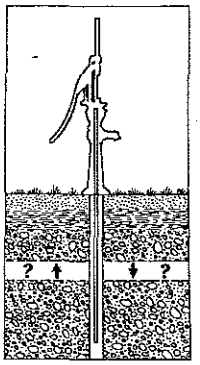
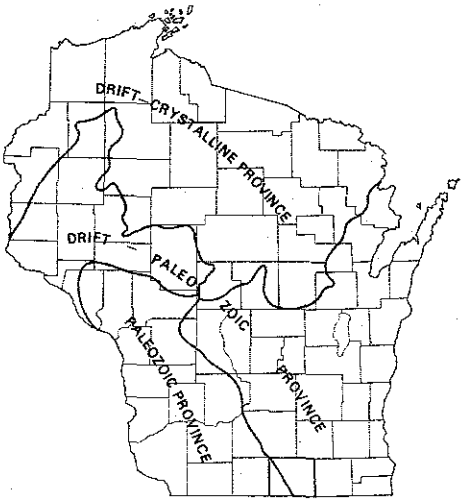
University of Wisconsin-Extension
GEOLOGICAL AND NATURAL HISTORY SURVEY

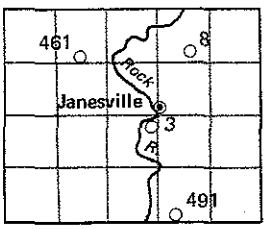


GROUND-WATER LEVELS IN ROCK COUNTY

July 1981

Prepared by Alex Zaporozec





University of Wisconsin-Extension
GEOLOGICAL AND NATURAL HISTORY SURVEY
Water Resources Program
1815 University Avenue, Madison, WI 53706
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).

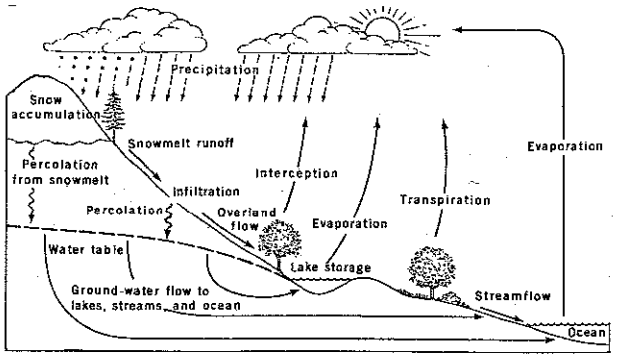
Much of the water in an underground reservoir infiltrates the ground within a radius of a few tens of miles from where it is found. It does not travel for hundreds of miles, and it certainly does not come "all the way from Canada." Most ground water originates within the county, although some comes from adjoining counties. After entering the aquifer, the water tends to move toward lower-lying places—being driven by gravity and a 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 Rock County, ground water flows from uplands toward the major streams and ultimately toward the Rock River. Only in the western and southwestern townships is the flow of ground water toward the Sugar River.

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)

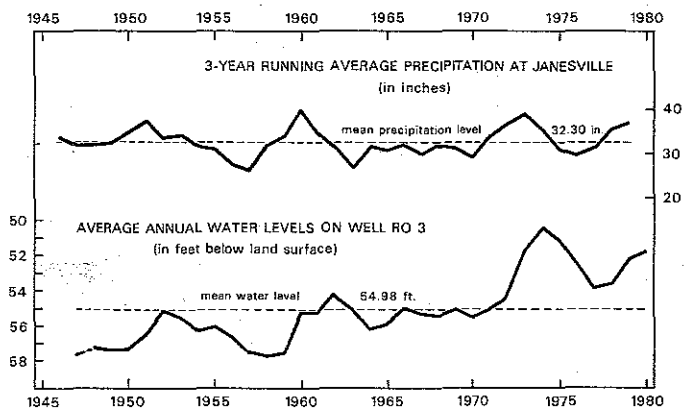
HOW DEEP IS GROUND WATER?

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.

Based on records from water wells, the depth to ground water in the county ranges from 1 to 150 feet below the land surface. In most of the county, water levels are between 10 and 70 feet. Only occasionally does the water level drop below 100 feet or rises above the land surface in an artesian well. Some of the wells in the county are included in a statewide network of observation stations where the changes in water levels are measured at regular intervals (see information on the other side).

HISTORICAL TRENDS IN WATER LEVELS



One of the main purposes of collecting data on water levels in observation wells is to determine the relationship of precipitation and other natural factors to fluctuations in water levels. Alternating series of wet and dry years, in which rainfall is above or below the average, will produce long-term fluctuations of water levels. A continual decline in water levels results from the lack of precipitation when discharge of ground water to streams, springs, and wells exceeds recharge by precipitation. Water levels usually rise when recharge is greater than discharge.

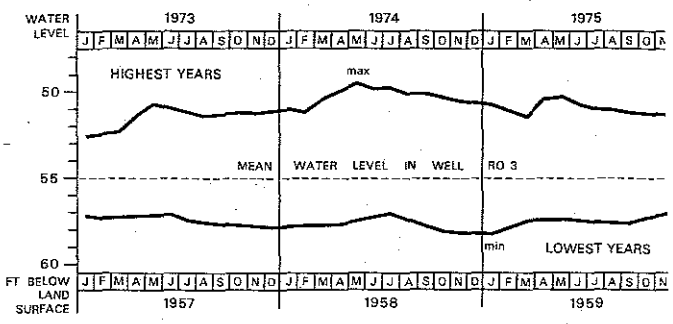
The similarity of the water-level record on well Ro 3, obtained during a period of 33 years, and the 3-year running average of precipitation (each successive average is obtained by moving the 3-year period forward one year) shows the dominant role that precipitation plays in water-level fluctuation. It is possible that the true magnitude of fluctuations in the period 1947-1950 may have been obscured by pumping that ceased in 1951.

The water level in well Ro 3, which represents typical ground-water conditions in much of the county (stable ground-water storage capacity), does not respond immediately to individual rainfalls but rather to the cumulative amount of precipitation during the preceding years. The wells in low-lying areas, however, respond directly to the amount of rainfall within a few days. Near river channels, the water levels in shallow wells may rise abruptly, responding within a few hours or even minutes to the increase in river water during the period of floods.

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.

The trend of average annual water levels on well Ro 3 has been generally increasing, with several lows and peaks. After the low in the late 1940's, the water levels recovered briefly in 1951-53 before reaching the record minimum in the late 1950's. Steady increase since 1959 has been interrupted by two peaks in 1962 and 1974 and by two lows in 1964 and 1977.

HIGH AND LOW WATER LEVELS



An understanding of fluctuating ground-water levels is important for agriculture, the general economy, and water suppli of the county. Extended periods of low levels considerably deplete soil moisture and ground-water storage, which may result in crop damage and reduced crop production, drying up of shallow wells and wetlands, possible water rationing, emergency well drilling, or hauling water to water-short areas. High levels, on the other hand, may cause waterlogged soils in low areas, and flooding of basements, septic tank systems, landfills, and construction sites, which may eventually create water quality problems.

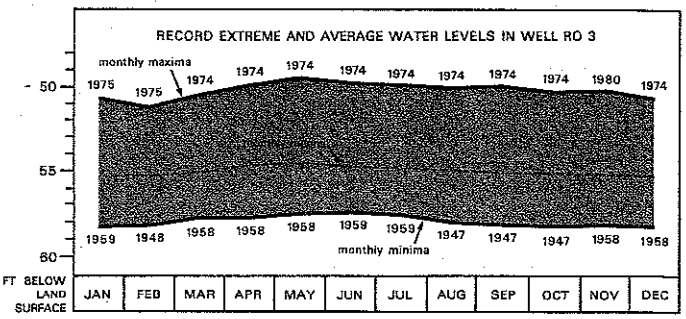
The change from low to high ground-water levels is irregulai and usually gradual. Ground-water levels do not vary like the total amount of rainfall, for example, which can change from extremely low to extremely high from one year to another. Minimal water levels do not occur immediately after maximum levels and vice versa. A number of years intervene with moderately low or high levels in between.

Generally, the interval between low or between high levels ranges from four to ten years. Average interval on well Ro 3 is five years. From the practical point of view, the extremely low and extremely high levels are of greatest significance. On well Ro 3, the longest duration of extremely low water levels was from January 1957 through September 1959; and the period of extremely high water levels lasted from April 1973 to January 1976.

EXTREME WATER LEVELS

The range of ground-water fluctuations is important for the management of water supplies in the county. Maximum difference in water levels which can be expected over a long period of time is about 20 feet. The annual fluctuations of wells that respond slowly to precipitation, such as Ro 3, are fairly uniform and are, on the average, between one and five feet. In rapidly responding wells, the annual range may be about twice this (2-10 feet). Maximum fluctuations in wells are small as compared to the saturated thickness of the aquifers and should not affect the overall ground-water availability in the county. Water use by municipalities and agriculture has not had a significant effect on ground-water levels either.

The lowest levels on well Ro 3 were recorded in the late 1940's and 1950's and the highest levels in the middle 1970's. Minimum water levels occur in January and February, and maximum water levels are usually attained in April and May.



SUMMARY DATA FOR OBSERVATION WELL RO 3

Characteristics	Feet below land surface	Date
Mean Water Level	54.98	(calculated)
Highest Recorded Level	49.88	July 22, 1974
Lowest Recorded Level	58.29	Sept. 3, 1947
Maximum Range of Fluctuations	8.41	(calculated)
Average Annual Fluctuation	1.22	(calculated)
Highest Monthly Mean	54.57	May
Lowest Monthly Mean	55.28	January
Highest Average Monthly Level	49.55	May 1974
Lowest Average Monthly Level	58.27	October 1947
Highest Average Annual Level	50.34	1974
Lowest Average Annual Level	57.77	1958

OBSERVATION WELLS IN ROCK COUNTY

Well Number	Location	Measur. Started
Ro 3	Tn. of Rock, SW¼ NE¼ Sec. 2; at Janesville.	1947
Ro 8	Tn. of Milton, SE¼ SE¼ Sec. 27; in Milton.	1952
Ro 461	Tn. of Porter, NW¼ SW¼ Sec. 33; 3 miles E of Evansville.	1975
Ro 491	Tn. of Turtle, SE¼ NW¼ Sec. 32; 1 mile N of state line.	1979

AVAILABILITY OF DATA

The water-level measurement program is a cooperative project of the U.S. Geological Survey and Wisconsin Geological and Natural History Survey. The Rock County Office of the University of Wisconsin-Extension cooperates on the measurement of observation wells in the county. Data on water-level measurements for all wells are available at:

GEOLOGICAL AND NATURAL HISTORY SURVEY
1815 University Avenue, Madison, WI 53706
Telephone: (608) 262-1705