

# Baseline Water Quality of Minnesota's Principal Aquifers: Region 4, Southwest Minnesota

GWMAP, March 1999

## What was the baseline study?

Between 1992 and 1996, the Minnesota Pollution Control Agency's (MPCA) Ground Water Monitoring and Assessment Program (GWMAP) sampled 954 primarily domestic wells across Minnesota. The goal of this study, called the baseline study, was to determine ambient water quality in Minnesota's principal aquifers.

## What parameters were sampled?

Each well was sampled for 48 inorganic chemicals, such as nitrate, chloride, arsenic and metals; 68 volatile organic compounds (VOCs), such as benzene; other parameters, such as pH and temperature; total dissolved solids and total organic carbon. In addition, selected wells were tested for tritium, the presence of which is an indicator of water less than 50 years old.

## What is Region 4?

The MPCA has divided Minnesota into six regions. Region 4 encompasses the southwestern portion of the state and includes the counties of Big Stone, Chippewa, Cottonwood, Jackson, Kandiyohi, Lac Qui Parle, Lincoln, Lyon, McLeod, Meeker, Murray, Nobles, Pipestone, Redwood, Renville, Rock, Swift and Yellow Medicine. The regional office is in Marshall.

## How many wells were sampled and in which aquifers?

In 1993 and 1994, 132 wells were sampled in Region 4. Of these 132 samples, 16 were collected from wells completed in surficial sand and gravel aquifers, 90 were from wells completed in buried confined sand and gravel aquifers, 19 were from wells completed in Cretaceous aquifers, and seven were from wells completed in Precambrian aquifers.

## What is the quality of ground water in Region 4?

Ground water quality in southwestern Minnesota is poor in comparison to water quality in similar aquifers statewide. The number of exceedances of drinking water criteria are shown in the table on page 2 of this fact sheet. The primary controls on water quality are geology, residence times and well construction. Parent material is enriched in chemicals, such as sulfate, bicarbonate, iron and boron. Concentrations of dissolved solids increase as the time that ground water is in contact with these minerals increases. Manganese and boron are the two most important chemicals of concern associated with natural sources. Cretaceous bedrock in particular has high concentrations of these elements.





When buried sand and gravel aquifers overlie Cretaceous deposits, they have high concentrations of these elements. This is because water moves upward from the Cretaceous deposits into the glacial aquifers. Nitrate is the most important chemical associated with human sources. Large-diameter wells are associated with high nitrate concentrations, often in excess of the

drinking water criteria. VOCs were found in 19 (14 percent) of the wells. The primary VOC was chloroform, which is associated with well disinfection. Some VOC detections were compounds commonly associated with fuel oils and gasoline. All VOC concentrations were below drinking water criteria.

Parameter	Number of exceedances of drinking criteria			
	Cretaceous	Precambrian	Buried sand and gravel	Surficial sand and gravel
Antimony (Sb)	0	0	1	0
Beryllium (Be)	0	2	0	0
Boron (B)	8	3	26	2
Manganese (Mn)	2	2	9	2
Nitrate (NO <sub>3</sub> )	3	1	9	4
Vanadium (V)	1	0	0	0
Zinc (Zn)	1	0	0	0

#### What are the primary research needs in Region 4?

The primary research needs for Region 4 include:

1. developing a conceptual model of regional flow;
2. identifying primary recharge and discharge areas and quantities;
3. correlating water quality with chemistry of parent material, particularly for boron; and
4. defining the geochemical sensitivity of surficial aquifers to nitrate contamination.

#### What are the primary monitoring needs for Region 4?

Monitoring needs for Region 4 include:

1. establishing a centralized database to expand and update baseline water quality information;
2. determining trends in nitrate concentrations of surficial aquifers;
3. determining the effectiveness of best management practices on water quality of

- surficial aquifers; and
4. establishing rigorous and uniform field sampling, data-management and data-analysis protocol.

#### What is the role of GWMAP in addressing these research and monitoring needs?

GWMAP discontinued baseline sampling in 1997. We feel the emerging ground water issues are identifying aquifer and regional water quality as impacted by human activity, assessing the effectiveness of environmental policies and programs, and establishing long-term monitoring networks to determine whether water quality is changing in response to human activity. We will strive to work with other ground water programs that deal directly with ground water problems and effectiveness monitoring, and attempt to secure funding for establishing long-term monitoring networks.