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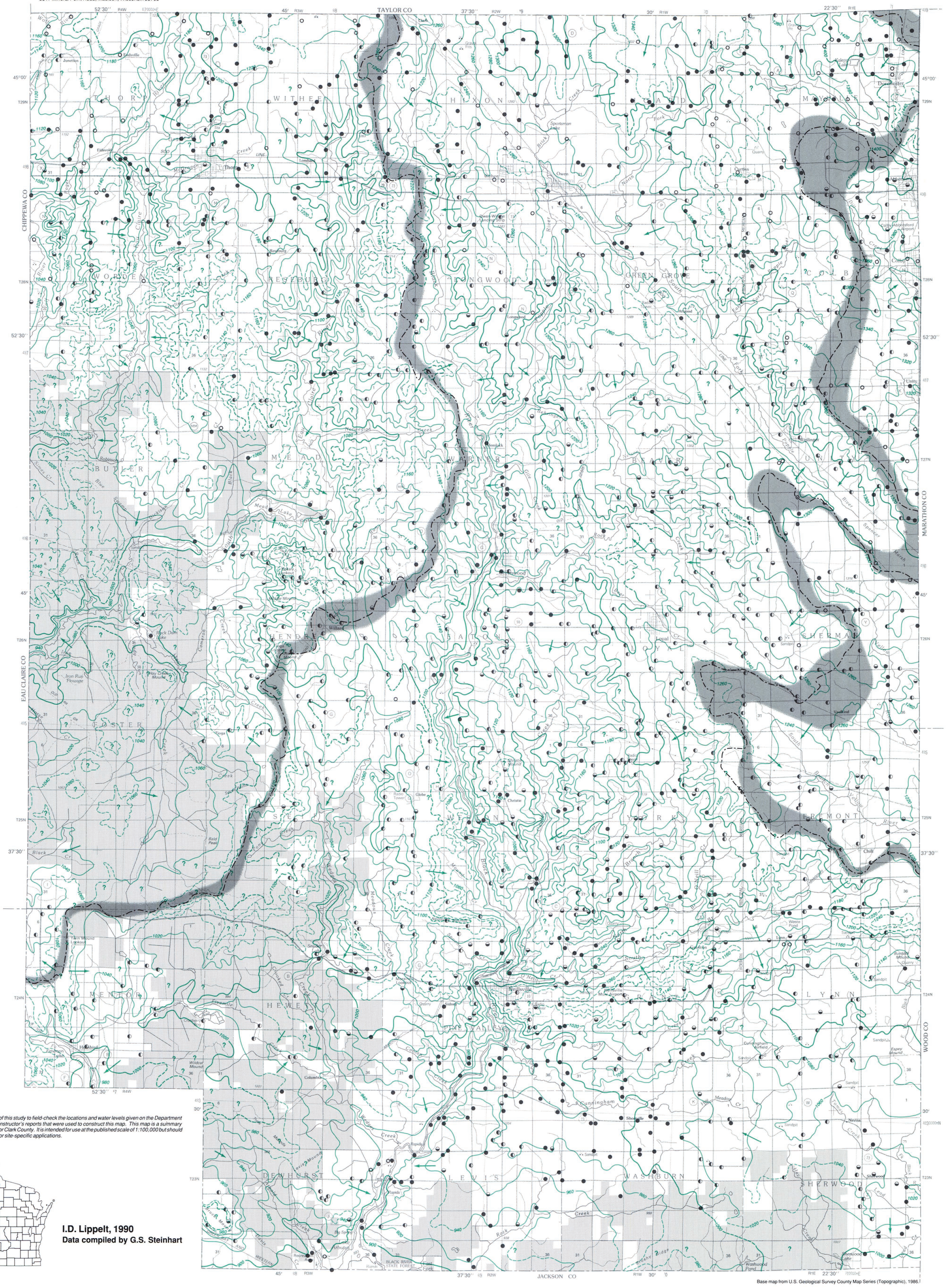
Generalized Water-Table Elevation Map of Clark County, Wisconsin



Base map from U.S. Geological Survey County Map Series (Topographic), 1986.

It was beyond the resources of this study to field-check the locations and water levels given on the Department of Natural Resources well constructor's reports that were used to construct this map. This map is a summary of available water-level data for Clark County. It is intended for use at the published scale of 1:100,000 but should not be considered definitive for site-specific applications.

I.D. Lippelt, 1990
Data compiled by G.S. Steinhart

Introduction

This map is part of the Clark County Groundwater Resource Investigation, a joint project of the Wisconsin Geological and Natural History Survey and the Clark County Board and its Land Conservation Committee. The intent of this project was to compile and interpret hydrogeologic data for Clark County. The resulting information can be used by Clark County's soil-and-water-resource and land-use planners.

Development of this project was coordinated in Clark County by University of Wisconsin Extension agents Arv Dopp (Agriculture Agent) and M.E. (Mary Ellen) Sjolin (Home Economist), and former County Conservationist Keith Foye.

The water cycle

Gravity and solar energy play active roles in a continuous water recycling process called the *water cycle* (fig. 1).

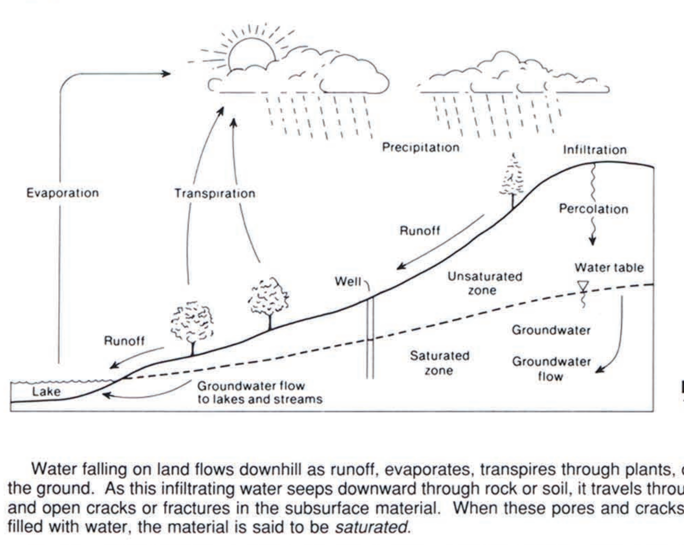


Figure 1.
The water cycle.

Water falling on land flows downhill as runoff, evaporates, transpires through plants, or infiltrates into the ground. As this infiltrating water seeps downward through rock or soil, it travels through pore spaces and open cracks or fractures in the subsurface material. When these pores and cracks are completely filled with water, the material is said to be *saturated*.

The *water table* is the surface of this saturated zone, where hydraulic pressure is equal to atmospheric pressure. *Groundwater* is the water contained in the saturated zone below the water table. The amount of infiltrating precipitation partly determines the position, or elevation, of the water table, which fluctuates seasonally, and from one year to another. Above the water table, pores and cracks are partly or completely filled with air, and the material is said to be *unsaturated*.

Gravity moves groundwater slowly through pore spaces; eventually, the groundwater discharges to a well, the land surface, or a water body where solar energy evaporates some of it into the atmosphere, thus continuing the water cycle.

In Wisconsin, the water cycle generally operates with 30 to 32 inches of precipitation during an average year, from which about 75 percent (22 to 26 inches) returns to the atmosphere by evapotranspiration. The remainder either flows over the land surface and collects in surface water bodies or infiltrates into the ground as *recharge* to the groundwater system. The ratio of surface runoff to groundwater recharge varies considerably around the state, depending upon factors such as topography, soil type, vegetative cover, rainfall intensity, and individual farming and general land-use practices.

Movement of groundwater and surface water

If a saturated subsurface material yields a sufficient quantity of water to a well, the material is called an *aquifer*. The upper boundary of an *unconfined aquifer* is the water table, not a confining layer of relatively impermeable material such as clay. *Permeability* is a measure of the relative ease with which water can flow through an aquifer; it is dependent on the nature of the materials through which the water is flowing. Large pores or fractures in the subsurface can hold more water than small ones, but in order for water to flow, these pores or fractures must be interconnected.

Groundwater can move as quickly as several feet per day in porous sand, or as slowly as less than 1 inch per year in clay or in dense crystalline rock. For example, sandy soils may have relatively large pore spaces that are well connected with each other, allowing water to move more easily than it can in clayey soils that have small, poorly connected pores. Rocks such as crystalline granite commonly have few, poorly connected fractures; as a result they commonly have a low permeability and transmit little water. However, no matter how rapidly or slowly the groundwater flows, its natural direction of movement is in response to gravity, from upland recharge areas (where water infiltrates into the subsurface) to lowland discharge areas (lakes, rivers, springs, and seeps). Discharge areas are often associated with surface-water bodies, so groundwater has a significant role in the development and environmental health of lakes, streams, and wetlands.

A *surface-water divide* is a line of separation, commonly a ridge or narrow tract of high ground that divides the surface waters that flow naturally in one direction from those that flow naturally in a different (often opposite) direction. It is a line across which no surface water flows. There are two major surface-water divides in Clark County. East of the eastern divide, streams flow southeast to the Wisconsin River, including the Yellow River, the South Branch of the Yellow River, Dill Creek, and other minor creeks and tributaries. West of the western surface-water divide, surface waters flow into the Eau Claire River. Streams in this area include the North and the South Forks of the Eau Claire River and creeks such as Hay Creek. In the central part of Clark County, between the surface-water divides, flow is into the Black River and its tributaries. The Black River flows south to the Mississippi River.

A *groundwater divide* is similar to a surface-water divide in that it is a ridge defined by contours of the water table. Shallow groundwater moves away from the divide in different (often opposite) directions. A groundwater divide does not necessarily coincide with a surface-water divide. There are two major groundwater divides in Clark County and they generally coincide with the surface-water divides. In the central part of Clark County, discharge points include the south-flowing Black River and its tributaries. East of the eastern groundwater divide, discharge points include the Yellow River, the South Branch of the Yellow River, and various creeks, including Dill Creek; all flow into the Wisconsin River to the southeast. West of the western groundwater divide, discharge points include the North and the South Forks of the Eau Claire River and their tributaries, which flow into the Eau Claire River to the west.

Contamination of groundwater

Because groundwater comes from water that percolates down from the land surface, any water-soluble material or liquid that is put on or in the ground has the potential to be transported to the groundwater. Soil is usually a good natural filter, removing many harmful materials from the recharging water as it moves downward. Areas of thin or sandy soils over a rock aquifer or thin or sandy soils with a shallow water table are especially susceptible to groundwater contamination from land-use activities. Thin or sandy soils do not effectively remove many potential contaminants contained in liquid or solid waste products, or in other materials — such as road salt, manure, chemical fertilizers, pesticides, and herbicides — that are applied to the land surface. Once a contaminant reaches the water table, very little attenuation takes place; dilution will reduce the concentration of contaminants but will not remove them.

Because groundwater can move as slowly as a few inches per year, contamination that occurs today may not become evident for several or even hundreds of years. Once contaminated, groundwater is difficult to purify and may take many years, decades, or centuries to become uncontaminated.

Data compilation and interpretation

Data were compiled at a scale of 1:24,000, using United States Geological Survey quadrangles (7.5-minute series, topographic) as base maps. All available Wisconsin Geological and Natural History Survey geologic logs were plotted onto these base maps. The Wisconsin Department of Natural Resources well constructor's reports were examined and checked against each other, and the most representative, reliable, and useful data available for each section were plotted. Data density varies considerably across Clark County, with very few data points on county-owned lands to a density of at least one report per 2 square miles in inhabited parts of Clark County.

Because well constructor's reports provide measurements taken at different times of the year and in different years, a water level determined from a well constructor's report was not usually used as an exact data point. Instead, the water level was considered to be part of a range of values. The elevations of springs, groundwater seepage areas (such as wetlands), lakes that intersect the water table, and rivers were used as data points in most areas.

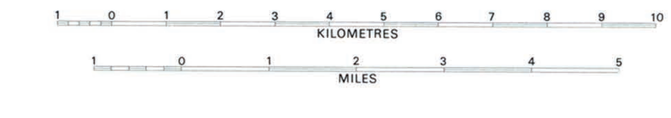
Clark County is underlain by crystalline rock (commonly referred to as granite) of Precambrian age, which is overlain in places by a thin veneer of Cambrian sandstone and/or a small amount of shale. Pleistocene deposits (thin in most places) consist of sandy to silty till deposited prior to the late Wisconsin; these deposits overlie most of Clark County. Although the geology is complex, the water table closely mimics topography, suggesting connections between the fractured granite, the sandstone/shale, and the surficial deposits. The shallow groundwater system appears to be a single unconfined aquifer at this scale despite local geologic complexity.

Most wells in Clark County are completed in bedrock. Because the sandstone is usually able to yield more water than the granite, the sandstone appears to be the aquifer of choice when it is available. In areas where the sandstone is thin, wells may be completed in the granite and are commonly open to the granite and the sandstone. Wells open to sandstone and granite commonly obtain the major part of their yield from the sandstone. Wells that are only open to the granite generally have low yields (less than 5 gallons per minute) and large drawdowns (more than 50 feet and as much as several hundred feet).

Limitations of the map

Because shallow groundwater flow is primarily perpendicular to lines of equal water-table elevation, this map shows a generalized picture of the direction of shallow groundwater flow. "Shallow" refers to depth below the water table, and not to depth below the land surface. The accuracy of the interpretation varies throughout the study area, increasing with greater data density, and decreasing with greater hydrogeologic complexity. The water-table elevation lines are solid where enough data are available to locate the lines with a reasonable degree of confidence (within ±0.3 mile on the map). The lines are dashed where data are less abundant or where hydrologic conditions are more complex and their location is considered to be accurate to within ±0.7 mile on the map. In areas where question marks appear on the map, such as the tops of hills, data are insufficient to interpret water-table elevation.

Scale 1:100,000



Explanation

1020	average elevation of water table in feet, solid where considered accurate within ±0.3 mile on the land surface; dashed where considered accurate within ±0.7 mile on the land surface; 20-ft contour interval. Datum is mean sea level.
?	elevation of water table unknown; insufficient data
	surface-water divide
	groundwater divide, approximately located
	general direction of shallow groundwater flow
	county-owned land

Geologic materials contributing water to well (all geologic determinations are based on Department of Natural Resources well constructor's reports on file at the Wisconsin Geological and Natural History Survey)

○	sand and/or gravel
◐	sandstone and/or shale and 0 to 5 feet of granite
◒	sandstone and/or shale and more than 5 feet of granite
●	granite and/or soapstone or soap rock (well driller's terminology)

Data have not been field checked. Water-table elevation data were generalized from information collected over a period of approximately 50 years.

Sources of data

United States Geological Survey quadrangles (7.5-minute series, topographic; 1969-85) were used to determine surface-water and well-water elevations

Water-level observation wells from the Groundwater Level Monitoring Network operated and maintained by the United States Geological Survey and Wisconsin Geological and Natural History Survey

Wisconsin Department of Natural Resources well constructor's reports (1936-87)

Wisconsin Geological and Natural History Survey published and unpublished geologic logs (1896-1988)

Cartography by D.L. Patterson

Miscellaneous Map 33