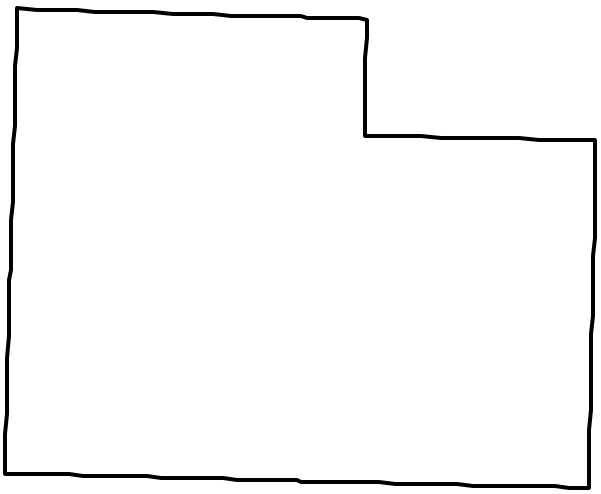
Drinking Water Quality Report
For
Cottonwood County



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

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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, Cottonwood County Board of Commissioners

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Introduction

The Groundwater Projects

Beginning in 1990, funding from the Minnesota Pollution Control Agency enabled Brown, Nicollet, and Cottonwood counties to take a close 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 under way 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 809 wells throughout Cottonwood 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. The ability to capitalize on newly developed technologies to identify and make vivid depictions of influences on water quality; and the ability to look 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 Cottonwood 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 1989. The Water Quality Database now has records on 501 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 0.99 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

Almost 27% (134 wells) of the 501 wells 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 may be at risk for contamination by coliform and other bacteria.

The water testing program was instituted in 1991 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 analyses for coliform bacteria, and the number and percentages of positive results from county well testing programs. 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.

Cottonwood County Coliform Analysis Results – 1991 through 2002

Township	Total Coliform Analyses (includes repeat samples for many wells)	Total Positive for Coliform	Percent Positive
Amboy	39	25	64%
Amo	16	9	25%
Ann	12	3	25%
Carson	45	28	62%
Dale	27	9	33%
Delton	48	23	48%
Germantown	71	20	28%
Great Bend	59	18	31%
Highwater	10	2	20%
Lakeside	52	18	35%
Midway	56	26	46%
Mountain Lake	56	13	23%
Rose Hill	31	16	52%
Selma	61	30	49%
Southbrook	12	4	33%
Springfield	16	2	12%
Storden	23	12	52%
Westbrook	29	14	48%
Cottonwood County Totals	**663**	**267**	**40%**

Well Construction

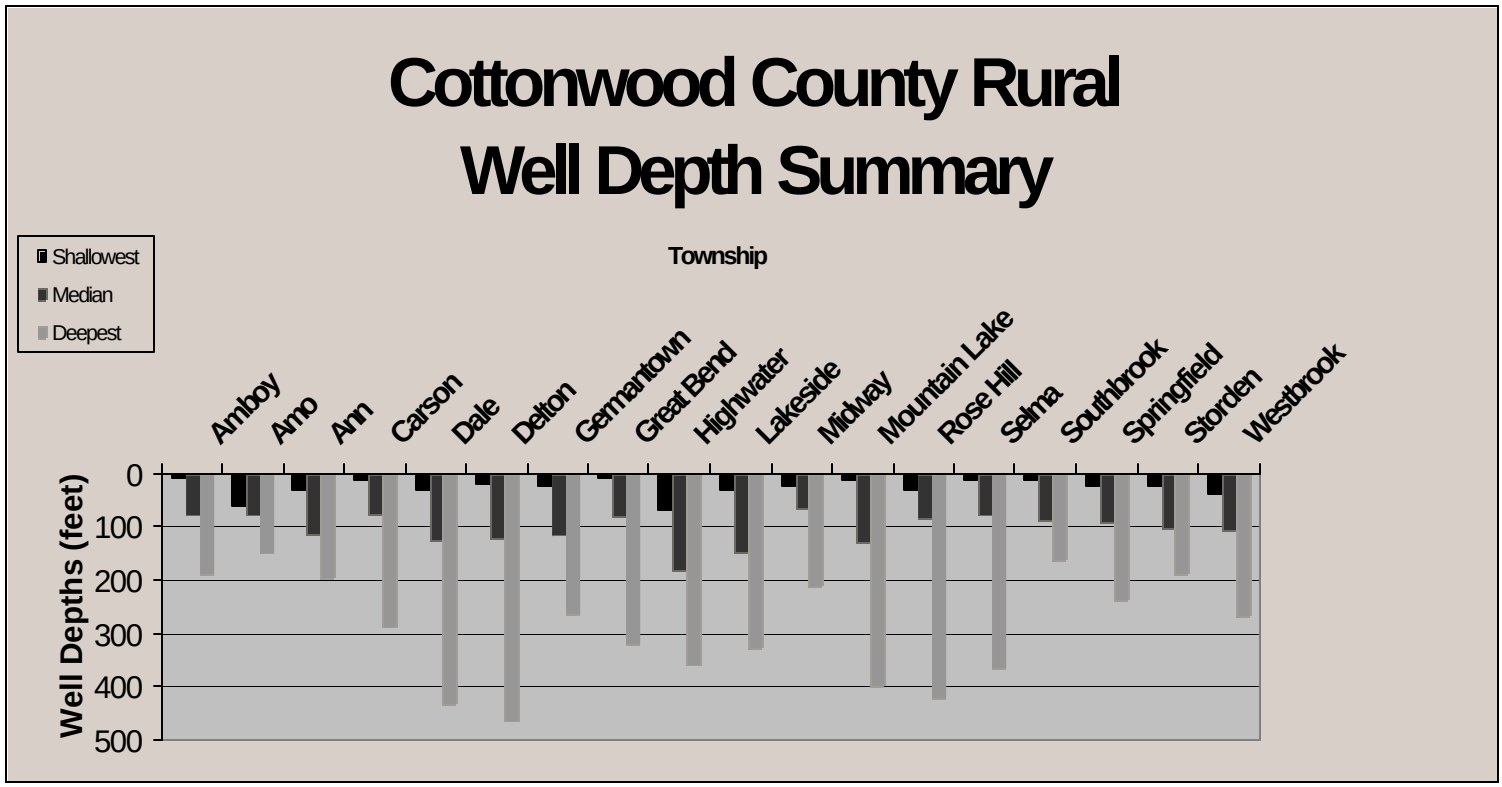
Since 1974, Minnesota has been operating under the Minnesota Well Code (Minnesota Rules Chapter 4725) administered by the Department of Health. Under this code, wells must be drilled and constructed according to standards designed to protect both individual sources of drinking water and the aquifers 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 a 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) depth of wells in each township. The data is taken from the Cottonwood County Well Index.



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 and materials that pre-date the standards established by the adoption of the Minnesota Well Code in 1975. Some Cottonwood 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.

Cottonwood County has several aquifers, with varying levels of susceptibility to contamination. The ability to find safe drinking water depends on the condition of the local aquifer. However, another problem in Cottonwood County is the quantity of underground water supplies. Many rural residents have found that local aquifers do not supply water in sufficient quantities to meet their needs. For this reason, the Red Rock Rural Water System was established. 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 Cottonwood 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 Cottonwood County

Glacial Aquifers

The thickness of glacial deposits in Cottonwood 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 results, 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 sediment layers left behind by the glaciers. Sand and gravel layers form the highest yielding aquifers in Cottonwood 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 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 and 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 til that was either plastered onto the countryside at the base of the ice or formed as mudflows when the ice melted. The till layers in Cottonwood 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 Cottonwood 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 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. Today ditches and tile lines help drain these areas. The aquifers that occur beneath the Des Moines Lobe till tend to be recharged slowly and they 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 sulphate than groundwater that is in more direct contact with surface water.

Several outwash channels occurred where meltwater from the Des Moines lobe drained toward either the southeast or northeast. Here sand and gravel deposits are used by wells but they are potentially vulnerable to contamination resulting from land uses because there is no cover of clay-rich till.

Cretaceous Aquifer

At the end of the Cretaceous Period (about 75 to 65 million years ago), Cottonwood 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 northern 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 than today, 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 ruing 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 water for domestic wells and the aquifer is generally protected from contaminants relating to land uses.

Sioux Quartzite Aquifer

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. One of these remnants includes parts of the northeastern corner of Cottonwood 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.

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 is used by farm wells. 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 is 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 reported in wells in these areas.

Summaries by Township & City

Townships

This section explores the varying groundwater situations in the townships and cities of Cottonwood 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.

Amboy Township

Located in central Cottonwood County, Jeffers is the only community in this mostly agricultural township. The statistics below do not include Jeffers; it is described in the next section. Amboy township is on high ground, with several streams having their origin including Dry Creek, Mound Creek, and the Little Cottonwood River. The geology is dominated by thick glacial drift deposits over the Sioux Quartzite Formation known as the Red Rock Ridge.

Population 172 (male: 89 female: 83) Households: 73
Population under 5 yrs: 5 Population over 85 years: 6
Median age: 46.0 years Population Density: 4.8 people /sq mi

Wells Wells in database: 26 Median Depth for all wells: 79 feet
Shallowest: 6 feet Deepest: 190 feet
# of wells with casing or tiles over 10" in diameter: 4 (15%)

Water Quality		
	# of wells sampled 1989-2000:	17
	# of Bacteria samples:	39
	# with positive coliform bacteria:	25 (64%)
	# of Nitrate-nitrogen samples:	99
	# of nitrate samples at 10 ppm or higher:	68 (67%)
	Highest nitrate reading:	56.7 ppm
	Median nitrate level:	14.8 ppm

Amo Township

Located in west central Cottonwood County, Amo is a mostly agricultural township. It also contains Augusta Lake and one Water Fowl Production Area.

Population 140 (male: 71 female: 69) Households: 32
Population under 5 yrs: 10 Population over 85 years: 3

Median age: 39.8 Population Density: 4 people / sq mi

Wells Wells in database: 19 Median Depth for all wells: 77 feet
Shallowest: 60 feet Deepest: 150 feet
# of wells with casing or tiles over 10" in diameter: 3 (16%)

Water Quality # of wells sampled 1989-2000: 8
# of Bacteria samples: 16
with positive coliform bacteria: 9 (56%)
of Nitrate-nitrogen samples: 22
# of nitrate samples at 10 ppm or higher: 2 (9%)
Highest nitrate reading: 42.0 ppm
Median nitrate level: 5.0 ppm

Ann Township

Located in northwest Cottonwood County, there are no cities in this mostly agricultural township. Many small tributary streams of the Cottonwood River have their origin in this township.

Population 191 (male: 100 female: 91) Households: 75
Population under 5 yrs: 12 Population over 85 years: 1
Median age: 46.4 years Population Density: 5.3 people / sq mi

Wells Wells in database: 13 Median Depth for all wells: 113 feet
Shallowest: 30 feet Deepest: 196 feet
# of wells with casing or tiles over 10" in diameter: 2 (15 %)

Water Quality # of wells sampled 1989-2000: 10
# of Bacteria samples: 12
with positive coliform bacteria: 3 (25%)
of Nitrate-nitrogen samples: 14
# of nitrate samples at 10 ppm or higher: 1 (7%)
Highest nitrate reading: 10.2 ppm
Median nitrate level: 2.1 ppm

Carson Township

Located in east-central Cottonwood County, the only community in Carson is Delft, which is served by Red Rock Rural Water System (statistics on the system are in the next section). Carson has two Wildlife Management Areas and several small lakes.

Population 191 (male: 167 female: 144) Households: 116
Population under 5 yrs: 21 Population over 85 years: 5
Median age: 41.3 years Population Density: 8.8 people / sq mi

Wells Wells in database: 44 Median Depth for all wells: 74 feet
Shallowest: 10 feet Deepest: 290 feet
# of wells with casing or tiles over 10" in diameter: 24 (55 %)

Water Quality # of wells sampled 1989-2000: 37
# of Bacteria samples: 45
with positive coliform bacteria: 28 (62%)
of Nitrate-nitrogen samples: 57
# of nitrate samples at 10 ppm or higher: 19 (33%)
Highest nitrate reading: 76.4 ppm
Median nitrate level: 11.9 ppm

Dale Township

Located in central Cottonwood County, Dale Township's land use is predominantly agriculture. There are two waterfowl areas and one wildlife management area in Dale. Most of the individual wells tap into the quaternary aquifers.

Population 154 (male: 78 female: 76) Households: 65
Population under 5 yrs: 7 Population over 85 years: 3
Median age: 44.0 years Population Density: 4.3 people /sq mi

Wells Wells in database: 23 Median Depth for all wells: 123 feet
Shallowest: 30 feet Deepest: 435 feet
# of wells with casing or tiles over 10" in diameter: 6 (23%)

Water Quality # of wells sampled 1989-2000: 14
# of Bacteria samples: 27
with positive coliform bacteria: 9 (33%)
of Nitrate-nitrogen samples: 37
# of nitrate samples at 10 ppm or higher: 9 (24%)
Highest nitrate reading: 57.0 ppm
Median nitrate level: 7.2 ppm

Delton Township

Located in northeast Cottonwood County, Delton is predominantly agricultural; although it is the home of the Jeffers Petroglyphs, a popular state historical site. Delton is the township of

origin for the North Fork of the Watonwan River. Aquifers tapped by Delton families include the Sioux Quartzite and Quaternary (Glacial Drift) aquifers.

Population 146 (male: 78 female: 71) Households: 55
Population under 5 yrs: 10 Population over 85 years: 4
Median age: 37.7 Population Density: 4.1 people / sq mi

Wells Wells in database: 40 Median Depth for all wells: 122 feet
Shallowest: 18 feet Deepest: 466 feet
# of wells with casing or tiles over 10" in diameter: 6 (15%)

Water Quality # of wells sampled 1989-2000: 22
# of Bacteria samples: 48
with positive coliform bacteria: 23 (48%)
of Nitrate-nitrogen samples: 127
# of nitrate samples at 10 ppm or higher: 88 (69%)
Highest nitrate reading: 37.0 ppm
Median nitrate level: 9.3 ppm

Germantown Township

Located in northern Cottonwood County, there are no cities in this mostly agricultural township. Red Rock County Park lies in section 35 of Germantown. The residents' wells tap a variety of aquifers from very shallow glacial drift aquifers to those finished deep in the Sioux Quartzite aquifer.

Population 224 (male: 111 female: 113) Households: 80
Population under 5 yrs: 15 Population over 85 years: 2
Median age: 35.7 years Population Density: 6.3 people / sq mi

Wells Wells in database: 55 Median Depth for all wells: 116 feet
Shallowest: 21 feet & a spring Deepest: 265 feet
# of wells with casing or tiles over 10" in diameter: 6 (11%)

Water Quality # of wells sampled 1989-2000: 40
# of Bacteria samples: 71
with positive coliform bacteria: 20 (28%)
of Nitrate-nitrogen samples: 132
# of nitrate samples at 10 ppm or higher: 49 (37%)
Highest nitrate reading: 34.1 ppm
Median nitrate level: 5.4 ppm

Great Bend Township

Located in south-central Cottonwood County, Great Bend surrounds the city of Windom on three sides, which makes it Cottonwood's smallest township in area. Section 8 of Great Bend is the location of the wellfield for Red Rock Rural Water System. Many wells in Great Bend are susceptible to possible contamination because they draw from the unprotected Des Moines alluvial aquifer.

Population 326 (male: 172 female: 153) Households: 125
Population under 5 yrs: 12 Population over 85 years: 2
Median age: 43.0 years Population Density: 10.1 people /sq mi

Wells Wells in database: 61 Median Depth for all wells: 80 feet
Shallowest: 6 feet Deepest: 320 feet
# of wells with casing or tiles over 10" in diameter: 20 (33 %)

Water Quality

# of wells sampled 1989-2000:	48
# of Bacteria samples:	59
# with positive coliform bacteria:	18 (31%)
# of Nitrate-nitrogen samples:	68
# of nitrate samples at 10 ppm or higher:	8 (12%)
Highest nitrate reading:	46.5 ppm
Median nitrate level:	3.7 ppm

Highwater Township

Located in northwest Cottonwood County, there are no cities in this mostly agricultural township.
The County Well Index has limited information about Highwater; there are only a few wells in the database. Many families make use of the Red Rock Rural Water System. Highwater and Dry Creeks help drain this hilly township.

Population 169 (male: 94 female: 75) Households: 66
Population under 5 yrs: 16 Population over 85 years: 0
Median age: 44.5 years Population Density: 4.7 people / sq mi

Wells Wells in database: 9 Median Depth for all wells: 180 feet
Shallowest: 68 feet Deepest: 360 feet
# of wells with casing or tiles over 10" in diameter: 1 (11%)

Water Quality	# of wells sampled 1989-2000:	7
	# of Bacteria samples:	10
	# with positive coliform bacteria:	2 (20%)
	# of Nitrate-nitrogen samples:	9
	# of nitrate samples at 10 ppm or higher:	1 (13%)
	Highest nitrate reading:	76.0 ppm
	Median nitrate level:	8.8 ppm

Lakeside Township

Located in southeast Cottonwood County, Lakeside contains several lakes and wildlife management areas as well as the city of Bingham Lake and some housing developments near the city limits of Windom. The ethanol plant near Bingham Lake is located in Lakeside, which also is the origin of the southernmost tributary to the Watonwan River.

Population 255 (male: 136 female: 119) Households: 97
Population under 5 yrs: 13 Population over 85 years: 1
Median age: 42.1 years Population Density: 7.6 people /sq mi

Wells Wells in database: 47 Median Depth for all wells: 145 feet
Shallowest: 30 feet Deepest: 329 feet
# of wells with casing or tiles over 10" in diameter: 11 (23 %)

Water Quality	# of wells sampled 1989-2000:	38
	# of Bacteria samples:	52
	# with positive coliform bacteria:	18 (35%)
	# of Nitrate-nitrogen samples:	61
	# of nitrate samples at 10 ppm or higher:	11 (18%)
	Highest nitrate reading:	108.3 ppm
	Median nitrate level:	5.4 ppm

Midway Township

Located in east Cottonwood County, the township surrounds the city of Mountain Lake on its east, north, and west sides. Although the township is mainly agricultural, recreation in and near the waters of Mountain Lake is another important land use.

Population 442 (male: 219 female: 223) Households: 99
Population under 5 yrs: 25 Population over 85 years: 1
Median age: 37.8 years Population Density: 12.4 people/sq mi

Wells Wells in database: 9 Median Depth for all wells: 66 feet

Shallowest: 21 feet Deepest: 210 feet
# of wells with casing or tiles over 10" in diameter: 34 (58%)

Water Quality # of wells sampled 1989-2000: 58
# of Bacteria samples: 56
with positive coliform bacteria: 26 (46%)
of Nitrate-nitrogen samples: 78
# of nitrate samples at 10 ppm or higher: 24 (31%)
Highest nitrate reading: 74.7 ppm
Median nitrate level: 8.4 ppm

Mountain Lake Township

Located in southeast Cottonwood County, Mountain Lake Township has no cities or lakes, so is mostly agricultural. The Mountain Park historic site is located in the township.

Population 442 (male: 219 female: 223) Households: 99
Population under 5 yrs: 25 Population over 85 years: 1
Median age: 22.3 years Population Density: 12.4 people/sq mi

Wells Wells in database: 45 Median Depth for all wells: 126 feet
Shallowest: 12 feet Deepest: 400 feet
# of wells with casing or tiles over 10" in diameter: 14 (31 %)

Water Quality # of wells sampled 1989-2000: 38
# of Bacteria samples: 56
with positive coliform bacteria: 13 (23%)
of Nitrate-nitrogen samples: 67
# of nitrate samples at 10 ppm or higher: 19 (28%)
Highest nitrate reading: 54.3 ppm
Median nitrate level: 8.6 ppm

Rose Hill Township

Located in west central Cottonwood County, Rose Hill has no cities; it is predominantly agricultural, although there are several lakes and one waterfowl area.

Population 189 (male: 102 female: 87) Households: 69
Population under 5 yrs: 13 Population over 85 years: 1
Median age: 38.4 years Population Density: 5.3 people/sq mi

Wells Wells in database: 26 Median Depth for all wells: 83 feet
Shallowest: 30 feet Deepest: 423 feet
# of wells with casing or tiles over 10" in diameter: 7 (27%)

Water Quality # of wells sampled 1989-2000: 18
# of Bacteria samples: 31
with positive coliform bacteria: 16 (52%)
of Nitrate-nitrogen samples: 37
# of nitrate samples at 10 ppm or higher: 14 (38%)
Highest nitrate reading: 193.9 ppm
Median nitrate level: 17.5 ppm

Selma Township

Located in northeast Cottonwood County, Selma Township is mostly agricultural. There are no cities located within the township; however it is adjacent to Comfrey. Selma is situated on the east edge of the Red Rock Ridge.

Population 204 (male: 104 female: 100) Households: 84
Population under 5 yrs: 13 Population over 85 years: 5
Median age: 45.7 years Population Density: 5.7 people/sq mi

Wells Wells in database: 45 Median Depth for all wells: 78 feet
Shallowest: 12 feet Deepest: 365 feet
# of wells with casing or tiles over 10" in diameter: 10 (22 %)

Water Quality # of wells sampled 1989-2000: 31
# of Bacteria samples: 61
with positive coliform bacteria: 30 (49 %)
of Nitrate-nitrogen samples: 69
# of nitrate samples at 10 ppm or higher: 28 (41 %)
Highest nitrate reading: 36.5 ppm
Median nitrate level: 8.5 ppm

Southbrook Township

Located in southwest Cottonwood County, Southbrook has no cities; it is predominantly agricultural, although there are also three good-sized lakes, one wildlife area, and the county park at Talcot Lake.

Population 112 (male: 58 female: 54) Households: 40
Population under 5 yrs: 3 Population over 85 years: 0
Median age: 41.0 years Population Density: 3.3 people/sq mi

Wells Wells in database: 12 Median Depth for all wells: 87 feet
Shallowest: 8 feet Deepest: 160 feet
# of wells with casing or tiles over 10" in diameter: 2 (17%)

Water Quality # of wells sampled 1989-2000: 9
# of Bacteria samples: 12
with positive coliform bacteria: 4 (33%)
of Nitrate-nitrogen samples: 12
# of nitrate samples at 10 ppm or higher: 1 (8%)
Highest nitrate reading: 16.5 ppm
Median nitrate level: 2.4 ppm

Springfield Township

Located in southwest Cottonwood County, there are no communities in this mostly agricultural township. Springfield has two wildlife areas and one water fowl area.

Population 161 (male: 81 female: 80) Households: 64
Population under 5 yrs: 6 Population over 85 years: 3
Median age: 40.3 years Population Density: 4.5 people/sq mi

Wells Wells in database: 20 Median Depth for all wells: 89 feet
Shallowest: 21 feet Deepest: 240 feet
# of wells with casing or tiles over 10" in diameter: 6 (30 %)

Water Quality # of wells sampled 1989-2000: 16
# of Bacteria samples: 16
with positive coliform bacteria: 2 (12 %)
of Nitrate-nitrogen samples: 20
# of nitrate samples at 10 ppm or higher: 4 (20 %)
Highest nitrate reading: 29.0 ppm
Median nitrate level: 5.3 ppm

Storden Township

Located in north-central Cottonwood County, Storden is mostly agricultural. The city of Storden is located in the southwest part of the township of Storden. These statistics to not include the city, which is described in the next section. There is also one wildlife area in the township.

Population 198 (male: 101 female: 97) Households: 87
Population under 5 yrs: 5 Population over 85 years: 5
Median age: 41.0 years Population Density: 8.7 people/sq mi

Wells Wells in database: 20 Median Depth for all wells: 103 feet
Shallowest: 23 feet Deepest: 190 feet
# of wells with casing or tiles over 10" in diameter: 8 (40%)

Water Quality # of wells sampled 1989-2000: 25
# of Bacteria samples: 23
with positive coliform bacteria: 12 (52%)
of Nitrate-nitrogen samples: 25
# of nitrate samples at 10 ppm or higher: 3 (12%)
Highest nitrate reading: 45.2 ppm
Median nitrate level: 5.9 ppm

Westbrook Township

Located in western Cottonwood County, Westbrook is mostly agricultural. The city of Westbrook is located in the southwest part of the township of Westbrook. These statistics do not include the city, which is described in the next section. There is also one wildlife area and one waterfowl area in the township, as well as the South Dutch Charlie county park and campground.

Population 302 (male: 147 female: 155) Households: 102
Population under 5 yrs: 9 Population over 85 years: 36
Median age: 39.7 years Population Density: 8.7 people/sq mi

Wells Wells in database: 30 Median Depth for all wells: 107 feet
Shallowest: 38 feet Deepest: 267 feet
# of wells with casing or tiles over 10" in diameter: 6 (20 %)

Water Quality # of wells sampled 1989-2000: 19
# of Bacteria samples: 29

# with positive coliform bacteria:	14 (48 %)
# of Nitrate-nitrogen samples:	34
# of nitrate samples at 10 ppm or higher:	9 (26 %)
Highest nitrate reading:	97.1 ppm
Median nitrate level:	10.5 ppm

Cities

Bingham Lake

Bingham Lake is located within Lakeside Township in southeast Cottonwood County. This community receives its water supply via pipeline from the city of Windom, which is 15 miles to the southwest.

Population 167 (male: 97 female: 70) Households: 60
Population under 5 yrs: 9 over 85 years: 1
Median age: 33.9 years Area: .7 square miles

Wells see the description of the Windom wells

Jeffers

Located in north-central Cottonwood County, Jeffers is situated within Amboy Township. The city well draws water from glacial deposits.

Population 396 (male: 194 female: 202) Households: 184
Population under 5 yrs: 15 Population over 85 years: 9
Median age: 45.0 years Area: .4 square miles

Wells Wells in database: 1 Depth: 184 feet

Mountain Lake

Located in southeast Cottonwood County, the city of Mountain Lake is situated within Midway Township. The Mountain Lake municipal wells draw from glacial deposits and the Sioux Quartzite.

Population 2,082 (male: 996 female: 1,084) Households: 817
Population under 5 yrs: 155 Population over 85 years: 160
Median age: 40.5 years Area: 1.3 square miles

Wells Wells in database: 4 Median Depth for all wells: 287 feet
Shallowest: 79 feet Deepest: 500 feet

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 fewer aquifer options than other parts of Cottonwood County. 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.

Storden

Located in northwest Cottonwood County, the city of Storden is situated within Storden Township. The Storden municipal wells draw from deep Quaternary (glacial deposit) aquifers.

Population 274 (male: 134 female: 140) Households: 120
Population under 5 yrs: 15 Population over 85 years: 17
Median age: 45.5 years Area: .2 square miles

Wells Wells in database: 2
Shallowest: 190 feet Deepest: 323 feet

Westbrook

Located in northwest Cottonwood County, the city of Westbrook is situated within Westbrook Township. The Storden municipal wells draw from protected Cretaceous and Dakota Aquifers.

Population	755 (male: 334 female: 421)	Households: 367
	Population under 5 yrs: 41	Population over 85 years: 62
	Median age: 51.9 years	Area: .8 square miles
Wells	Wells in database: 2; Well # 1 is 588' deep & Well # 2 is 428' deep	

Windom

Located in south central Cottonwood County, Windom is the county seat. The Windom municipal wells draw from Quaternary (glacial deposit) aquifers and the Des Moines Alluvial Aquifer.

Population	4,490 (male: 2,096 female: 2.394)	Households: 1,910
	Population under 5 yrs: 246	Population over 85 years: 200
	Median age: 41.8 years	Area: 2.9 square miles
Wells	Wells in database: 8	Median Depth: 117 feet
	Shallowest Well: #4 (87')	Deepest well: # 7 (142')

Nitrates over Time

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

The next two 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 testing in Cottonwood County. Five of these examples plot changes in wells where the owners tested through the Township Water Testing program, bringing in samples for analysis every few years. One of the charts illustrates the fluctuations for wells in the Clean Water Partnership project, in which water was tested several times a year.

These graphs must be checked for varying scales—the left side (also known as the Y-axis) shows nitrate ranges from 0 to 25 parts per million (ppm), 0 to 3.5 ppm, 0 to 12 ppm, 0 to 70 ppm, 0 to 40 ppm, and 0 to 0.8 ppm respectively.

Shallow well
High nitrate levels

This 35’ deep well in northeast Cottonwood County shows a steady increase in nitrates in the ten years of testing.

Deep well
Low nitrate levels

The 90’ well from northwest Cottonwood County has shown improvement in nitrate levels over the past eight years.

Shallow well
Elevated nitrates

Although this southeast Cottonwood County well is only 12’ deep, the nitrate levels it has shown over the past seven years are not as high as might be expected in such a shallow well.

Shallow well
High nitrates

This well, located in central Cottonwood County is only 30’ deep and has fluctuating nitrate levels that are almost always over the drinking water standard.

Sioux Quartzite well
High nitrates

This 106’ deep well was part of the Clean Water Partnership project that tracked nitrate levels in wells near the Mound Creek. This well is located on the Red Rock Ridge; it shows consistently high nitrate levels.

Deep well
No nitrates

This 170’ deep well is located in northern Cottonwood County. This well is representative of hundreds wells in the county that have shown no nitrate contamination.

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 Cottonwood 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 page 28 are described below; compositing these individual maps results in the nitrate-nitrogen probability map on page 29.

Landforms: This map was derived from the Minnesota Geological Survey Landform Associations of Minnesota database. In the database classification of landforms 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 173 well logs from Cottonwood 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 Map: This map was developed by the Minnesota Department of Health using the data from 69 recently drilled wells in the Cottonwood 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 172 wells with diameters less than 10 inches and completed at 50 or more feet in depth. Using the Spatial Analyst extension in arc view, the grid for this database 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 37.

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. Statistically, 90% of the wells that have average nitrate concentrations above 3 ppm are located in areas ranked as medium or high probability of nitrate contamination. Almost two-thirds (63.9%) of the wells that have average nitrate concentrations above 10 ppm are located in areas ranked as medium or high probability of nitrate contamination.

- High probability areas constitute less than 7.5 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 without nitrate is available in areas designated as having high or medium probability of nitrate contamination. Forty percent of the wells in areas designated high probability have average nitrate concentrations below 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	70	67	4	141
# of wells with nitrates between 3 & 10 ppm	2	6	4	12
# of wells with nitrates more than 10 ppm	1	6	12	19
Total Wells	73	79	20	172

C. Cross Section Representations

The geologic cross sections below are taken from the Cottonwood 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 mappable.

The Cottonwood County cross sections show the predominance of Sioux Quartzite bedrock in the northern part of the county.

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 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 Cottonwood County are ranked this way:

Red Rock Rural Water System	Tier 1	Rank 100
Jeffers	Tier 1	Rank 208
Windom	Tier 2	Rank 629
Mountain Lake	Tier 2	Rank 649
Caldwell Packing Co.	Tier 3	Rank 621

Storden	Tier 5	Rank 1316
Westbrook	Tier 5	Rank 1471

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 of Individual Wells

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

Bacterial Contamination

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 "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 needs to be properly sealed, and a new well drilled.

Nitrate-nitrogen Contamination

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 contingency 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 Cottonwood County.

Cottonwood County

Water Planning
Windom phone 507-831-2060

Soil & Water Conservation District
Windom phone 507-831-1550

University of Minnesota Extension Service
Windom phone 507-831-4022

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
Mankato phone 507-389-5563

Source Water Protection Unit – Metro Office
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

Cottonwood County Comprehensive Water Plan 1997-2006
Cottonwood County Environmental Office, Windom, MN

Cottonwood 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 Cottonwood 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 Cottonwood 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 – Hydrologist for the Source Water Protection Unit, for the 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 Cottonwood 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