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MAJOR AQUIFERS IN YANKTON
COUNTY, SOUTH DAKOTA

by

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DEFINITIONS OF TERMS

ALLUVIUM: Material, usually consisting of silt, deposited in stream valleys by running water. Alluvium generally does not contain significant amounts of sand and gravel in Yankton County.

AQUIFER: A 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: An aquifer in which the water level in a tightly cased well completed in the aquifer stands above the top of the aquifer.

BEDROCK: Any consolidated rock, such as shale, limestone, quartzite, and so forth, exposed at the surface of the earth or overlain by unconsolidated material.

FRESH WATER: water containing less than 1,000 milligrams per liter of dissolved solids.

GLACIAL AQUIFER: A water-yielding formation composed mainly of unconsolidated sand and gravel deposited as glacial outwash.

GLACIAL DRIFT: A collective term applied to all material, including till, transported and deposited by glacial ice.

GLACIAL OUTWASH: Gravel, sand, silt, and clay that was deposited by water from melting ice. In this report, glacial outwash is restricted to sand and gravel.

HARDNESS: Dissolved calcium and magnesium salts that decrease the lathering capacity of soap and form scale in boilers and pipes. Hardness is reported as calcium carbonate.

HYDRAULIC HEAD: Pressure of a fluid upon a unit area due to the height at which the surface of the fluid stands above the point where the pressure is determined.

PERMEABILITY: The capacity of a porous material to transmit a fluid through that material.

POROSITY: The ratio of the volume of open space in a material to that material's total volume, usually stated as a percent. A material may be porous but not permeable if the spaces are not connected.

PROPERLY-CONSTRUCTED WELL: A well constructed to admit a maximum amount of water from an aquifer without excessive loss of hydraulic head at the well. This generally requires installing a well screen or perforating the casing and installing a gravel pack opposite the water-yielding interval of the

aquifer. It also requires pumping 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: water containing more than 1,000 milligrams per liter of dissolved solids; slightly saline 1,000 to 3,000 milligrams per liter, moderately saline 3,000 to 10,000 milligrams per liter.

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

WATER TABLE: That surface in an unconfined water body at which the pressure is atmospheric. Generally this is the upper surface of the zone of saturation, except where the surface is within a relatively impermeable body.

UNIT CONVERSION FACTORS AND HARDNESS CLASSIFICATION

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

| Multiply inch-pound unit | By | To obtain metric unit |
|--------------------------|--------|-----------------------|
| foot | 0.3048 | meter |
| gallon per minute | 0.063 | liter per second |
| inch | 25.40 | millimeter |
| mile | 1.609 | kilometer |
| square mile | 2.590 | square kilometer |

Water hardness may be converted from milligrams per liter to grains per gallon by using the following conversion table:

| Classifi- cation | Milligrams per liter | Grain 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 |

ABSTRACT

One major glacial aquifer, the Lower James-Missouri, and the two major bedrock aquifers, the Niobrara and the Dakota, underlie Yankton County in southeastern South Dakota.

The Lower James-Missouri aquifer underlies 240 square miles of the County. Total aquifer thickness ranges from 100 feet under the Missouri River floodplain in the southeast to more than 400 feet under James Ridge in the northwest part of the County. The aquifer has the potential to supply about 1,000 gallons of water per minute to individual wells. The top of the aquifer generally is within 100 feet of the land surface. The dominant chemical constituents of the water are calcium, magnesium, and bicarbonate. The water is very hard; hardness, as calcium carbonate, averaged 870 milligrams per liter. Dissolved-solids concentrations ranged from 560 to 2,360 milligrams per liter.

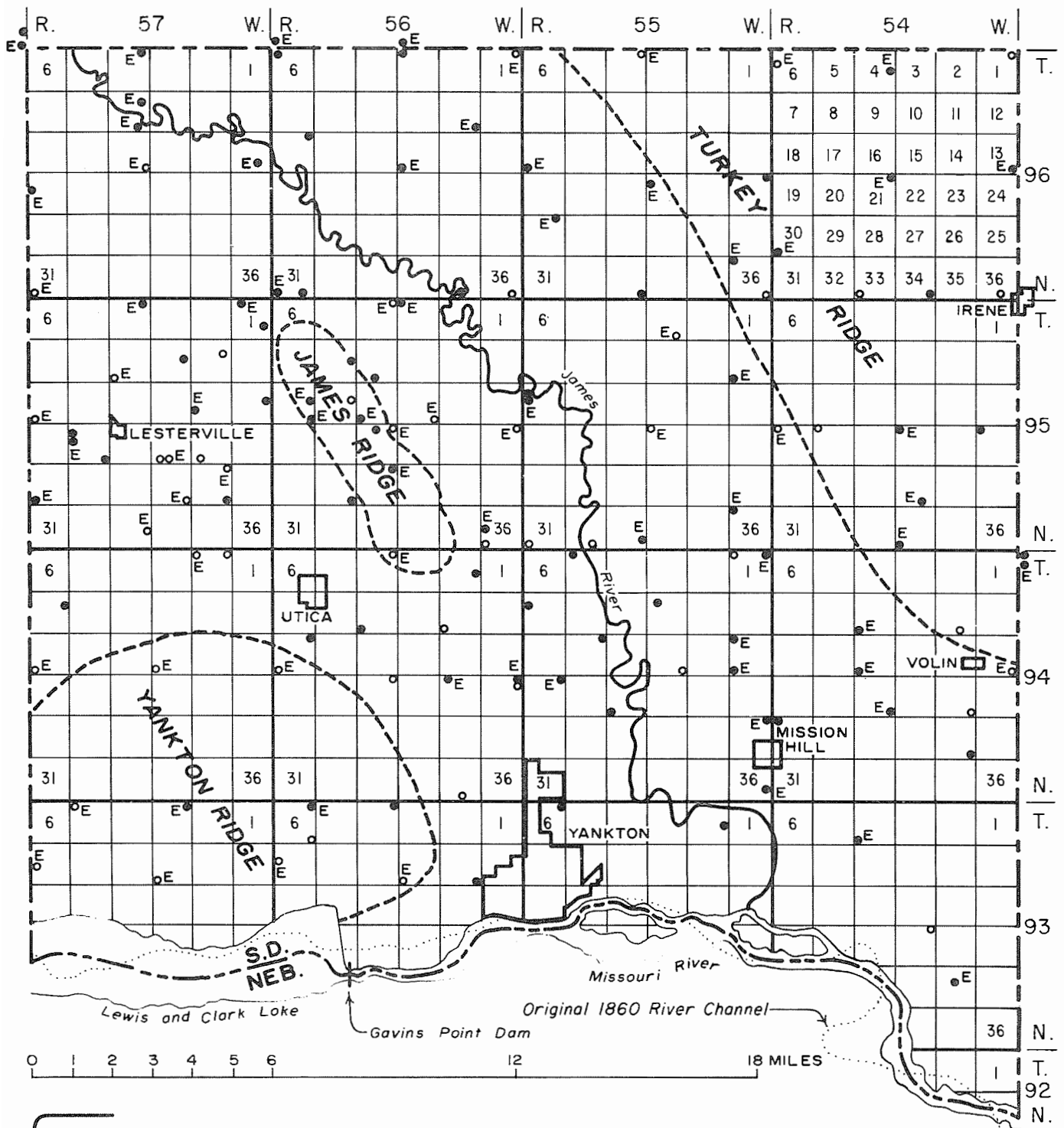
The Niobrara aquifer underlies about 240 square miles in the northeast and southwest parts of the County and is approximately coincident with Yankton and Turkey Ridges where the aquifer is more than 250 feet thick. Potential well yields, which vary locally depending on the amount of fracturing in the bedrock, are not large enough for irrigation purposes. Calcium, magnesium, and bicarbonate are the dominant ions in the water. Hardness averaged 1,160 milligrams per liter. Dissolved-solids concentrations ranged from 1,240 to 2,740 milligrams per liter.

The Dakota aquifer underlies all of Yankton County and depth from land surface to the aquifer ranges from about 300 feet under the Missouri and James River valleys where wells flow, to about 500 feet beneath the ridges, where wells do not flow. Wells completed in the aquifer can be expected to produce from 5 to 40 gallons per minute. The dominant ions in the water are calcium, magnesium, and sulfate. Hardness averaged 1,150 milligrams per liter and, dissolved-solids concentrations ranged from 1,790 to 2,030 milligrams per liter.

INTRODUCTION

This information pamphlet, one of a series of reports on water-resource studies of South Dakota counties, is designed to acquaint the reader with the distribution, quantity, and quality of ground-water resources in Yankton County. Information in the report is based on data collected by the U.S. Geological Survey and the South Dakota Geological Survey during 1979-81 (fig. 1).

Copies of this report and other publications pertaining to the hydrology and geology of counties in South Dakota may be obtained from the South Dakota Geological Survey. Additional information about the hydrology and geology of Yankton County may be obtained



E • • Test hole, cased. Used as observation well.

Eo • • Test hole, uncased

A letter "E" denotes electric log available. Drillers logs available for all test holes.

- - - - - Approximate boundary of major ridges.

Figure 1. Map showing location of test holes, observation wells, and major ridges.

from the U.S. Geological Survey in Huron, or the South Dakota Geological Survey in Vermillion.

GLACIAL AQUIFER

Lower James-Missouri Aquifer

The Lower James-Missouri aquifer underlies about 240 square miles or about 46 percent of Yankton County (fig. 2) and trends across the County from the northwest to the southeast. The top of the aquifer generally is within 100 feet of the land surface. The aquifer is composed of layers of relatively uniform medium to coarse sand and gravel but, in some areas, especially beneath the James River valley, gravels 3 inches in diameter were deposited. The glacial outwash was deposited by meandering streams; consequently, the deposits may be absent in some areas only several hundred feet from the aquifer. The aquifer is overlain by sandy till except in the James River area where it is covered by several feet of soil, and in the Missouri and James River valleys where it is overlain by 10 to 20 feet of alluvium. The aquifer ranges in thickness from 100 feet beneath the Missouri River valley to as much as 410 feet beneath James Ridge. The average thickness of the aquifer is about 150 feet.

Water-table conditions in the aquifer exist under the Missouri River valley and beneath areas of higher land surface altitudes such as James Ridge. Artesian conditions occur in the Lesterville area and the James River valley. The depth to water beneath the Missouri and James River valleys range from about 10 to 15 feet. In other areas, such as beneath James Ridge, depth to water may be more than 200 feet.

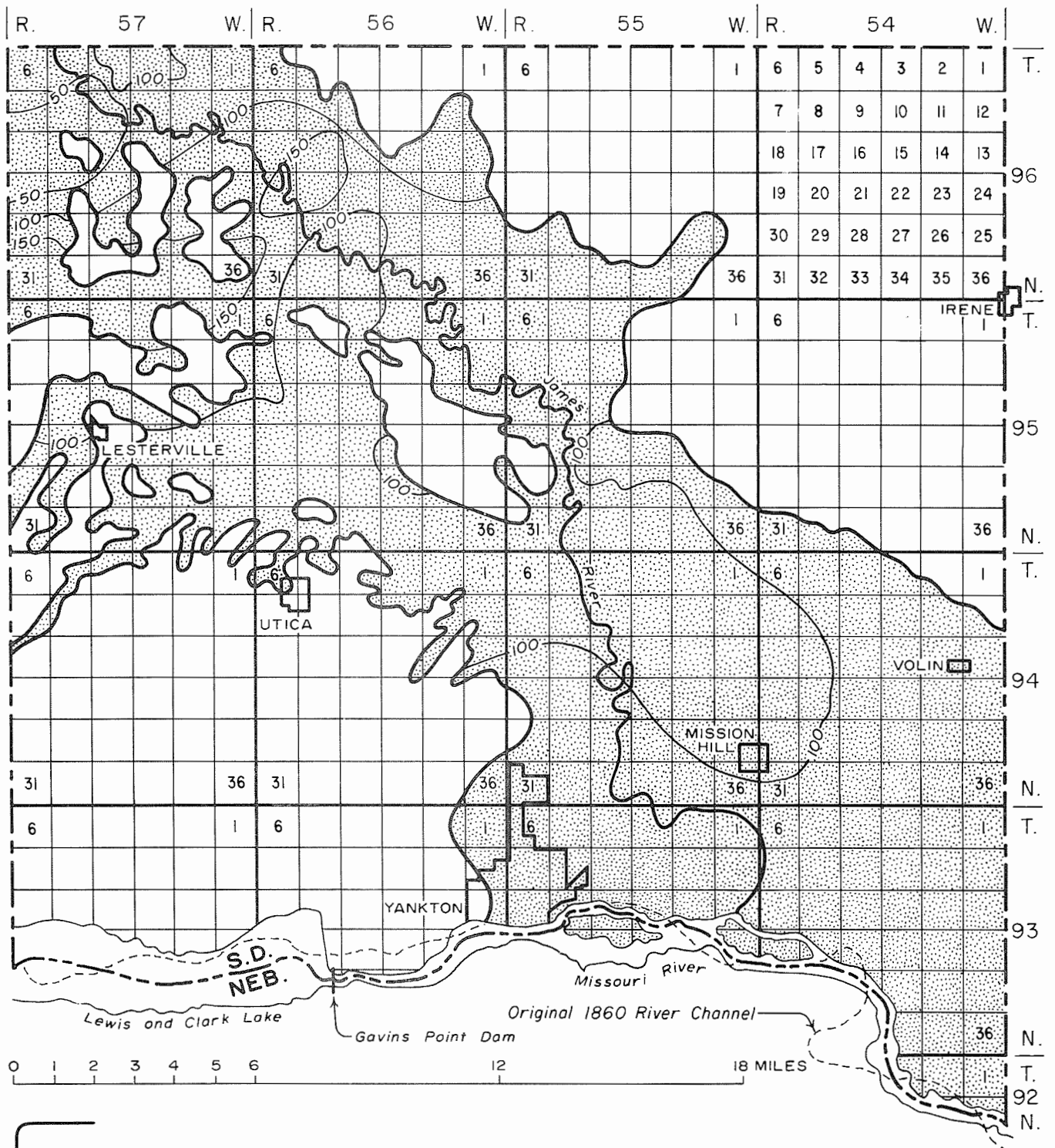
The glacial aquifer is more porous and permeable than the bedrock aquifers, and consequently its yields to wells are greater. Yields of 1,000 gallons per minute may be obtained from properly-constructed wells in virtually any area of the Lower James-Missouri aquifer.

The dominant ions in water from the Lower James-Missouri aquifer are calcium, magnesium, and bicarbonate. Concentrations of dissolved solids ranged from 560 to 2,360 milligrams per liter; hardness ranges from 330 to 1,700 milligrams per liter and averaged 870 milligrams per liter.

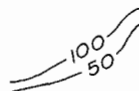
BEDROCK AQUIFERS

Niobrara Aquifer

The Niobrara aquifer underlies about 240 square miles in northeastern and southwestern Yankton County (fig. 3). The Niobrara Formation of Cretaceous age is composed of chalk, calcareous claystone (marl), and calcareous shale, and is commonly referred



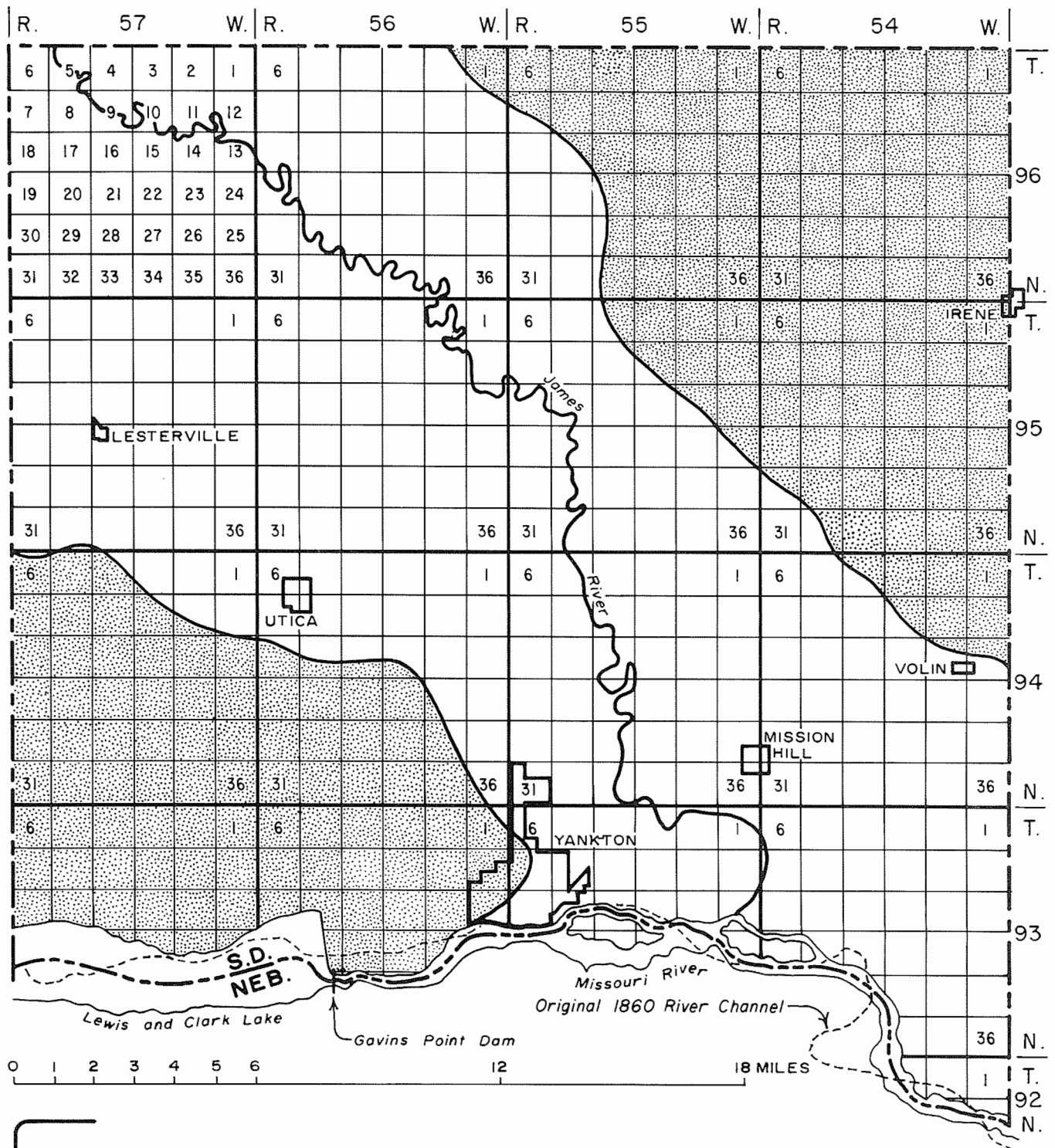
Area underlain by Lower James-Missouri aquifer



Line of equal saturated thickness of aquifer.
Interval is 50 feet.



Figure 2. Map showing areal extent of the Lower James-Missouri aquifer.



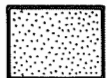
 Area underlain by Niobrara aquifer.



Figure 3. Map showing areal extent of the Niobrara aquifer.

to as "chalkrock" by local drillers. Productive wells can be constructed where the bedrock is densely fractured. Both water-table and artesian conditions exist in the northeastern part of the County; whereas, only water-table conditions exist in the southwestern part.

The aquifer ranges in thickness from a few feet along the flanks of Turkey and Yankton Ridges to more than 250 feet beneath the ridges. Yields of wells completed in the aquifer generally range from 2 to 10 gallons per minute.

The dominant ions in water from the Niobrara aquifer are calcium, magnesium, and bicarbonate. Dissolved-solids concentrations ranged from 1,240 to 2,740 milligrams per liter and hardness, which averages 1,162 milligrams per liter, ranges from 860 to 1,700 milligrams per liter. The water contains excessive concentrations of iron ranging from about 100 to 13,000 micrograms per liter (1,000 micrograms per liter equal 1 milligram per liter).

Dakota Aquifer

The Dakota aquifer, commonly referred to as the "artesian flow" by local residents and drillers, underlies all of Yankton County. The Dakota Sandstone of Cretaceous age consists of fine-grained sand or sandstone interlayered with shale. Two distinct water-yielding layers (possibly three in some areas) can be recognized. Depth to the top of the aquifer from land surface ranges from 300 feet beneath the James and Missouri River valleys to more than 500 feet beneath the ridges and higher altitudes. Total thickness of the aquifer is not known, but test holes have penetrated thicknesses up to 290 feet. The water-yielding layers of the aquifer are 5 to 40 feet thick.

Wells completed in the Dakota aquifer in the James and Missouri River valleys and in areas below about 1,260 feet altitude will flow from 5 to 40 gallons per minute. In other areas wells must be pumped but yields are similar to those from wells that flow.

The dominant ions in water from the Dakota aquifer are calcium, magnesium, and sulfate. Dissolved-solids concentrations ranged from 1,790 to 2,030 milligram per liter; hardness ranges from 1,100 to 1,200 milligrams per liter and averages 1,150 milligrams per liter.

IRRIGATION POTENTIAL

The best possibilities for obtaining large-capacity wells capable of supplying more than 500 gallons per minute for a sustained period are in the Lower James-Missouri aquifer. However, due to the meandering nature of the streams that deposited the glacial outwash, it is usually necessary to drill test holes to

determine aquifer thickness and static-water level before constructing a permanent well. Yield generally can be determined by a controlled pumping test of the well for several hours. A representative water sample for chemical analysis also can be obtained at that time. Then once the soil-water compatibility has been approved, application for a water right permit can be made.