Water Quality Report
For
Brown County

2002

compiled
by
Brown-Nicollet Environmental Health
&
Minnesota Department of Health

January 2002

Dear Reader:

After monitoring and studying the county's groundwater since 1988, we are pleased to introduce this report summarizing the condition of today's drinking water resources.

Recent technological advances in data management have enabled the Environmental Health staff and the Minnesota Department of Health to produce graphic representations of the influences on our aquifers and to summarize the results of thirteen years tracking the county's water quality.

We hope this information can be used to help individuals in protecting wells on a family-by-family basis, and also to help the county, townships, and cities better understand the influences on the drinking water of today and tomorrow.

Chair, Brown-Nicollet-Cottonwood Water Quality Board

and

Chair, Brown County Board of Commissioners

Table of Contents

Introduction

The Groundwater Projects

Township Testing began in 1988 as an attempt to bring low-cost analysis of drinking water for rural families in Brown and Nicollet counties. Between June 1988 and April 1989, all townships had sponsored clinics for their families; water had been analyzed for nitrate-nitrogen levels and for the presence of coliform bacteria.

This testing has been repeated at 3-year intervals since 1991 with various levels of support from the townships and counties.

Beginning in 1990, funding from the Minnesota Pollution Control Agency enabled Brown, Nicollet, and Cottonwood counties to take a closer look at the sources and extent of groundwater contamination and to begin programs to protect and improve the groundwater. This project, the Brown-Nicollet-Cottonwood Clean Water Partnership Groundwater Analysis and Improvement Project, extended through 1998; many of its activities are still underway today.

Beginning in 1998 and continuing until 2001, a grant from the Minnesota Department of Health enabled the counties to finalize a database of all the water quality results. The Minnesota Geological Survey assisted the project by field locating 2,188 wells throughout Brown County. Well construction information, geological data, and water testing results have been entered into a computer database. Geographic Information System technology made possible the creation of maps and charts showing the status of the groundwater. These “portraits” of our drinking water influences are included in this report.

This Report

The purpose of this report is to summarize the years of analysis. Capitalizing on newly developed technologies to identify and make vivid depictions of influences on water quality; and looking ahead to potential uses of this data are important by-products of the database. The report is intended to provide summary information about groundwater quality in Brown County to county and area governments, students, and individuals concerned about groundwater today and in the future.

Uses of this Information

A summary can be important for surveying the “big picture”; but we must take care not to lose sight of our goal of providing safe drinking water for every family and industry in the county. It is most important that the readers gain a complete understanding of the status of our groundwater and its vulnerability to contamination. Protection of the resource will be the next step.

Part I: Current Conditions
Water Quality Conditions

Nitrate-Nitrogen Results

The county has sponsored several nitrate-nitrogen water testing opportunities since 1988. The water quality database now has 1,701 wells with nitrate-nitrogen analysis results.

This contaminant which can cause serious problems for infants and pregnant women, has a number of sources ranging from natural processes, to excess nitrogen fertilizer and human or animal waste infiltrating the water supply.

The federal government has established a national public drinking water standard of 10 parts per million. The Minnesota Department of Health has determined that these levels should also be considered when determining a course of action for wells with elevated nitrates:

- from 0 to .99 ppm this range is considered natural
- from 1.0 to 2.99 ppm this range is considered to be a possible indication of contamination
- from 3.0 to 9.99 ppm this range is considered to be a probable indication of contamination
- 10 ppm & over the well is contaminated; its water should not be consumed by infants or women who are pregnant

About 12 % (199 wells) of the 1,701 wells with nitrate results in the water quality data base have average nitrate concentrations over 10 ppm. (An average was calculated if a well was analyzed more than once over the twelve year period.) The percentage of wells showing elevated levels of nitrate varies as to the aquifers available, the depth and construction of the well, and the presence or absence of a source of contamination near the wellhead. If an aquifer is near the ground surface, or is overlain with sandy soils, it is more vulnerable to contamination, including nitrates. If a family's well is shallow, constructed with a tiled casing, located in a pit, or in poor repair, nitrates and/or bacteria may be present.

The township summaries in the next section of this report, generally illustrate that townships using the Sioux Quartzite aquifer and those using shallow alluvial aquifers, are more likely to have a high percentage of wells with nitrate contamination.

Coliform Detection Results

Coliform bacteria are a group of several different species of bacteria that are commonly found in human and animal wastes. They are easy and inexpensive to test for, and are usually present when disease causing organisms such as other bacteria, viruses, and protozoans are present. The presence of coliform bacteria may indicate contamination from a septic system, abandoned outhouse, feedlot, wastewater application, or manure. Wells with construction problems mentioned above are at risk for contamination by coliform and other bacteria.

The water testing program was instituted in 1988 and repeated at three year intervals. In 1993, after widespread record rainfall, the federal government financed additional water testing to check for well contamination from ground runoff.

This table shows the total number of county well testing analyses for coliform bacteria, the number and percentages of positive results, and locations of last year's E. coli detections (which only became available in 2000). The table is cumulative—it contains analyses from all wells—including some that have been replaced after initial tests showed contamination from construction problems. These statistics do not include analyses for newly drilled wells.

Brown County Coliform Analysis Results – 1988-2001

Township	Coliform Analyses *	# Positive for Coliform	Percent Positive For Coliform	E coli Detections (2001 only)
Albin	208	82	39%	
Bashaw	149	64	43%	1
Burnstown	192	58	30%	
Cottonwood	361	142	39%	1
Eden	183	72	39%	1
Home	381	130	34%	
Lake Hanska	198	73	37%	1
Leavenworth	217	88	41%	1
Linden	166	52	31%	
Milford	388	103	27%	
Mulligan	159	61	38%	
North Star	197	70	36%	
Prairieville	154	45	29%	
Sigel	253	81	32%	1
Stark	233	70	30%	
Stately	129	39	30%	
Brown County	**3,568**	**1,230**	**34%**	**6**

*** these numbers include repeat samples from many wells**

Well Construction

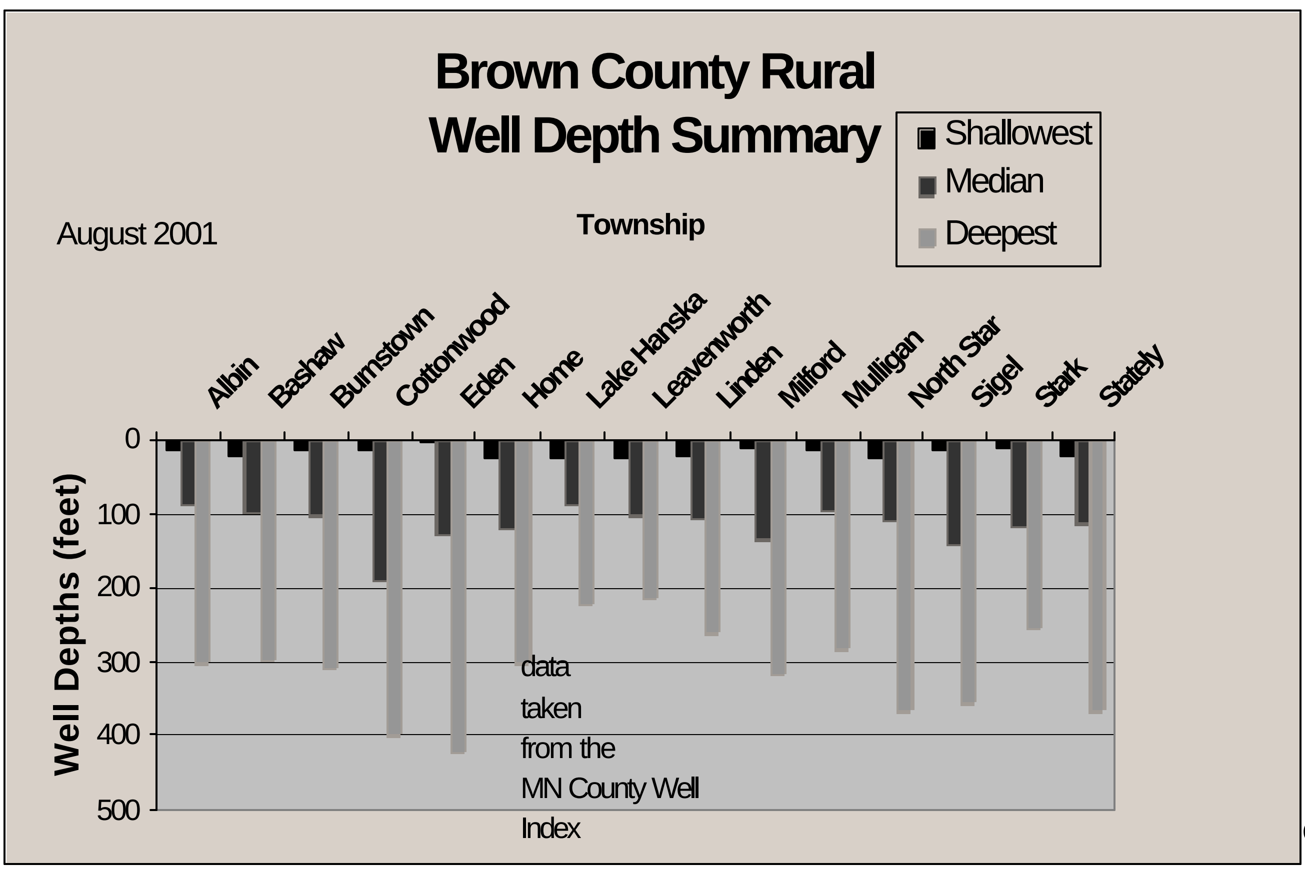
Since 1974, Minnesota has been operating under the Minnesota Well Code (Minnesota Rules Chapter 4725) administered by the Department of Health. Under this code, wells must be drilled and constructed according to standards designed to protect both individual sources of drinking water and the aquifers used. Water well contractors and well repair businesses must be licensed and bonded and must meet current standards for experienced knowledge of well construction in order to be licensed.

After wells are completed, the water is tested to be sure it is safe to drink. Specifically, the newly completed well must yield water that is free from coliform bacteria and low in nitrate-nitrogen.

Well records must include the location of the well, information about drilling methods, a record of the underground formations encountered, information on the level at which water is found (static water level), and details on the casing, screen, and pump.

Another source of well information is provided by well owners at county-sponsored well testing clinics. Here, well depth, diameter, and year of construction are provided. This information, well record data and water testing analyses have been entered into a computer database called the County Well Index.

This figure illustrates the depths of wells by township. It shows the shallowest, deepest, and median (average) wells in each township.



Well construction practices are very important when it comes to obtaining safe drinking water. Most wells drilled since the well code went into effect generally show little contamination. However, some old wells are not “up to code” because they were constructed using practices that pre-date the standards established by the adoption of the Minnesota Well Code in 1974. Some Brown County wells are constructed in pits, which may be subject to overland flooding during wet years. These wells may become contaminated by yard waste, fertilizer, or pesticides when excess water stands in the pit and eventually seeps down the sides of the well casing.

Some old wells were constructed using cement tiles for the casing and are easily subject to contamination because contaminants can seep through the spaces between the tiles.

Some wells are completed at very shallow depths (less than 50 feet) whereas, many others are much deeper. Generally, the deeper the well, the less likely it will be susceptible to contamination caused by people’s activities. The exception to this statement occurs where wells are completed in exposed bedrock.

Brown County has several aquifers, with varying levels of susceptibility to contamination. The ability to find safe drinking water depends on the aquifer situation. But another problem in southwest Brown County is the quantity of underground water supplies. Some rural residents have found that local aquifers do not supply water in sufficient quantities. Fortunately they are able to access the Red Rock Rural Water System. This system supplies safe and abundant drinking water to hundreds of rural homes and farms through a complex system of pipelines and individual connections.

The following section is a general summary of the types of aquifers used in Brown County. Later in this report, the drinking water situation is summarized for each township and city and for the Red Rock Rural Water System.

Aquifers in Brown County

The residents of Brown County obtain their drinking water from several different types of aquifers. The distribution and composition of these aquifers affects the natural quantity and quality of their drinking water. Also, local geological conditions may affect the rate at which contamination may enter the aquifers used to supply drinking water.

Glacial Aquifers

The thickness of glacial deposits in Brown County varies considerably because of the long geologic history of Minnesota. The deposits left behind by the earliest glacier were exposed to wind and stream erosion before being covered by the next ice sheet. The sequence of deposition and erosion of glacial deposits has been repeated many times over the long period of the Pleistocene epoch (Ice Age). As a result, the geologic record of the county's glacial deposits is fragmented and difficult to piece together. In some places, the accumulation of glacial deposits is greater than 200 feet, whereas, in other places no glacial deposits remain.

Many wells obtain their water from sediments left behind by the glaciers. Sand and gravel layers for the highest yielding aquifers in Brown County and are often referred to as "outwash deposits" because they were formed by meltwater draining from glaciers as they advanced and retreated across the landscape. Groundwater is stored in these deposits in the spaces between the sand and gravel-sized particles. These types of aquifers may contain as much as 25 to 30% pore space, so they may contain a lot of water. Outwash deposits supply the high capacity wells used by communities such as New Ulm and are used by many farm wells. Wells constructed into outwash deposits have a screen (slotted cylinder) at the bottom of the well casing to keep sand from plugging the pump or the plumbing system.

Glaciers also left behind unsorted debris called till that was either plastered onto the landscape at the base of the ice or formed as mudflows when the ice melted. The till layers in Brown County contain a high percentage of clay and silt and therefore, do not yield large amounts of water. Wells constructed into till were originally hand dug and lined with wood or masonry. Later on, holes were drilled with a bucket auger and lined with cement tiles. These wells collect water that seeps out of the till and generally, do not yield large amounts of water.

Much of Brown County is part of a till plain formed by the advance and retreat of the last glacier to cover south-central Minnesota. Called the Des Moines Lobe, it advanced as far as central Iowa by about 20,000 years ago but had completely melted from Minnesota by about 11,000 years ago. Many of the rich soils that we farm today developed in the clay-rich till that is attributed to this ice sheet. Before settlement, much of the till plain was poorly drained and covered with wetlands and shallow lakes. The aquifers that occur beneath the Des Moines Lobe till tend to be recharged slowly and are not very susceptible to contamination from land uses. However, because groundwater in these areas moves slowly, it may contain higher levels of dissolved minerals such as iron, manganese, and sulfate than groundwater in the county that is in more direct contact with surface water.

Several outwash channels occur where meltwater from the Des Moines Lobe drained toward the Minnesota River valley. Here, sand and gravel deposits are used by wells but are potentially vulnerable to contamination resulting from land uses because there is no cover of clay-rich till.

The Minnesota River forms the northeastern boundary of Brown County and causes groundwater in the glacial deposits to move toward it. The valley of the Minnesota River was cut by Glacial River Warren after the Des Moines Lobe receded and a large lake formed in western Minnesota, the eastern Dakotas, and southern Manitoba. Most of the water drained from the lake went down the River Warren channel to the Mississippi River in the Twin Cities area. Today, the Minnesota River occupies the deep channel carved by River Warren. Local rivers and streams flow toward the Minnesota River and the groundwater does the same, only at a much slower rate.

Cretaceous Aquifer

At the end of the Cretaceous Period (about 75 to 65 million years ago), Brown County was a much different place than today. Slow moving rivers carried sediment westward toward a large, shallow ocean that extended from eastern Colorado into western Minnesota. During heavy rainstorms and wet periods, these streams overflowed their banks and deposited clay and silt as well as thin layers of sand. Slowly, the meandering of these streams left behind a mantle of clay, silt, and some sand over parts of the bedrock surface. These deposits are exposed today in some northern and western parts of the county. However, where they are covered by glacial deposits, it is difficult to tell them apart in well drilling reports because both are described as “clay”.

The climate during the late Cretaceous was much warmer too, and tropical weathering of the landscape occurred for long periods of time. Much of the bedrock surface was reduced to clay and minerals that resisted this type of weathering. Today, weathered bedrock is encountered by well contractors who refer to it as “marl” even though marl is actually formed in lakes.

Collectively, the sediments that were deposited during the Cretaceous Period are referred to as the Cretaceous aquifer even though they do not form a single aquifer. Most of the Cretaceous deposits are either covered by glacial deposits or were completely eroded. It is very difficult to predict whether Cretaceous deposits are present in the subsurface because of the lack of good information describing their distribution. However, where they occur, the sand layers yield good water for domestic wells and the aquifer is generally protected from contaminants relating to land uses.

Sioux Quartzite Aquifer

The Sioux Quartzite is one of the hardest rocks found in North America. It formed about 1.7 billion years ago when a sandstone was exposed to great heat and pressure during a period of mountain building called the Penokean Orogeny. Over the eons since it formed, the Sioux has been subjected to extensive weathering and today it occurs as erosional remnants in parts of south central and southwestern Minnesota.

There are two areas of Sioux Quartzite in Brown County. One of remnants includes parts of the southwestern corner of the county in the area known as Red Rock Ridge.

The Sioux is easily recognized because of its reddish-pink to purple hues; this area of the county is aptly named. Another remnant is located in the eastern corner of Brown County in the New Ulm area. In this area, Sioux Quartzite is even quarried for aggregate where it is exposed along the Minnesota River. Here the Sioux is recognizable not only because of its color, but also by the hummocky nature of topography where it is exposed at the land surface.

Groundwater occurs in the fractures and joints within the quartzite. The grains of the parent sandstone were fused together when the Sioux Quartzite formed so there is no original porosity left. As such, the Sioux does not yield large amounts of water, but can be used by smaller farms. However, many families in the area where the Sioux is exposed have connected to the Red Rock Rural Water system to obtain a more adequate water supply.

Groundwater in the Sioux is low in dissolved solids and generally good tasting. However it is susceptible to contamination from land uses where it is exposed because surface water can quickly enter the aquifer through cracks and joints. High nitrate-nitrogen levels are often reported in wells in these areas.

Precambrian Aquifer

Granite and gneiss (a type of metamorphic rock) that formed long before the Sioux Quartzite occur beneath the glacial deposits and the Cretaceous sediments. The term Precambrian is used to describe the period between the time the bedrock that was formed since the earth first cooled (about 4.6 billion years ago) to the start of the Paleozoic Era (about 600 million years ago). Little is known about the general composition and distribution of the bedrock that is older than the Sioux Quartzite because few water wells have been completed in these types of bedrock. Groundwater occurs in fractures and zones where these rocks have been heavily weathered. As such, they do not yield much water, but are used by some wells where no other aquifer is present.

Summaries by Township & City

This section explores the varying groundwater situations in the townships and cities of Brown County. The statistics on population (men, women, small children, elderly, median age, and population density are taken from the 2000 Census. The statistics on wells (number, depths, percentage of tile wells) are taken from the County Well Index compiled by the Department of Health and the MN Geologic Survey. The statistics on water quality (numbers of tests, coliform bacteria and nitrate-nitrogen analytical results) are taken from Brown-Nicollet-Cottonwood rural water testing programs and Department of Health analyses.

Albin Township

Located in south-central Brown County, there are no cities in this mostly agricultural township. The west half of Lake Hanska is located in east central Albin.

Population 329 (male: 170 female: 149) Households: 126
Population under 5 yrs: 22 over 85 years: 1
Median age: 37.6 years Density: 9.5 people /sq mi

Wells Wells in database: 108 Median Depth for all wells: 86 feet
Shallowest: 14 feet Deepest: 300 feet
# of wells with casing or tiles over 10" in diameter: 31 (39%)

Water Quality # of wells sampled 1989-2000: 108
# of Bacteria samples: 208
with positive coliform bacteria: 82 (39%)
of Nitrate-nitrogen samples: 250
# of nitrate samples at 10 ppm or higher: 57 (23%)
Highest nitrate reading: 74.9 ppm
Median nitrate level: 4.7ppm

Most of the wells in Albin draw water from buried layers of sand and gravel left by the glaciers (these are known as "surficial outwash deposits"). The sections near Lake Hanska appear to have a higher level of nitrates than those in the southwest part of the township.

Bashaw Township

Located in southwest Brown County, Comfrey the only town in this mostly agricultural township. The statistics below do not include Comfrey; it is described in the next section.

Population 255 (male: 135 female: 120) Households: 97
Population under 5 yrs: 13 over 85 years: 2
Median age: 39.3 Density: 7 people / sq mi

Wells Wells in database: 88 Median Depth for all wells: 99 feet
Shallowest: 20 feet Deepest: 297 feet
# of wells with casing or tiles over 10" in diameter: 29 (41%)

Water Quality	# of wells sampled 1989-2000:	87
	# of Bacteria samples:	149
	# with positive coliform bacteria:	64 (43%)
	# of Nitrate-nitrogen samples:	176
	# of nitrate samples at 10 ppm or higher:	38 (22%)
	Highest nitrate reading:	61.7 ppm
	Median nitrate level:	4.9 ppm

It is likely that most of the wells in Bashaw draw water from buried layers of sand and gravel left by the glaciers (these are known as "surficial outwash deposits"). Some coarse soils in areas of former river valleys formed by glacial melting have the potential for contamination of the groundwater.

Burnstown Township

Located in western Brown County, Burnstown surrounds the city of Springfield on three sides. The township's statistics do not include Springfield, which is described in the next section.

Population 260 (male: 145 female: 115) Households: 106
Population under 5 yrs: 19 over 85 years: 6
Median age: 39.5 years Density: 7.5 people / sq mi

Wells Wells in database: 94 Median Depth for all wells: 101 feet
Shallowest: 14 feet Deepest: 309 feet
# of wells with casing or tiles over 10" in diameter: 15 (16 %)

Water Quality	# of wells sampled 1989-2000:	83
	# of Bacteria samples:	192
	# with positive coliform bacteria:	58 (30%)
	# of Nitrate-nitrogen samples:	241
	# of nitrate samples at 10 ppm or higher:	36 (15%)
	Highest nitrate reading:	168.2 ppm
	Median nitrate level:	4.6 ppm

The aquifers serving Burnstown are mostly finished in glacial drift aquifers. The topography is mainly flat to rolling. Near the Cottonwood River, the soils are more likely to be alluvial in origin, so the groundwater in these areas may also be more susceptible to contamination.

Cottonwood Township

Located in eastern Brown County, northern Cottonwood is adjacent to New Ulm. The community of Searles is located in southern Cottonwood Township. Searles' statistics are included in this summary. Cottonwood is Brown County's most populous township.

Population 938 (male: 487 female: 451) Households: 340
Population under 5 yrs: 48 over 85 years: 7
Median age: 37.8 years Density: 26.5 people / sq mi

Wells Wells in database: 190 Median Depth for all wells: 189 feet
Shallowest: 15 feet Deepest: 400 feet
# of wells with casing or tiles over 10" in diameter: 25 (13%)

Water Quality # of wells sampled 1989-2000: 171
# of Bacteria samples: 361
with positive coliform bacteria: 142 (13%)
of Nitrate-nitrogen samples: 398
# of nitrate samples at 10 ppm or higher: 19 (5%)
Highest nitrate reading: 47.7 ppm
Median nitrate level: 2.1 ppm

Cottonwood's topography consists of rolling uplands under agricultural production and bluffs over the valleys and flood plains of three rivers: the Minnesota, the Little Cottonwood, and the Cottonwood. The protected aquifers of Cottonwood Township generally yield good quality water in abundance. It should also be noted that water quality in the shallower individual wells owned by residents of Searles improved between 1989 and 2000, partly due to the installation of a sewage treatment system for the community.

Eden Township

Located in northern Brown County, there are no cities in this agricultural township which borders the Minnesota River on the northeast.

Population 321 (male: 184 female: 137) Households: 123
Population under 5 yrs: 21 over 85 years: 3
Median age: 40.0 years Density: 8 people / sq mi
Wells Wells in database: 100 Median Depth for all wells: 128 feet
Shallowest: 3 feet Deepest: 421 feet
# of wells with casing or tiles over 10" in diameter: 9 (9%)
Water Quality # of wells sampled 1989-2000: 82
# of Bacteria samples: 183
with positive coliform bacteria: 72 (39%)
of Nitrate-nitrogen samples: 247
# of nitrate samples at 10 ppm or higher: 48 (19%)
Highest nitrate reading: 132.0 ppm
Median nitrate level: 5.1 ppm

Eden's groundwater comes from a mix of springs, shallow wells, and deeper wells completed in glacial drift aquifers. There are small areas of localized nitrate contamination; especially in wells near the Minnesota River.

Home Township

Located in north-central Brown County, Home includes the outskirts of Sleepy Eye and extends northward to the Minnesota River. Statistics on Sleepy Eye itself are included below.

Population 800 (male: 392 female: 408) Households: 227
Population under 5 years: 47 over 85 years: 88
Median age: 42.7 years Density: 15 people / sq mi

Wells Wells in database: 193 Median Depth for all wells: 121 feet
Shallowest: 26 feet Deepest: 300 feet
# of wells with casing or tiles over 10" in diameter: 10 (5%)

Water Quality	
# of wells sampled 1989-2000:	176
# of Bacteria samples:	381
# with positive coliform bacteria:	130 (34%)
# of Nitrate-nitrogen samples:	424
# of nitrate samples at 10 ppm or higher:	51 (12%)
Highest nitrate reading:	235.0 ppm
Median nitrate level:	3.0 ppm

The wells in Home Township generally provide water of good quality and quantity from the protected glacial drift aquifers.

Lake Hanska Township

Located in southeast Brown County, Lake Hanska Township includes the east half of Lake Hanska. It also surrounds three sides of Hanska (statistics for Hanska are included in the section on cities).

Population 322 (male: 171 female: 151) Households: 124
Population under 5 years: 19over 85 years: 0
Median age: 38.3 yrs Density: 8.4 people / sq mi

Wells Wells in database: 117 Median Depth for all wells: 87 feet
Shallowest: 25 feet Deepest: 220 feet
# of wells with casing or tiles over 10" in diameter: 42 (36%)

Water Quality	
# of wells sampled 1989-2000:	115
# of Bacteria samples:	198
# with positive coliform bacteria:	73 (37%)
# of Nitrate-nitrogen samples:	247
# of nitrate samples at 10 ppm or higher:	60 (24%)
Highest nitrate reading:	62.0 ppm
Median nitrate level:	4.7 ppm

Shallow wells in the glacial drift and alluvial aquifers predominate the groundwater sources in this township. Agriculture and recreation around Lake Hanska are the predominant land uses.

Leavenworth Township

Leavenworth is located in east central Brown County. The Cottonwood River flows west to east through the township, which is mostly agricultural. The small, unincorporated community also known as Leavenworth is included in these statistics.

Population 336 (male: 195 female: 141) Households: 1\120
Population under 5 years: 20 over 85 years: 6
Median age: 39.1 yrs Density: 9.5 people / sq mi

Wells Wells in database: 109 Median Depth for all wells: 102 feet
Shallowest: 26 feet Deepest: 212 feet
# of wells with casing or tiles over 10" in diameter: 21 (19%)

Water Quality

# of wells sampled 1989-2000:	108
# of Bacteria samples:	217
# with positive coliform bacteria:	88 (44%)
# of Nitrate-nitrogen samples:	347
# of nitrate samples at 10 ppm or higher:	62 (18%)
Highest nitrate reading:	129.2 ppm
Median nitrate level:	3.9 ppm

Leavenworth has a high percentage of shallow wells. With two rivers winding through it and some ancient stream beds, many wells are finished in the alluvium, with the rest drawing water from sand and gravel drift aquifers

---

Linden Township

Located in southeast corner of Brown County, Linden Township is bordered on the east by Blue Earth County, and on the south by Watonwan County. The predominant land use in Linden is agriculture.

Population 343 (male: 183 female: 160) Households: 122
Population under 5 years: 24 over 85 years: 1
Median age: 37.5 yrs Density: 9.7 people / sq mi

Wells Wells in database: 94 Median Depth for all wells: 105 feet
Shallowest: 20 feet Deepest: 260 feet

# of wells with casing or tiles over 10" in diameter: 32 (34%)

Water Quality # of wells sampled 1989-2000: 95
# of Bacteria samples: 166
with positive coliform bacteria: 52 (31%)
of Nitrate-nitrogen samples: 237
# of nitrate samples at 10 ppm or higher: 74 (31%)
Highest nitrate reading: 47.2 ppm
Median nitrate level: 4.4 ppm

Many of the shallow wells in Linden tap into sand and gravel aquifers in glacial drift: deeper wells appear to draw from sandstone layers that are better protected from contamination.

Milford Township

Located in northeast Brown County, Milford Township is bordered on the east by New Ulm, and on the north by the Minnesota River. Partly agricultural and partly suburban to New Ulm, Milford includes bluffs, wetlands, and Minnesota River terrains. Essig is a village in central Milford; it has a community well which is 150' deep.

Population 793 (male: 421 female: 372) Households: 269
Population under 5 years: 48 over 85 years: 6
Median age: 39.4 yrs Density: 20 people / sq mi

Wells Wells in database: 194 Median Depth for all wells: 133 feet
Shallowest: 10 feet Deepest: 315 feet
# of wells with casing or tiles over 10" in diameter: 7 (4%)

Water Quality # of wells sampled 1989-2000: 152
# of Bacteria samples: 388
with positive coliform bacteria: 103 (27%)
of Nitrate-nitrogen samples: 469
# of nitrate samples at 10 ppm or higher: 17 (4%)
Highest nitrate reading: 59.4 ppm
Median nitrate level: 2.3 ppm

Milford exhibits a variety of well/aquifer situations and also several water quality variations. The wells with contamination by nitrate-nitrogen appear to be most predominant in the shallow wells near the river.

Mulligan Township

Mulligan is in south-central Brown County, bordered on the south by Watonwan County. Mulligan contains no communities; agriculture is the predominant land use.

Population 245 (male: 134 female: 111) Households: 93

Population under 5 years: 13 over 85 years: 3
Median age: 41.9 yrs Density: 6.8 people / sq mi

Wells Wells in database: 84 Median Depth for all wells: 94 feet
Shallowest: 15 feet Deepest: 283 feet
# of wells with casing or tiles over 10" in diameter: 15 (18%)

Water Quality # of wells sampled 1989-2000: 79

# of Bacteria samples:	159
# with positive coliform bacteria:	61 (38%)
# of Nitrate-nitrogen samples:	214
# of nitrate samples at 10 ppm or higher:	48 (22%)
Highest nitrate reading:	59.6 ppm
Median nitrate level:	4.9 ppm

Mulligan's shallow aquifers show some signs of water quality problems, particularly in the north and west. During dry periods, water quantity has also been a source of concern. Ancient creek beds contributed coarse soils to the glacial overburden in and near Mulligan; these soils don't filter contaminants as well as more organic or clayey soils found in other townships.

North Star Township

North Star is in western Brown County, bordered on the west and north by Redwood County. The Cottonwood River flows through southern North Star; Springfield is on the east edge of the township.

Population 325 (male: 161 female: 164) Households: 105
Population under 5 years: 24 over 85 years: 3
Median age: 33.9 yrs Density: 9 people / sq mi

Wells Wells in database: 100 Median Depth for all wells: 109 feet
Shallowest: 26 feet Deepest: 365 feet
# of wells with casing or tiles over 10" in diameter: 11 (11%)

Water Quality # of wells sampled 1989-2000: 99

# of Bacteria samples:	197
# with positive coliform bacteria:	70 (36%)
# of Nitrate-nitrogen samples:	234
# of nitrate samples at 10 ppm or higher:	37 (16%)
Highest nitrate reading:	110.6 ppm
Median nitrate level:	3.9 ppm

North Star has springs, deep wells, and shallow wells—all show above-average water quality. The alluvial aquifers near the cottonwood River and Coal Mine Creek and the drift aquifers *which underlie the rest of the township have generally shown few signs of contamination thus far.*

Prairieville Township

Prairieville is in north-central Brown County, bordered on the west by Redwood County. The township includes the communities of Cobden and Evan.

Population 346 (male: 181 female: 165) Households: 119
Population under 5 years: 15 over 85 years: 3
Median age: 36.0 yrs Density: 10 people / sq mi

Wells Wells in database: 103 Median Depth for all wells: 96 feet
Shallowest: 25 feet Deepest: 211 feet
# of wells with casing or tiles over 10" in diameter: 22 (21%)

Water Quality # of wells sampled 1989-2000: 101

# of Bacteria samples:	154
# with positive coliform bacteria:	45 (29%)
# of Nitrate-nitrogen samples:	247
# of nitrate samples at 10 ppm or higher:	56 (23%)
Highest nitrate reading:	262 ppm
Median nitrate level:	7.2 ppm

Prairieville has contamination problems in shallow wells; but generally, water quality is satisfactory in the wells which are drilled into deeper aquifers. Both Evan and Cobden have had serious water quality problems in individual wells.

Sigel Township

Sigel Township is in east-central Brown County. Both the Cottonwood and Little Cottonwood Rivers flow eastward through the township. The Brown County Landfill is located on the northern edge of Sigel, which is predominantly agricultural.

Population 432 (male: 233 female: 199) Households: 151
Population under 5 years: 16 over 85 years: 3
Median age: 37.8 yrs Density: 11 people / sq mi

Wells Wells in database: 130 Median Depth for all wells: 143 feet
Shallowest: 14 feet Deepest: 354 feet
# of wells with casing or tiles over 10" in diameter: 10 (8%)

Water Quality # of wells sampled 1989-2000: 112

# of Bacteria samples:	253
# with positive coliform bacteria:	81 (32%)

# of Nitrate-nitrogen samples: 290
# of nitrate samples at 10 ppm or higher: 18 (6%)
Highest nitrate reading: 92.0 ppm
Median nitrate level: 2.5 ppm

Both the water quality and quantity of water supplies tapped by Sigel residents' wells is generally good. Although some of the soils are alluvial, most of the aquifers appear to be protected from contamination.

Stark Township

StarkTownship is in central Brown County, south and southeast of Sleepy Eye. Stark is generally agricultural, except near Sleepy Eye.

Population 384 (male: 200 female: 184) Households: 137
Population under 5 years: 22 over 85 years: 2
Median age: 35.6 yrs Density: 11 people / sq mi

Wells Wells in database: 127 Median Depth for all wells: 117 feet
Shallowest: 10 feet Deepest: 255 feet
# of wells with casing or tiles over 10" in diameter: 12 (9%)

Water Quality # of wells sampled 1989-2000: 124
# of Bacteria samples: 233
with positive coliform bacteria: 70 (30%)
of Nitrate-nitrogen samples: 279
# of nitrate samples at 10 ppm or higher: 36 (13%)
Highest nitrate reading: 95.9 ppm
Median nitrate level: 2.4 ppm

In parts of Stark Township, many wells appear to be contaminated by nitrate-nitrogen. These problems occur at homesites situated in or near areas where alluvial soils predominate; usually these are locations of ancient creek beds.

Stately Township

Stately Township is in southwest Brown County, there are no communities in this township, which is predominantly row crop agriculture and livestock production. Stately contains the highest point in Brown County, on the Red Rock Ridge, so both surface water and groundwater drains to the northeast.

Population 206 (male: 109 female: 99) Households: 67
Population under 5 years: 15 over 85 years: 1
Median age: 34.5 yrs Density: 6 people / sq mi

Wells Wells in database: 68 Median Depth for all wells: 111 feet
Shallowest: 20 feet Deepest: 365 feet

# of wells with casing or tiles over 10" in diameter: 9 (13%)

Water Quality	# of wells sampled 1989-2000: 54	
	# of Bacteria samples:	129
	# with positive coliform bacteria:	39 (30%)
	# of Nitrate-nitrogen samples:	270
	# of nitrate samples at 10 ppm or higher:	99 (37%)
	Highest nitrate reading:	200.0 ppm
	Median nitrate level:	10.1 ppm

Stately has some wells with nitrate-nitrogen levels well over the drinking water standard. These wells are finished in the Sioux Quartzite aquifer. It is believed that fractures in this rock formation can transport contaminants far from the sources of origin. However, parts of the township enjoy good quality water.

Brown County Cities

Comfrey

Comfrey continues its recovery from the March, 1998 tornado. Fortunately, the water tower was not destroyed during the storm. Comfrey is located in southern Brown County on the border with Watonwan County.

Population 367 (male: 174 female: 193) Households: 160
Population under 5 yrs: 10 --over 85 years: 11
Median age: 43.6 years Area: .5 square miles

Wells Wells in database: 3 Median Depth for all wells: 92 feet
Shallowest: 62 feet Deepest: 151 feet

Comfrey wells are also finished in buried layers of sand and gravel left by the glaciers (these are known as "surficial outwash deposits").

Evan

Evan is located in west-central Brown County in Prairieville Township. As of 2001, Evan's drinking water supplies come from individual wells.

Population 91 (male: 40 female: 51) Households: 37
Population under 5 yrs: 5 --over 85 years: 1
Median age: 32.5 years Area: 1.0 square miles

Wells — Wells in database: 4 — Median Depth for all wells: 80 feet
Shallowest: 40 feet — Deepest: @100 feet

Evan's wells are likely drawing water from shallow, alluvial aquifers; there have been some problems with contamination. This may be due to small lots and leaking septic systems, or to well construction.

Hanska

Hanska is located in southwest Brown County; it surrounded on three sides by Lake Hanska Township, and on the east by Linden Township.

Population — 443 (male: 225 female: 218) — Households: 187
Population under 5 yrs: 26 --over 85 years: 14
Median age: 34.0 years — Area: .2 square miles

Wells — Wells in database:
Shallowest: 165 feet — Deepest: 172 feet

Hanska's wells draw from a protected Quaternary aquifer which is protected from contamination by thick glacial drift and/or layers of clay, called aquitards.

New Ulm

New Ulm is the county seat and largest city in Brown County; it is located on the eastern edge of the county with the Minnesota River as its eastern boundary.

Population — 13,594 (male: 6,647 female: 6,947) — Households: 5,494
Population under 5 yrs: 658 --over 85 years: 265
Median age: 37.8 years — Area: 8.6 square miles

Wells — Wells in database: 8 — Median Depth for all wells: 158 feet
Shallowest: 67 feet — Deepest: 247 feet

New Ulm's wells draw from glacial drift and the Cretaceous aquifers. Even though some of the wells are located near the Minnesota River, the city's wells do not show any evidence of nitrate-nitrogen contamination found in other river cities.

Sleepy Eye

Sleepy Eye is in central Brown County. It is surrounded on all four sides by agricultural townships.

Population — 3,515 (male: 1,689 female: 1,826) — Households: 1,479
Population under 5 yrs: 230 --over 85 years: 135
Median age: 38.3 years — Area: 1.4 square miles

Wells — Wells in database: 3 — Median Depth for all wells: 161 feet
Shallowest: 143 feet — Deepest: 188 feet

The wells serving Sleepy Eye draw water from glacial aquifers. The city's wells do not show any evidence of the nitrate-nitrogen contamination that is sometimes found in surrounding townships.

Springfield

Springfield is located in western Brown County. One interesting feature of the town is its proximity to clay deposits from the Cretaceous Age; some of these deposits are being mined for brick production.

Population	2,215 (male: 1,030 female: 1,185)	Households: 897
	Population under 5 yrs: 127 --over 85 years: 151	
	Median age: 42.0 years	Area: 1.4 square miles
Wells	Wells in database: 5	Median Depth for all wells: 90 feet
	Shallowest: 40 feet	Deepest: 112 feet

Four of the Springfield wells are drawing water from the Cretaceous Aquifer; its water is usually good tasting and free from contamination.

Red Rock Rural Water System

The Red Rock Rural Water System was established in 1985, initially to provide sufficient quantities of good quality water to the Red Rock Ridge, an area with few aquifer options. Since completion of the original system the number of individual customers has increased from 326 to 911 and the system continues to grow.

Population Served:	911 families, with 211 more connections to be added in 2002 and 150 additions planned for 2003
Communities Served:	Wilder, Garvin, Dundee, Dovray, Delft, Odin, and Ormsby, with Butterfield to be added in 2002
Counties Served:	Brown, Cottonwood, Jackson, Lyon, Martin, Murray, Nobles, Redwood & Watonwan
Water Sources:	The system is or will be purchasing water from: the city of Windom; the city of Balaton the city of St. James the Lincoln-Pipestone Rural Water System It also has a wellfield located in Section 8, Great Bend Township

Wellfield: Wells in database: 3 – #1 is 79' deep, #2 is 86' deep, # 3 is 85', deep all drawing from the Quaternary (glacial deposit) aquifer.

Nitrates over Time

It is important to note that charts of the following wells were selected to show the fluctuations in nitrate levels. There are hundreds of wells in the county which have never shown detections of nitrate contamination.

The next six pages feature selected wells and their nitrate levels over a period of years. These examples are taken from wells owned by citizens who have participated in voluntary well testing in Brown County. Most of the examples are taken from records of the Township Water Testing program, in which citizens bring in water samples every few years. Some of the charts with more entries show the fluctuations for wells in the Clean Water Partnership project, during which water was tested several times a year.

Each sample chart must be checked as to the scale used to show nitrate contamination. The left side (also known as the Y-axis) shows varying scales—some range from 0 to 20 or 0 to 45, and for some with low nitrate detections, the scale runs from 0 to 0.6.

Protected Glacial Aquifer

This 100’ deep well from northern Brown County draws from an aquifer protected by deep glacial drift.

Protected Glacial Aquifer

This chart from a eastern Brown County well is is 150’ deep.

Unprotected Glacial Aquifer

This well is 120’ deep. It is located near the Minnesota River where the aquifer it uses is not protected. While the nitrates are below the drinking water standard of 10 parts per million, the levels may rise during periods of high rainfall, or in the spring.

Unprotected Glacial Aquifer

This chart shows the nitrate levels in a 97' southeastern Brown County well. The levels are consistently over 10 parts per million.

Unprotected Glacial Aquifer

Another southeastern well chart, this represents levels found in a 90' deep well. Although the levels are lower than the well described above, the fluctuations show the importance of annual testing for wells drawing from unprotected aquifers.

Hand Dug Well

This well is characteristic of those used in the past. Only 30' deep, it was probably hand dug. The nitrate levels are consistently High in this southern Brown County well.

Protected Glacial Aquifer

Here's an example of a central Brown County chart showing nitrate levels in a well drawing from an aquifer that is protected from contamination. This 150' deep well has only tested positive for nitrates once; that test may be the result of a heavy rainfall, or a sampling error.

Protected Glacial Aquifer

This 100' well chart from north Brown County is another example of nitrate levels in water from an aquifer protected by thick glacial drift.

Unprotected Glacial Aquifer

Here's an example of nitrate levels in a 85' well from northern Brown County. This well is located near the Minnesota River; the nitrates have been rising in recent years.

Cretaceous Aquifer

This chart showing nitrate levels in a well that is 161' deep is very representative of many wells in western Brown County. The wells in this part of the county are finished in aquifers that are protected from contamination.

Hand Dug Well

Here's another example of an historic well. This tile well is only 14' deep; it was probably hand dug. Its proximity to the surface makes it susceptible to contamination.

Well with Tile Casing

This eastern Brown County well is only 35' deep and shows fluctuating nitrate levels. Most eastern wells are much deeper; they draw uncontaminated water from protected aquifers.

Well with Tile Casing

Here's another example of a well with fluctuating levels of nitrate. This is a 40' deep tile well, representative of many shallow wells in southern Brown County.

Well with Tile Casing

The southern tier of Brown County townships have lots of these shallow, tile wells. This chart shows the nitrate levels of a 23' well.

Protected Shallow Aquifer

The nitrate levels in this south-western Brown County well illustrate an exception to the "shallow wells are contaminated" generalization. This well is only 50' deep, but its aquifer is protected from contamination.

Unprotected Glacial Aquifer

This chart shows the nitrate levels in a 60' deep well drawing water from a shallow aquifer near the Red Rock Ridge.The nitrate levels are consistently high.

Sioux Quartzite Aquifer

Another southwestern well, this one was completed in the Sioux Quartzite. Although the nitrate levels are somewhat lower in this 80' well, there are always some nitrates because the Sioux Quartzite Aquifer is contaminated.

Tiled Well

This chart shows a fourth type of well from southwestern Brown County. This shows nitrates in a 52' deep tile well. There are wide fluctuations in the nitrate levels; this well has also shown contamination from pesticides.

B. County Maps & Explanations

In this section, a series of maps illustrating different factors affecting nitrate vulnerability are shown with brief explanations about the science and technology involved in their creation. The five individual maps are combined to create a sixth map showing Nitrate-Nitrogen Probability levels in Brown County. This map represents our best estimate, at this time, of the vulnerability of the groundwater to contamination by nitrates.

Nitrate-Nitrogen Probability Map Data Inputs

Each of the maps on page 30 are described below; compositing these individual maps results in the nitrate-nitrogen probability map on page 32.

Landforms: This map was derived by the Minnesota Geological Survey Landform Association of Minnesota database in which landforms are reclassified to indicate geologic sensitivity: most permeable, permeable, and least permeable. These classifications only apply to the surface geology; it is important to realize that the geology of underlying layers may significantly affect geologic sensitivity.

Land Use: The Minnesota Department of Health reclassified the land use database developed by the International Coalition for Land and Water Stewardship in the Red River Basin in accordance with the "guidance for Mapping Nitrate in Minnesota Groundwater". The categories are 1) Forested or Undeveloped, 2) Residential or Commercial, and 3) Agricultural.

Percent Clay above the Static Water Level: This map was developed using a program that calculated the percent of clay above the static water level in 903 well logs from Brown County submitted by well drillers. MDH used a reclassification scheme to rate various lithologies (descriptions of layers of rock or soil encountered during drilling) as to permeability. The lithologies termed clay, hardpan, peat, regolith, shale, or silt are nonpermeable; all other terms are rated as permeable.

Depth to Bedrock: This map was developed by MDH using the data from 404 recently drilled wells in the Brown County Well Index. Shallow depth to bedrock (2 to 83.9 feet) ranks the highest since these locations are most vulnerable to nitrate contamination.

Average Nitrate-Nitrogen Concentrations: This map was developed using data from 879 wells with diameters less than 10 inches and completed at 50 or more feet in depth. Using the Spatial Analyst extension in ArcView, the grid for this data base was reclassified into three categories (from the Guidance for Mapping Nitrate in Minnesota Groundwater). Less than 3 parts per million nitrate-nitrogen represent background water quality. Three to 10 ppm represent water that probably has been impacted by human activity. Nitrate-nitrogen over 10 ppm is above the drinking water quality standard.

Copies of the MDH report explaining the map inputs are available; see the reference section on page 36.

The Nitrate-Nitrogen Probability Map

The map identifies areas of the county with high, moderate, and low probability of having elevated nitrate concentrations in groundwater drinking water supplies. This mapping effort is the combination of scores from the above map layers.

There are a few important points to consider regarding the county map:

- Although nitrate can be a valuable indicator of areas that are susceptible to contamination, elevated nitrate concentrations may result from contamination of the aquifer or more localized well problems, such as surface water drainage into the well, poor well construction, or location of the well near a pollution source. Localized well problems may occur anywhere and cannot be predicted by using the probability map.

- Drinking water without nitrates also can be found in areas labeled medium and high probability. The absence of nitrate in groundwater may indicate that 1) the nitrogen loading was small, 2) the nitrogen is in another form (such as ammonia), or 3) the nitrate has been denitrified (reduced to nitrogen gas).

- MDH conducted a statistical evaluation of the water quality information with respect to the probability map. Almost 80 percent of the wells that have average nitrate concentrations above 3 ppm are located in areas ranked as medium or high probability of nitrate contamination. And two-thirds of the wells with nitrate concentrations above 10 ppm are located in areas having a high probability of nitrate contamination.

- High probability areas constitute less than 20 percent of the total area of the county. Medium and high areas constitute less than 50 percent of the total area in the county.

- Drinking water with low or no detectable nitrate is available in areas designated as having high or medium probability of nitrate contamination. Only 16 percent of the wells in areas designated high probability have average nitrate concentrations above 10 ppm. Good water quality, in regards to nitrate-nitrogen, generally can be found by using a deeper well installed by a licensed well driller.

Number of Wells in Probability Map Areas

Nitrate-Nitrogen Level	Low Probability Area	Medium Probability Area	High Probability area	Total Wells
# of wells with nitrates less than 3 ppm	531	191	98	820
# of wells with nitrates between 3 & 10 ppm	8	10	11	29
# of wells with nitrates more than 10 ppm	4	6	20	30
Total Wells	543	207	129	879

C. Cross Section Representations

The geologic cross sections below are taken from the Brown County Geologic Atlas compiled by the Water Resources Center of Mankato State University in July, 1991. The cross sections combine surface topography, bedrock topography and information contained in the geologic portions of water well driller's logs. The vertical scale is a twenty-time exaggeration of the horizontal scale so thin rock units would be mapable.

Part II: Potential Uses of Groundwater Vulnerability Information

A. County Level: Zoning Decisions & Planning

Because Cottonwood County is 100% dependent on groundwater for its drinking water, programs to protect and enhance groundwater are valued highly by county residents and officials. The newly developed database and maps bring a fresh perspective to long-term protection efforts. By helping visualize the effects of current and changing practices on existing water resources, it may be possible to design new residential, agricultural, and industrial developments so that the changes have minimal impact.

With that goal in mind, a pilot project—the Groundwater Vulnerability Zoning Project—is now in progress. The GWVZ Project has developed Nitrate-Nitrogen Probability Maps based on six criteria (these are illustrated in Part I- Section B) that can be reproduced on a township level to help determine a location's susceptibility to contamination. The project will also provide developers, neighbors, county advisory committees, and decision-makers with written information about underground conditions for any proposed sites. It is hoped that the maps and information will be helpful in determining conditions for permits, in selecting sites with variable factors, and in providing long-term protection for areas of vulnerability.

During 2002, this project will provide information for zoning decisions on request. After the pilot year, an evaluation phase will determine the usefulness of the maps and database information for future zoning operations.

B. Townships, Cities & Systems: Wellhead Protection

The Minnesota Department of Health (MDH) is charged with cooperative work with communities to protect their sources of drinking water. This cooperative effort is called the "Source Water Protection Program". In our area the effort comes under the heading "Wellhead Protection Program" because all our drinking water comes from groundwater through wells.

The first step in wellhead protection is to find out where the water comes from. Next, possible sources of pollution are identified. Finally, the community develops a plan to manage contaminant sources so they will not pose a threat to drinking water.

To systematically address the over 8,000 community water systems in the state that use wells, MDH has developed a prioritization strategy based on each community water supply's vulnerability to contamination. The most vulnerable communities are listed in order of risk in Tier 1, the next level of vulnerability is Tier 2, and so on to communities with very protected water supplies, which are placed in Tier 5.

Community water systems in Brown County are ranked this way:

Red Rock Rural Water System	Tier 1	Rank 100
Hanska	Tier 1	Rank 185
New Ulm	Tier 2	Rank 550
Sleepy Eye	Tier 2	Rank 573

Springfield	Tier 2	Rank 614
Comfrey	Tier 3	Rank 875

County non-transient, non-community wells are also required to assess sources of possible contamination and to develop a plan for protection of their water source. Examples of such wells are those supplying rural churches, restaurants, and schools. In the meantime, these wells are tested annually for contaminants to ensure short-term drinking water safety.

C. Protection for Individual Wells

Despite the fact that a safe water supply can usually be obtained in Brown County, a majority of wells can be vulnerable to contamination. Protection of the "wellhead" (area near the well) is critical to have and maintain a safe supply of drinking water.

<u>Bacterial Contamination</u>
Bacteria is the most common water quality problem in rural water supplies. Overall, roughly one-third of all individual well water samples test positive for coliform bacteria. Coliform bacteria are a group of several different species which are commonly found in human and animal wastes. Because it is relatively easy to test water for coliforms, they are considered as "indicator" organisms. They are usually present when disease causing organisms such as salmonella or shigella are present.

The presence of coliform may indicate contamination from a sewer, septic system, feedlot, wastewater application or animal yard. Because coliform bacteria will generally not survive for long periods of time in groundwater, their presence usually means that the contamination source is nearby. An improperly constructed or sealed well, a defect or failure in the well or plumbing system, or a well drilled into a vulnerable aquifer may result in coliform contamination.

If coliform bacteria are found, the well, plumbing and water storage systems should be disinfected with a product such as chlorine bleach. If, after disinfection and resampling the well continues to show the presence of coliform, an evaluation of the wellhead area should be made.

A well located in a pit, a well without a watertight cap, or a well with a poor seal can be corrected. In some cases, the well might be in poor enough repair that it may need to be properly sealed, and a new well drilled.

<u>Nitrate-nitrogen Contamination</u>
As noted in earlier sections, nitrate contamination is a serious problem in many parts of the county.

There are many possible sources of nitrates in groundwater. Decayed vegetation, atmospheric nitrogen from rainfall, and minerals found in certain soils and rock are considered "natural" sources of nitrate; they contribute only small concentrations of nitrate to the groundwater. The major sources of nitrate are animal and human wastes, chemical fertilizers, manure, and to a much lesser extent in this area, industrial wastes, wastewater, and landfills. Nitrate can enter the groundwater from improper management of wastes, over-application of nitrogen fertilizers, or failing septic systems.

Nitrate can also act as an early warning of contamination, or it may indicate the possible presence of other contaminants.

If a well water sample tests at over 3 parts per million of nitrate-nitrogen, several cautionary steps can be taken.

1. The well should be inspected to determine if repair or reconstruction might be needed.

2. Nearby sources of nitrate contamination should be reduced or eliminated. This may include better management of fertilizers and animal wastes, modification or repair of septic systems, or removal of contamination sources.

3. Sometimes, only minor adjustments to the wellhead protection area may be needed. These include regrading so that excess overland runoff runs away from the well. Seeding or planting in the area around the well may also help keep any overland water that could be contaminated from pet waste or fertilizer from ponding around the top of the well.

4. Sometimes, it may be necessary to take structural steps. These include the use of filtration water treatment devices, replacing a faulty septic system with a new code-compliant sewage treatment system, or drilling a new well into a deeper, more protected, uncontaminated aquifer.

PART III: INFORMATION & REFERRAL

A. For More Information

This list of state and local agencies can be used for questions, problems, or more information on water quality in Brown County.

Brown County

Water Planning
New Ulm phone 507-233-6641

Soil & Water Conservation District
Sleepy Eye phone 507-794-2553

University of Minnesota Extension Service
Sleepy Eye phone 507-794-7993

Brown-Nicollet-Cottonwood Water Quality
St. Peter phone 507-934-4140

Minnesota Department of Health

Well Management Section – SW District
Marshall phone 507-537-7151

Source Water Protection Unit-South
Mankato phone 507-389-5563

Source Water Protection Unit - Metro
St Paul phone 651-215-0768

Minnesota Board of Water & Soil Resources

Area Conservationist
New Ulm phone 507-359-6047

Minnesota Pollution Control Agency

Clean Water Partnership Program
Rochester phone 507-281-7345

Southwest District Office
Marshall phone 507-537-7146

Regional Environmental Management
St Paul phone 651-296-7363

Minnesota Department of Natural Resources

Waters Division
New Ulm phone 507-359-6053

Fisheries Division
New Ulm phone 507-359-359-6046

Minnesota Department of Agriculture

Agronomy Services
St. Paul phone 651-296-6121

Minnesota Geological Survey

St. Paul phone 651-627-4780

B. References

Brown-Nicollet-Cottonwood Clean Water Partnership Groundwater Implementation Project 1993-1997, Brown-Nicollet-Cottonwood Water Quality Board, St. Peter, MN

Brown County Comprehensive Water Plan 1996
Brown County Environmental Office, New Ulm, MN

Brown County Nitrate-Nitrogen Probability Map - 2002
Minnesota Department of Health, St Paul, MN

Guidance for Mapping Nitrate in Minnesota Groundwater – 1998
Minnesota Department of Health, St Paul, MN

Minnesota's Geology, University of Minnesota Press, Minneapolis, MN 1982
RW Ojakangas & CL Matsch

Nitrate in Minnesota Groundwater – a GWMAP Perspective - 1998
Minnesota Pollution Control Agency, St Paul, MN

Nitrogen in Minnesota Ground Water – a LCMR Report – 1991
Minnesota Pollution Control Agency & Minnesota Department of Agriculture, St Paul, MN

Shorter Contributions to the Geology of the Sioux Quartzite, Southwestern MN - 1984
DL Southwick, Editor; Minnesota Geologic Survey, University of Minnesota, St Paul, MN

Township Water Testing Reports 1988-2000
Brown-Nicollet Environmental Health, St Peter, MN

C. Acknowledgements

As the editor of this report, I wish to express my appreciation and gratitude to three groups of people and three individuals.

First, to the citizens of Brown County who participated in water testing programs, who keep us on our toes with questions and their interest, and who are striving to preserve water resources for future generations.

Next to the Brown County Board and the staff of the Environmental Office for their dedicated public service, their support, and their hard work on these innovative projects to protect the groundwater of the county.

Next to the governments, departments, organizations, schools, and agencies at all levels (local, state, and federal) who support groundwater protection.

Three individuals stand out in the effort of compiling and using groundwater data. Without the help and hard work of these three, the county would still be in the very dark ages for water quality data—several shelves of dusty water test results and a vague understanding of geologic problem areas but no way to use the data or make improvements.

Thanks to

Bruce Olsen – Source Water Protection Unit Supervisor for the Environmental Health Division of the Minnesota Department of Health. Bruce is the godfather of these projects. He has freely bestowed his technical assistance, staff and financial resources, and moral support to groundwater projects in the county since 1989.

Sheila Grow – Hydrogeologist for the Source Water Protection Unit, Environmental Health Divison of the Minnesota Department of Health. Sheila is pioneering the use of new technology to understand, interpret, and use water data and mapping systems. She's given tremendous support to Brown County groundwater projects, actually developing the data base and maps while working out problem after problem with total cheerfulness since 1997.

Marcy Pengilly – Environmental Health Assistant for the Brown-Nicollet-Cottonwood Water Quality Board. Since 1989 when she assisted with the birth of the Board, she's been a constant source of hard work, enthusiasm, and joy in the development, carrying out, and completion of the many groundwater projects. Her personal entry of over 4,000 pages of water quality data has made the programs relevant and usable today and in the future.

With sincere gratitude,

Bonnie Holz
Water Quality Administrator
December 2001