohio River Valley into western New York and Pennsylvania (fig. 5*B*). Above-average precipitation also was recorded in the Tennessee Valley and other parts of the Southeast.

Three major tropical storms affected the United States. Hurricane Andrew hit south Florida on August 24 and the Louisiana coast on August 26. In both areas, widespread damage was caused by strong winds. Typhoon Omar, which hit Guam in the western Pacific Ocean on August 27, was the worst typhoon in the preceding 16 years. Strong winds damaged from 75 to 90 percent of the buildings on Guam. On September 11, Hurricane Iniki devastated Kauai, Hawaii, by producing storm surges and waves that smashed into the southern coast. Iniki was the costliest hurricane in Hawaiian history.

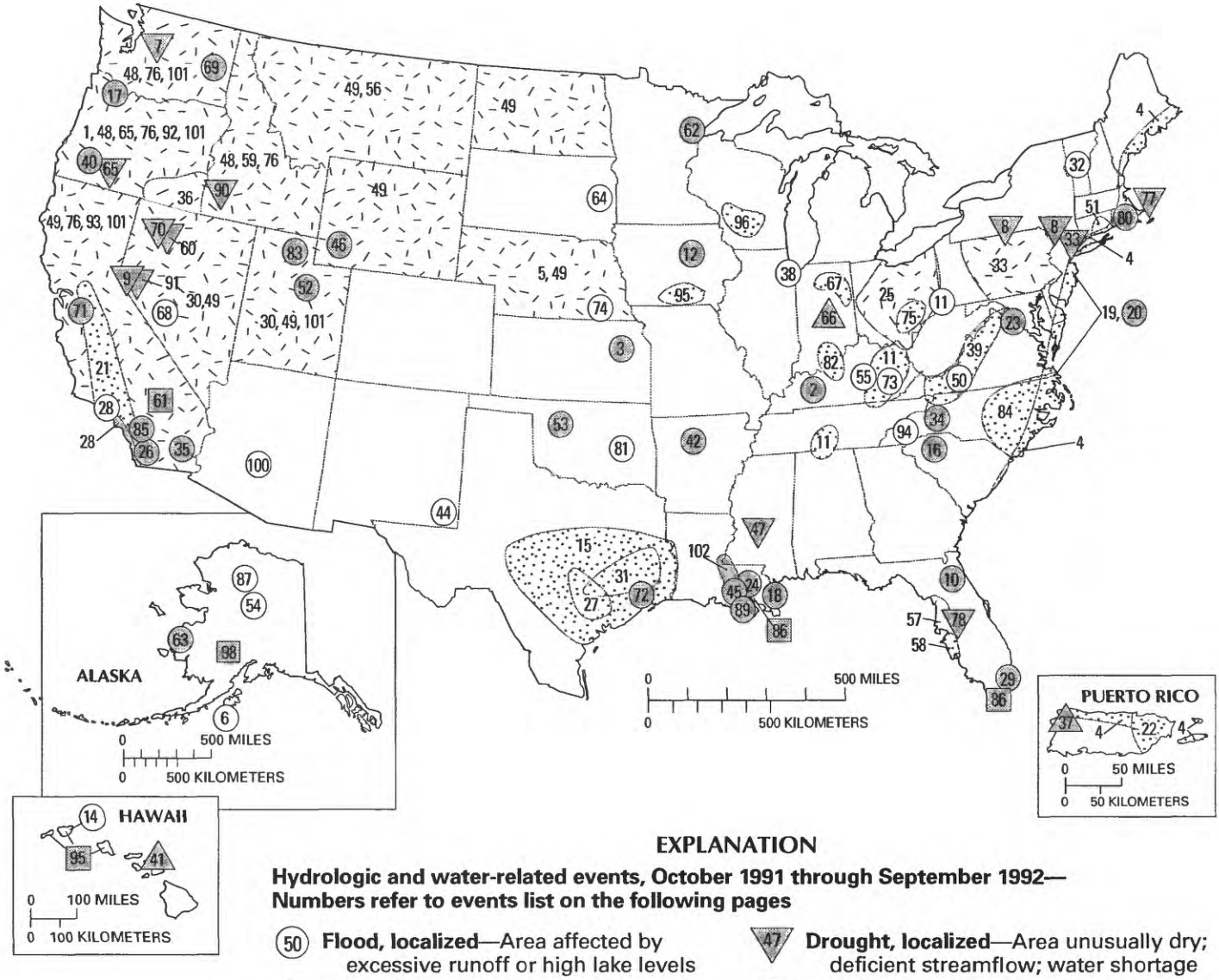
In September, intense thunderstorms caused severe flooding in south-central Iowa. Heavy rain in south-central and southwestern Wisconsin caused widespread flooding there.

For the Nation as a whole, temperatures were below average (fig. 5*C*). In fact, nearly 50 percent of the conterminous United States experienced much-below-average temperatures. A trough of low pressure over the Central United States pulled in cool air fromCanada and caused the northern and central Great Plains to experience cooler-than-average summer temperatures. In contrast, above-average temperatures were recorded throughout California and much of the Pacific Northwest.

Reference Cited

U.S. Army Corps of Engineers, 1992, Annual flood-damage report to Congress, fiscal year 1992: U.S. Army Corps of Engineers Report DAEN–CHW–W, 63 p.

Chronology of Significant Hydrologic and Water-Related Events—Water Year 1992



EXPLANATION

Hydrologic and water-related events, October 1991 through September 1992—Numbers refer to events list on the following pages

- (50) **Flood, localized**—Area affected by excessive runoff or high lake levels
- (27) **Flood, widespread**—Area affected by excessive runoff
- (45) **Contamination, localized**—Includes fishkills and toxic spills
- (101) **Contamination, widespread**—Includes fishkills and toxic spills
- (47) **Drought, localized**—Area unusually dry; deficient streamflow; water shortage
- (25) **Drought, widespread**—Area unusually dry; deficient streamflow; water shortage; statewide droughts are shown to State bountaries
- (41) **Landslide**—Includes mudslides and sinkholes
- [61] **Unique observation**

Figure 9. Location or extent of significant hydrologic and water-related events in the United States, October 1991 through September 1992.

[Abbreviations used: ft^3/s, cubic feet per second; mi^2, square miles; mph, miles per hour; gal/d, gallons per day; Mgal/d, million gallons per day; USGS, U.S. Geological Survey.]

October 1991

1 OREGON—At the beginning of October, after 6 years of below-average precipitation and streamflow, five major reservoirs were at all-time low levels (15 percent of their combined capacity), and 35 percent fewer acres than normal were farmed. The Governor declared the central part of the State a drought emergency area. Portland had received no rain since September 13, and city officials asked residents to voluntarily reduce water consumption.

2 KENTUCKY—On October 3, an oil company's 8-inch pipeline ruptured and released an unknown quantity of xylene into the Green River near Calhoun. A boom was deployed to contain the product. Downstream of the release, a 2.5-mile stretch of the river was temporarily closed to boat traffic, and the water-supply intakes for the city of Ashbyburg were temporarily shut down. On October 4, the intakes for Ashbyburg and the river were reopened.

3 KANSAS—On October 9, a city well in Meriden was shut down by State health officials when benzene from a leaking underground storage tank at a nearby gas station entered the well.

4 PUERTO RICO, ATLANTIC COAST—A huge Atlantic storm produced intense rain and gale-force winds from Puerto Rico to Maine on October 31. Widespread flooding and beach erosion accompanied the storm. In Puerto Rico, flooding caused widespread damage and evacuations, and two people drowned. In the Northeast, damage in Cape May, N.J., was estimated to be $72 million. In New England, the storm toll was 12 dead, 16 injured, and $168 million in damages.

5 NEBRASKA—At the end of October, most of Nebraska remained in a drought that lasted 4 years. Precipitation for the year through the end of October was about 30 percent below average. October mean discharges at stream-gaging stations Big Blue River at Beatrice and Little Blue River near Fairbury (both in southeastern Nebraska) were the lowest mean October flows for the period of record. Much of the western part of the State escaped the extended drought.

November 1991

6 ALASKA—Between October 30 and November 2, about 12 inches of rain fell on Kodiak Island, causing flooding and mudslides. The city of Kodiak's previous 24-hour rainfall record (February 25, 1947) of 4.53 inches was broken when 7.44 inches fell during a 24-hour period that ended on October 31. Mudslides destroyed two homes, damaged several others, and forced the evacuation of at least 50 others. The main road to the airport was closed; residents trying to get off the island were transported by a U.S. Coast Guard ferry or fishing boats. Damage to public facilities was estimated to be more than $5 million. On November 2, the Governor declared Kodiak a disaster area.

7 WASHINGTON—In early November, Seattle residents were asked to reduce their nonessential water use from 17 to 10 gal/d per person because of unusually dry conditions during September and October.

8 NEW YORK—Drought conditions continued, causing low water levels in streams, reservoirs, and aquifers. Between November 8 and 13, drought warnings were announced for New York City and 11 counties in the southeastern part of the State, and a drought alert was issued for 4 southwestern counties. Residents in these areas were asked to voluntarily conserve water.

9 NEVADA—On November 16, the water level of Lake Tahoe fell to its lowest elevation (6,221.64 feet) since records began in 1900 and shows the effects of 5 years of drought in northwestern Nevada. The minimum elevation, measured at the outlet to the Truckee River, was 1.4 feet below the natural rim of the lake, which marks the minimum level for usable storage.

10 FLORIDA—On November 25, a storage tank containing black liquor (a byproduct of paper making) collapsed at a facility near the St. Johns River in Jacksonville. An estimated 524,000 gallons entered the river causing a white foam on the water's surface. Cleanup ended on December 6.

December 1991

11 TENNESSEE, KENTUCKY, WEST VIRGINIA, ALABAMA—Between November 30 and December 2, heavy rain fell in the lower Mississippi, Tennessee, and Ohio Valleys and along the Appalachians and caused widespread flooding. Many places across south-central Tennessee, northeastern Mississippi, and northern Alabama received from 10 to 12 inches of rain. In Kentucky, 14 counties reported flooding and mudslides on November 30, and one person died. Throughout the State, damages were estimated to be $2.25 million. On December 2, in Huntsville, Ala., 3.14 inches of rain fell causing flooding and some evacuations. One person died when his car was swept away as he attempted to cross a flooded bridge. In Marshall County, W. Va., a car was washed off the road and into Big Grave Creek, tributary to the Ohio River.

12 IOWA—Between December 2 and 4, after a high level of nitrate was found in the town supply, residents of Washburn were advised to not drink or boil the water; boiling the water would raise the nitrate concentration.

13 AMERICAN SAMOA—On December 10, Typhoon Val hit Pago Pago with sustained winds of 150 mph and even higher gusts. One person was killed, 200 were injured, and 4,000 were left homeless. Six fishing vessels, grounded during the typhoon, leaked an estimated 12,000 gallons of diesel fuel into the Pago Pago harbor. Total damage was estimated to be $83.2 million. The President authorized Federal disaster assistance.

14 HAWAII—A moderate rain began falling on Kauai on December 14 and intensified significantly during the early morning hours of December 15. In northeastern Kauai, as much as 2 inches per hour of rain fell from midnight to 3 a.m.; as much as 6.7 inches fell in 1 hour at the National Weather Service gaging station at Anahola. Storm totals exceeded 15 inches in northeastern Kauai. Flooding was especially severe in the areas of Anahola, Aliomanu, Moloaa, and Kapaa. Four fatalities occurred as a direct result of the flooding, and damage estimates were in excess of $7 million. Peak flows exceeded the 100-year flood at four USGS gaging stations—Kapaa Stream at Kapahi, Akulikuli Stream near Kapaa, Anahola Stream near Kealia, and Halaulani Stream near Kileauea.

15 TEXAS—Between December 17 and 23, from 10 to 15 inches of rain fell over a large area of Texas, causing extensive flooding from Dallas to the coastal plains of south-central Texas and from west Texas to east Texas near the State line. Major flooding occurred at

more than 200 USGS streamflow gaging stations, most of which are in the Trinity, the Brazos, the Colorado, and the Guadalupe River Basins. At least nine stations recorded floods equal to or exceeding the 100-year recurrence interval. Flooding continued throughout the month in parts of the State. Bacterial contamination and huge amounts of fresh water entering the Gulf of Mexico killed oysters and halted most of the State's oyster harvesting. As a result of the storm, 28 counties were declared Federal disaster areas, 16 people died, and property damage was about $75 million.

16 SOUTH CAROLINA—Late on December 19, a 36-inch pipeline ruptured and spilled about 550,000 gallons of diesel fuel into the Enoree River near Fountain Inn. Clinton and Whitmire, about 20 and 30 miles downstream of the spill, temporarily discontinued drawing drinking water from the river and used alternate sources. Fishkills near the pipeline rupture were sporadic and light.

17 OREGON—During a refueling operation on December 28, an estimated 12,000 gallons of fuel oil spilled into the Willamette River in Portland. An oil sheen extended 5 miles down the river. Cleanup continued on a 3-foot-wide strip of beach at the high-tide line until March 27.

18 LOUISIANA—On December 30, a tank barge carrying 150,000 gallons of crude oil hit a submerged object and was holed, spilling an estimated 10,500 gallons of crude oil into Bayou Norman, Barataria Waterway at Lafitte, near New Orleans. A boom was deployed, and the waterway was closed to traffic for 10 miles to facilitate cleanup. About 420 gallons of crude oil was recovered. Cleanup was completed on January 6.

January 1992

19 ATLANTIC COAST—On January 4, severe winds and rain caused coastal flooding and beach erosion from the Outer Banks, N.C., to Long Island, N.Y. The storm had sustained winds of 50 mph and gusts as high as 83 mph; tides were 2 to 3 feet above normal with sea swells of 18 to 20 feet. The storm destroyed sand dunes and boardwalks at Rehoboth Beach, Del., and Ocean City, Md.; three structures were washed into the ocean, and several others were severely damaged. The storm damaged water and sewer pipes and caused the closing of low-lying roads, including Delaware Route 1 along Delaware beaches. In Delaware, city officials declared a state of emergency at Rehoboth Beach, Dewey Beach, and Bethany Beach, and the Delaware National Guard was called in to assist. Residents of Dewey Beach were asked not to drink the tap water; drinking water was brought in by the National Guard. In North Carolina, the storm caused some flooding on parts of Pea Island and Kitty Hawk, and water covered stretches of the main coastal road along the Outer Banks. Some flooding also occurred in the Atlantic City, N.J. area, closing White Horse Pike, a main road into the city.

20 NEW JERSEY—On January 4, five containers carrying 540 thirty-gallon drums of rat poison (about 11,000 gallons of arsenic trioxide), were washed off a freighter off the New Jersey coast. Two damaged containers, which remained on deck, released an unknown quantity of the poison. As of May 8, the drums that had been located had been removed. On May 11, sonar surveys were initiated to locate the remaining drums. A commercial fishing ban was in effect through August 10 (near Cape May, N.J.) because the drums not located posed a threat to fish and shellfish; however, tests done on clam beds located near the debris site did not show elevated arsenic levels.

21 SOUTHERN CALIFORNIA—In early January, a violent Pacific storm moved inland, bringing with it high winds that uprooted trees, snow that clogged highways, and rain that triggered mud and rock slides and flooded roads. In 12 hours on January 5, 3 inches of rain fell at Mt. Wilson, and 2 inches fell on north Los Angeles. Flooding was reported in the San Joaquin Valley. Total rainfall since October 1 was above average for the first time in 5 years.

22 PUERTO RICO—Intense rainfall, as much as 15 inches in some places, caused severe flooding on January 5–6. Most of the rain fell between noon on the 5th and 6 a.m. on the 6th, the largest amounts fell in the east-central part of the island near the drainage divide, which caused flooding on the northern and southern slopes. The island's flood-alert system provided real-time rainfall, streamflow, and meteorological data to the National Weather Service and to local government agencies; however, because of holiday celebrations associated with Three Kings Day (January 6), most people were preoccupied with family gatherings and were reluctant to leave their homes. The storm left 23 people dead, $200 million in damages, and 35 towns Federal disaster areas. Two USGS streamflow-gaging stateions were washed away, and several others were severely damaged. Streamflow peaks of record occurred at 17 gaging stations located in 8 river basins. Discharge at the site Río Grande de Patillas near Patillas, on the southeastern side of the island, was 30,900 ft^3/s—1.1 times the 100-year flood.

23 WASHINGTON, D.C.—Early on January 19, 51,000 gallons of fuel oil was spilled at a petroleum company. Most of the spill was contained by a moat; however, about 3,500 gallons did reach the Anacostia River, and caused the river to be closed to boat traffic for several days. Cleanup continued into April.

24 LOUISIANA—On January 26, two strings of barges collided near Morgan City, spilling 87,400 gallons of styrene into the Intercoastal Waterway. About 100 vessels were backed up when a 15-mile stretch of the waterway was closed until cleanup was completed on February 4. About 200 fish died in the nearby Bear Bayou.

25 OHIO—Drought persisted throughout much of the State in January. Precipitation deficiencies ranged from 2.21 inches in the south-central region to 10.0 inches in the central hills region. In areas affected by the drought, ground-water levels had been declining since April 1991, and monthly record low water levels had been set at several USGS observation wells between October and December. With the exception of the northwestern and southwestern parts of the State, where the drought was less severe, streamflow in Ohio was below median for much of the preceding 6 months. Streamflow in the Scioto River at Higby was 29 percent of median for January and was below normal for 4 of the preceding 7 months.

February 1992

26 CALIFORNIA—On February 2, a sewage pipeline off the coast of San Diego was spewing partially treated sewage into the Pacific Ocean at the rate of 170 Mgal/d. The pipeline, which normally carries effluent 2.2 miles offshore and releases it in 220 feet of water, ruptured in 35 feet of water. Because of the rupture, 5 miles of beach was closed, and fishing was quarantined for 3 miles offshore. Because storms delayed repair of the broken pipeline, coliform bacteria counts along a 20-mile stretch of coastline were up to 1,100 times the legal limit on February 8.

27 TEXAS—More than 5 inches of rain fell on February 3–4 in parts of southeastern Texas, causing flooding along the Trinity and the Brazos Rivers. Flows of several other rivers in southeast Texas neared the record high levels set in December 1990. San Antonio had more than 3 inches of rain during the week, pushing their December through February total to more than 20 inches, a new high. In the Colorado River Basin, two dozen homes were evacuated because of flooding on Lake Travis above Austin. Austin also had the wettest December through February on record with more than 25 inches of rain. Several locations in Texas reported total December through February rainfall levels of more than five times the average. The rainfall helped push monthly totals to record highs at Galveston and Austin.

28 CALIFORNIA—A series of storms brought heavy rains to the southern part of the State and heavy snows to the mountains in the central part of the State. The first storm came ashore on February 2, and was followed by others on February 3, 5, and 7. The storm on the 7th came ashore in northern and central California dropping 3 feet of snow in the southern Sierra Nevada (37 inches of snow fell in 24 hours). During the week of February 9 through 15, as much as 15 inches of rain fell in the southern part of the State and nearly 7 feet of snow fell in the mountains; however, the storms provided only limited relief from the 6-year drought because most rain fell south of the State's major reservoirs and much ran off into the ocean. Flooding and mudslides killed 8 people and damaged or destroyed 150 homes. Property damage was estimated to be $23 million. Nearly 100 miles of beach in San Diego, Orange, and Los Angeles Counties was closed when 66 million gallons of sewage spilled into the Pacific Ocean as a result of flooding.

29 FLORIDA—Contaminated ground water was found in 200 wells in the Sunniland area of Miami on February 11. Concentrations of dry-cleaning chemicals as high as 49 times the Federal drinking water standards were found in an eastward moving plume about 1 mile in diameter. Environmental officials predicted that as many as 1,200 wells could be affected eventually.

March 1992

30 NEVADA, UTAH—Both States were in their sixth consecutive year of drought as March began. Mountain snowpack, which provides the bulk of the area's water, was below average in all sub-basins of the Great Basin region. As of March 1, seasonal snowpacks across Nevada ranged from a low of 33 percent of average in the northern part of the Great Basin to 70 percent of average in eastern Nevada. Snowpacks in the Lake Tahoe Basin and the Truckee and the Carson River Basins were at 50 percent of average. Lake Tahoe was at its all time low elevation, with none of the usual water reserves. In Utah, the reservoirs also were below the average storage capacity. Most basins in Utah were in the 50 to 60-percent of average precipitation range. Seven major reservoirs in Nevada averaged 8 percent of capacity and 13 percent of the long-term average storage capacity.

31 TEXAS—During the first week of March, as much as 8 inches of rain fell on already saturated soil in southeastern Texas, causing extensive flooding and more than $25 million in damages in Houston. In the immediate Houston area, five USGS stream gaging stations recorded record streamflow peaks and two recorded peaks with at least 100-year recurrence intervals.

32 VERMONT—Rainfall during the evening of March 10 and the morning of March 11 caused the stage of the Winooski River in downtown Montpelier to rise and the ice cover to break up and jam at the Bailey Avenue Bridge and at several upstream bridges. On March 11, water was flowing on Main Street, power and telephone transmissions were interrupted, and as much as 5 feet of water stood in some places. All State offices and the Federal building were evacuated, streets were closed, and shelters were set up. This was the first significant flooding in Montpelier since 1927. Damage was estimated to be $4.5 million.

33 PENNSYLVANIA, NEW YORK (not shown)—In mid-March, drought conditions persisted. New York City's reservoir system had a total usable storage of 63 percent compared with the normal 88 percent for this time of year, and the city remained under a drought warning. Water restrictions also were in effect in 48 Pennsylvania counties under a drought emergency.

34 NORTH CAROLINA—On about March 18, thousands of gallons of acidic waste were released from a textile plant into a sewer system, which caused the sewage plant to release partially treated sewage into the French Broad River near Asheville.

35 CALIFORNIA—On March 20, researchers reported that thousands of birds (eared grebes) had died around the Salton Sea since January. The birds were found to have large concentrations of selenium and mercury in their bodies. Selenium found in farm runoff can lower immune response systems.

36 OREGON—By late March, a drought emergency had been declared for all counties in the Great Basin. Conditions remained extremely dry with precipitation at less than 50 percent of the March average in many places. Average reservoir storage was 41 percent of capacity and 54 percent of median. Some smaller irrigation reservoirs were dry. Streamflow was approaching record low flows throughout the eastern part of the State and in several streams west of the Cascades, especially coastal streams. Many wells were going dry as groundwater levels declined. Snowpack was essentially melted at elevations below 5,000 feet.

April 1992

37 PUERTO RICO—Landslides on April 6 choked off the water supply in Moca, Isabela, Aquadilla, Aguada, and Rincon. Water was rationed and delivered to residents until service was restored on April 13. Even after service was restored, residents were advised to boil their water.

38 ILLINOIS—On April 13, a section of a 100-year-old underground freight tunnel in downtown Chicago was breached where the tunnel crosses under the Chicago River. Water from the Chicago River flowed into the 45-mile tunnel system and into buildings connected to the tunnel. As a result, utility services to more than 100 buildings in downtown Chicago were lost, several hundred thousand workers were sent home, and the entire subway system and a major expressway were shut down. The breach in the tunnel eventually was sealed, and the tunnel was dewatered by the U.S. Army Corps of Engineers and its contractors. The USGS assisted in the efforts to plug and dewater the tunnel and buildings by measuring velocity near the tunnel plugs, conducting dye-tracer tests to check for leaks in the plugs, and installing water-level gages.

39 NORTH CAROLINA—As much as 7 inches of rain fell in some areas on April 20 flooding streams in the mountainous northwestern part of the State. In Watauga County, more than 300 residents along the Watauga River below the earthen dam at Devil's Lake were evacuated on April 21 when a 60-foot-high embankment started to slide. On April 22, schools were closed, and one-quarter of the

secondary roads were under water. Many private and State-owned bridges were damaged or destroyed in the flooding. In Mitchell and Avery Counties, flooding was at the 5- to 10-year recurrence interval level along the Watauga, the Elk, and the North Toe Rivers. On April 22, in Surry County, the Fisher and the Ararat Rivers, tributaries to the Yadkin River, rose to the 100-year recurrence interval level. Flooding in North Carolina claimed five lives, and estimates of damage exceeded $2 million.

VIRGINIA—On April 21, rainfall amounts ranged from 5 inches in areas away from the Blue Ridge Mountains to more than 13 inches along the mountains. The Big Reed Island Creek near Allisonia in Pulaski County exceeded the previous flood of record (records began in 1909), peaking at 17,900 ft^3/s with a recurrence interval of 50 to 75 years. Flooding on the creek destroyed the Pulaski County Route 693 bridge. The highest recurrence interval recorded on a large river was 30 years for the Roanoke River at Roanoke, which was 10,300 ft^3/s less than the 1985 flood of record and 5.26 feet lower in stage. U.S. Highway 220 south of Roanoke was blocked in at least two places by water and mudslides. State Road 24 and U.S. Highway 460 were closed temporarily in parts of Bedford County owing to water on the roads. The Governor requested Federal aid for 23 counties and cities damaged by the floods. Flood damage to homes, businesses, farms, and other property in Virginia was $15 million. State highway damage was estimated at $11 million.

MAY 1992

40 OREGON—The water-supply pipeline for the Medford area, including Medford, Central Point, Eagle Point, Jacksonville, Phoenix, and White City (about 80,000 people), was shut down on May 2 when the parasitic protozoan, *Cryptosporidium parvum*, was discovered in Big Butte Springs. This was only the fourth documented incident of public water-supply contamination by this protozoan. The other incidents occurred in England, Georgia, and North Carolina. At least 40 people were reported to have contracted the parasite from Medford's municipal drinking water.

41 HAWAII—Intense rainfall (3.16 inches) on May 5 caused a mudslide near Wailuku that blocked the intake to the main water source for West Maui.

42 ARKANSAS—During the week of May 12 through 18, thousands of fish died along a 1.5-mile stretch of Spadra Creek near Clarksville when drilling chemicals from a natural gas well entered the creek.

43 TEXAS—Flash flooding occurred in isolated locations across much of the State during mid-May as a result of heavy rainfall. Three deaths and damage estimates in the low millions of dollars resulted from the flooding.

44 NEW MEXICO—May was an exceptionally wet month in New Mexico. Of the 13.82 inches of rain that fell on Hobbs during May, most of it fell between May 20 and 27, causing severe flash flooding in Lea County. Damages were estimated to be $32 million. The May snowpack was 2.5 times the average, and Albuquerque had the wettest May in 51 years with 1.81 inches of rain, which is 1.35 inches above the 30-year (1951–80) average.

45 LOUISIANA—On May 25, a tank barge leaked about 7,000 gallons of fuel oil into the lower Mississippi River near St. Rose and Norco, affecting about 15 miles of shoreline. Cleanup of the affected shoreline was completed on June 10; an estimated 840 gallons of oil and 200 cubic yards of soaked debris were collected.

46 WYOMING—On May 25, a crew drilling for fresh water in Rock Springs drilled into a water-bearing zone that contained trona (a poisonous mineral). The contaminated water moved up the drill hole to the surface and then entered a tributary of the Big Sandy River at the rate of 4,000 barrels per day. Flow was finally shut off with hermatite, an iron oxide-based mud.

47 MISSISSIPPI—This was the third consecutive month of below-average rainfall. Only 1.22 inches of rain, which is 3.61 inches below the 1951 to 80 average, fell on Jackson. By the end of May, Jackson had received only 12.91 inches of precipitation for the year, which is 13.11 inches below average. As a result of this rainfall deficit, the Tombigbee River near Columbus, the Pascagoula River at Merrill, and the Black River near Bovine had discharges of 18, 37, and 14 percent respectively of the 1951 to 80 average.

48 PACIFIC NORTHWEST—Mild temperatures, below-average precipitation, and low-volume snowpack (25 percent of average), left much of the area in a drought by the end of spring. Streamflows were below median and at record low levels.

WASHINGTON—The Seattle area had the driest spring in 90 years of recordkeeping, and water-use restrictions were in effect in many cities by mid-May.

OREGON—The Governor declared 24 of the State's 36 counties drought emergency areas, qualifying them for Federal drought-relief programs. Record high temperatures were recorded at Eugene. In southern Oregon, farmers in the Klamath River Basin who rely on the Klamath Project for irrigation water were told that they would receive only one half of their allocation. Irrigation water-use was reduced to maintain water quality in the Upper Klamath Lake for endangered fish. Estimated crop losses totaled about $30 million.

IDAHO—The State was in its sixth year of drought; six counties requested Federal drought status for low-interest loans. Many wells in Idaho went dry. Because of unexpected high farm demands, almost 8 miles of the Snake River southwest of Blackfoot were almost dry. This was in spite of the fact that many farmers had switched to crops requiring little water or did not plant at all. Because of the dry conditions, the fire season started 6 weeks early.

49 MONTANA—The State received almost no snowfall during the winter, and only one-quarter of average rainfall during spring, and temperatures were 60 percent above normal by late May. Discharge of the Missouri River was about one half of the spring median.

NORTH DAKOTA—Low precipitation and early warm weather contributed to continued drought conditions in the southwestern part of the State.

WYOMING, NEBRASKA—By late May, water levels in reservoirs on the North Platte River in Wyoming were low. This river provides irrigation water to Nebraska. Continued drought conditions during the early part of the year affected agricultural production in May, causing losses in beet, bean, corn, and wheat crops in the Nebraska panhandle.

UTAH—Parts of the State experienced the sixth year of below-normal runoff, and reservoirs were being depleted earlier and faster than normal.

NEVADA—Snowpack was less than one half of the average and reservoirs were at 15 to 35 percent of capacity. The 24 stream sites of the

USGS Lake Tahoe tributary monitoring project had runoff peaks that were lower than those peaks of 1991, and the peaks occurred almost a month earlier than normal. Record high temperatures were recorded at Reno.

CALIFORNIA—The State entered its sixth consecutive year of drought. Precipitation was about 25 percent of average in most areas; month-end reservoir storage was about 68 percent of average; and record high temperatures were recorded at Sacramento and San Francisco.

June 1992

50 VIRGINIA—Intense rainfall associated with a strong frontal system caused localized flooding in Giles County about 40 miles west of Roanoke. On June 5, a new peak of record of about 25,000 ft^3/s, about equal to the 100-year flood, occurred on Walker Creek at Bane in the New River Basin. A stage of 19.28 feet was the highest since the stream-gaging station was established in 1938; however, local residents indicated that the flood of September 1878 had reached a stage of 23.5 feet.

51 CONNECTICUT—As much as 10 inches of rain fell in south-central and central Connecticut on June 5–6 causing flooding in some areas. Flood recurrence intervals at USGS stream-gaging stations were 75 years on the Quinnipiac River at Wallingford, 50 years on streams in Meriden and New Britain, 25 years on the Indian River at Clinton and the Coginchaug River at Middlefield, and 8 to 10 years on the Farmington River. One person was killed in Plainville; 39 businesses and homes were flooded in Southington; and sewage, attributed to the storm, closed beaches in Milford and West Haven on June 10. Flood damage was estimated to be $10 million.

52 UTAH—On June 8, a tanker truck careened into the Provo River near Provo and spilled an ammonium-nitrate diesel fuel into the river. The accident closed U.S. Highway 189 for five hours.

53 OKLAHOMA—On June 9, residents of Mooreland were asked to boil their drinking water until further notice. Routine water-quality tests of the public water supply indicated elevated levels of fecal coliform bacteria.

54 ALASKA—Spring snowmelt caused the third worst flooding season on record. On June 11, record streamflows on the Yukon River at Stevens Village flooded homes. The flood was equivalent to the 100-year flood.

55 KENTUCKY—On June 18, locally intense rain and high winds associated with tornadoes occurred in central and northern Kentucky. As a result of 5 inches of rain falling within a few hours, localized flooding caused damages estimated to be $3.35 million in Washington County.

56 MONTANA—The State was in one of the worst droughts in its history. Most mountain snowpack was 10 percent of average; 82 percent of the State had below-average topsoil moisture; streamflow ranged from 16 to 69 percent of average; and fire danger was high to extremely high. About 80 percent of Montana farmers and ranchers had 40 percent crop and feed losses. On June 19, Montana's Governor requested Federal drought disaster relief designation for 12 counties.

57 FLORIDA—Southwestern Florida was entering its fourth year of drought in late June. Lake levels averaged 1.5 feet below average in the west-central part of the State, and the Southwest Florida Water Management District had placed many counties on water-use restrictions.

58 FLORIDA—One of the worst storms in decades dumped as much as 24 inches of rain in 4 days (June 24–28) and caused flooding on the Braden, the Manatee, the Little Manatee, and the Myakka Rivers in southern Hillsborough and northern Manatee Counties. Three of the seven USGS stormwater project stations in Sarasota County measured more than 20 inches of rain in a 3-day period. About 5,000 residents living along the Manatee and the Braden Rivers fled their homes when more than 10,000 ft^3/s of flood water was released through floodgates on the Manatee River as Manatee Lake overflowed its rim. The floods in North Port in Sarasota County had a recurrence interval of 100 years, according to a city engineer. Estimated damages in Manatee and Sarasota Counties were several million dollars.

59 IDAHO—On June 23, the U.S. Department of Agriculture granted emergency funds for six counties to help farmers who had lost more than 40 percent of their livestock feed to the 6-year drought. On June 25, the State released land in 14 other counties for livestock grazing or haying to help ranchers and farmers cope with the drought.

60 NEVADA—During June 27–28, Rye Patch Reservoir in Pershing County, known for its walleye and white bass, was drained to 330 acre-feet to provide water for ranchers downstream on the Humboldt River who were suffering from the extended drought.

61 CALIFORNIA—On June 28, earthquakes in the Mojave Desert (magnitude 7.6) and near Big Bear Lake (magnitude 6.6) triggered landslides that closed mountain roads and caused extensive damage in towns near the epicenter. In all, 1 death, 400 injuries (mostly minor), and $92 million in damage were attributed to the pair of earthquakes. The quakes caused existing flows of crude oil from seeps in the Santa Susana mountain range in Ventura County to increase to about 2,300 gallons per week. The oil entered the Santa Clara River through two tributaries, threatening birds and fish (including the endangered unarmored threespine stickleback) in the area. Berms were constructed to prevent the flow of oil to the river.

62 WISCONSIN, MINNESOTA—On June 30, 14 railroad cars derailed while crossing the Nemadji Bridge near Superior, Wis. One tank car containing benzene fell into the Nemadji River, spilling about 20,000 gallons of aromatic concentrate (45 percent benzene). The Nemadji River drains into the Superior–Duluth, Minn., harbor on Lake Superior about 4 miles downstream from the accident. A vapor cloud caused the evacuation of nearly 50,000 people from their homes and offices in an 8-mi^2 area of Duluth, and a 6-mi^2 area within the city of Superior also was evacuated as a precaution. This was one of the largest chemical spill evacuations in the Nation. Containment booms were placed in the river to prevent the benzene from spreading.

63 ALASKA—Sometime during the month, well equipment malfunctioned and dumped 40 times the safe level of fluoride into the Hooper Bay water supply; 260 people became sick from the excessive levels of fluroide in their drinking water.

64 SOUTH DAKOTA—Several intense, localized thunderstorms caused substantial runoff in several basins during the last part of June. Personal injuries and extensive damage to personal property, crops, and livestock resulted. Discharge of Hidewood Creek near Estelline, which drains the Clear Lake area, substantially exceeded the 100-year flood flow. Flooding was extensive in the upstream reaches of the Big Sioux River through Brookings County, and Bruce City residents were advised not to drink water from the city well because of possible bacterial contamination caused by the flooding.

65 OREGON—The drought-plagued area was warmer and drier than usual in June. Higher-than-normal precipitation, which occurred at the end of the month, did little to alleviate the effects of the persistent drought. For the first time in the Klamath Project's 87-year history, a full allocation of irrigation water for farmland could not be maintained. Portland imposed mandatory restrictions on use of water from the city's supply reservoirs. In Medford, National Weather Service records indicate that this was the driest 7-year period since recordkeeping began in 1911.

July 1992

66 INDIANA—On July 6, a downpour (3.77 inches of rain in 24 hours) in Indianapolis triggered a mudslide that closed Interstate Highway 65 and caused some downtown roofs to collapse.

67 INDIANA—On July 13, an intense storm dropped as much as 4 inches of rain in a narrow band from Tipton County east to Randolph County. Flooding was reported in several counties in central and east-central Indiana; 50 people were evacuated from Alexandria, and 150 were evacuated from Elwood. Record flows occurred at Pipe Creek at Frankton and Wildcat Creek near Jerome.

68 NEVADA—On July 13 near Hawthorne, 2 inches of rain (1.20 inches in 20 minutes) caused flooding; and mudslides closed parts of U.S. Highway 95 (the main route between Reno and Las Vegas) and State Route 359.

69 WASHINGTON—On July 17, health officials closed West Medical Lake in Spokane to fishing, boating, and swimming because coliform bacteria levels in the lake were as much as 32 times higher than State standards owing to discharges from a sewage-treatment plant.

70 NEVADA—On July 17, the gates of the Rye Patch dam were reopened, draining the reservoir of its remaining water (330 acre-ft), to water cattle grazing along the banks of the Humboldt River. This caused the worst fishkill (between 600,000 and 1.5 million fish, including carp, walleye, bass, crappie, and catfish, died) since the reservoir was drained to provide water for cattle in 1961.

71 CALIFORNIA—On July 21, a water-treatment plant near Sunol accidentally dumped 420 gallons of potassium permanganate, a chemical used in small quantities to purify drinking water, into Alameda Creek. All aquatic life (including minnows, frogs, crayfish, tadpoles, and other animals) in a 0.5-mile stretch of the creek were killed. The chemical, which is toxic in high concentrations, dissipated in 3 days; no drinking-water sources were affected.

72 TEXAS—On July 24, an estimated 63,000 gallons of oil sprayed from a crack in a pipeline into a ditch leading into San Jacinto Bay near Deer Park in the Houston area. Booms were deployed at the entrance of the ditch and in San Jacinto Bay; about 38,800 gallons of the product was recovered. Shoreline cleanup was required on both sides of the creek.

73 KENTUCKY—Intense rains (2.33 inches in a 24-hour period ending at 8:00 a.m. on July 25) in the southeastern part of the State caused flash flooding of Bear Creek (drainage area about 10 mi^2) in Clay County near Manchester. Four people were killed, about 20 to 30 people were trapped or stranded by rising water, and 11 homes were destroyed.

74 NEBRASKA—Intense rain at the end of July produced flooding along the Little Blue River in southeastern Nebraska. On July 25, streamflow at the USGS gaging station on the Little Blue River at Fairbury set a new record—54,000 ft^3/s—with a stage of 24.33 feet. The recurrence interval of this event was about 100 years.

75 OHIO—On July 26–27, intense rains caused mudslides and flooding in the eastern part of the State. At the USGS gaging station at Indian Creek at Massieville, the flood peak was 2.67 feet higher than the previous peak of record (31 years of record) with a recurrence interval of about 100 years. About 50 people were evacuated from their homes in Dillonvalle and Glen Robbins, 2 people died in flash floods in the Massieville area, and more than 100 homes and several businesses suffered major damage. Total damage was estimated to be $17 million. Federal disaster aid was granted to 20 counties.

76 CALIFORNIA—Streamflow, reservoir storage, and ground-water levels throughout most of the State continued to decline. Streamflow index station records indicated that this was the worst drought in California since records began in 1944. At the end of July, storage in 155 major reservoirs was about 58 percent of average, and about 7 percent below that of a year earlier. Precipitation was below normal in the northern part of the State. State and Federal water-project customers received between 25 and 75 percent of their usual seasonal surface-water allotments, and as a result, ground-water pumping increased substantially.

PACIFIC NORTHWEST—At the end of July, Idaho, Washington, and Oregon were coping with the hottest and driest conditions since recordkeeping began 90 years earlier. Eastern Washington and Oregon were in a 7-year drought. Fires ravaged mountain forests, crops fell victim to drought, and water-use restrictions continued in urban areas. Streamflow in the Snake River at Weiser, Idaho, set a record low of 572 ft^3/s; normal flow for this time of year is 24,288 ft^3/s.

77 MASSACHUSETTS—Provincetown on Cape Cod declared a water emergency because ground-water levels had been below average since November 1990.

78 FLORIDA—At the end of July, levels of gaged lakes in northwestern Hillsborough County were at record lows, about 2.5 feet below average July levels; many lakes were dry.

August 1992

79 GUAM (not shown) —The Fena Valley Reservoir, a critical water supply for the Island of Guam, reached its lowest level in 40 years.

80 RHODE ISLAND—On August 4, the public water supply for about 114,000 residents of Pawtucket, Central Falls, and Cumberland was found to contain high levels of fecal coliform bacteria. Residents were asked to boil tap water before drinking it. On August 5, the source of contamination was found to be a 13,000-ft^2 area where recently installed water pipes apparently had disturbed fecal coliform bacteria in the old pipes. On August 15, residents of North Kingstown were warned to boil tap water because of high levels of fecal coliform bacteria. The contamination was isolated to one supply source, which was subsequently removed from service.

81 OKLAHOMA—On August 5, flash flooding in Okmulgee County near Henryetta caused estimated damages in excess of $10 million.

82 INDIANA, KENTUCKY— On August 8, a 100-mile-wide storm system caused flash flooding in southeastern Indiana and north-central Kentucky. Rainfall exceeded 10 inches in 6 hours in parts of south-central Indiana, and 3 to 4 inches in 4 hours in parts of Louisville, Ky. Three deaths were attributed to floods associated with the storm.

83 UTAH—On August 12, a chemical spill from an unidentified source killed more than 63,000 fish in the Weber River about 2 miles south of Weber Canyon near Ogden.

84 NORTH CAROLINA—From August 12 through 18, rainfalls totaling 6.5 inches in Wilmington and 14.5 inches in Goldsboro caused widespread flooding. In Wayne and Wilson Counties, extreme flooding on small streams left many rural roads and urban streets impassable. Many families in Lenoir, Wayne, and Pender Counties were evacuated from their homes. Record flows or stages occurred at five USGS gaging stations—Potecasi Creek near Union and Ahoskie Creek at Ahoskie in Hertford County, the Cashie River near Windsor in Bertie County, Little Rockfish Creek at Wallace in Duplin County, and Moccasin Run near Patetown in Wayne County.

85 CALIFORNIA—Algae blooms and 9 days of record high temperatures depleted the oxygen in the water in the 3,000-acre Lake Elsinore near Los Angeles, killing 50,000 fish and 40 ducks.

86 FLORIDA—On August 23 at 5:20 a.m., Hurricane Andrew, a category 4 hurricane (sustained winds of 131-155 mph) and one of the most powerful storms to hit the United States this century, made landfall in southern Dade County, devastating an area from Kendall south to Homestead and the northern Keys. The ocean storm surge associated with the hurricane was generally from 5 to 8 feet except at Perrine where it was nearly 17 feet, the third highest of record at this location. Because the storm moved rapidly across the State, rainfall was limited to 2 to 5 inches, and inland flooding damage was minimal. The storm left 43 dead, 160,000 homeless, about 75,000 homes destroyed, and damages estimated to be $20 billion.

LOUISIANA—Hurricane Andrew made landfall between Morgan City and New Iberia early on the 26th with sustained winds of nearly 120 mph (a category 3 hurricane). Storm surge along the coast ranged from 5 to more than 9 feet in the hardest hit areas and traveled 20 miles inland. Six people were reported dead, and damages were estimated to be $2.4 billion. Eight parishes in Louisiana were declared Federal disaster areas.

87 ALASKA—From August 25 through 27, about 4 inches of rain fell at Wiseman in the Brooks Range, in the northern part of the State, causing flooding on Wiseman Creek and several other streams in the area, including the upper Kaparuk River and the Sagavanirktok River Tributary (Oks Creek). On September 1, this same storm caused several streams to flood, washing out roads and halting oil production for several days at some of the oil fields in the area.

88 GUAM (not shown)—On August 27, Typhoon Omar, a category 5 storm with sustained winds of 150 mph and gusts to 184 mph, passed directly over Guam, leaving the island without power and water for several days. Omar, the worst typhoon to hit Guam in at least 16 years, damaged from 75 to 90 percent of the buildings on the island. Preliminary damage estimates exceeded $237 million. At least 132 people were injured, and 1 death was reported. The President declared Guam a disaster area on August 28.

89 LOUISIANA—On August 31, 21,000 gallons of crude oil leaked from a pipeline in the Gulf of Mexico off the southeastern coast. On September 2, a 1- by 10-mile oil slick was moving parallel to the coast 4 miles offshore. On September 3, the oil slick reached shore at two beaches on Wine Island. On September 10, oil was spotted in marshland in the northwestern corner of Lake Pelto and south of Pelican Lake. The damaged section of pipeline was replaced, and pumping was resumed on September 11. All affected areas had been cleaned by this time.

90 IDAHO—By late August, the continuing drought amplified concerns about over-appropriation of ground and surface waters in the eastern Snake River Plain. The Idaho Department of Water Resources had a temporary moratorium on additional water use during the drought. Streamflow in the Snake River at Weiser, 5,348 ft^3/s, was a record low monthly mean.

91 NEVADA—By late August, streamflows in the northern part of the State were nearing low flows last reached during the 1977 drought. Cumulative streamflows for the 6-year period from 1987 to 1992 were about equal to those during the historic drought of the early 1930's. For the first time since 1900, the water level in Lake Tahoe was 2.5 feet below the rim, and no flow had issued from the lake in 24 months.

92 OREGON—Irrigation-water supplies reached critically low levels, and several Bureau of Reclamation reservoirs were depleted of storage. Lake Owyhee, a 715,000-acre-foot lake and major source of irrigation water in southeastern Oregon, was depleted by August 6.

93 CALIFORNIA—At the end of August, California remained in the grips of its sixth year of drought. The dry weather fueled many fires and led to reduced streamflow and reservoir storage. Month-end reservoir storage at 155 major reservoirs in California was 57 percent of average for the date.

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94 NORTH CAROLINA—On September 10–11, an intense, late-night thunderstorm brought torrential rain that caused flooding at the mouths of Raven and Straight Forks, two tributaries of the Oconaluftee River in the Great Smoky Mountains National Park. About 2,000 people were evacuated from homes on the Cherokee Indian Reservation in Swain County and from many campgrounds along the streams. The flood had a recurrence interval in excess of 100 years. Damage was estimated to be $5 million.

95 HAWAII—On September 11, Hurricane Iniki, with sustained winds of 130 mph and gusts up to 160 mph, struck the Islands of Kauai, Niihau, and Oahu and caused widespread damage. The strong winds pushed water toward the southern coast of Kauai, producing storm tides of 4.5 to 6 feet above normal. The waves and storm surge caused water to inundate coastal areas almost 1,000 feet inland. Nearly every manmade structure on Kauai was damaged. The storm moved so quickly across the islands that no severe flooding was reported. Iniki caused three deaths; two on Kauai and one on Oahu; injured nearly 100 people; destroyed 1,439 homes; damaged 14,467 homes; and left about 8,000 residents homeless. Damages were estimated to be $1.6 billion.

96 IOWA—On September 14, as much as 16 inches of rain fell in 24 hours in a narrow band across south-central Iowa causing severe flooding on September 15–16. Record high stages were recorded on the Chariton, the South Fork Chariton, and the Thompson Rivers.

Discharge of the Thompson River at Davis City was 57,000 ft^3/s—25,000 ft^3/s greater than the previous record set in 1885. The Governor declared six southern counties disaster areas. Flood damage in Iowa was estimated to be $48 million.

97 WISCONSIN—On September 16, intense rains associated with a slow-moving cold front caused widespread flooding in south-central and southwestern Wisconsin. High water closed many roads and flooded many homes and businesses in several localities. Flooding was most severe in Richland, Trempealeau, Vernon, Crawford, Columbia, and Buffalo Counties where from 2 to 8 inches of rain fell. The Buffalo River near Mondovi had a peak flow exceeding the 10-year flood level. The Governor declared a state of emergency for southern Wisconsin. Damage in 10 counties was estimated to be $18 million.

98 ALASKA—On September 16–17, Crater Peak on Mount Spurr, about 75 miles west of Anchorage, erupted for the third time during the summer. An ash plume traveled to the northeast, depositing about 0.25 inch of ash on the community of Willow. Pyroclastic flows generated during the eruption scoured and melted upper parts of the west arm of Kidazgeni Glacier, sending a debris flow into the Chakachatna River. The debris flow formed an alluvial fan at the mouth of the Kidazgeni gully, which dammed the steep channel. The combination of the breakout of this dam and the transport of sediment eroded from the debris fan caused considerable bank erosion downstream.

99 GREAT PLAINS (not shown)—Much of the region, with the exception of Oklahoma, Texas, and a few isolated areas, continued in a 5- to 6-year drought in mid-September. Many reservoirs recorded the lowest month-end contents since initial filling, and releases to irrigation districts from Bureau of Reclamation reservoirs were insufficient to fulfill contractual obligations and to meet water-supply needs. Keyhole Reservoir, Wyo., was only 9 percent full; Belle Fourche Reservoir, S.D., 8 percent; and Cedar Bluff, Nebr., 5 percent.

100 ARIZONA—On September 20 in the western Salt River Valley, a high-intensity local storm produced nearly 4 inches of rain that resulted in extensive flooding in the area of Luke Air Force Base. Floodwater had overtopped the Maricopa County flood control channel (Dysart Drain) and spilled southward onto the runways, and into the aircraft parking and base housing areas. Estimates of damages exceeded $1 million.

101 THE WEST—By the end of September, widespread drought in the West continued to affect water storage, particularly in parts of Utah, most of California, southern Oregon, and Washington.

UTAH—The 6-year drought was taking its toll on the northern part of Utah—water sources were drying up; reservoir storage was very low; plants were withering; fire hazards were great; and all water districts were strongly recommending water-conservation practices. Extreme drought conditions continued in the Wasatch Front–Great Basin. Reservoirs content ranged from 2 to 41 percent of capacity, all less than 50 percent of average; Bear Lake Reservoir in the Bear River Basin, which provides irrigation water for 155,000 acres of farmland, was just 3 feet above the 1915 historic low.

CALIFORNIA—Storage on the California Central Valley Project (CVP) was 51 percent of average for this time of year which is the second lowest in its history. The CVP delivered only 3.5 million acre-ft of water in 1992; in a normal year, it would have delivered about 7.0 million acre-ft. Low rainfall and decreasing ground-water levels had a cumulative effect on trees with shallow root systems, making them susceptible to disease and causing them to dry up, which, in turn, increased the risk of fire. Lake Berryessa, part of the Solano Project, is located northwest of San Francisco and is a prime recreational area. Its September 21 lake level of 365 feet (75 feet below full lake elevation) was the lowest since the lake was filled in the late 1950's. At the end of the water year, statewide precipitation was 86 percent of average, and reservoir storage was 56 percent of normal. The Sacramento River runoff for the water year was 8.9 million acre-ft (less than one-half of the 1941–1990 average).

OREGON—Water recreation at reservoirs was greatly affected by the 6-year drought. Gerber Reservoir, which normally holds 100,000 acre-ft of water, held only 1,000 acre-ft at the end of September.

WASHINGTON—Natural water sources that provide crucial wildlife habitat and had been dependable for 50 years, were drying up. Ranchers were having to haul water to livestock.

102 LOUISIANA—Following Hurricane Andrew, large areas of the Atchafalaya Basin were devoid of oxygen, which resulted in massive fish kills (estimated at 182 million freshwater game and commercial fish worth about $160 million). The oxygen depletion was the result of the hurricane stirring up silt and other organic material in the waterways. As soon as the extent of the oxygen depletion was determined, the recovery of the basin was monitored by the USGS. In early September, the U.S. Army Corps of Engineers began diverting 300,000 gallons of Mississippi River water toward the Atchafalaya Basin to restore oxygen and to flush out dead fish. In Bayou Lafourche, a fishing community near Raceland, dead catfish, perch, shad, and bass were seen floating in mass. Fishkills are common after hurricanes, but not in such great magnitude, according to a State fishery biologist. Fishkills were reported in most waterways south of Baton Rouge. Along the coast, an additional 9 million fish, primarily menhaden, were killed. The State's $30-million oyster harvest also was damaged, (about $3.5 million worth).