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Richard Kneip, Governor

SOUTH DAKOTA GEOLOGICAL SURVEY
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Information Pamphlet No. 1

MAJOR AQUIFERS AND SAND AND GRAVEL
RESOURCES IN MARSHALL COUNTY, SOUTH DAKOTA

by

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Major Aquifers and Sand and Gravel Resources in Marshall County, South Dakota

by
Neil C. Koch

INTRODUCTION

This publication is designed to acquaint the reader with the general distribution, quantity, and quality of water available from major aquifers, and to aid in the exploration and development of sand and gravel resources in Marshall County. A comprehensive report on the technical aspects of the geology and hydrology will be published at a later date.

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

Figure 1 shows the location of test holes and wells from which data are available.

AQUIFERS

An aquifer is defined as a formation from which water may be obtained in useful quantities. Glacial aquifers are composed mostly of sand and gravel. Where the glacial aquifers are confined by overlying material, this overlying material generally consists of clay containing some sand, gravel, and stones of all sizes. When an aquifer is confined by an overlying, relatively impermeable material such as clay, and the water in wells rises above the top of the aquifer, the water is said to be under artesian pressure. Some aquifers are under sufficient pressure that water flows from the well at the land surface. In an unconfined aquifer the surface of the saturated zone is called the water table. In the saturated zone all openings between rock particles are filled with water.

Glacial Aquifers

Three major glacial aquifers, the Veblen, James, and Coteau-Lakes aquifers, are present in the county (fig. 2). The Veblen aquifer underlies an area of about 24 square miles in northeastern Marshall County and extends north into North Dakota and east into Roberts County. The aquifer may yield as much as 500 gpm (gallons per minute) to properly constructed wells at depths ranging from 130 to 180 feet. Aquifer thickness ranges from 10 to 70 feet except at one test hole which penetrated 200 feet of aquifer. Water in the Veblen aquifer occurs under artesian conditions, and water levels in wells tapping the aquifer range from about 14 to 80 feet below land surface.

The James aquifer is in north-central Marshall County with narrow channels extending southwest into Brown County and southeast into Day County. The aquifer may yield as much as 500 gpm to properly constructed wells. In low-lying areas, the aquifer is at depths ranging from 120 to 190 feet below land surface. At higher altitudes, on the Coteau des Prairies (hereafter call the coteau), the aquifer is 590 feet or more below land surface. Aquifer thickness ranges from 10 to 70 feet. Water in the aquifer occurs under artesian conditions and water levels range from 3 to 40 feet below land surface in low-lying areas.

The Coteau-Lakes aquifer is in the southeastern part of the county. It occurs at or near land surface and is hydraulically connected with the waters in Buffalo, Red Iron and Clear Lakes. The thickness of the aquifer differs considerably from place to place, ranging from about 5 feet to a known maximum to 57 feet. Water in the aquifer may be under water-table or artesian conditions, and water levels range from that of the lake levels to 40 feet below land surface. Because of the considerable range in aquifer thickness it is difficult to predict yield; however,

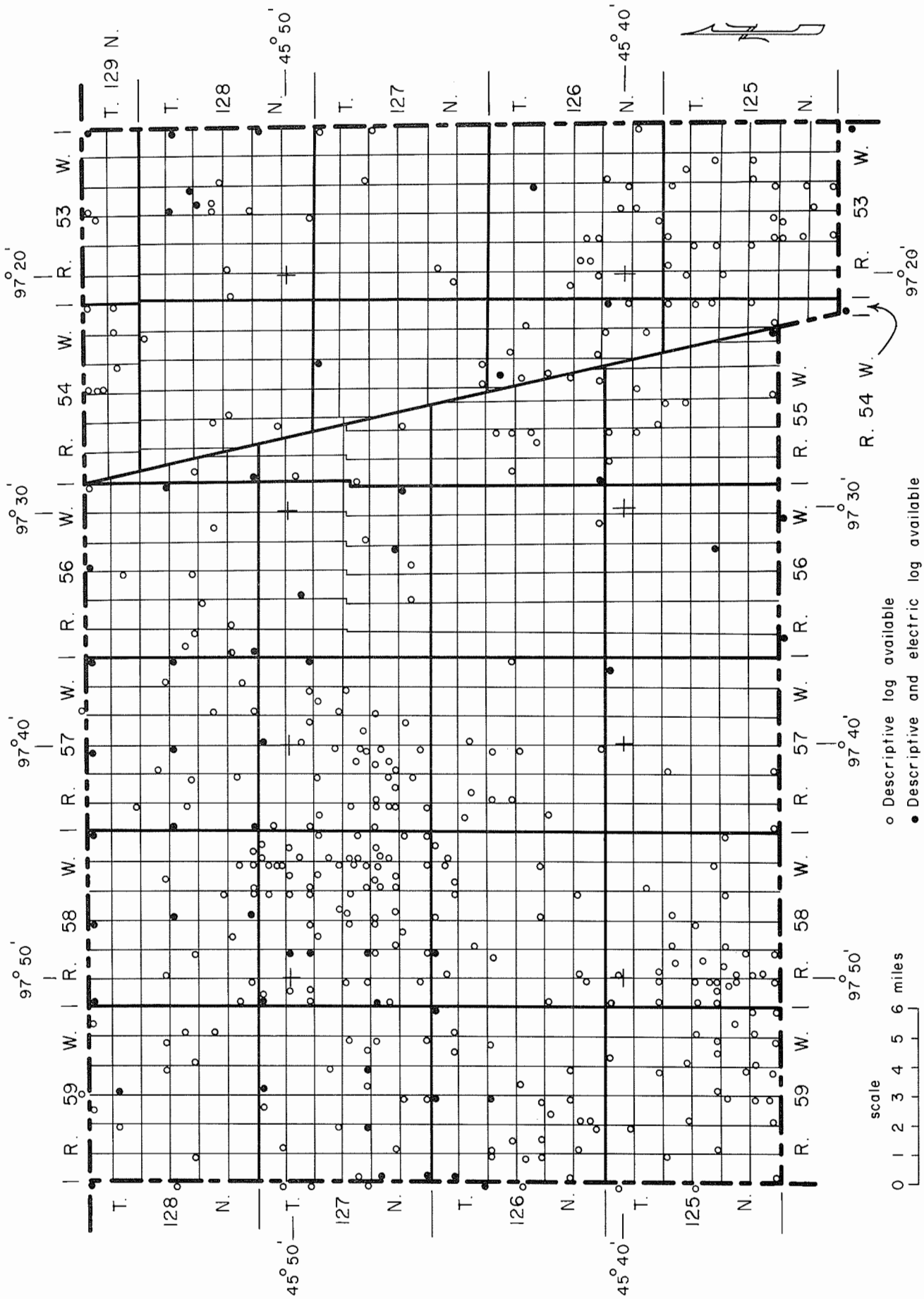


Figure 1. Map showing locations of wells and test holes in Marshall County for which data are available.

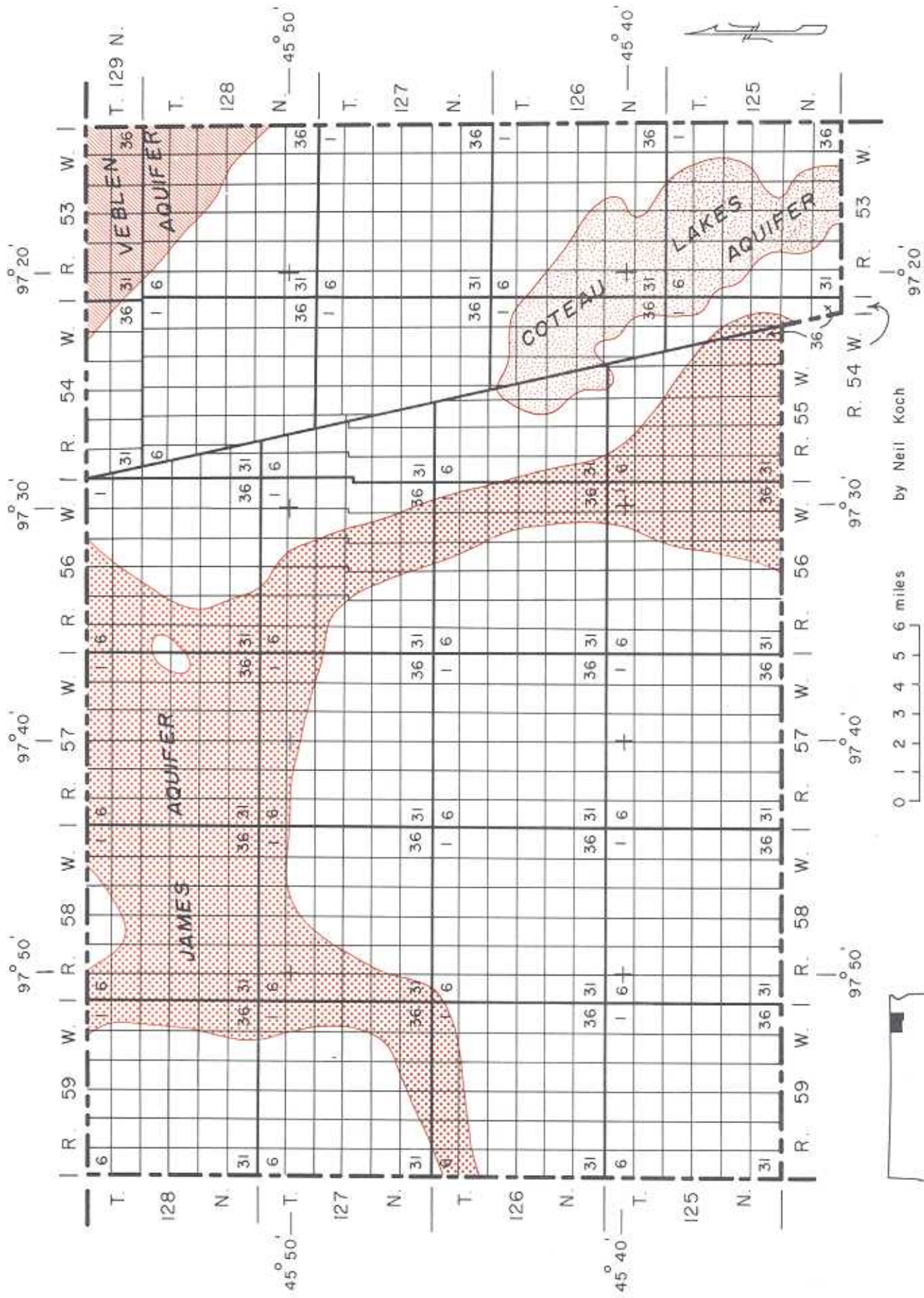


Figure 2. Map showing locations of major glacial aquifers in Marshall County.

Index map of South Dakota

where the aquifer is sufficiently thick and has a good permeable connection with a lake, well yields of 500 gpm can be expected.

The Veblen aquifer yields water that is predominantly of calcium-sulfate and calcium-bicarbonate types, with specific conductance ranging from 777 to 2,130 micromhos per centimeter. The specific conductance of water is a measure of the water's capacity to conduct an electrical current; it is the function of the amount and kind of dissolved mineral matter. An estimate of the total dissolved solids in milligrams per liter can be obtained by multiplying specific conductance by 0.65. Hardness ranges from 274 to 856 mg/l (milligrams per liter) or 16 to 50 grains per gallon.

Water in the James aquifer is predominantly of sodium-, calcium-, bicarbonate, sulfate types with specific conductance ranging from 1,030 to 2,050 micromhos per centimeter. Hardness ranges from 103 to 856 mg/l (6 to 50 grains per gallon).

The water from the Coteau-Lakes aquifer is of a calcium-magnesium-bicarbonate type with specific conductance ranging from 400 to 700 micromhos per centimeter. Hardness ranges from 205 to 702 mg/l (12 to 41 grains per gallon).

Bedrock Aquifer

The Dakota sandstone aquifer underlies all of Marshall County at depths ranging from 900 feet beneath the low-lying areas in the western part of the county to 1,500 feet below the high areas of the coteau in the eastern part. Water in the aquifer occurs under artesian conditions, and in the low-lying area in western Marshall County many of the wells flow. Yields of up to 200 gpm may be obtained from properly constructed wells.

Water from the Dakota aquifer is soft, ranging from 17 to 137 mg/l (1 to 8 grains per gallon) hardness, and is of the sodium-sulfate type with specific conductance ranging from 3,500 to 4,050 micromhos per centimeter.

HIGH-YIELD WELLS

Before high-yield wells such as those generally needed for irrigation are constructed, it is desirable that a test well be drilled at the selected location to determine the thickness of the aquifer and provide samples for determining the grain size of the aquifer material. This information will help in the selection of the proper slot size and length of screen to be used. Pumping the test well shows the yield of the aquifer at that locality and provides a water sample for chemical-quality analysis. The type of soil and subsoil and the topography are also important in determining the suitability of the land for irrigation, and in selecting the most suitable irrigation system.

SAND AND GRAVEL RESOURCES

The following definitions of geologic terms are intended to aid in understanding the occurrence of sand and gravel deposits in Marshall County.

Outwash

Outwash is any deposit of clay, silt, sand, gravel, or boulders that has been washed and sorted by natural processes during transport, and subsequently deposited by water from melting glacial ice. An outwash deposit is usually composed primarily of sand and gravel. Most of the sand and gravel pits in Marshall County are in outwash deposits.

Till

Till in Marshall County consists of clay containing some sand and gravel, and stones varying in size up to boulders. It is the unsorted and unstratified material deposited by continental glaciers. This material in general has not been subjected to the action of running water.

Pockets of stratified sediment containing sand and gravel occur within the till. Occasionally these sand and gravel pockets are large enough for commercial production; however, in general, the till areas do not contain much sand and gravel and do not constitute good areas for exploration.

Alluvium

Alluvium is sediment deposited by streams. It consists of material ranging in size from clay to boulders, depending on the kinds of material available to the stream and the velocity of the stream. In Marshall County most of the alluvium does not contain large deposits of sand and gravel.

Bedrock

The term bedrock refers to consolidated rock. In Marshall County it is predominantly shale. There is no possibility of finding unconsolidated sand and gravel deposits beneath the bedrock.

Location of Sand and Gravel Deposits

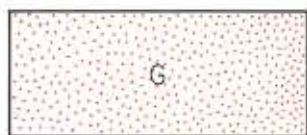
Figure 3 is a map showing the probability of occurrence of sand and gravel deposits, and the locations of gravel pits. The map does not show the quality of the sand or gravel, and should be used only as a guide to further exploration of sand and gravel resources. The development of any specific site would depend upon material specifications for the desired use.

Table 1 is a list of sand and gravel pits that have been tested by the South Dakota Department of Highways.

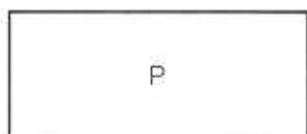
EXPLANATION



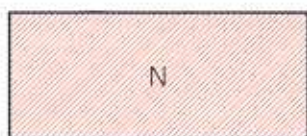
High probability of finding sand and gravel deposits.



Good probability of finding sand and gravel deposits.



Poor probability of finding sand and gravel deposits.



Shale - no probability of finding sand and gravel deposits.

^x_s Sand and gravel pit, no distinction between those presently used and those abandoned. Number refers to pits for which data are available. (see table 1)



Lake or pond

Scale



Index map of South Dakota



6	5	4	3	2	1
7	8	9	10	11	12
16	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Sectionized township

by Neil C. Koch, 1972

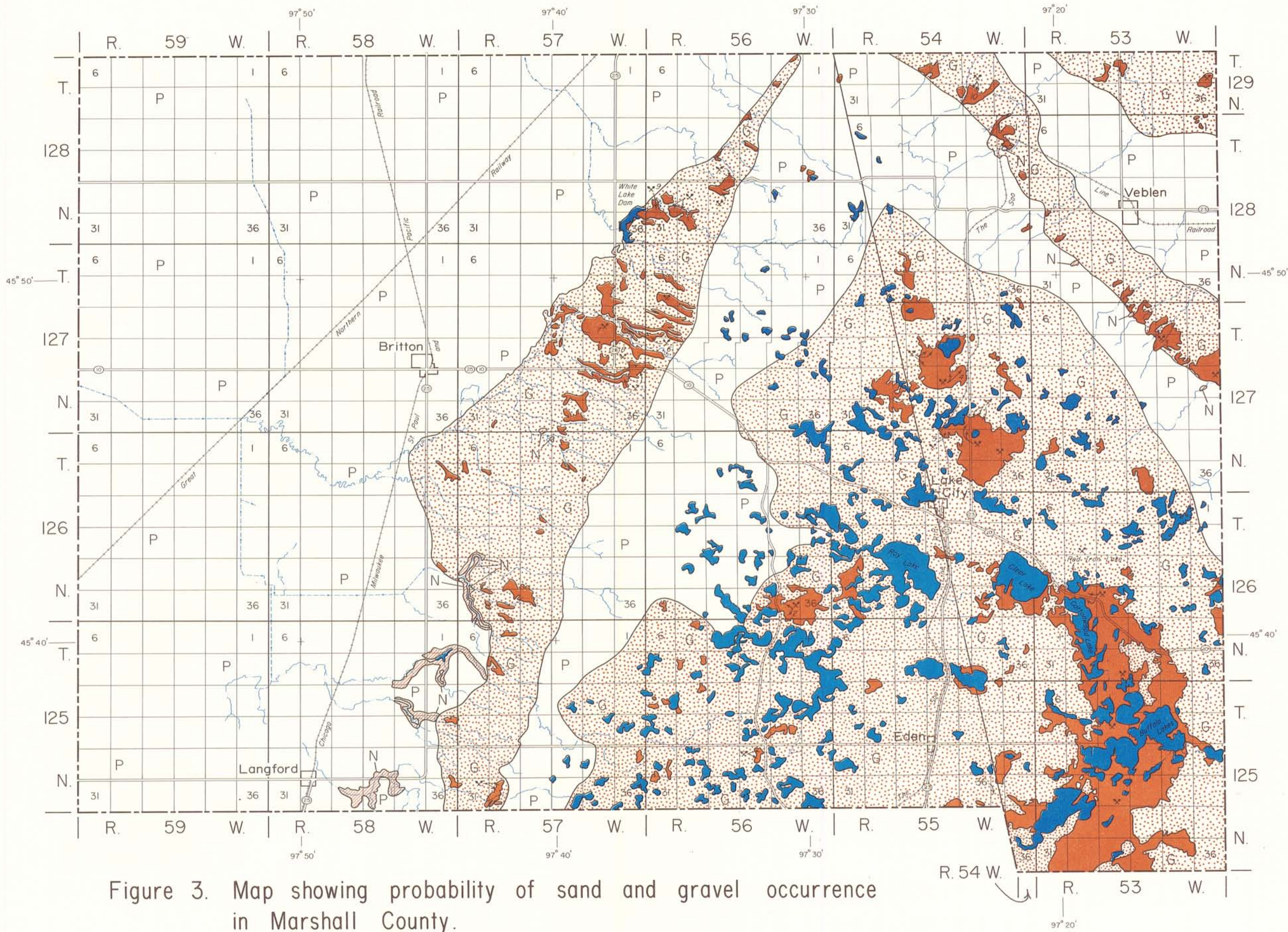


Figure 3. Map showing probability of sand and gravel occurrence in Marshall County.

Table 1 -- List of sand and gravel pits in Marshall County described
by the South Dakota Department of Highways

Pit No.	Owner	Location	Type	Approximate size of deposit, in cubic yards
1	John Johannsen	NW ¹ / ₄ &W ¹ / ₂ NE ¹ / ₄ 27-125-56	Gravel	37,000
2	Roman Mechlitsch	NE ¹ / ₄ SW ¹ / ₄ 35-126-56	Gravel	35,000
3	Henry Anderson Bennet and Verlyn Tollefson Ingeborg Vestly	NW ¹ / ₄ 11-127-53	Sand & Gravel	100,000
4	Robert Juran	NE ¹ / ₄ NE ¹ / ₄ 15-127-54	Sand & Gravel	
5	Paul Casperson	NW ¹ / ₄ 27-127-54	Sand & Gravel	48,000
6	Merle Behnke	SW ¹ / ₄ 18-127-56	Gravel	8,000
7	Philip Muth	N ¹ / ₂ SE ¹ / ₄ 14-127-57 N ¹ / ₂ SW ¹ / ₄ 14-127-57	Gravel	47,000
8	Ross Hinkley	S ¹ / ₂ SE ¹ / ₄ 24-127-57	Sand & Gravel	
9	Thorp Farm	SE ¹ / ₄ 21-128-56	Gravel	30,000
10	Arman Crandall	W ¹ / ₂ NE ¹ / ₄ 35-129-54 NW ¹ / ₄ NW ¹ / ₄ 35-129-54	Gravel	80,000