WATER FACT SHEET

U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

THE EFFECTS OF THE 1988 DROUGHT ON WATER RESOURCES IN WISCONSIN

INTRODUCTION

The 1988 drought was one of the most severe droughts since weather records have been kept in Wisconsin. This fact sheet describes the cause of the drought and its effects on the water resources, water use, and agriculture in the State.

PRECIPITATION—1988 CALENDAR YEAR

Precipitation in Wisconsin was below normal in most areas during the 1988 calendar year. Most of the precipitation deficit occurred early in the 1988 growing season, especially in northeastern Wisconsin. The statewide May–June precipitation total was 2.9 inches, the lowest in 149 years of record (Clark, 1989). For the entire year, precipitation ranged from 2.6 inches above normal (1951–80) in small areas of central Wisconsin to 15.3 inches below normal in southwestern Wisconsin. The statewide precipitation average of 25.7 inches for the year was 5.6 inches below the normal precipitation of 31.2 inches; 1988 was the 14th driest year since 1840. A preliminary departure-from-normal precipitation map (*The Dryline*, 1989) prepared by Douglas Clark, Wisconsin State Climatologist, is shown in figure 1.

STREAMFLOW—1988 WATER YEAR

Annual runoff during the 1988 water year (October 1, 1987 to September 30, 1988) was below normal (long-term average) in the entire State, except for a few basins in south-central and southeastern Wisconsin, where runoff was 101 percent of normal. The least runoff occurred in north-central Wisconsin where flow in many streams was from 40 to 60 percent below normal. The lack of precipitation during the first 9 months of the 1988 calendar year, together with hot temperatures in July and August, caused record low flows at 10 of 90 active streamflow-gaging stations in Wisconsin.

The differences between annual and long-term average (or "normal") streamflows during the May–September period, which includes a large part of the growing season in Wisconsin, are shown in figure 2 for two streams, the Oconto River near Gillett and the Wisconsin River at Muscoda. The Oconto River near Gillett is an unregulated stream in northeastern Wisconsin. The May–September average discharge in 1988 for the Oconto River was a record low of 250 cubic feet per second compared with the long-term (water years 1907–08, 1914–88) average of 569 cubic feet per second. The Wisconsin River at Muscoda is a regulated stream in southwestern Wisconsin. A record low also was recorded at this site; the average May–September discharge was 3,800 cubic feet per second as compared with the long-term (water years 1914–88) average of 8,490 cubic feet per second.

LAKES

The water quality of many eutrophic (enriched) lakes improved because of reduced nutrient loadings. At Wind Lake, for example, the inlet stream, a major nutrient source, ceased to flow from late May through November. In response to this nutrient reduction, phosphorus concentrations in water near the lake surface declined, resulting in a substantial improvement in the lake's water quality (fig. 3).

GROUND WATER—1988 WATER YEAR

Record or near record low water levels were measured in about 50 observation wells during 1988. These low water levels are similar to those measured during the 1978 drought (fig. 4).

In 1988, water levels in wells in the shallow unconfined aquifer declined more than levels in wells completed in the deeper confined dolomite and sandstone aquifer. Water levels in the deeper wells declined from only slight ly to not at all; however, the water-level decline in these wells became more pronounced about 14 months after levels dropped in the shallow-aquifer wells.

WATER USE—1988 CALENDAR YEAR

Irrigation—The amount of water used for irrigation during 1988 increased because the drought occurred during the growing season. Ground water accounts for approximately 98 percent of the water used for irrigation, and permit applications to construct new irrigation wells in 1988 increased by 95 percent for the period June–August. During 1988, the supply of water was usually adequate to operate all irrigation systems. Approximately 95 million gallons per day of ground water were used for irrigation during 1988 compared with 82 million gallons per day in 1985.

During drought years, temporary permits (from 30 to 60 days duration) are issued for the diversion of surface water for use in irrigation. In 1988, about 700 applications for such permits were received by the State, of which 593 were granted. Only 196 of the temporary permits were actually used, however, because of the difficulty in obtaining irrigation equipment. It is estimated that about 3 million gallons per day of surface water were used in 1988 compared with 2 million gallons per day in 1985.

Public Supply—Wisconsin has about 550 public water-supply systems that serve approximately 65 percent of the State's population. Ground water is used as a source for 495 systems and the remaining systems either purchase water from larger suppliers or use surface water. Ground-water supplies were adequate during the 1988 drought, but in many communities water-use restrictions were imposed for uses such as watering lawns and washing cars. Stand-by wells were put into use, and some pumps had to be lowered to compensate for water-level declines.

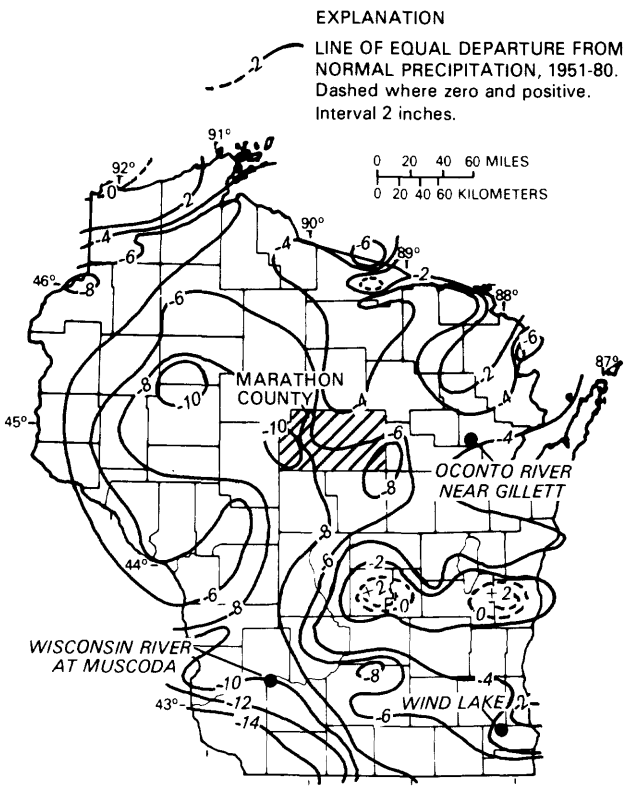

Figure 1. Departure-from-normal (1951–80 calendar years) precipitation in Wisconsin for 1988 calendar year (prepared by Douglas Clark, State Climatologist, University of Wisconsin-Extension).

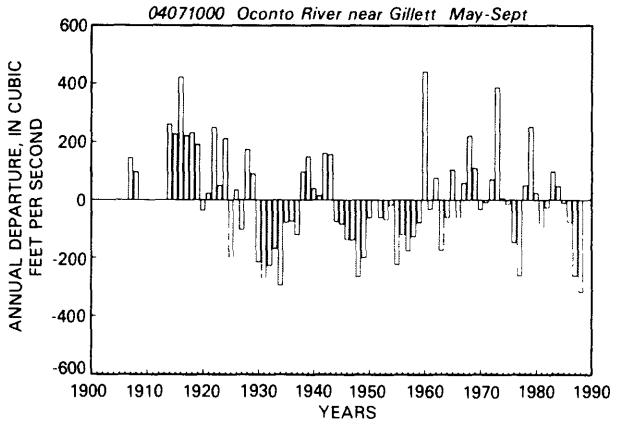

Figure 2a. Annual departure-from-normal May-September streamflow at Oconto River near Gillett.

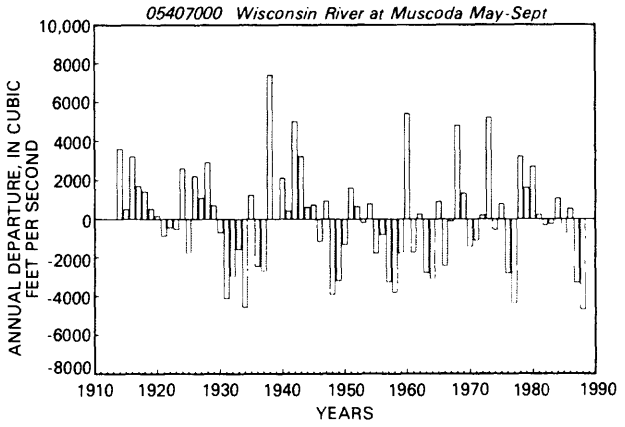

Figure 2b. Annual departure-from-normal May-September streamflow at Wisconsin River at Muscoda.

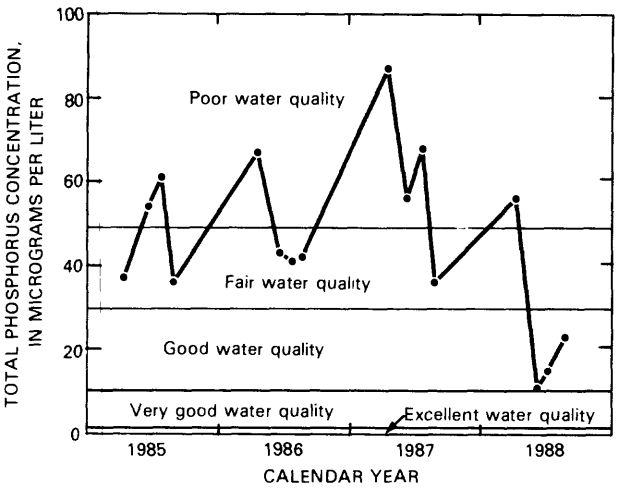

Figure 3. Phosphorus concentrations 1.5 feet below lake surface—April, June, July, and August—at Wind Lake. (Water quality divisions based on data from "Limnological characteristics of Wisconsin lakes," Wisconsin Department of Natural Resources Technical Bulletin 138.)

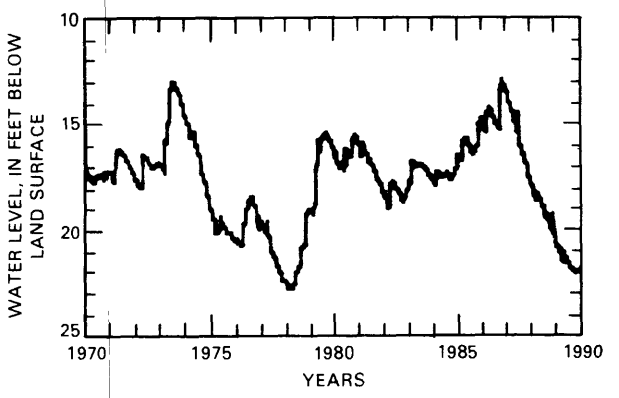

Figure 4. Water levels in the sand- and gravel-aquifer well, Marathon County.

SURRFACE WATER USE—INDUSTRIAL AND THERMOELECTRIC

The use of surface water for self-supplied industrial and thermoelectric purposes increased during the 1988 drought, possibly because of increased water use for cooling during hot weather. Some withdrawal restrictions were imposed because of low streamflow, and some industries had to reduce production because of the inadequacy of surface-water supplies. About 6,300 million gallons per day of surface water were withdrawn in 1988 for thermoelectric power production compared with 5,440 million gallons per day in 1985. Most water withdrawn for thermoelectric power generation is for once-through cooling, and about 99 percent is returned to the stream.

AGRICULTURE

A large deficit in rainfall from April through mid-July 1988 and unusually high temperatures from June through August produced drought conditions that stressed crops and caused crop-related losses. Drought appraisals by personnel of the Wisconsin Agricultural and Conservation County offices indicated that drought-related crop losses in the State in 1988 exceeded $900 million (*Wisconsin State Journal*, 1989).

SUMMARY

The 1988 drought was severe in Wisconsin, and similar droughts appear to occur about every 10 years. On the basis of statewide average rainfall, 1988 was the 14th driest year since 1840. Streamflow on many rivers was far below normal (long-term average) during the summer months, and record low streamflow was recorded on two major streams in the State. These record lows were possibly caused by a combination of one or more of the following factors: low streamflow due to deficient precipitation statewide reduced the flow of all tributary streams; a large amount of water evaporated from many reservoirs; and consumptive use of water for irrigation increased.

SELECTED REFERENCES

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