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MAJOR AQUIFERS IN AURORA AND JERAULD COUNTIES, SOUTH DAKOTA

by

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ABSTRACT

Five major glacial aquifers and three major bedrock aquifers underlie much of the 1,236 square miles of Aurora and Jerauld Counties, south-central South Dakota. The glacial aquifers generally are penetrated within 200 feet of the land surface and the bedrock aquifers from 100 feet to a maximum of 1,300 feet in the northwestern part of the study area.

The glacial aquifers can yield as much as 1,000 gallons per minute to a well. Well yields for bedrock aquifers vary greatly. Yields for the Niobrara and Codell aquifers generally range between 2 and 75 gallons per minute, but a densely-fractured part of the Niobrara has yielded 1,500 gallons per minute. Reported yields for the Dakota aquifer are as large as 150 gallons per minute.

The water yielded by glacial aquifers generally is very hard (hardness concentrations greater than 180 milligrams per liter) and has concentrations of dissolved solids ranging from 700 to 3,300 milligrams per liter. The Niobrara and Codell aquifers yield soft to moderately hard water (hardness concentrations less than 120 milligrams per liter) and the Dakota aquifer yields very hard water that has a maximum hardness of 1,400 milligrams per liter. The concentration of dissolved solids ranges from 1,100 to 2,400 milligrams per liter for water from bedrock aquifers.

INTRODUCTION

This information pamphlet is one of a series of reports on water-resources studies of South Dakota counties. It is designed to acquaint the reader with the general distribution, quantity, and quality of ground water available from the major aquifers in Aurora and Jerauld Counties. A comprehensive report to be published later will contain additional information on the hydrology and geology of the area. Information in this pamphlet is based on data (fig. 1) collected by the U.S. Geological Survey and the South Dakota Geological Survey between 1976 and 1980.

Copies of this publication and other county reports may be obtained from the South Dakota Geological Survey as they become available. Persons wishing additional information about the hydrology and geology may contact the U.S. Geological Survey in Huron, South Dakota, or the South Dakota Geological Survey in Vermillion, South Dakota.

The inch-pound units used in this report may be converted to metric units by the following conversion factors:[1]

DEFINITION OF TERMS

Aquifer.--A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Artesian aquifer.--A confined aquifer where water in a well completed in the aquifer rises above the top of the aquifer.

Basement rock.--A general term for granite, quartzite, and other dense, relatively impermeable rocks that are considered to be the base of the hydrologic system.

Bedrock.--A general term for the rock, usually consolidated, that underlies soil, sand, clay, or other unconsolidated material. In Aurora and Jerauld Counties the uppermost bedrock is shale or chalk.

Dissolved solids.--The sum of all dissolved material in water, expressed as the weight (milligrams) of solute per unit volume (liter) of water.

Glacial aquifer.--As used in this report, an aquifer consisting mainly of unconsolidated sand and gravel deposited as outwash from a glacier.

Glacial outwash.--Stratified sorted, unconsolidated rock material (usually sand and gravel) that has been washed and deposited by water from melting glacial ice.

Hardness.--Dissolved calcium and magnesium that

[1]Multiply inch-pound	By	To obtain metric unit
foot (ft)	0.3048	meter
gallon per minute (gal/min)	0.06309	liter per second
mile	1.609	kilometer
square mile (mi^2)	2.590	square kilometer

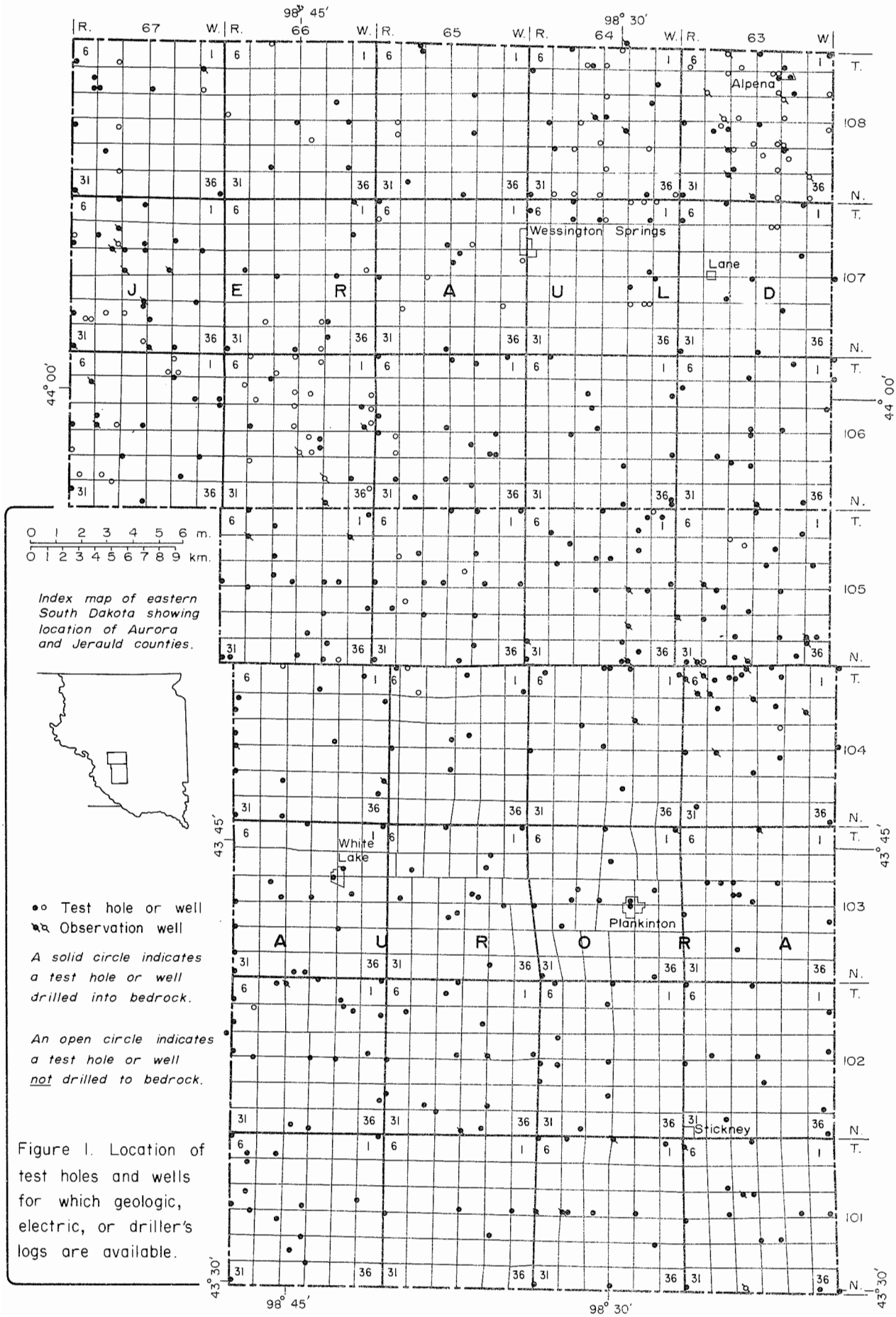

Figure 1. Location of test holes and wells for which geologic, electric, or driller's logs are available.

reduce the lathering ability of soap and form scale in boilers and pipes. Hardness is reported as calcium carbonate and is classified by the U.S. Geological Survey as follows:[2]

Large-capacity well.--Defined by South Dakota law as a well capable of yielding at least 18 gallons per minute on a sustained basis.

Properly-constructed well.--A well constructed to transmit the maximum amount of water from an aquifer without excessive drawdown of water level at the well. This usually involves installing a well screen or perforating the casing opposite the aquifer. It also involves developing the well in such a manner as to remove drilling mud and other fine-grained material from the aquifer adjacent to the well.

Saline water.--As used in this report, water that contains more than 1,000 milligrams per liter of dissolved solids.

Till.--An unsorted, unstratified mixture of clay, silt, sand, gravel, and boulders deposited by a glacier.

GLACIAL AQUIFERS

Glacial aquifers in the 1,236-mi^2 study area in south-central South Dakota are composed of water-yielding sand and gravel deposits that are as much as 100 ft thick. Some of the sand was deposited by streams that drained the Black Hills of western South Dakota. However, most of the sand was deposited with gravel as glacial outwash. Later, the advancing glacier covered the outwash with till. This sequence repeated many times to produce interlayering of till and outwash.

Five major glacial aquifers underlie nearly 25 percent of Jerauld and Aurora Counties (fig. 2). In 1978, the Crow Creek, Warren, and Crow Lake aquifers, mostly in Jerauld County, supplied 15 irrigation wells in addition to domestic and livestock wells. In Aurora County, the Corsica and White Lake aquifers supplied only domestic and livestock wells.

Depths to the top of the Crow Creek, Crow Lake, Warren, and White Lake aquifers range from 5 to 200 ft below land surface. The deeper aquifers are composed of one to three layers of sand and gravel that are separated by as much as 50 feet of till.

The top of the Corsica aquifer occurs 100 to 400 ft below land surface, within a broad channel eroded into shale bedrock. The aquifer is composed of as many as five separate sand and gravel units. Locally, some of the deepest units of the Corsica aquifer lie next to or on sandstone of the Codell bedrock aquifer. When drilling in these places, it can be difficult to distinguish between cuttings of material from the two aquifers.

Although the thickness of glacial aquifers can vary greatly over distances of a few tenths of a mile, the average thickness of most aquifers is between 20 and 40 ft. The average thickness of the White Lake aquifer probably is between 10 and 20 ft.

Glacial aquifers in the study area generally are much more porous and permeable than the bedrock aquifers and consequently can yield water more readily to wells. Yields of as much as 1,000 gal/min can be obtained from a properly-constructed well where the aquifer consists of at least 30 ft of well-sorted, coarse sand and gravel.

Water in the aquifers generally occurs under artesian conditions, being confined by less-permeable till or alluvium. However, water in aquifers in and near stream valleys can occur under water-table conditions. Depth to water in nonpumping wells generally is within 50 ft of land surface. Water levels in the Corsica aquifer are deeper than 50 ft and are about 200 ft below land surface for wells completed in the deepest aquifers layers.

Water from the glacial aquifers generally is of the calcium bicarbonate sulfate type. Concentrations of dissolved solids generally range from 700 to 1,400 mg/L and the hardness of the water ranges from 250 to 800 mg/L. However, water from the Corsica aquifer is slightly saline and of the sodium calcium sulfate type. Concentrations of dissolved solids in the Corsica water range from 1,800 to 3,300 mg/L and the hardness ranges from 600 to 800 mg/L. Slightly saline water may not be suitable for irrigating many types of soil in the area.

BEDROCK AQUIFERS

Three major bedrock aquifers supply most of the municipal, domestic, and livestock wells in Aurora and Jerauld Counties. The aquifers, in order of increasing depth, are the Niobrara, Codell, and Dakota. Water from bedrock aquifers generally is

[2] Description	Milligrams per liter	Grains per gallon
Soft	0- 60	0- 3.4
Moderately hard	61-120	3.5- 7.0
Hard	121-180	7.1-10.5
Very hard	More than 180	More than 10.5

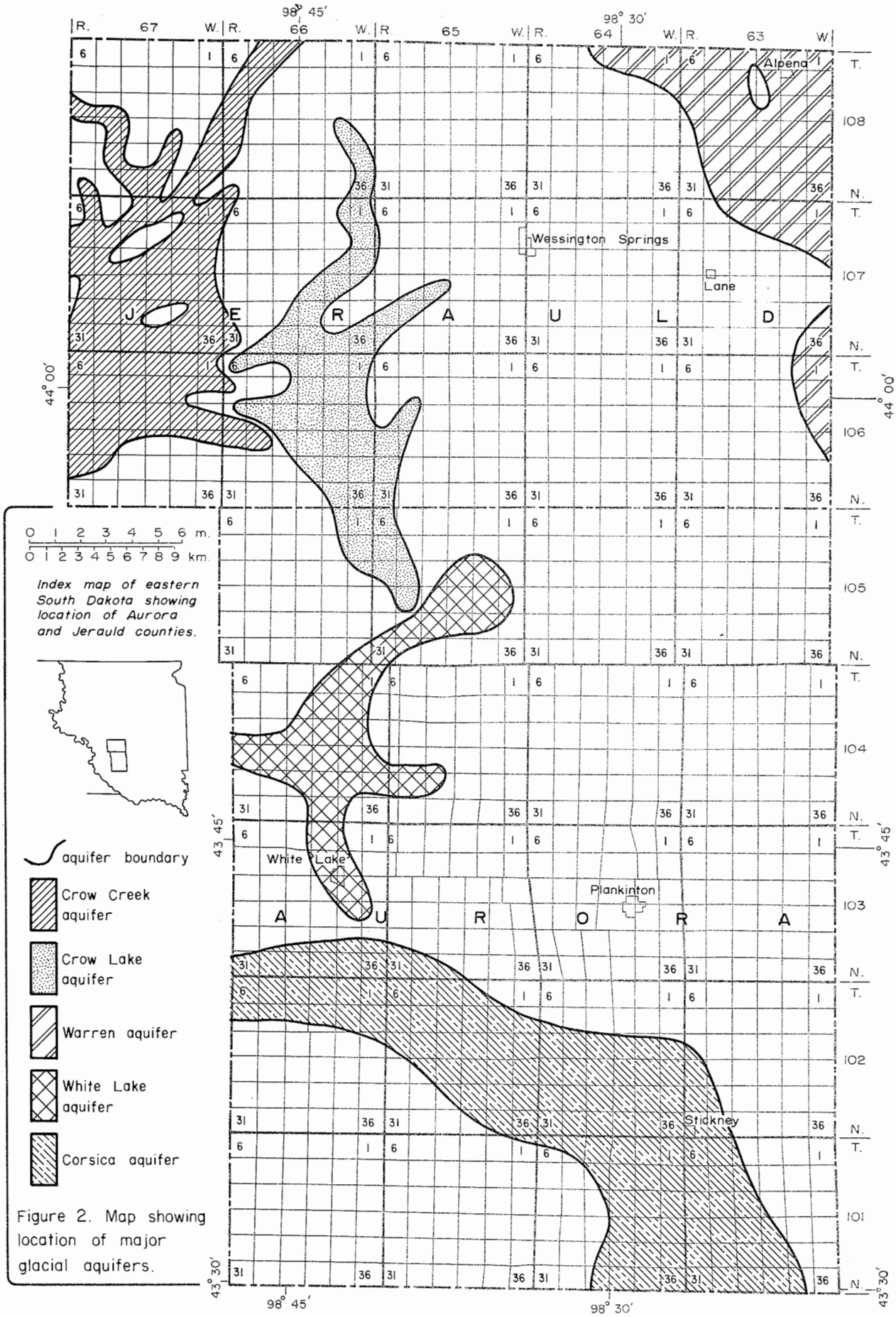

Figure 2. Map showing location of major glacial aquifers.

slightly saline and is not used for irrigation because the chemical quality is unsuitable for application on many types of soil in the area.

Niobrara Aquifer

The Niobrara aquifer, called "chalk" or "chalkstone" by drillers, underlies most of Aurora and Jerauld Counties. Depths to the top of the aquifer increase from 100 ft in the eastern part to 300 ft in the southwestern part and 800 ft in the northwestern part of the study area.

The aquifer consists of as much as 140 ft of chalk, calcareous claystone or marl, and calcareous shale. The yield of wells ranges from 2 to 10 gal/min in most of the area. However, in sec. 6 of T. 104 N., R. 63 W. an irrigation well pumped 1,500 gal/min from the aquifer. The Niobrara, within a mile of this irrigation well, consists of a brittle, densely-fractured chalk and marl that is very permeable.

The Niobrara is an artesian, confined aquifer, but there is only one area (sec. 20, T. 104 N., R. 63 W.) where wells flow. Throughout the rest of the area, the depth to water in wells increases southward and westward from 20 ft below land surface along the eastern side of the counties to 150 ft in central Aurora and 250 ft in southeastern Aurora County.

Water from the aquifer is slightly saline and generally of the sodium sulfate bicarbonate type. Concentrations of dissolved solids range from 1,100 to 2,400 mg/L and hardness ranges from 80 to 270 mg/L.

Codell Aquifer

The Codell aquifer, called "sandrock" by drillers, probably underlies most of Aurora and Jerauld Counties, but most wells are in the southern and eastern parts of the study area. Depths to the top of the aquifer range from 170 ft near the eastern side of the counties to 450 ft in southwestern Aurora County.

The aquifer consists of as much as 136 ft of cemented sandstone, siltstone, loose, fine to medium sand, and silty shale. Well yields range from 2 to 75 gal/min. The Codell aquifer is artesian, being confined between shale beds. The depth to water in wells ranges from 30 ft in northeastern Jerauld to 240 ft in southeastern Aurora County.

Water from the aquifer is slightly saline and of the sodium sulfate bicarbonate type. Concentrations of dissolved solids range from 1,600 to 2,300 mg/L. The water is soft to moderately hard, the hardness ranging from 30 to 120 mg/L. In southeastern Aurora County the Codell aquifer has been eroded locally and replaced by the Corsica glacial aquifer, which yields very hard water.

Dakota Aquifer

The Dakota aquifer, called "artesian sandrock" or "hard-water sand" by drillers, underlies most of the study area. Depths to the top of the aquifer range from 700 ft in southwestern Aurora County to 1,300 ft in northwestern Jerauld County.

The Dakota aquifer consists of as much as 440 ft of fine-grained sand or sandstone and shale. Locally the aquifer is very thin or missing, as in sec. 22, T. 103 N., R. 64 W. (City of Plankinton) and in sec. 6, T. 104 N., R. 63 W. The aquifer is underlain by basement rock, mostly relatively impermeable granite or quartzite.

The yields of flowing wells completed in the aquifer range from 5 to 50 gal/min and larger flows of as much as 150 gal/min have been reported by drillers. A pumping yield of as much as 35 gal/min has been reported for a municipal well in sec. 15, T. 103 N., R. 66 W. (City of White Lake). Wells do not flow in the western part of the study area with the exception of the southern part of T. 101 N., R. 66 W. Depths to water in wells increase from southwestern Aurora County northward to a reported maximum of 430 ft below land surface in northwestern Jerauld County.

Water from the aquifer is of the calcium sulfate type except in eastern Jerauld County, where sodium and calcium percentages are about equal. Concentrations of dissolved solids range from 1,900 to 2,200 mg/L and hardness ranges from 540 to 1,400 mg/L.

LARGE-CAPACITY WELLS

The best possibilities for obtaining large-capacity wells capable of supplying more than 500 gal/min are in the areas where the aquifers are more than 20 ft thick. Before wells are constructed, test holes often are drilled to determine the thickness of the aquifer and to provide samples for determining the grain size of the aquifer material. This information helps in the selection of the proper slot size and length of screen to be used in the construction of a well. Controlled pumping of the well for at least several hours indicates the yield of the aquifer at that locality and provides a representative water sample for chemical analysis. Measurement of the recovery of water level in the well provides information that is useful for estimating the yield of a well during longer pumping periods. If the well is to be used for irrigation, knowledge of the type of soil, subsoil, and topography are also important in selecting the most suitable irrigation system. Increased ground-water development, especially in stream valleys, may decrease streamflow.