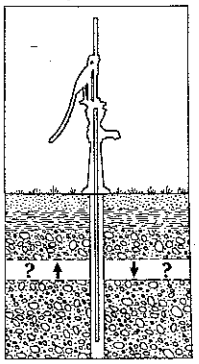
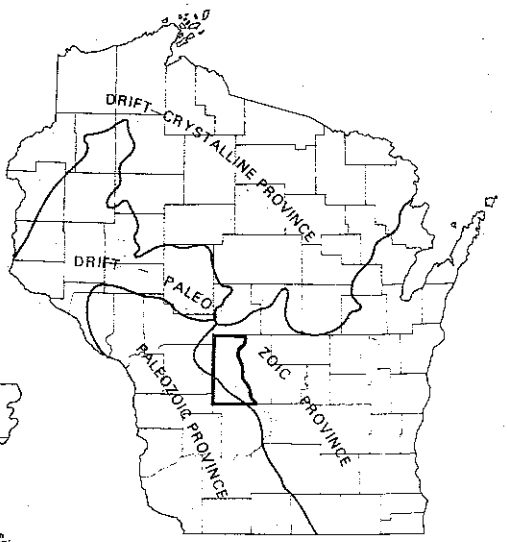
UWEX University of Wisconsin-Extension
GEOLOGICAL and NATURAL HISTORY SURVEY

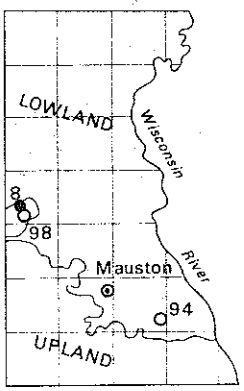


GROUND-WATER LEVELS IN JUNEAU COUNTY

December 1982

Prepared by
Irene Lippelt and Alex Zaporozec





University of Wisconsin-Extension
GEOLOGICAL and NATURAL HISTORY SURVEY
Water Resources Program
1815 University Avenue, Madison, WI 53705-4096
Telephone: (608) 262-1705

WHAT YOU SHOULD KNOW ABOUT GROUND WATER

HOW GROUND WATER OCCURS AND ORIGINATES

Hidden beneath the land surface of the county—below a certain level called the water table—are natural reservoirs full of clean water that we call ground water. Contrary to popular belief, ground water does not flow in veins. There are some underground streams and lakes in cavernous limestone or lava rock, but they are rare and do not occur in your county. Ground water simply fills numerous small openings, pores or cracks in subsurface rocks.

The source of ground water is precipitation. When rain falls or snow melts, the first water is taken by plants and soil. After their thirst is satisfied and after some water runs off into streams, the excess water percolates down and joins the ground water stored in subsurface rocks.

HOW GROUND WATER MOVES

Rocks not only store water, they also transmit it. Upon joining the body of ground water, the percolating water moves through the openings in rocks and is constantly in motion. However, the ground water does not flow as freely and rapidly as water in surface streams. It has to squeeze through the intricate maze of interconnected openings that offer natural frictional resistance to the flow. Therefore, the ground water moves through this system (called an aquifer) very slowly. Flow is measured in feet per day or in feet per year (compared to the flow in streams, which is measured in feet per second).

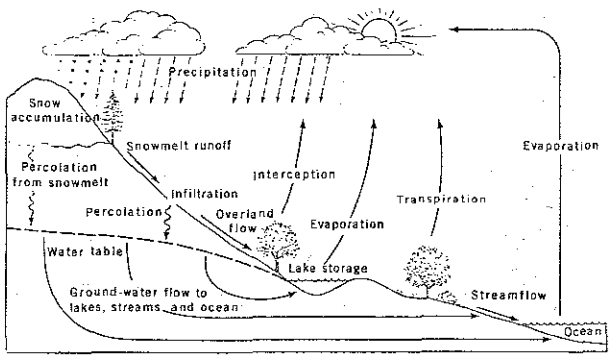
Much of the water in an underground reservoir infiltrates the ground within a radius of a few tens of miles from where it is found. It does not travel for hundreds of miles, and it certainly does not come "all the way from Canada." Most ground water originates within the county, although some comes from adjoining counties. After entering the aquifer, the water tends to move toward lower-lying places—being driven by gravity and difference in pressure between the higher- and lower-lying places—and ultimately discharges into streams or springs. Ground water also can move upward when it is confined under artesian pressure (a pressure higher than atmospheric pressure).

In Juneau County, ground water flows from uplands toward the major streams and ultimately toward the Wisconsin River, which borders the county in the east. In the relatively flat northern part of the county, drainage ditches have a major role in determining the ground-water flow pattern.

WHY STREAMS FLOW IN THE WINTER

Have you ever wondered why streams continue to flow in the middle of winter even though air and ground temperatures are below freezing and even though there is no rainfall? The answer is that winter streamflow is largely ground water continuously seeping into streams, and ground water is relatively warm, having a constant temperature between 46°F to 52°F. This shows that ground water and surface water do not represent isolated systems, as is commonly believed. Nor is ground water isolated from other water in nature's gigantic solar-driven machine, called the hydrologic cycle. After entering a

stream, ground water continues in its path until it reaches its home base, the sea, where the sun causes water to evaporate and rise into the atmosphere. Moisture-laden clouds are blown by winds over the land, clash with cold air and produce rain. The water falls again on the land and replenishes the streams and ground-water reservoirs, thus closing the never-ending water cycle.



Schematic diagram of the hydrologic cycle

(adapted from: Water in Environmental Planning, W.H. Freeman and Co., 1978)

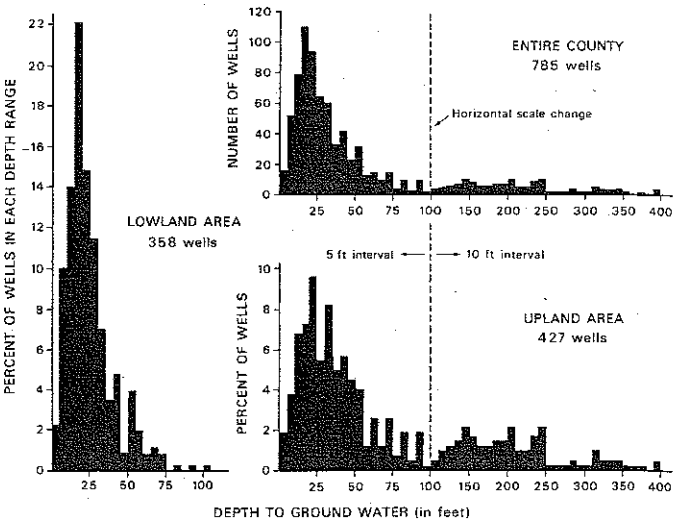
HOW DEEP IS GROUND WATER?

The surface of a ground-water reservoir, the water table, is not the same throughout the county and it varies both in time and place. The water table tends to be closest to the land surface in river valleys and marshes, and at greater depths beneath hills and ridges. It usually resembles a flattened form of the surface relief. Ground-water levels are fluctuating almost constantly, and decline and rise within a relatively short period of time, mainly in response to changes in the amount of rainfall and withdrawal of water from wells. Water levels respond to changes in precipitation only after a certain period of time, depending on the character of rocks and depth to ground water.

Besides short-term fluctuations, variations in precipitation cause seasonal variations of water levels. Water levels rise relatively rapidly in the spring due to recharge from snowmelt and spring rains and then gradually decline throughout the summer when evapotranspiration exceeds precipitation, which means that less water is available for infiltration. A small rise occurs in the fall due to fall rains. It is followed by a decline during the winter, when precipitation is stored on the land surface as snow. In addition, alternating series of wet and dry years produce gradual, long-term changes in water levels.

Juneau County can be divided into two distinct areas, an upland area and a lowland area (see county map on the title page). Generally, ground water is deeper in the upland area and closer to the land surface in the lowland area. More information on the depth of wells and fluctuations of water levels is on the other side.

DEPTH TO GROUND WATER



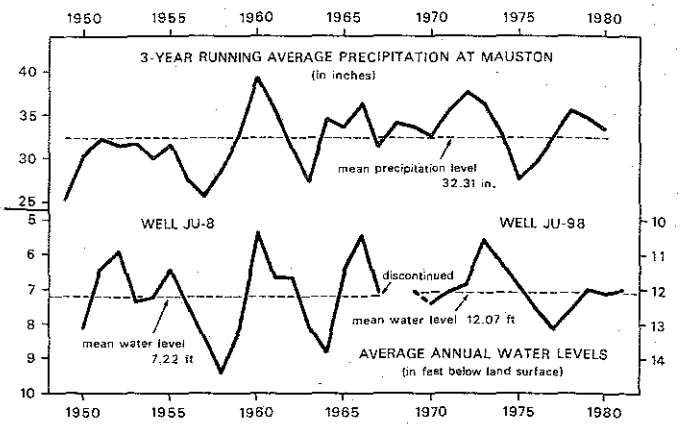
Based on records from water wells, the depth to ground water in the county ranges from 5 to 400 feet below the land surface in the upland area, and from 1 to 110 feet in the lowland area. The histograms above show the distribution of the depth to ground water. In the majority of wells, the water levels are between 5 to 55 feet below the land surface. In the upland areas, about one fourth of the wells have water levels deeper than 100 feet. In the lowlands, only occasionally is the water level deeper than 75 feet, and about two thirds of the wells have water levels closer than 25 feet to the land surface.

HISTORICAL TRENDS IN WATER LEVELS

Some of the wells in Juneau County are included in a statewide network of observation stations where the changes in water levels are measured at regular intervals. One of the main purposes of collecting these data is to determine the relationship of precipitation and other natural factors to fluctuations in water level. This relationship is best observed on wells with a long period of measurements, at least 20-25 years. Since the longest continuous period of measurements in this county is only 18 years, hydrographs of wells Ju-8 and Ju-98 (which are only one half of a mile apart) were combined to show the long-term trends in water levels. (See graph on top of next page.)

The similarity of the water-level record for wells Ju-8 and Ju-98, obtained during a period of 32 years, and the three-year running average of precipitation at Mauston shows the dominant role that precipitation plays in water-level fluctuations.

The water level in well Ju-98, which is typical of wells on the border between the upland and lowland areas of the county, does not respond immediately to individual rains, but rather to the cumulative amount of precipitation during the



10 to 12 preceeding months. The wells in the lowland areas, however, would respond more immediately to the amount of rainfall. Near river channels, the ground-water levels may rise abruptly, responding within a few days, or even hours, to a heavy rainfall and corresponding rise in the river stage.

The similarity between trends in precipitation and trends in water levels permits both the estimate of future behavior of ground-water levels and the reconstruction of past water-level fluctuations from precipitation graphs for earlier periods without water-level records.

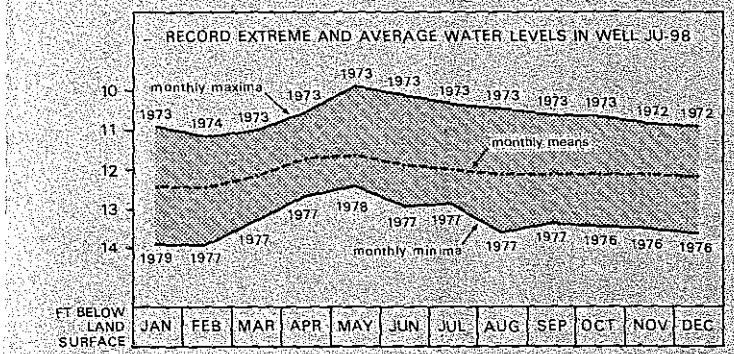
No long-term changes in water level are apparent from the hydrographs above, although there is a slightly increasing trend since the late 1950s. The ground-water level fluctuates within three feet from the average level, and was nearly the same in 1981 as it was 30 years ago. This indicates that over a long-term period, natural changes are in balance. Following a period of less than normal precipitation in the late 1940s and 1950s, ground-water levels declined to the record low in 1958. Other periods of precipitation caused similar declines in ground-water levels in 1964, 1970, and 1977. These declines were offset by significant rises in 1960, 1966, and 1973. The lows and peaks have approximately the same interval of 6 to 8 years.

EXTREME WATER LEVELS

The change from high to low ground-water levels is irregular and usually gradual. For example, ground-water levels do not change as quickly as yearly rainfall totals, which can change from extremely high one year to extremely low the next. Minimal ground-water levels do not occur immediately after maximum ground-water levels and vice verse. At least one year of moderate ground-water levels, and more usually several years of such levels, intervene between the years of extreme levels.

On well Ju-8, the record minimum monthly levels occurred in 1958-59, and the record maximum monthly levels in 1965-66. Lows and peaks on well Ju-8 come about 1-2 months later than on well Ju-98: in March, and in June and July, respectively.

Most often the lowest monthly levels on well Ju-98 were recorded in 1976 and 1977, and the highest levels in 1973 (see graph below). Minimum water levels generally occur from December to February, and maximum water levels are usually attained in April and May.



SUMMARY DATA FOR OBSERVATION WELLS JU 8 & 98

Characteristics	Feet below land surface Ju-8	Ju-98	Date Ju-8	Ju-98
Mean Water Level	7.22	12.07	(calculated)	
Highest Recorded Level	3.48	9.86	11/30/65	5/24/73
Lowest Recorded Level	10.80E	13.90	Feb./59	1/10/79
Maximum Range of Fluctuations	7.32	4.04	(calculated)	
Average Annual Fluctuation	2.88	1.40	(calculated)	
Highest Monthly Mean	6.49	11.64	July	May
Lowest Monthly Mean	8.22	12.44	March	February
Highest Average Annual Level	5.43E	10.64	1960	1973
Lowest Average Annual Level	9.41	13.15	1958	1977

OBSERVATION WELLS IN JUNEAU COUNTY

Well Number	Location	Measur. Started
Ju-8	Town of Orange, SW¼ SW¼ Sec. 21; at Camp Douglas. *Discontinued:*	1949 1967
Ju-94	Town of Lemonweir, NE¼ NW¼ Sec. 25; 6 miles SE of Mauston.	1964
Ju-98	Town of Orange, NW¼ NE¼ Sec. 28; at Camp Douglas.	1969

AVAILABILITY OF DATA

The water-level measurement program is a cooperative project of the U.S. Geological Survey and the Wisconsin Geological and Natural History Survey. Precipitation data, and data on water-level measurements for all observation wells are available at:

GEOLOGICAL and NATURAL HISTORY SURVEY
1815 University Avenue, Madison, WI 53705-4096
Telephone: (608) 262-1705