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Information Pamphlet No. 18

**AQUIFERS IN WALWORTH COUNTY,
SOUTH DAKOTA**

by

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Prepared in cooperation with the
South Dakota Geological Survey,
Walworth County, and the
Oahe Conservancy Sub-District

Science Center
University of South Dakota
Vermillion, South Dakota
1979

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DEFINITIONS OF TERMS

Alluvium: Unconsolidated material deposited during comparatively recent geologic time in stream valleys by running water. The alluvium of the study area is commonly high in silt; significant amounts of sand and gravel are rare.

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 hydraulic head is above the top of the aquifer.

Bedrock: A general term for the rock, commonly solid, that underlies soil, sand, clay, or other unconsolidated, surficial material.

Borehole geophysical log: A record of well logging including electrical, nuclear, and acoustical logging.

Fresh water: Water containing less than 1,000 mg/L of dissolved solids.

Glacial aquifer: A water-bearing formation composed of materials derived from a glacier. Glacial aquifers consist mainly of unconsolidated sand and gravel deposited from glacial meltwaters.

Glacial drift: A collective term applied to all material transported by and deposited from glacial ice.

Glacial outwash: Sorted, stratified sand, gravel, silt, and clay deposited by glacial meltwaters. For the purposes of this report, outwash is restricted to sand and gravel.

Hardness of water: A property of water caused principally by dissolved calcium and magnesium that reduce the lathering ability of soap and form scale in boilers and pipes. Total hardness is reported as calcium carbonate and noncarbonate hardness and is classified by the U.S. Geological Survey as follows:¹

Properly-constructed well: One that admits a maximum amount of water from an aquifer without excessive loss of head at the well. This generally requires installing a well screen or perforating the casing and installing a gravel pack opposite all or part of the aquifer. It also requires developing the well--pumping it so as to remove drilling mud and other fine-grained material from the aquifer adjacent to the well.

Saline water: Water containing 1,000 mg/L or more of dissolved solids--slightly saline contains 1,000 to 3,000 mg/L; moderately saline, 3,000 to 10,000 mg/L.

Till: An unsorted, unstratified mixture of clay, silt, sand, gravel, and boulders deposited by glacial ice.

Water table: That surface of an unconfined ground-water body at which the pressure is atmospheric. Generally this is the upper surface of the zone of saturation, except where the surface is formed by a poorly permeable body.

¹ Description	Milligrams per liter (mg/L)	Grains per gallon (g/gal)
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

Glacial outwash sand and gravel aquifers in Walworth County, South Dakota, include the Grand, Selby, Bowdle, Java, and other outwash aquifers. The water in these aquifers generally is of suitable quality for domestic, stock, municipal, and irrigation use.

The Grand aquifer underlies about 105 square miles, averages 39 feet in thickness, and may yield as much as 600 gallons per minute to a discharging well.

The Selby aquifer underlies about 20 square miles, averages 18 feet in thickness, and may yield as much as 400 gallons per minute to a discharging well.

The Bowdle aquifer underlies about 30 square miles, averages 15 feet in thickness, and may yield as much as 250 gallons per minute to a discharging well.

The other outwash aquifers underlie about 20 square miles, average 7 feet in thickness, and may yield as much as 30 gallons per minute to a discharging well.

The Java sand and gravel aquifer consists of glacial outwash and preglacial stream sediments. The aquifer underlies about 100 square miles, averages 22 feet in thickness, and may yield as much as 50 gallons per minute to a discharging well.

The Dakota and Fall River sandstone aquifers are the major sources of water from the bedrock in the area. The Dakota aquifer is about 225 feet thick at an average depth of 1,940 feet. The Dakota water is of the sodium chloride type. The Fall River aquifer ranges in thickness from about 140 to 175 feet at an average depth of 2,100 feet. The Fall River water is of the calcium sulfate type. Water from these bedrock aquifers is used for domestic and stock purposes, but because of poor chemical quality is unsuitable for irrigation.

The best possibilities for obtaining a well capable of supplying a sufficient yield for irrigation are in the areas where the thickness of the Grand and Selby aquifers is greater than 30 feet thick.

INTRODUCTION

This Information Pamphlet is one of a series of reports on water-resource 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 aquifers in Walworth County. A comprehensive report to be published later will contain selected hydrologic data collected during the study and much additional information on the hydrology and geology of the area.

Information in this report is based on data (fig. 1) collected by the United States Geological Survey and the South Dakota Geological Survey during the period 1974-77.

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

The U.S. Customary units used in this report may be converted to metric units by the following conversion factors:²

GLACIAL AQUIFERS

Selby Aquifer

The Selby aquifer (fig. 2) underlies an area of about 20 mi² in north-central Walworth County. This major aquifer may yield as much as 400 gal/min of water to a properly constructed-discharging well at depths ranging from 22 to 62 ft. The composition is glacial-outwash sand and gravel which occurs at or near the land surface. Its saturated thickness averages 18 ft and ranges from 5 to 35 feet. Water occurs under water-table conditions. The depth to water in wells averages 9 ft below the land surface.

Water in the Selby aquifer is predominantly of the calcium bicarbonate type and is fresh, with dissolved-solids concentrations averaging 540 mg/L

² Multiply U.S. Customary Unit	By	To Obtain Metric Unit
foot (ft)	0.3048	meter (m)
gallon (gal)	3.785	liter (L)
gallon per minute (gal/min)	0.063	liter per second (L/s)
mile (mi)	1.609	kilometer (km)
square mile (mi ²)	2.590	square kilometer (km ²)

and ranging from 450 to 670 mg/L. Total hardness of the water averages 330 mg/L and ranges from 260 to 390 mg/L. The water generally is of suitable quality for domestic, stock, municipal, and irrigation use and is used for those purposes.

Bowdle Aquifer

The Bowdle aquifer (fig. 2) underlies an area of about 30 mi² in the extreme eastern part of Walworth County. This major aquifer may yield as much as 250 gal/min of water to a properly constructed-discharging well at depths ranging from 24 to 55 ft. The composition of the aquifer is glacial-outwash sand and gravel which occurs at or near the land surface. Its saturated thickness averages 15 ft and ranges from 1 to 31 ft. Water in the aquifer occurs under water-table conditions. The depth to water in wells averages 11 ft below the land surface.

Water in the Bowdle aquifer is predominantly of the calcium bicarbonate type and is fresh, with dissolved-solids concentrations averaging 480 mg/L and ranging from 260 to 830 mg/L. Total hardness averages 320 mg/L and ranges from 210 to 520 mg/L. The water generally is of suitable quality for domestic, stock, municipal, and irrigation use and is used for those purposes.

Grand Aquifer

The Grand aquifer (fig. 3) underlies an area of about 105 mi² in northwestern and west-central Walworth County. This major aquifer may yield as much as 600 gal/min of water to a properly constructed-discharging well at depths ranging from 207 to 288 ft. Its composition is glacial-outwash sand and gravel which generally is buried by stony clay till. Its thickness averages 39 ft and ranges from 1 to 157 ft. Water occurs under artesian conditions. The depth to water in wells averages 25 ft and ranges from 7 to 63 ft below the land surface except in the area just northwest of Akaska where the depth to water in wells averages 190 ft below the land surface.

Water in the Grand aquifer is predominantly of the sodium bicarbonate or sodium sulfate type. The calcium sulfate type occurs in a few localities. The water is fresh to slightly saline--dissolved-solids concentrations average 1,630 mg/L and range from 740 to 3,330 mg/L. Its total hardness averages 490 mg/L and ranges from 170 to 1,700 mg/L. The water generally is of suitable quality for domestic, stock, municipal, and irrigation use and is used for those purposes.

Other Outwash Aquifers

The other outwash aquifers (fig. 2) underlie an

area of about 20 mi² in a terrace at Mobridge and in two drainage channels extending from Glenham to Selby and from Akaska to Lowry. These three unnamed minor aquifers may yield as much as 30 gal/min of water to a properly constructed-discharging well at depths ranging from 40 to 70 ft. The composition of these aquifers is glacial-outwash sand and gravel, commonly overlain by alluvium. The saturated thickness averages 7 ft and ranges from 3 to 30 ft. Water occurs mostly under artesian conditions except in the terrace area at Mobridge and in both drainage channels where in local areas the confining clay is absent. The depth to water in wells generally is less than 25 ft except near Mobridge where it is about 65 ft below the land surface.

Water in these aquifers is of the sodium bicarbonate type in the Akaska-Lowry area, of the sodium sulfate type in the Glenham-Selby area, and of the calcium sulfate type in the Mobridge area. The water is fresh to slightly saline--dissolved-solids concentrations average 860 mg/L and range from 530 to 1,820 mg/L. Total hardness in water averages 270 mg/L and ranges from 200 to 300 mg/L. The water generally is of suitable quality for domestic, stock, and municipal use and is used for those purposes. It is generally suitable for irrigation but is not used for that purpose.

GLACIAL-PREGLACIAL AQUIFER

Java Aquifer

The Java aquifer (fig. 3) underlies an area of about 100 mi² in southeastern and east-central Walworth County. Included in the Java aquifer are two aquifer segments. This major aquifer may yield as much as 50 gal/min of water to a properly constructed-discharging well at depths ranging from 174 to 243 ft. Its thickness averages 22 ft and ranges from 5 to 69 ft. Its composition consists of undifferentiated glacial outwash and preglacial stream sediment. The unit is composed mainly of sand and gravel, generally overlain by stony clay till. Water occurs under artesian conditions. The depth to water in wells averages 28 ft and ranges from 6 to 44 ft below the land surface.

Water in the Java aquifer is predominantly of the calcium bicarbonate type and is fresh, with dissolved-solids concentrations averaging 670 mg/L and ranging from 350 to 810 mg/L. Total hardness of the water averages 460 mg/L and ranges from 230 to 610 mg/L. The water generally is of suitable quality for domestic, stock, and municipal use and is used for those purposes. It is generally suitable for irrigation but it is not used for that purpose.

BEDROCK AQUIFERS

The major bedrock aquifers in Walworth County are the sandstones of the Dakota and Fall River Formations. They occur at depths greater than 1,700 ft below the land surface. The Dakota aquifer is about 225 ft thick at depths to the top of the sandstone ranging from about 1,800 to 2,100 ft and averaging 1,940 ft. The thickness of the Fall River aquifer ranges from about 140 to 175 ft at depths to the top of the sandstone ranging from about 1,990 to 2,200 ft and averaging 2,100 ft.

Water in these bedrock aquifers occurs under artesian conditions. It will flow freely from most wells finished in the Fall River aquifer. Depth to water in wells finished in the Dakota aquifer ranges from about 20 to 117 ft below the land surface.

The Dakota water is of the sodium chloride type and is slightly to moderately saline, with dissolved-solids concentrations ranging from 4,630 to 6,090 mg/L. Its total hardness ranges from 83 to 153 mg/L.

The Fall River water is predominantly of the calcium sulfate or sodium sulfate type, with

dissolved-solids concentrations averaging 2,290 mg/L and ranging from 1,800 to 3,250 mg/L. Its total hardness averages 970 mg/L and ranges from 1,000 to 1,200 mg/L.

The water in these bedrock aquifer is used for stock purposes and rarely for domestic use. Because the water has a very high salinity hazard, it is unsuitable for irrigation and may be unsuitable for domestic use.

POSSIBILITIES FOR OBTAINING WATER FOR IRRIGATION WELLS

The best possibilities for drilling a well capable of supplying enough water for irrigation are in the Grand and Selby aquifers where the outwash thickness is greater than 30 ft. A test hole drilled at the proposed well site enables a determination of the thickness of the aquifer and provides 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 both the test and production wells. Pumping the test well shows the yield that may be obtained at the site. During this aquifer test a water sample can be collected for chemical-quality analysis.

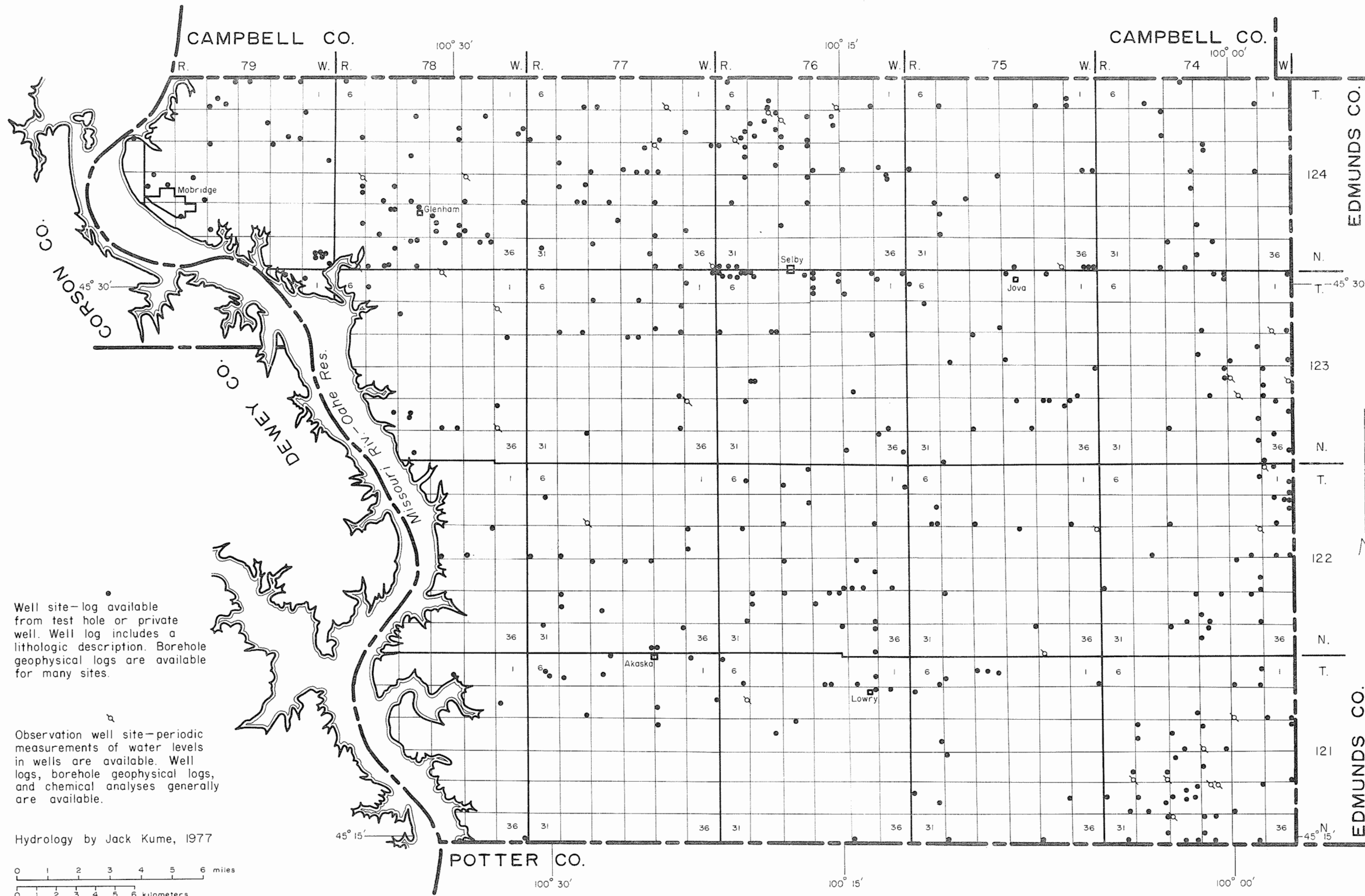


Figure 1. Map showing locations of data sites in Walworth County.

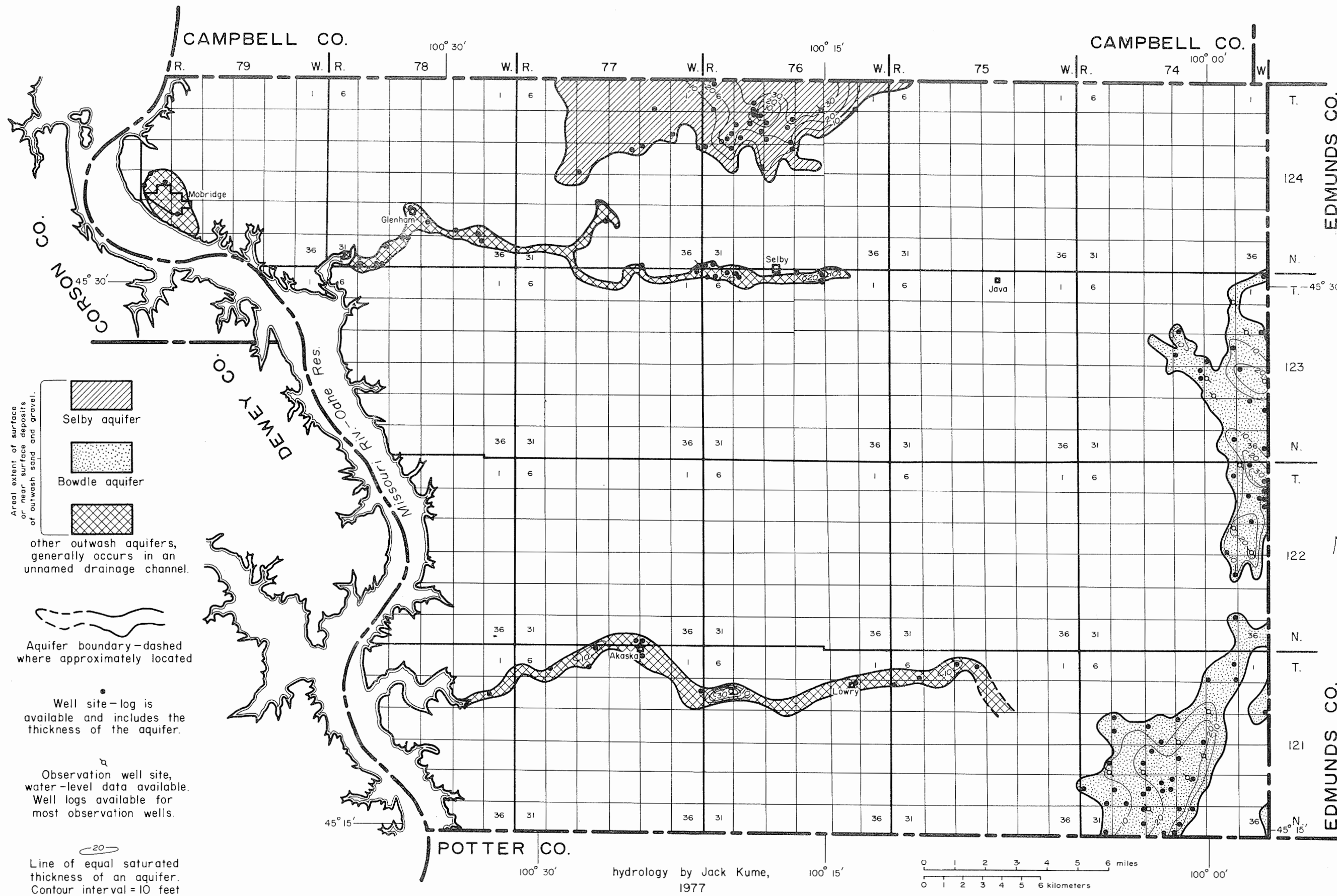


Figure 2. Preliminary map showing the thickness and the areal extent of the Selby, Bowdle, and other outwash aquifers.

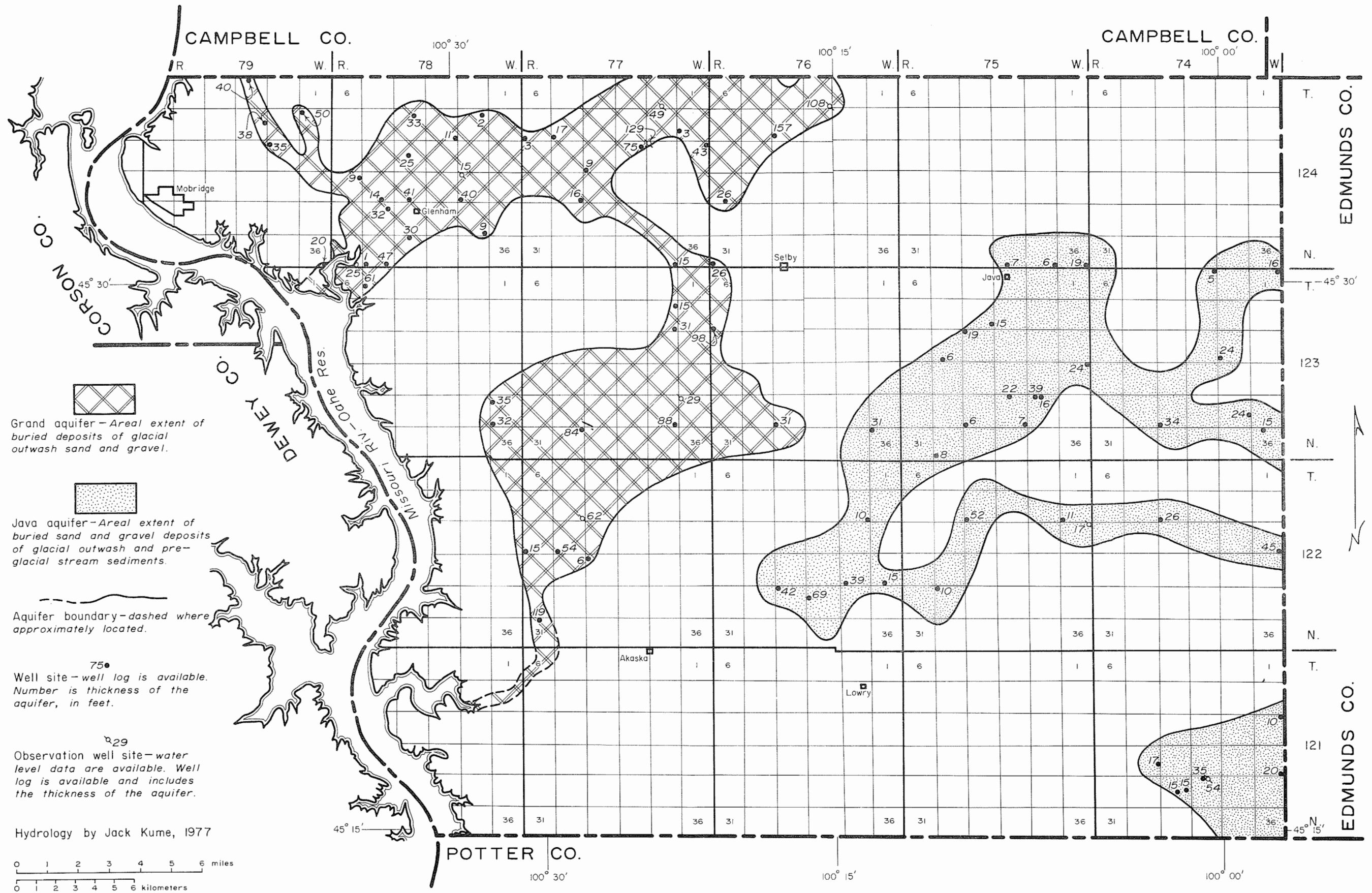


Figure 3. Preliminary map showing the thickness and the areal extent of the Grand and Java aquifers.