GROUNDWATER RESOURCES

Grundy County

GWR-38
1988
Compiled by CAROL A. THOMPSON

Iowa Department of Natural Resources
Geological Survey Bureau

GROUNDWATER RESOURCES OF GRUNDY COUNTY

Introduction

Virtually all of the residents of Grundy County rely on groundwater as the source of their drinking water. In addition, livestock, agriculture, and industries all primarily utilize groundwater. Estimated use of groundwater in the county is approximately 1.3 billion gallons per year.

The users of groundwater in the county draw their supplies from several different geologic sources. Various factors must be considered in determining the availability of groundwater and the adequacy of a supply source:

distribution- having water where it is needed

accessibility- affects the costs for drilling wells and pumping water

yield- relates to the magnitude of the supply that can be sustained

quality- determines for what purposes the water can be used

In terms of these factors, there are few locations in Grundy County where the availability of groundwater is not limited to some degree. The most common limitation is poor water quality, that is, highly mineralized groundwater. Secondary limitations are generally related to poor accessibility due to the great depths to adequate sources.

Occurrence of Groundwater in Grundy County

The occurrence of groundwater is influenced by geology -- the position and thickness of the rock units, their ability to store and transmit water, and their physical and chemical make-up. Geologic units that store and transmit water and yield appreciable amounts to wells are called aquifers. The most productive aquifers are usually composed of unconsolidated sand and gravel, porous sandstone, and fractured limestone and dolomite. Other units composed of materials such as clay, silt, shale, and siltstone yield little or no water to wells. These impermeable units are called aquicludes or aquitards, and commonly separate one aquifer unit from another.

Grundy County, the principal sources from which users obtain water supplies are the loose, unconsolidated materials near the land surface that comprise the surficial aquifers, and several deep rock aquifers. Figure 1 is a cross section showing the geologic relations of aquifers beneath the county. Each aquifer has its own set of geologic, hydrologic, and water-quality characteristics which determine the amount and potability (suitability for drinking) of water it will yield. Table 1 lists the geologic and hydrogeologic characteristics of the aquifers underlying Grundy County.

Surficial Aquifers

Surficial deposits consist of mixtures of clay, silt, sand, gravel, and assorted boulders. The water-yielding potential of surficial deposits is greatest in units composed mostly of sand and/or gravel. In most Iowa counties, three types of surficial aquifers exist: alluvial, drift, and buried channel aquifers.

Alluvial aquifers (Fig. 2) consist mainly of sand and gravel deposited by streams and associated with the floodplains and terraces of major valleys. Alluvial deposits lie close to the land surface, and are generally less than 50-60 feet thick. Thus, alluvial aquifers are highly susceptible to contamination. Yields in alluvial systems are often quite variable due in part to the inhomogeneity of the sediment and to rapid lateral changes in thickness. Yields from 20-100 gallons per minute can be expected from the alluvial deposits in Grundy County. Higher yields may be possible in some locations.

Drift aquifers (Fig. 3) are found in the thick layer of clay-to-boulder-size material (till) deposited by glacial ice which invaded the county several times in the last two million years. The composition of the glacial drift varies considerably, and in many places does not yield much water. There are, however, lenses or beds of sand and gravel in the drift which are thick and widespread enough to serve as dependable water sources. Usually one or two sand layers can be found in most places that will yield minimum water supplies for domestic wells. Yields from glacial drift aquifers are generally low, often below 10 gallons per minute.

Buried channel aquifers, such as shown in Figure 4, consist of sand and gravels found in stream valleys that existed before the

Figure 1.

CROSS-SECTION FROM NORTH TO SOUTH ACROSS GRUNDY COUNTY

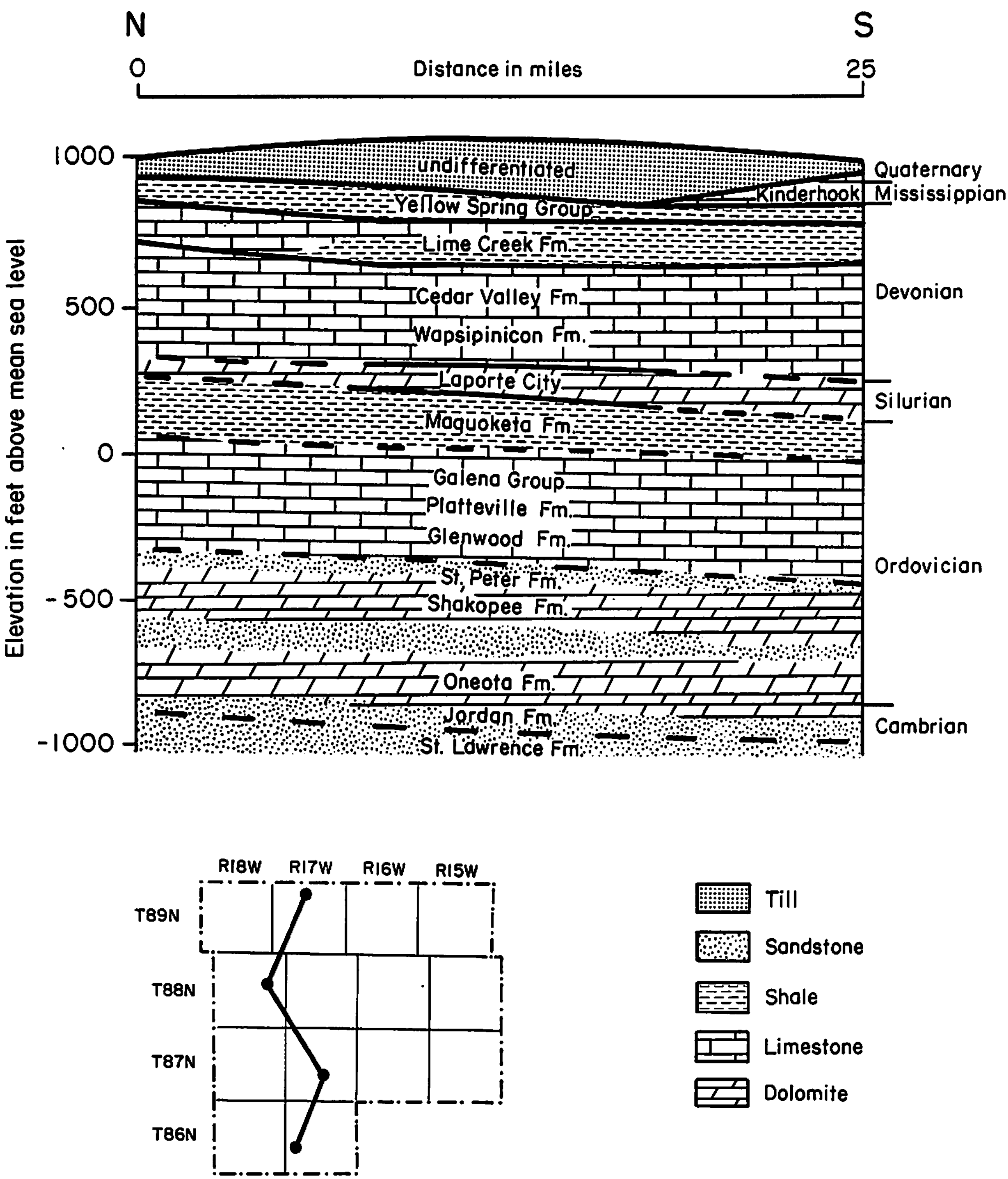


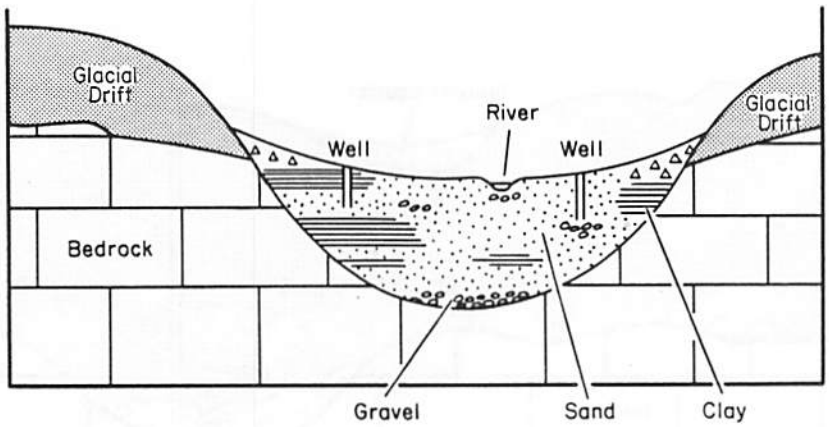
Table 1

GEOLOGIC AND HYDROLOGIC UNITS IN GRUNDY COUNTY

GEOLOGIC AGE	SERIES	GROUP	FORMATION	DESCRIPTION	THICKNESS RANGE	HYDROGEOLOGIC UNIT	WATER-BEARING CHARACTERISTICS
Quaternary	Pleistocene			alluvium (sand and gravel)	0-30	alluvial aquifer	low to moderate yields (20-100 gpm)
				glacial drift (clay, loess, sand and gravel)	20-320	glacial drift aquifer	low yields (5-30 gpm)
				buried channel (sand and gravel, silt)	0-30	buried channel aquifer	low to moderate yields (20-100 gpm)
Mississippian	Kinderhook		Hampton	limestone, dolomite	0-105	Mississippian aquifer	low to high yields (10-200 gpm)
		North Hill		limestone, dolomite, siltstone, chert, sandstone	0-45	aquiclude	
Devonian	Upper	Yellow Spring	Maple Mill Aplington Sheffield	shale dolomite shale	0-160	aquiclude	
			Lime Creek Shell Rock	shale, dolomite, limestone limestone, dolomite	0-100	Devonian aquifer	moderate to high yields (50-300 gpm)
	Middle		Cedar Valley Wapsipinicon Bertram	dolomite, limestone shale, dolomite dolomite	300-400		
Silurian			LaPorte City	dolomite, chert	50-100	Silurian aquifer	moderate to high yields
Ordovician			Maquoketa	shale, dolomite, chert	200-300	aquiclude	
		Galena	Dubuque Wise Lake Dunleith	dolomite, limestone, shale dolomite, limestone dolomite, limestone, chert	250	Galena aquifer	low yields
			Decorah	shale, limestone	50-150	aquiclude	
			Platteville	limestone, shale			
		Ancell	Glenwood	shale			
			St. Peter	sandstone	50	Cambro-Ordovician aquifer	high yields (100-1000 gpm)
		Prairie du Chien	Shakopee Oneota	dolomite, chert sandstone	500		
Cambrian		Trempleau	Jordan	sandstone	80-100		
			St. Lawrence	dolomite		(not known to produce potable water in Grundy Center)	
		Tunnel City	Davis/Lone Rock	sandstone, shale			
		Elk Mound	Wonewoc Eau Claire/ Bonneterre Mt. Simon	sandstone sandstone/shale, dolomite sandstone			
Precambrian				sandstone, quartzite igneous and metamorphic rocks			

Figure 2

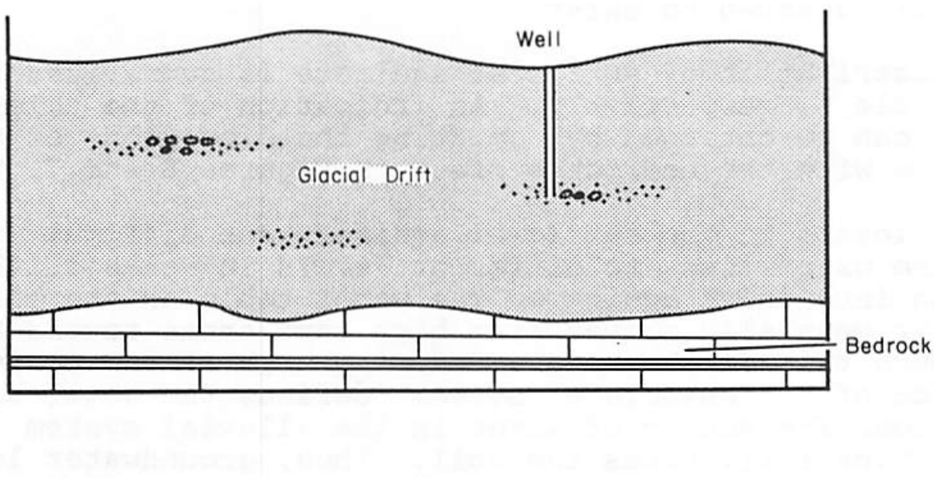
ALLUVIAL AQUIFER



An alluvial aquifer is a sand and gravel deposit which allows relatively free water movement.

Figure 3

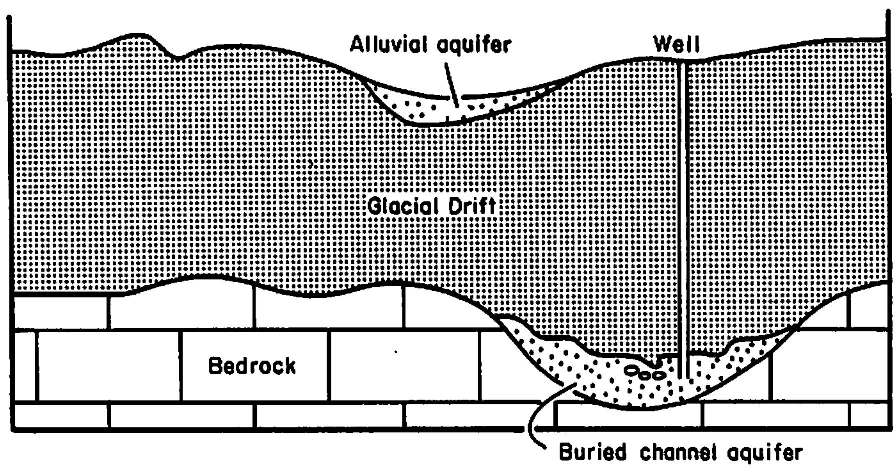
GLACIAL TILL AQUIFER



A drift aquifer is formed by thin discontinuous sand and gravel zones within less permeable drift materials.

Figure 4

BURIED CHANNEL AQUIFER



A pre-existing landscape was buried by the glacial till. The buried valleys may contain good sources of water.

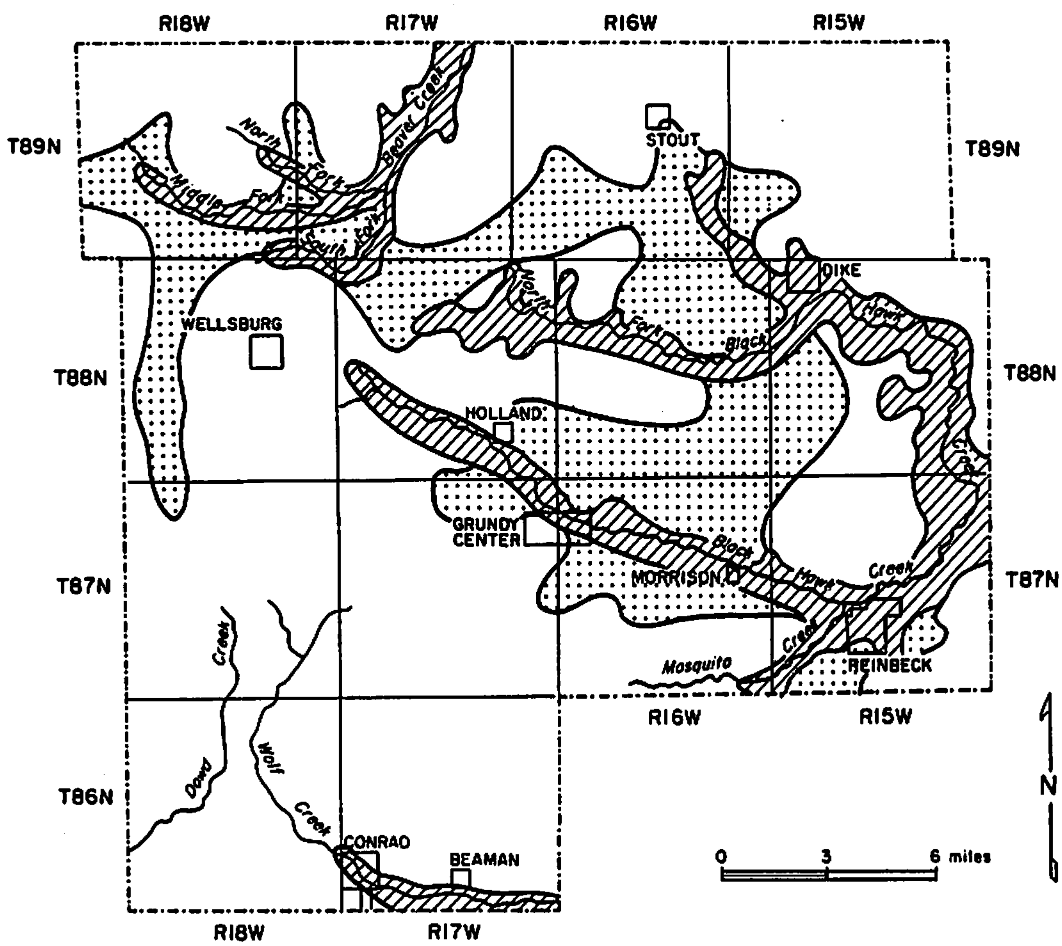
glacial period. The valleys were later overridden by the glaciers, and are now buried under the glacial drift. The former valleys may or may not coincide with present day stream valleys. Although not much is known about the buried channel in Grundy County, it is estimated that yields of 20-100 gallons per minute could be produced. In Grundy County, one relatively large buried channel is known to exist.

The distribution of surficial aquifers is summarized in Figure 5 and Table 1, respectively. An indication of the thickness of the drift can be obtained by comparing the elevations of the land surface with the bedrock surface in Figures 6 and 7, respectively.

Water levels in the surficial aquifers are difficult to analyze because water rises to different levels in wells drilled into alluvial and into drift aquifers. The water table in the alluvial aquifer generally slopes from high land areas toward the streams, although this can be reversed during high stream stages. The surface of the associated stream defines the water table at that location. The source of water in the alluvial system is precipitation which infiltrates the soil. Thus, groundwater levels change noticeably throughout the year in response to precipitation, and are highest in late spring and fall. Water levels in shallow drift aquifers fluctuate in the same way as those in alluvial aquifers.

Figure 5

DISTRIBUTION OF SURFICIAL AQUIFERS



Alluvial Aquifer

Buried channel aquifer

Drift aquifer

Figure 6

ELEVATION OF LAND SURFACE IN FEET
ABOVE MEAN SEA LEVEL

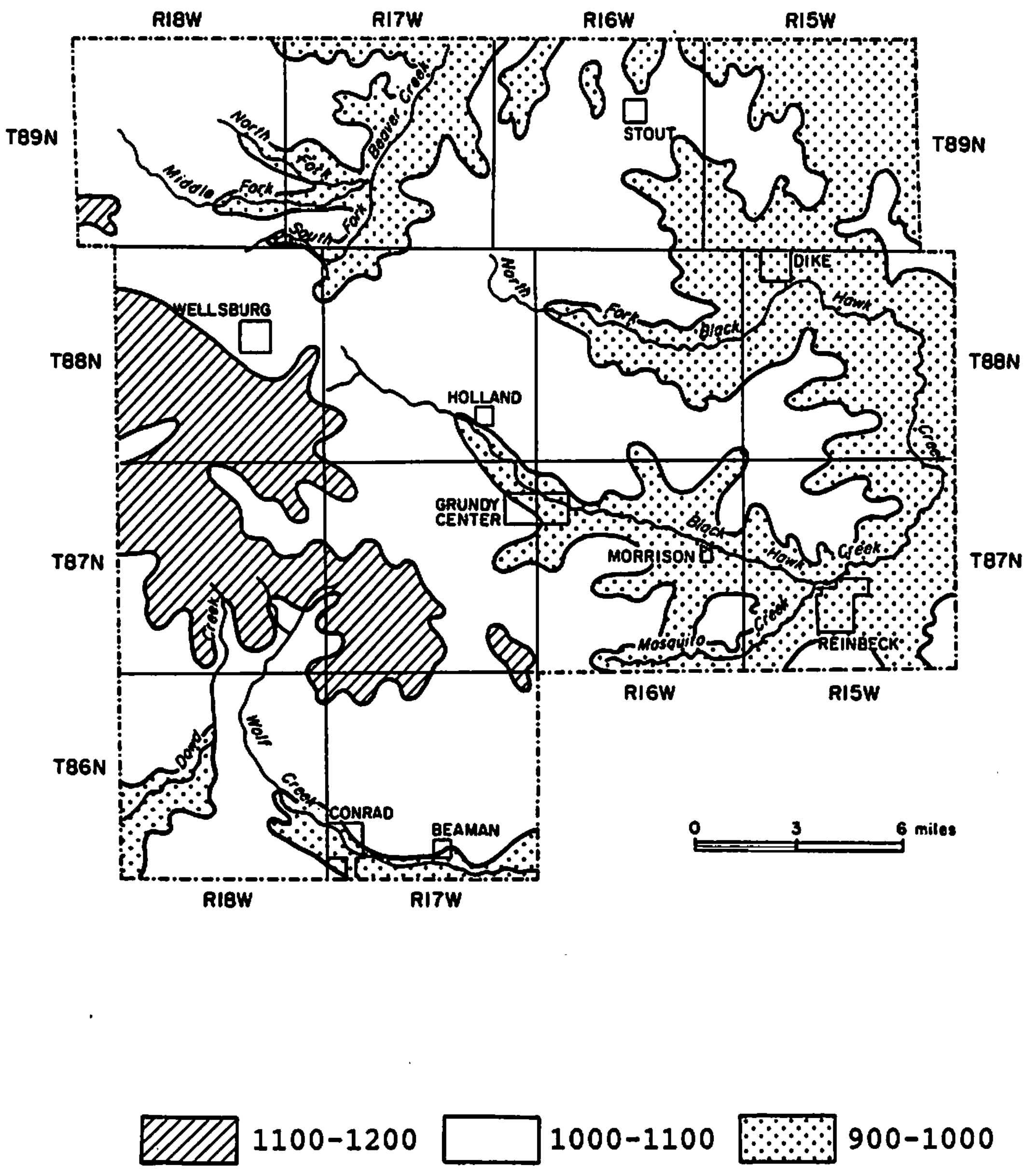
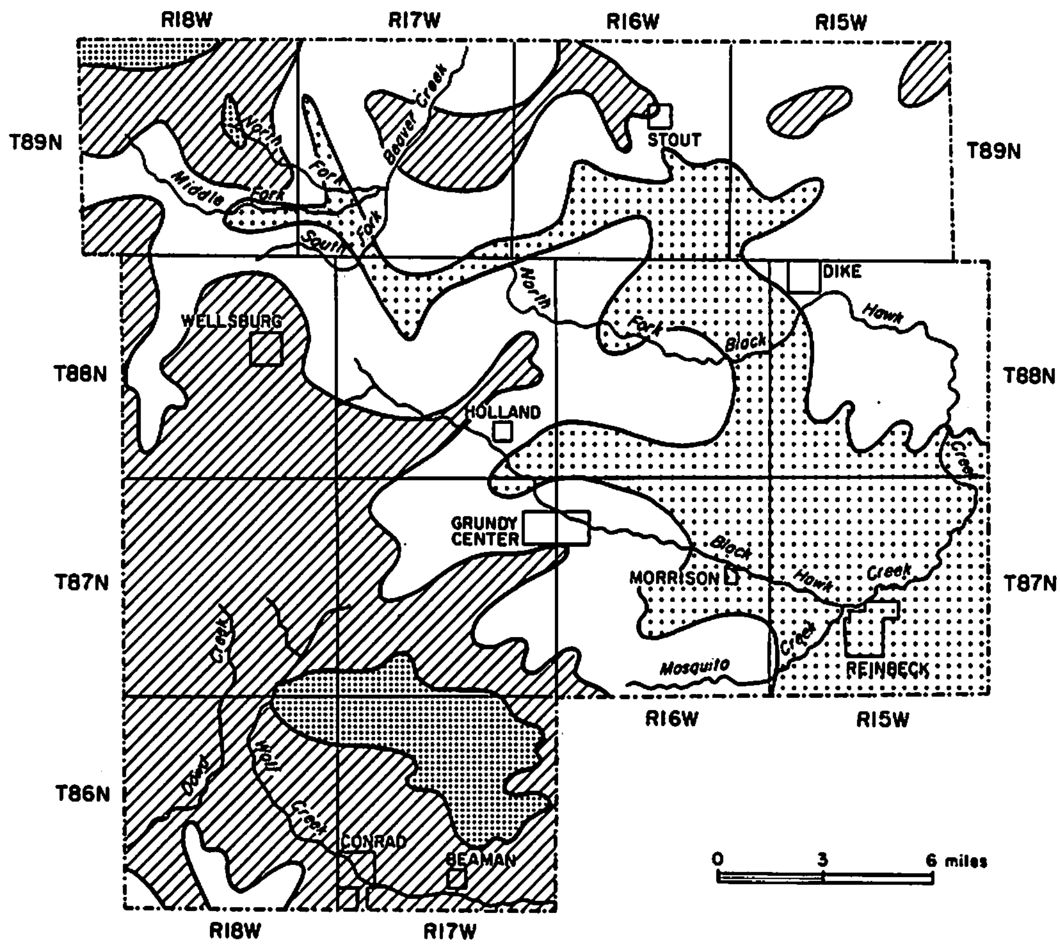


Figure 7

ELEVATION OF BEDROCK SURFACE IN FEET
ABOVE MEAN SEA LEVEL



1000-1100	800-900
900-1000	700-800

Deeper drift aquifers are under confined (artesian) conditions and are generally unaffected by local recharge-discharge relationships.

Water levels in the drift aquifers are commonly from 10-50 feet below the land surface. The water levels in alluvial wells are from 4 to 20 feet below the land surface.

Rock Aquifers

Below the drift and other surficial materials is a thick sequence of layered rocks. These formed from sediments deposited in shallow seas that periodically inundated the state millions of years ago. The geologic map (Fig. 8) shows the geologic units which form the surface of this rock sequence. Two rock aquifers are shown schematically in Figure 9.

The relative accessiblity of groundwater in rock aquifers depends on the depth to the aquifer. The deeper a well must be, the greater the cost for well construction and pumping. The depths to units at specific sites will vary somewhat because of irregularities in the elevation of the land surface and in the elevation of the underlying rock units. Estimates of depths can be made by comparing Figure 7, the land surface elevation map, with the maps of aquifer elevations (Figures 10,13,17).

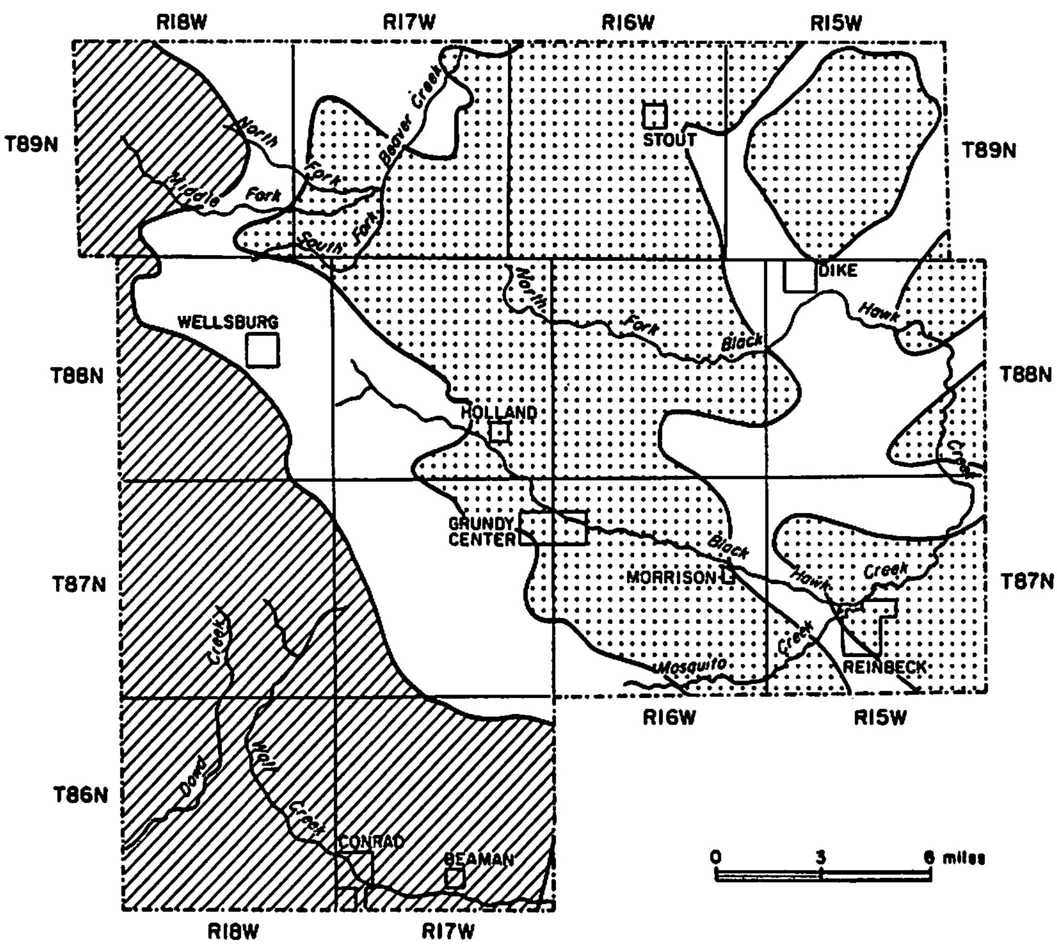
A second factor affecting groundwater accessiblity is the level to which the water will rise in a well (the static water level). Throughout the county, water in the rock aquifers is under hydrostatic pressure, and rises in wells when an aquifer is penetrated. This can reduce the cost of pumping.

Rates of yield are also often an important consideration in determining groundwater accessiblity. Yield can be quite variable throughout an aquifer, particularly in limestone and dolomite aquifers where yield is often determined by the presence of fractures in the rock.

Rocks of Mississippian and Devonian age lie below the glacial materials in Grundy County. Mississippian rocks of the Kinderhook series occur primarily in the western third of the county. Figures 10, 11, and 12 show respectively the elevation, thickness, and water levels in the Mississippian aquifer. The aquifer is composed of limestone and dolomite with some chert nodules and minor sandstone and siltstone lenses. Pumping rates range from 60 to 220 gallons per minute for municipal wells finished in the Mississippian, indicating at least moderate yields can be obtained in some locations.

Figure 8

GEOLOGIC MAP



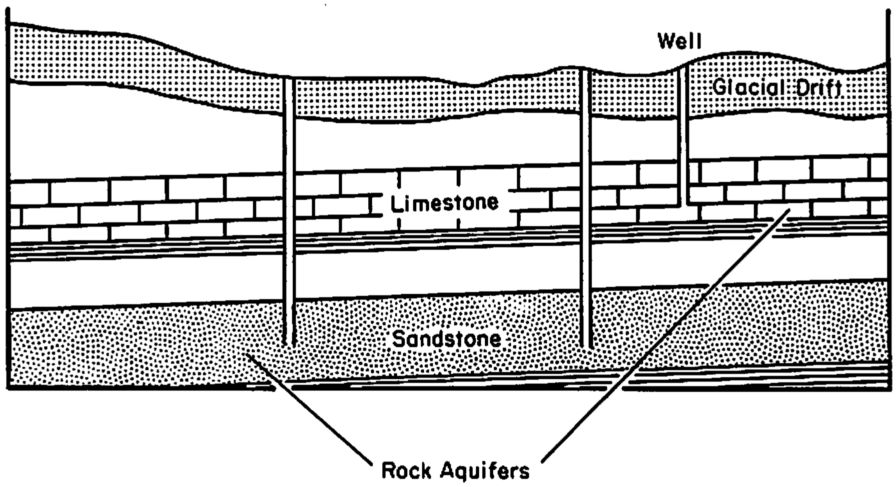
Mississippian Kinderhook

Devonian Yellow Spring

Devonian Lime Creek

Figure 9.

ROCK AQUIFERS



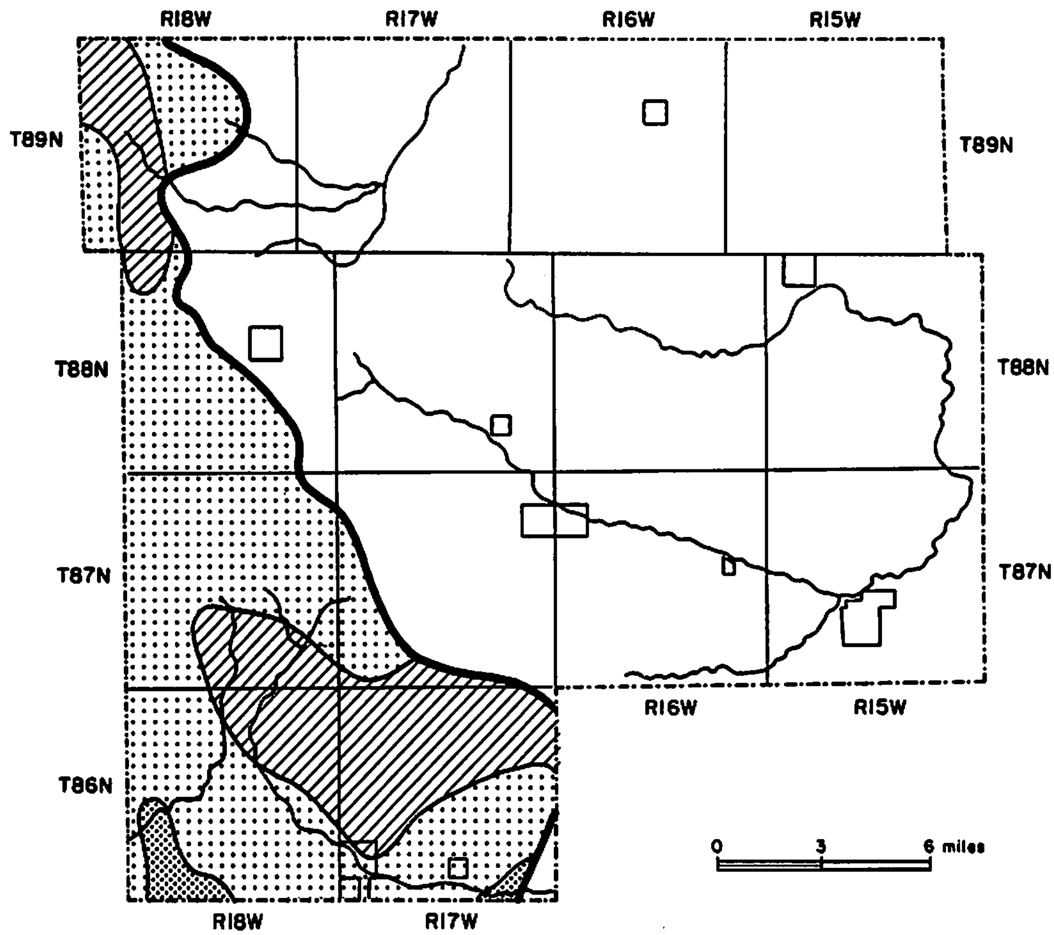
Water-bearing rock aquifers occur at or below the land surface. Two different types of rock aquifers are shown: one composed of limestone, another of sandstone.

The Silurian-Devonian aquifer (Figures 13-16) is the most extensively used aquifer in Grundy County. Most wells are completed in the Devonian at depths between 200 and 300 feet. A few wells are completed into the Silurian at depths of up to 900 feet. Silurian rocks are relatively thin in Grundy County (averaging only 75 feet thick) while overlying Devonian rocks are exceptionally thick (up to 700 feet). The aquifer consists of a series of limestones and dolomites interspersed with minor shale beds. Municipal pumping rates vary from 100 to 375 gallons per minute, indicating moderate yields.

The Cambro-Ordovician aquifer includes the St. Peter Sandstone, the Prairie du Chien Group, and the Jordan Sandstone (Figs. 17-19). The St. Peter is highly friable and is generally cased out in wells. The Prairie du Chien Group is comprised of the Shakopee dolomite and the Oneota sandstone. The Jordan sandstone is thin, but is the major water producing unit in the aquifer. The depth to the top of the aquifer, which averages 1700 feet, precludes its use by most residents. However, it is the most productive rock aquifer in the state, producing yields adequate for large municipalities and industry.

Figure 10

ELEVATION OF THE MISSISSIPPIAN AQUIFER
IN FEET ABOVE MEAN SEA LEVEL



Edge of Mississippian

900-1000

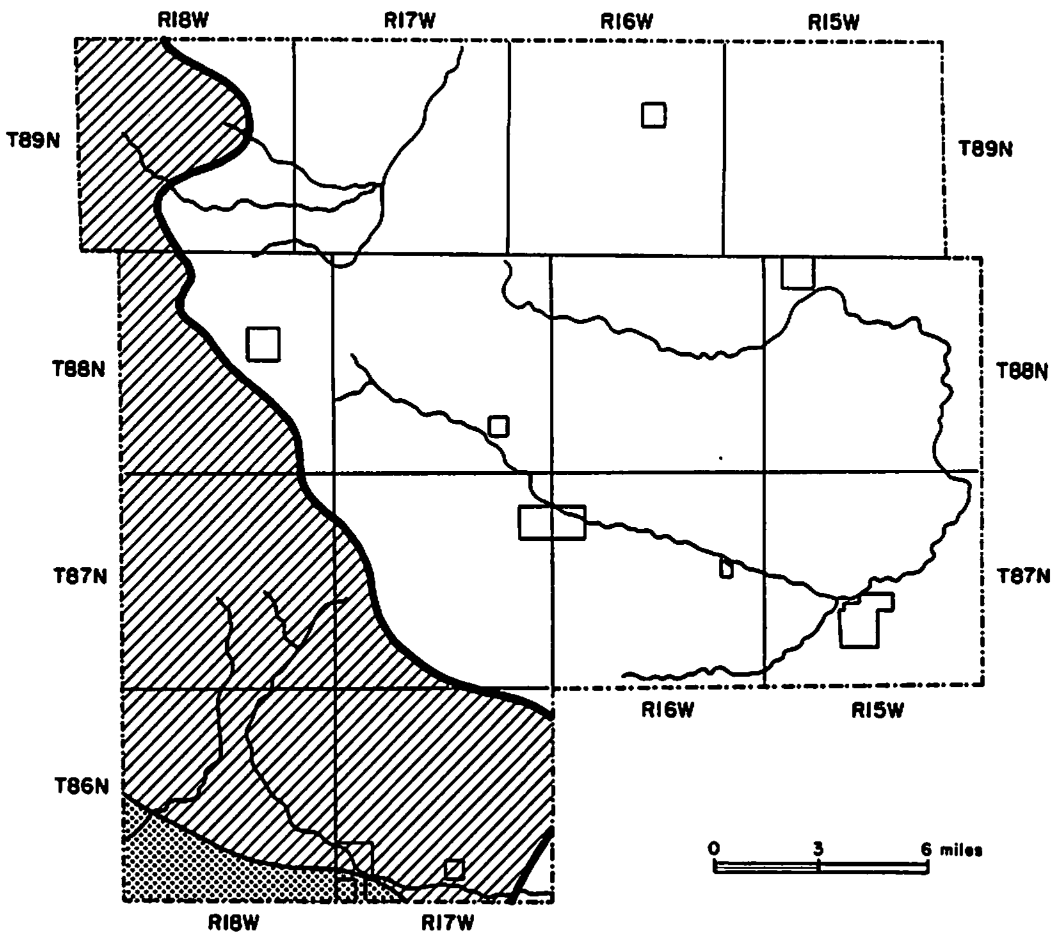
Mississippian not present

1000-1100

800-900

Figure 11

THICKNESS OF THE MISSISSIPPIAN AQUIFER IN FEET



Edge of Mississippian

Mississippian not present

0-100

100-200

Figure 12

WATER LEVELS IN WELLS COMPLETED IN THE MISSISSIPPIAN AQUIFER IN FEET ABOVE MEAN SEA LEVEL

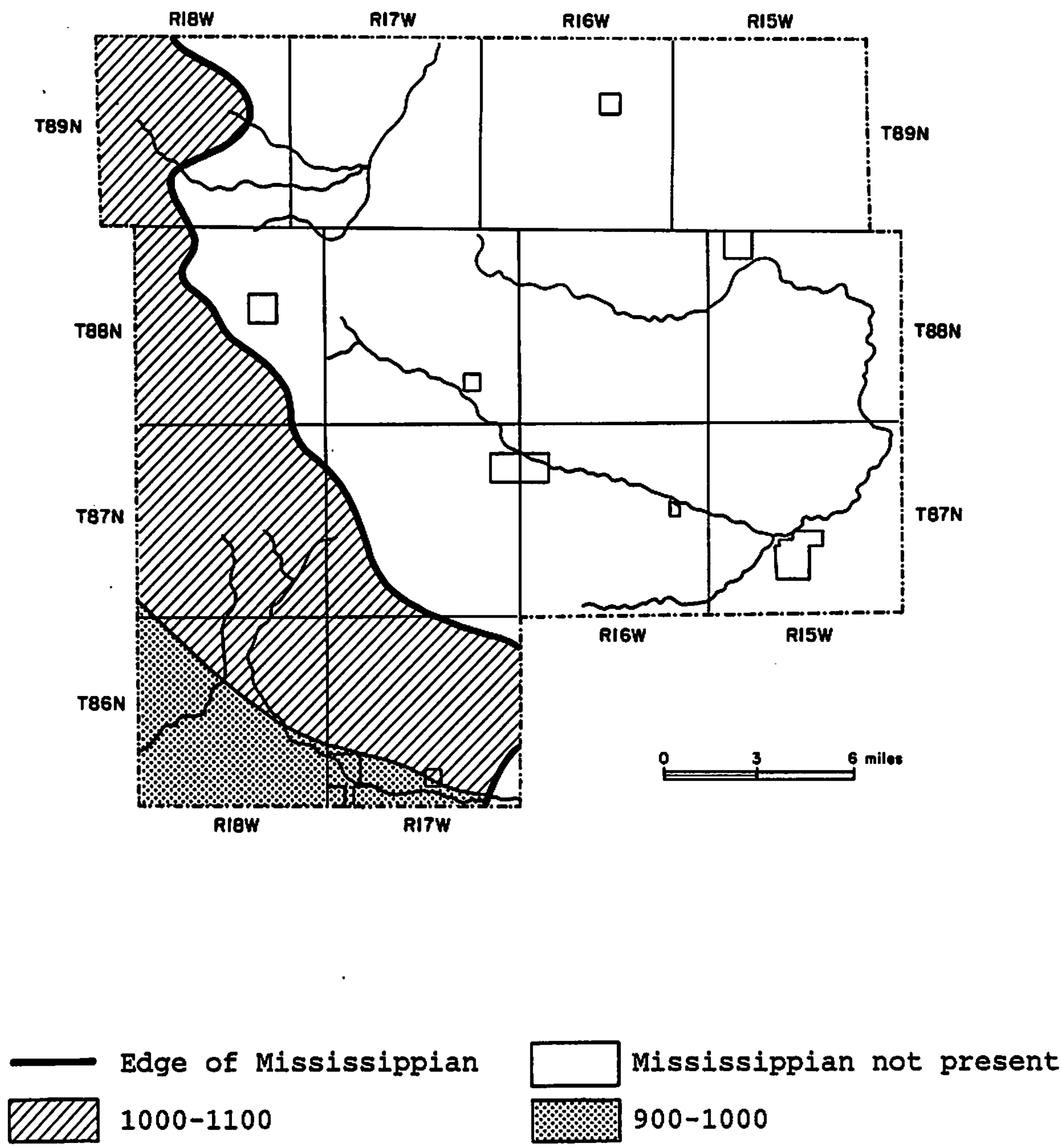


Figure 13

ELEVATION OF THE SILURIAN-DEVONIAN AQUIFER IN FEET ABOVE MEAN SEA LEVEL

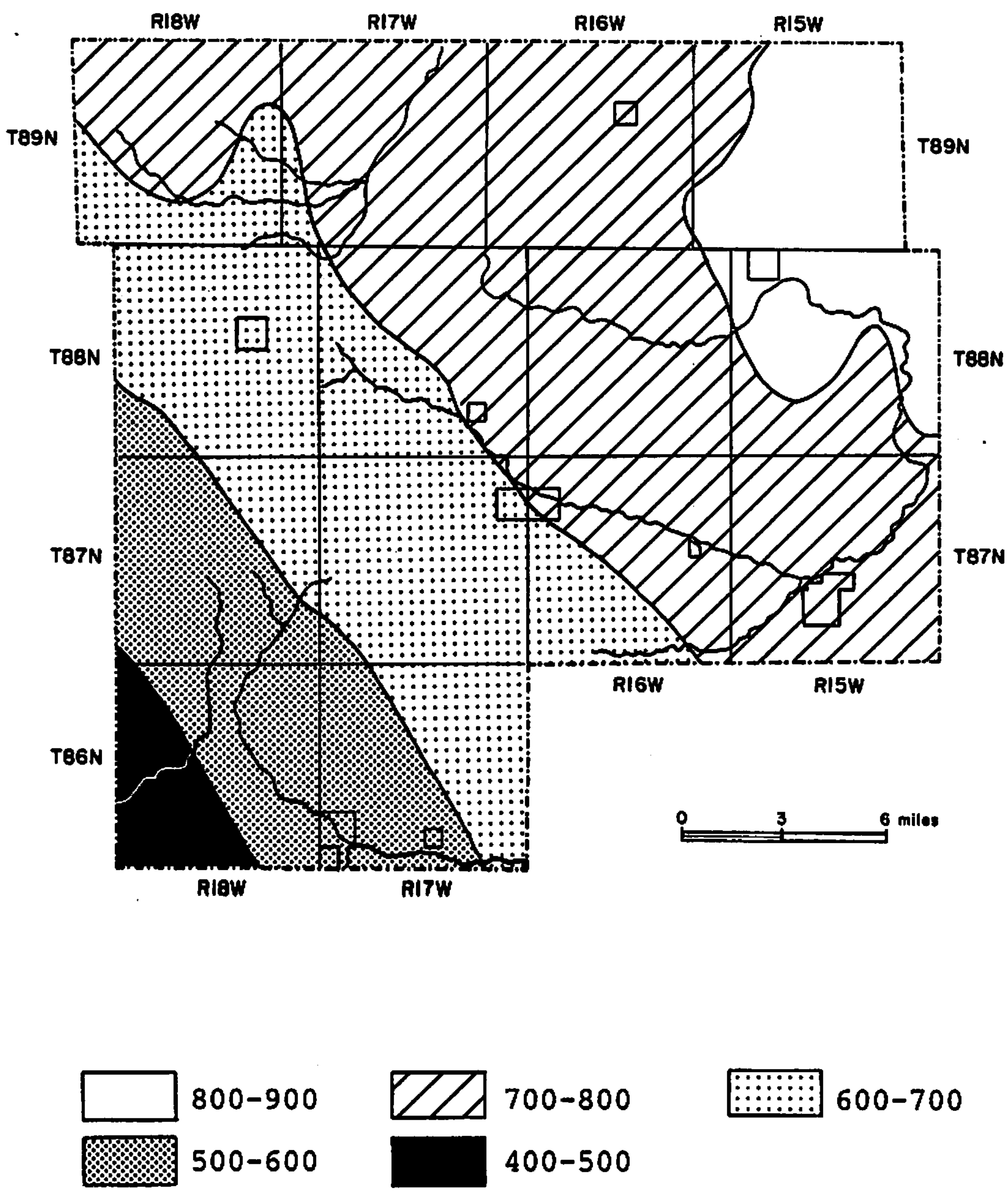
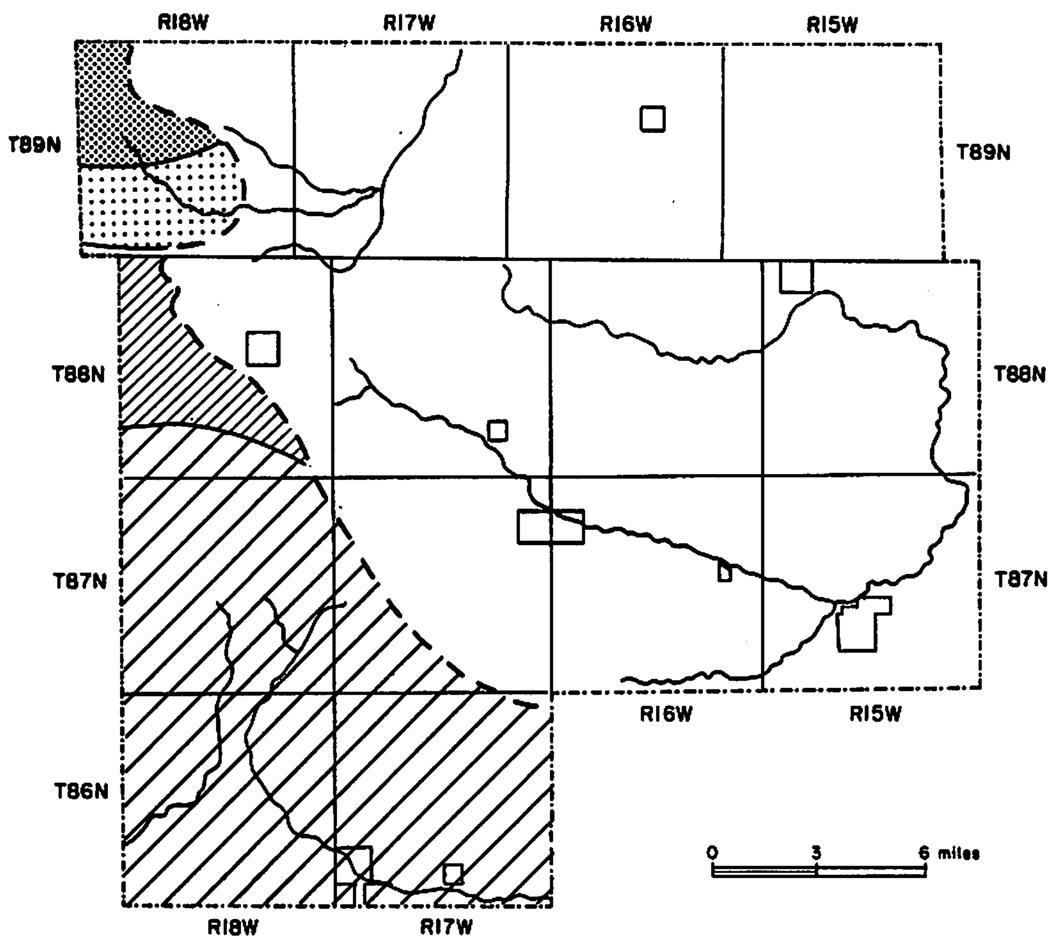


Figure 14

THICKNESS OF DEVONIAN ROCKS IN FEET



650-700

600-650

550-600

500-550

Outcrop area

— — — Line separating Devonian subcrop (overlain by Mississippian rocks) and Devonian outcrop (uppermost bedrock)

Figure 15

THICKNESS OF SILURIAN ROCKS IN FEET

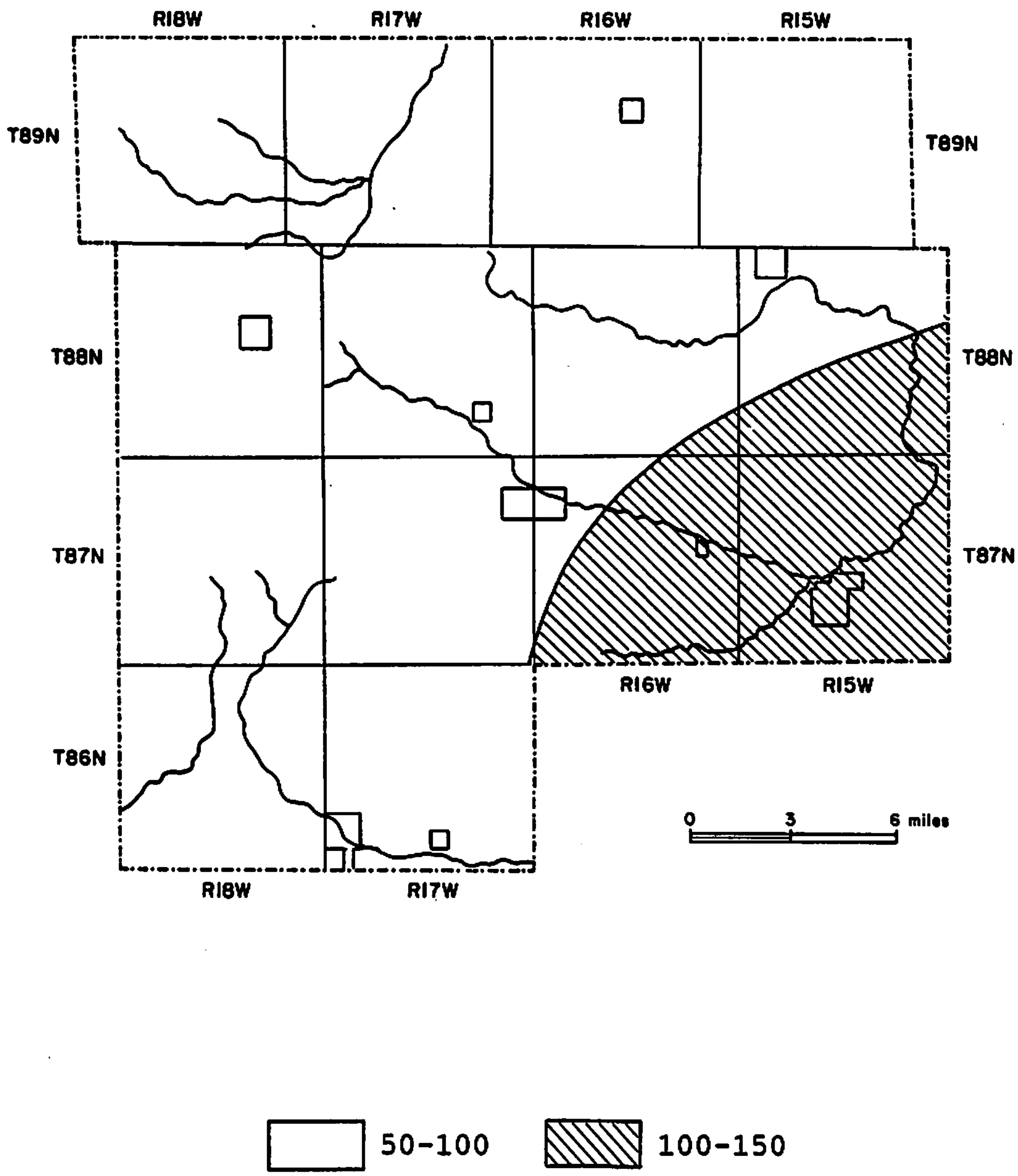


Figure 16

WATER LEVELS IN WELLS COMPLETED IN THE SILURIAN-DEVONIAN AQUIFER IN FEET ABOVE MEAN SEA LEVEL

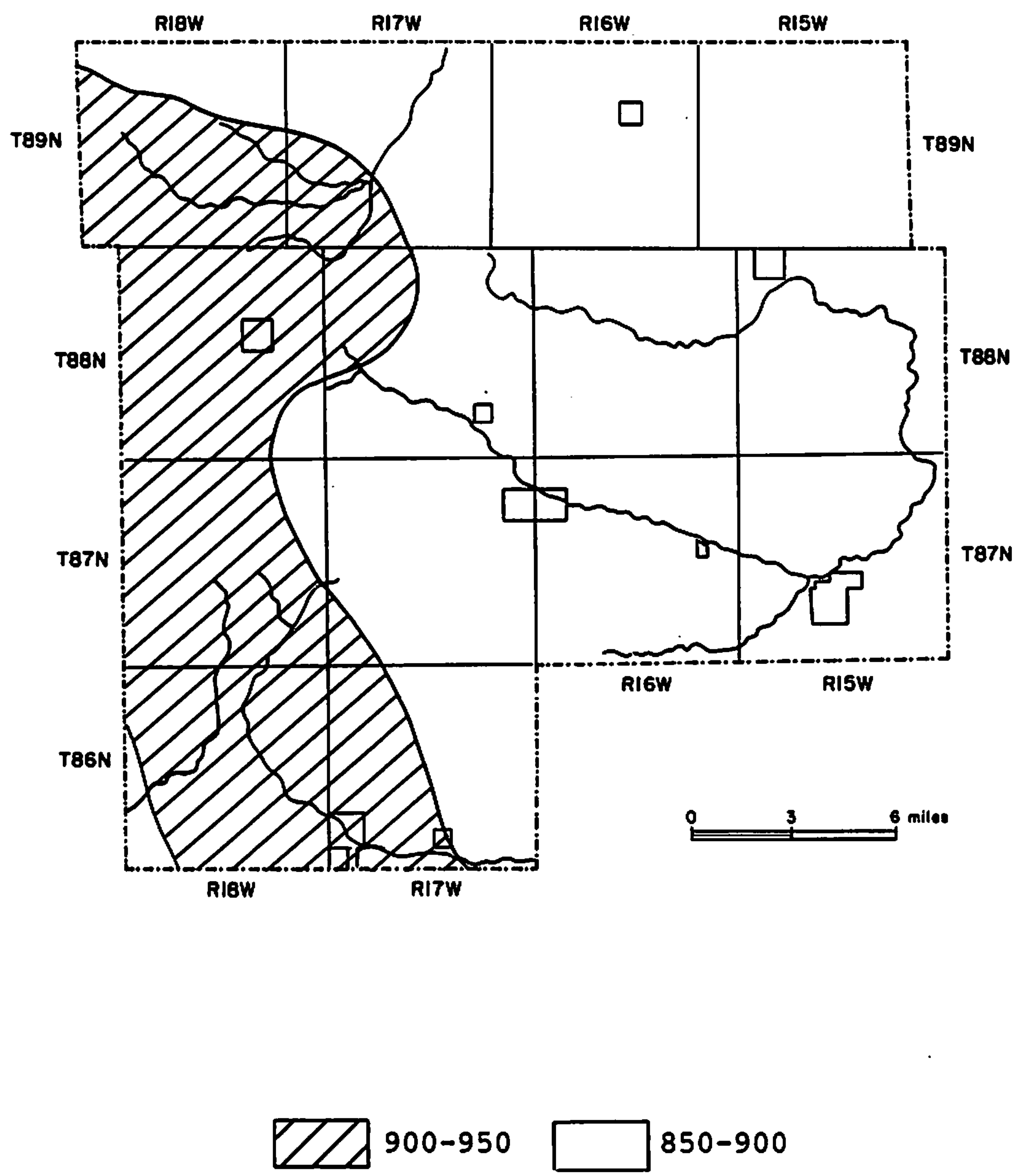


Figure 17

ELEVATION OF THE PRARIE DU CHIEN GROUP IN
FEET BELOW MEAN SEA LEVEL

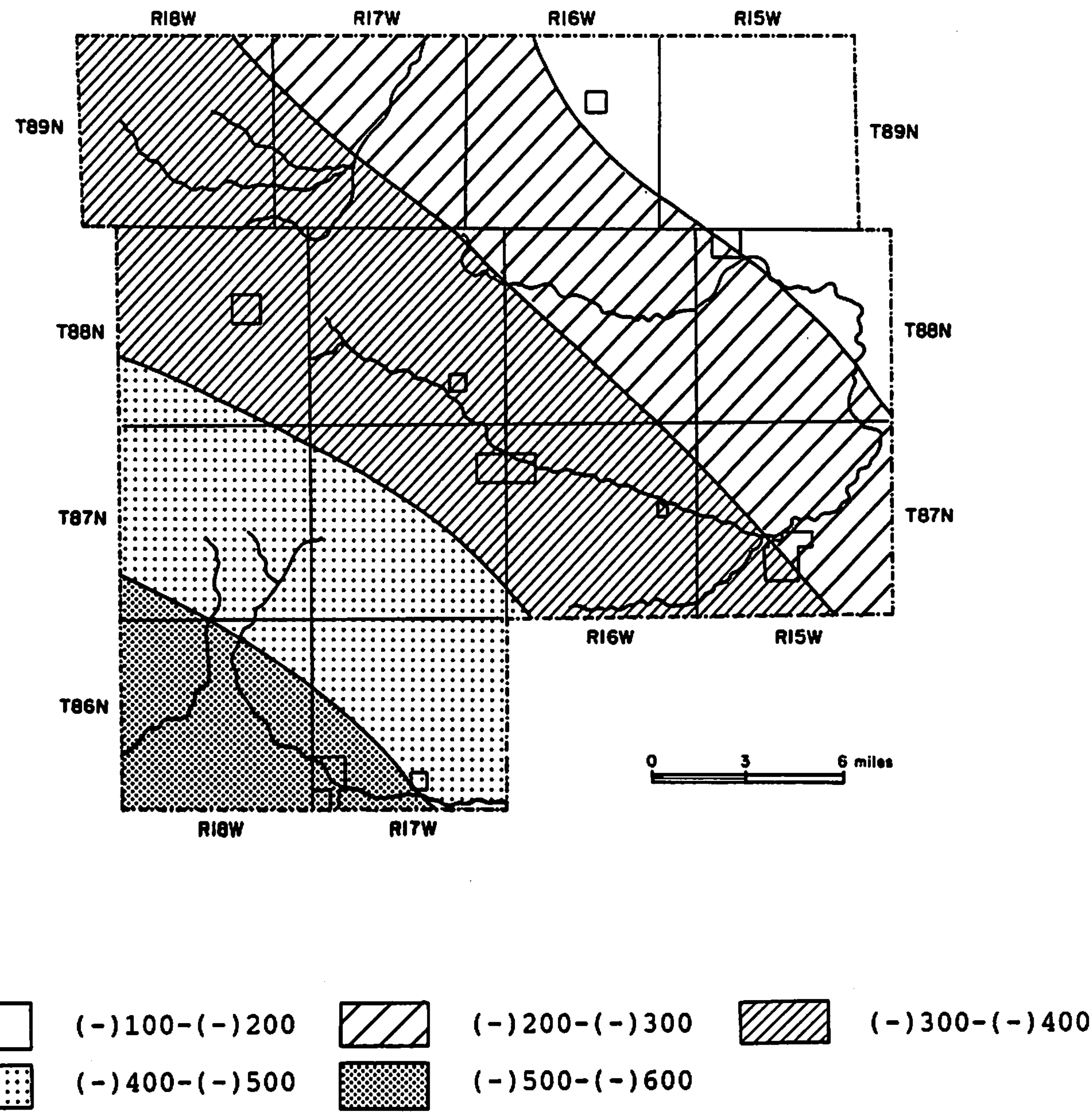


Figure 18

ELEVATION OF THE JORDAN SANDSTONE IN
FEET BELOW MEAN SEA LEVEL

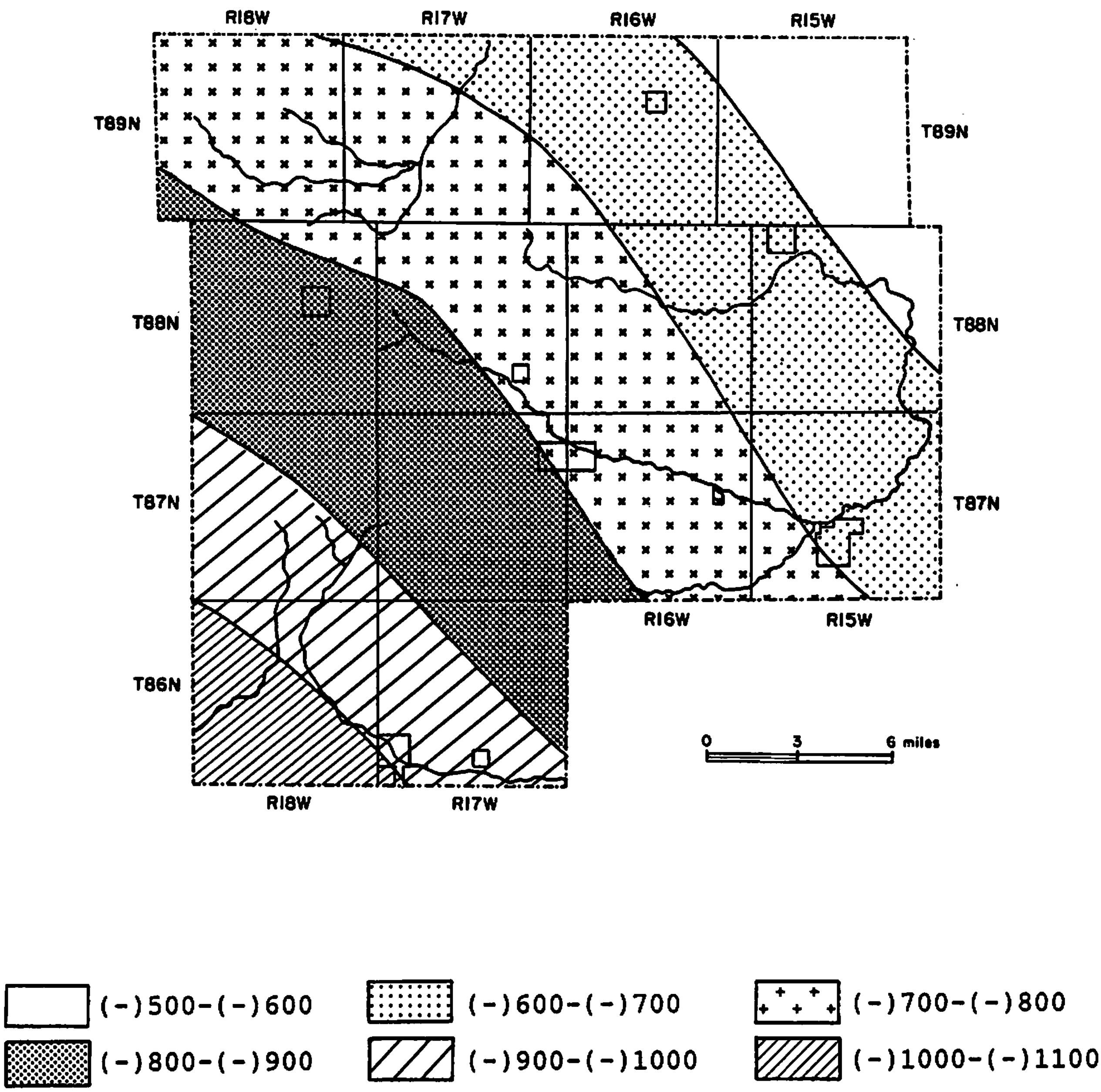
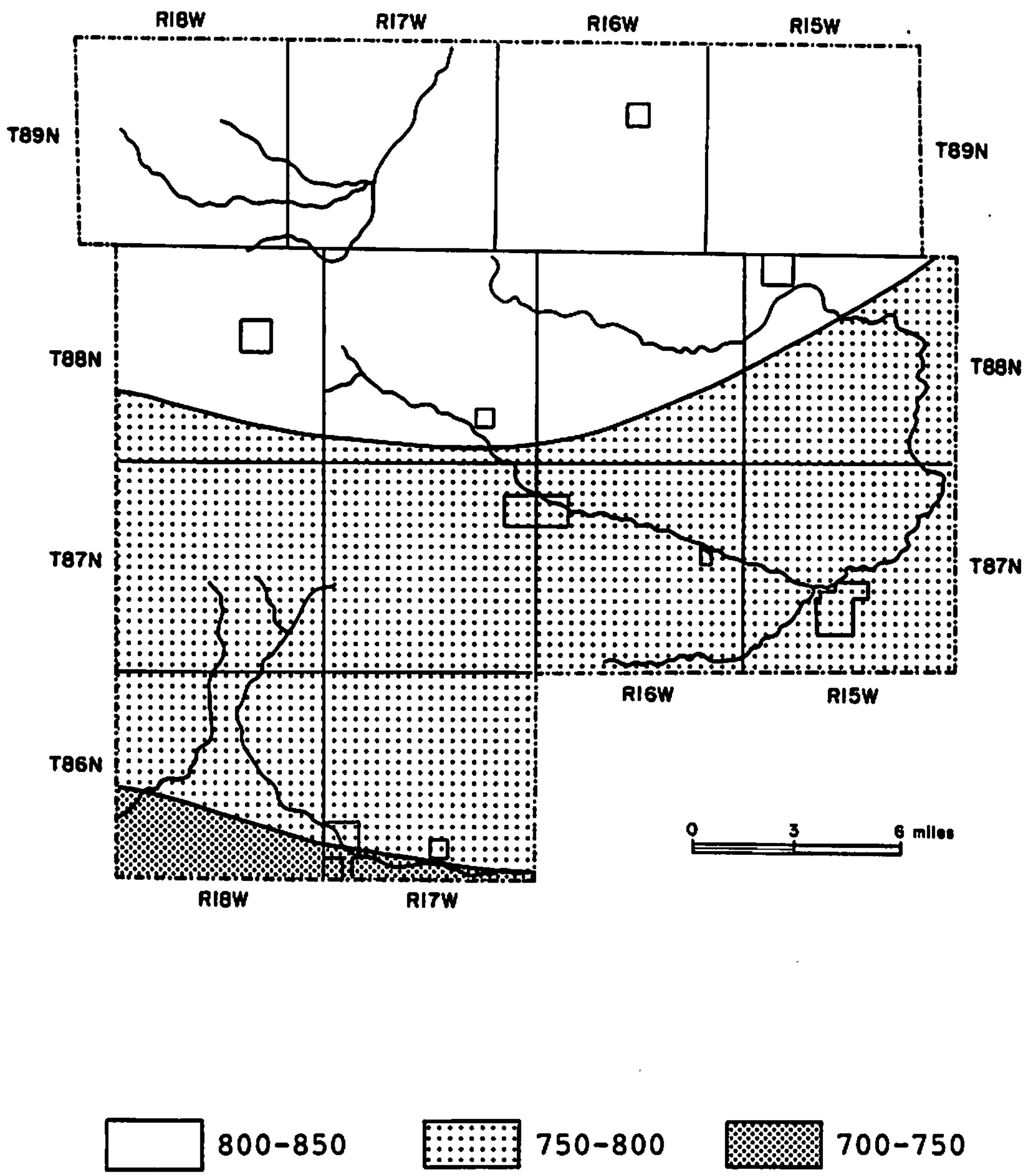


Figure 19

WATER LEVELS IN WELLS COMPLETED IN THE CAMBRIAN-ORDOVICIAN AQUIFER IN FEET ABOVE MEAN SEA LEVEL



Water Quality

To the user, the quality of groundwater is as important as the amount of water that an aquifer will yield. As groundwater moves through soil and rock materials, it dissolves some of the minerals which, in turn, affect water quality. In addition to mineral content, bacterial and chemical contamination may be introduced through poorly constructed wells and seepage from other pollution sources.

Recommended maximum concentrations for the common mineral constituents in water are described in Table 2. These are accepted as standards for drinking water supplies. Limits for uses other than drinking often differ from these. For instance, water that is unacceptable for drinking and household use may be completely satisfactory for industrial cooling.

From past analyses of groundwater, the averages (A) and ranges (R) of values in milligrams per liter (mg/l) for several constituents are summarized in Table 3 for the bedrock aquifers in Grundy County. Water-quality analyses for individual wells should be obtained to determine if concentrations of constituents affecting health are exceeded.

Although, there is no data available on the quality of water from shallow aquifers in Grundy County, in general, alluvial sources yield the least mineralized groundwater in central Iowa. However, alluvial aquifers are the most susceptible to contamination. Water quality in the drift aquifers is usually similar to that of alluvial sources, but with slightly higher mineral concentrations. Iron, manganese, and sulfate can all be high, and the possibility of contamination from surface sources also exists. Water quality in the buried channel is often quite dependent on the depth of burial and connections with other aquifers. Mineral concentrations can be high from some buried channels.

The water in these shallow aquifers is usually acceptable for most purposes if the wells are constructed properly. Nitrate contamination of shallow groundwater is becoming more of a problem and may require water treatment. Nitrate content should be checked in shallow wells and any water supply containing over 45 mg/l, the maximum contaminant level (MCL), should not be used for infant feeding.

The Mississippian aquifer, where it is present in the Grundy County, provides good quality water with dissolved solids averaging less than 500 mg/l, the secondary standard. High nitrate concentrations have been noted at some locations, however.

Table 2

SIGNIFICANCE OF CHEMICAL CONSTITUENTS IN WATER

Constituent or Property	Maximum Recommended Concentration	Significance
Dissolved solids	500 mg/l	This refers to all material that is in solution. It affects the chemical and physical properties of water for many industrial uses. High concentrations will have a laxative effect and may cause an objectionable taste.
Hardness (as $CaCO_3$)		This affects the lathering ability of soap. Primarily caused by calcium and magnesium. Water is generally classified as: 0-100 mg/l as soft; 100-200 mg/l as moderate; anything above 200 mg/l as hard.
Iron (Fe)	0.3 mg/l	Iron is objectionable as it may impart an unpleasant taste and may cause discoloration of laundered goods and porcelain fixtures.
Manganese (Mn)	0.05 mg/l	Objectionable for the same reasons as iron.
Potassium (K) and Sodium (Na)		When combined with chloride, imparts a salty or brackish taste. In the presence of suspended matter, causes foaming in boilers. Important ingredients in human cell metabolism. Low sodium diets are prescribed in the treatment of certain types of heart disease and high blood pressure.
Calcium (Ca) and Magnesium (Mg)		Calcium and magnesium cause water hardness. They reduce the lathering ability of soap. They react with bicarbonate and sulfate to form scale in pipes.
Sulfate (SO_4)	250 mg/l	Commonly has a laxative effect and imparts a bitter taste when concentrations exceed 500 mg/l, particularly when combined with magnesium or sodium. The effect is less when combined with calcium. Persons may become acclimatized to the water, but concentrations above 750 mg/l generally affect everyone. Sulfate combined with calcium causes scale in boilers and water heaters.
Chloride (Cl)	250 mg/l	Imparts a salty taste, especially when combined with sodium and potassium.
Fluoride (F)	2.0 mg/l	Concentrations of 0.8--1.3 mg/l are effective in reduction of tooth decay, especially in children. Concentrations in excess of 2.0 mg/l will cause mottling of dental enamel.
Nitrate (NO_3)	45 mg/l	Concentrations of nitrate above the recommended limits may cause cyanosis or methemoglobinemia (blue baby syndrome) when used for feeding infants under one year of age. This disease reduces the ability of the blood to absorb oxygen and may be fatal unless properly treated. High concentrations suggest organic pollution from sewage, decaying organic matter, or fertilizers.
Radioactivity gross alpha Radium 226 (Ra^{226}) Radium 226 & 228 (RA ^{226}, Ra^{228}) Strontium 90 (Sr^{90}) gross beta (in absence of alpha emitters such as Sr^{90} and Ra^{226})	picocuries/l 15 3 5 10 1000	Groundwater may contain naturally occurring radioactivity. Human exposure to radiation is viewed as harmful, and unnecessary exposure should be avoided. Limits have been set insofar as is technically and economically feasible.

Table 3

CHEMICAL CHARACTER OF GROUNDWATER

	Diss Solids	Fe	Hardness as $CaCO_3$	K	Na	Ca	Mg	Mn	NO_3	F	Cl	SO_4	HCO_3	Cond	pH
Mississippian	326	<0.01	320	0.7	7.8	76	23	<0.01	<0.1	0.2	1	30	300	600	7.3
Aquifer	508	0.8	404	3.7	16.0	100	40	0.3	57.0	0.5	28	68	403	790	7.8
(12 samples,	414	0.15	362	2.3	11.6	89	33	0.08	21.1	0.3	13	47	356	631	4.45
5 wells)															
Silurian-Devonian	205	0.3	241	1.6	5.5	64	19	<0.01	<0.01	0.2	<0.5	26	264	460	7.0
Aquifer	2240	2.4	1460	12.0	66.0	360	130	0.06	0.9	2.3	15.0	1300	499	2300	7.9
(26 samples,	810	1.0	624	4.2	19.8	146	55	0.03	0.2	1.2	1.5	272	299	1161	7.4
11 wells)															
Cambro-Ordovician	547	0.8	328	22	65	83	29	0.01	0.3	1.1	0.9	180	376	940	7.5
Aquifer	601	1.0	344	22	71	81	38	0.01	0.4	1.3	13.0	200	382	950	7.4
(2 samples,	574	0.9	336	22	68	82	34	0.01	0.3	1.2	7.0	190	379	945	7.45
1 well)															

Water quality is good in the Silurian-Devonian aquifer over most of the county. Dissolved solids content increases to the south and west where the aquifer is more deeply buried (Fig. 20). Sulfate and hardness both increase significantly to the southwest. Iron is generally high.

Only one municipality (Wellsburg) uses the Cambro-Ordovician aquifer in Grundy County. Dissolved solids are between 500 and 750 mg/l, slightly over the secondary standards, and sulfate concentrations are below 250 mg/l. Radium 226 concentrations are between 3 and 5 picocuries per liter which is at or above recommended levels. High concentrations of radium can be reduced by certain methods of water softening.

RECOMMENDATIONS FOR PRIVATE WATER WELLS

Well Location

A well should be located where it will be least subject to contamination from nearby sources of pollution. Table 4 lists the minimum distances recommended between wells and sources of contamination. Greater distances should be provided where possible. Often county health departments will have additional guidelines.

The well location should not be subject to flooding or surface-water contamination. Select a well-drained site, extend the well casing a few feet above the ground, and mound earth around it. Diversion terraces or ditches may be necessary on slopes above a well to divert surface runoff around the well site.

In the construction of all wells, care should be taken to seal or grout the area between the well bore and the well casing (the annulus) as appropriate, so surfacewater and pollutants cannot seep into the well and contaminate the aquifer.

Water Treatment

Following well construction, repair, or maintenance, disinfection of the well and distribution system is required. Shock chlorination is a convenient method to combat nuisance and disease-causing organisms which may appear in the water system.

Figure 20

DISSOLVED SOLIDS IN THE SILURIAN-DEVONIAN AQUIFER IN MG/L

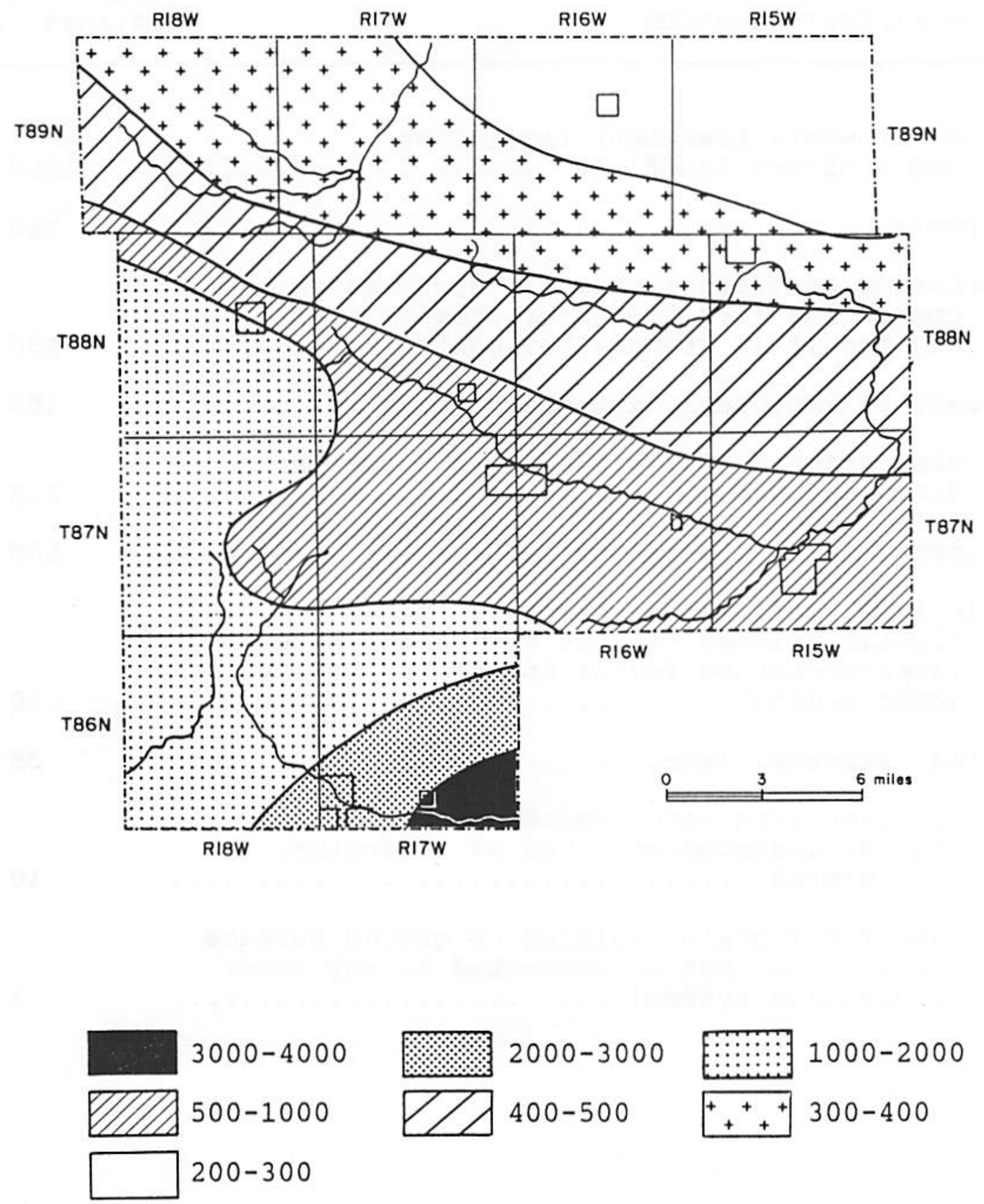


Table 4

MINIMAL LATERAL DISTANCES BETWEEN WELLS AND COMMON SOURCES OF CONTAMINATION (From Iowa Administrative Code)

Source of Contamination	Minimum Lateral Distance (in ft)
Lagoons or waste treatment facilities and sanitary landfills	1000
Cesspools	150
Preparation or storage area for spray materials, commercial fertilizers or chemicals that may result in groundwater contamination	150
Drainage or improperly abandoned wells	100
Soil absorption field, pit privy, or similar disposal unit	100
Confined feeding operations	100
Septic tank, concrete vault privy, sewer, or tightly jointed tile or equivalent material, sewer-connected foundation drain, or sewers under pressure	50
Ditches, streams, lakes	25
Sewer of cast iron with leaded or mechanical joints, independent clear water drains, or cisterns	10
Pumphouse floor drain draining to ground surface (Drains must not be connected to any sewer or drainage system)	5

Shock chlorination is the one-time use of a strong chlorine solution to disinfect a well and the distribution system. Shock chlorination should be repeated if the first treatment does not rid the system of bacteria. If repeated treatments do not solve the problem, the water should be continuously disinfected with the proper chlorination equipment, or the well should be abandoned.

Chlorination or other forms of oxidation, followed by filtration, will remove most forms of iron. Iron can cause an unpleasant taste and odor, and is usually the cause of "red water." If the problem persists, iron-removal equipment can be used.

A black or dark brown slimy coating on water fixtures may indicate an iron bacteria problem. Iron bacteria are not known to affect on human health, but they will plug wells, pumping and treatment equipment, and distribution lines. A three step procedure is commonly used for removal. The first step is chlorination, followed by an acid treatment and then another chlorination. Because iron bacteria are so difficult to remove, a regular maintenance program is necessary to control the problem.

Since groundwater in Grundy County is mineralized to varying degrees, water treatment may make the water more palatable and pleasant to use. There are many treatments available for specific desired results. Some common treatments are: disinfection, filtration, distillation, ion exchange, reverse osmosis, absorption, oxidation, and softening.

Commonly, softened water increases the sodium content of the treated water. If you are on a sodium-restricted diet, you should consult your physician before using this type of water softener. Other types of softening equipment are available that do not create a sodium problem.

Water Testing

Ideally, water from private wells should be tested every six months. Studies have shown that wells less than 50 feet deep are subject to contamination by nitrate and bacteria. The University of Iowa Hygienic Laboratory will test water supply samples for coliform bacteria, nitrate, iron, hardness, and iron bacteria. Special bottles must be used for collecting and sending water samples to the laboratory. A sample kit can be obtained by writing to the University Hygienic Laboratory, University of Iowa, Oakdale Campus, Iowa City, Iowa 52242. Indicate whether your water has been treated with chlorine, iodine, or bromine, as different sample bottles must be used for treated and untreated water. The current charge for a bacterial test is $6; iron bacteria or hardness, $5; and nitrate or iron, $9. If your well is determined to be unsafe, advice for correcting the problem can be obtained from your county or state Department of Health. Several certified private laboratories also perform water analyses.

Concern is currently being expressed related to pesticides in groundwater. Testing for these compounds is comparatively expensive; however, it may be advisable especially for shallow wells. If a well is located in an area with a past history of high chemical useage, near a mixing or formulation area, or near an area where a spill has occurred, then it should tested for suspected contaminants. Currently, the test for common agricultural herbicides is $100. If orthophosphate insecticides are included, the cost is $160.

Well Abandonment

Old, poorly maintained wells which are not currently used provide easy access for pollution to enter aquifers supplying water to other wells in the vicinity. Unprotected wells may also cause personal injury. Proper abandonment procedures should be followed to restore the natural conditions that existed before well construction and to prevent any future contamintion. Permanent abandonment requires careful sealing. Wells require different sealing techniques depending on the depth and type of well. Contact your local health department, a well contractor, or the Geological Survey Bureau for specifics.

Temporary abandonment procedures should ensure that surface water will not enter the well, thus protecting the aquifer. A tight cap should be maintained over the well. This is not an alternative for proper plugging techniques. Abandoned wells should never be used for disposal of sewage or other waste materials.

Contracting for Well Construction

To protect your investment and guarantee satisfactory well completion, it is a good idea to have a written agreement with the well driller. The agreement should specify in detail:

- size of well, casing specifications, and types of screen and well seal

- methods of eliminating surface and subsurface contamination

- disinfection procedures to be used

- type of well development

- test-pumping procedure to be used

- date for completion

- itemized cost list including charges for drilling per foot, for materials per unit, and for other operations such as developing and test pumping

- guarantee of materials, of workmanship, and that all work will comply with current recommended methods

- liability insurance for owner and driller

For a statewide listing of water well drillers, contact the Iowa Water Well Driller's Association, 900 Des Moines St., Des Moines, Iowa, 50309, (515) 266-2189.

Additional Information

In planning the development of a groundwater supply or contracting for the drilling of a new well, additional information is often required. This section lists several types and sources of information.

State Agencies

Iowa Department of Natural Resources (515) 281-8666
Environmental Protection Division
Wallace Building
Des Moines, IA 50319-0034 (Pollution problems, public drinking water, wastewater treatment, water quality, assistance to local communites, protection of surface and underground reservoirs, allocates water use, permits water use of 25,000 or more gallons per day)

Environmental Protection Division (515) 653-2135
Regional Office No. 5
Wallace Building
Des Moines, IA 50319 (Routine sanitary inspections of municipal water supplies and wastewater treatment , local pollution problems, assistance to communities)

Energy and Geological Resources Division
Geological Survey Bureau (319) 335-1575
123 North Capitol Street
Iowa City, IA 52242 (Geologic and groundwater data repository, consultant for well problems, well forecasting, hydrogeologic research, and related services)

Iowa Department of Public Health
Lucas Building (515) 281-4942
Des Moines, IA 50319 (Encourages public health, hygiene, and sanitation; programs of health education, quality of health care)

University of Iowa Hygienic Laboratory
University of Iowa (319) 335-4500
Oakdale Campus
Iowa City, IA 52242 (Water Analyses)

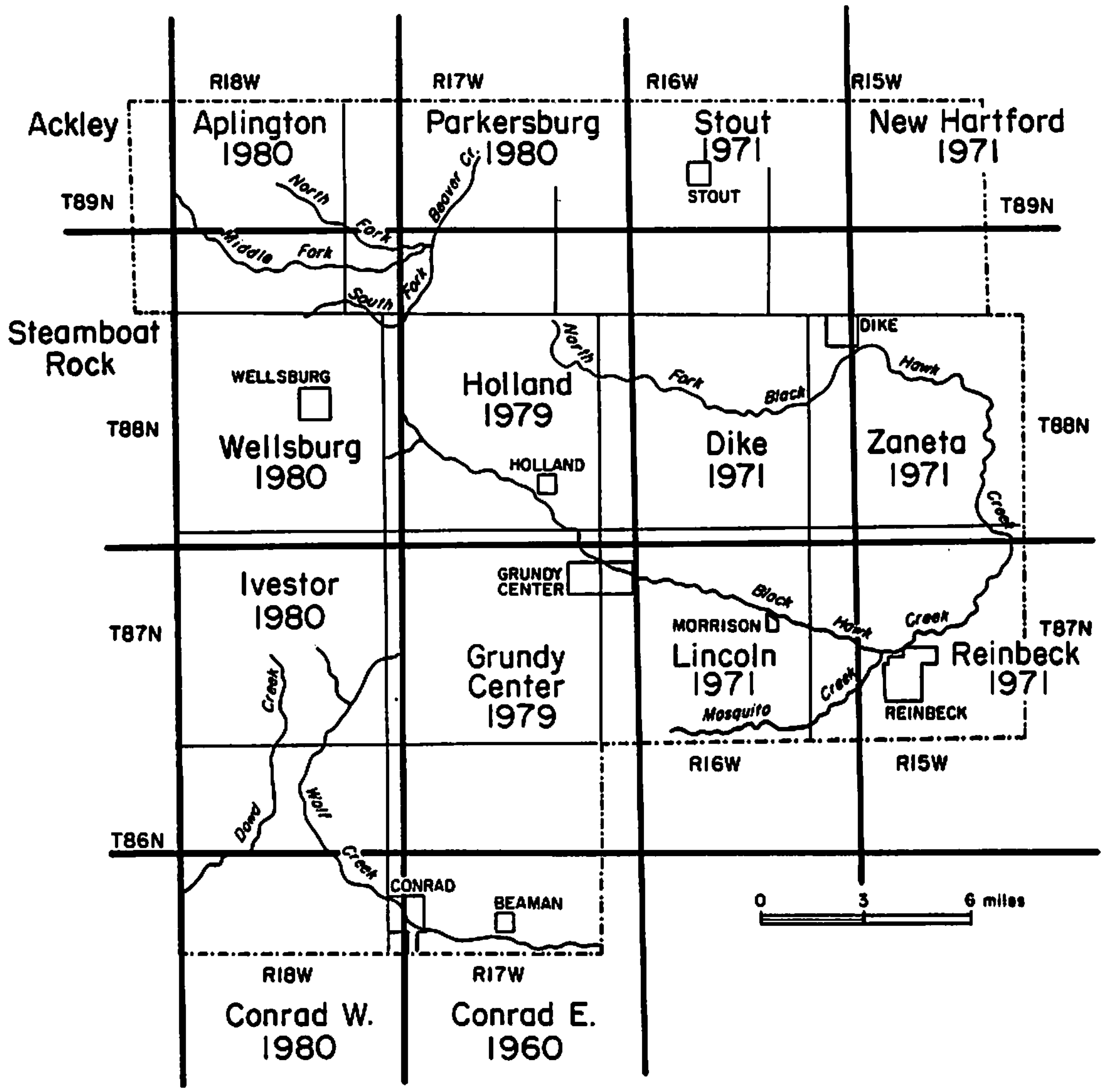
Cooperative Extension Service
Iowa State University (515) 294-4569
Ames, IA 50011 (Advice on water system design and maintenance)

Topographic Maps

Figure 21 shows the 7 1/2 minute quadrangle maps which cover Grundy County. The map names are followed by the date of publication. All these maps are at the same scale, 1:24,000, and have a contour interval of 10 feet. They are all available from the Iowa Department of Natural Resources, Geological Survey Bureau, 123 North Capitol Street, Iowa City, Iowa 52242, for $2.50 each plus postage and handling charges.

Figure 21

TOPOGRAPHIC MAPS IN GRUNDY COUNTY



References

Glanville, T.D., 1978, Good wells for safe water: Cooperative Extension Service, Iowa State University, 4 p.

Glanville, T.D., 1979, Shock-chlorinating small water systems: Cooperative Extension Service, Iowa State University, 4 p.

Glanville, T.D., 1981, Water quality for home and farm: Cooperative Extension Service, Iowa State University, 4 p.

Hansen, R.E., 1972, Bedrock topography of East-Central Iowa: U.S. Geological Survey. Miscellaneous Geologic Investigations Map FI-717.

Herrick, J.B., 1978, Water quality for livestock: Animal Health Fact Sheet No. 8, Cooperative Extension Service, Iowa State University, 4 p.

Hershey, H.G., 1969, Geologic map of Iowa: Iowa Geological Survey.

Horick, P.J. and Steinhilber, W.L., 1973, Mississippian aquifer of Iowa: Iowa Geological Survey Misc. Map Series No. 3.

Horick, P.J. and Steinhilber, W.L., 1978, Jordan aquifer of Iowa: Iowa Geological Survey Misc. Map Series No. 6.

Horick, P.J., 1984, Silurian-Devonian aquifer of Iowa: Iowa Geological Survey, Misc. Map Series 10.

Twenter, F.R. and Coble, R.W. 1965, The water story in central Iowa: Iowa Geological Survey Water Atlas No. 1.

Van Eck, O.J., 1971, Optimal well plugging procedures: Iowa Geological Survey, Public Information Circular No. 1.