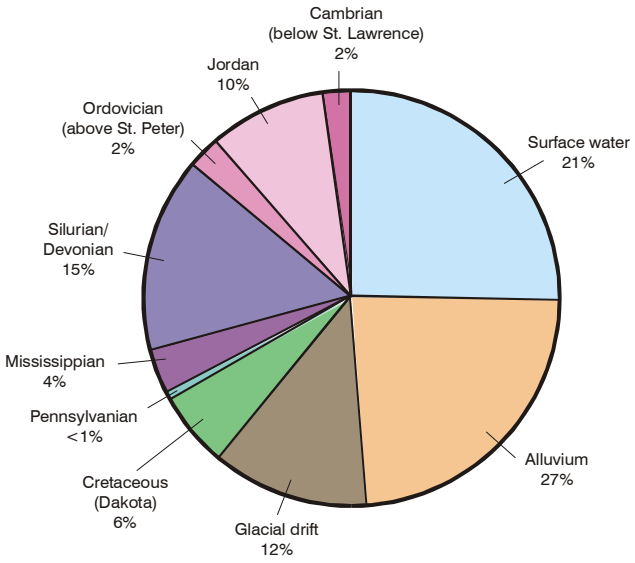
IOWA'S WATER

Ambient Monitoring Program

Groundwater Monitoring in Iowa

Groundwater is a vital resource for many people in Iowa. The quality of groundwater for drinking, agricultural, or commercial uses is a concern not only for Iowa's Ambient Water Monitoring Program, but also for all the citizens of Iowa who rely on these resources. For approximately 79 percent of Iowans, the water in their drinking glass is groundwater. The average Iowan uses nearly 1,100 gallons of water each day if indirect sources such as manufacturing of products, food production and energy generation are included. Individually, Iowans use approximately 100 gallons per day for drinking and other household uses.



Source: Iowa Geological Survey
(Unpublished data)

Figure 1. *Drinking water by source. Groundwater is used by 79% of Iowans for their drinking water, while the remaining 21% rely on surface water.*

Groundwater is found below the ground surface in the open spaces between grains of sand or gravel and along fractures in the rock. Any geologic material that can hold water and transmit that water to a well is called an *aquifer*. In Iowa, nine aquifers supply the groundwater that most Iowans use for drinking water (Figure 1). Alluvial aquifers consist of sand and gravel deposits along Iowa's major rivers. Glacial drift aquifers transmit water from sand and gravel lenses located within a glacial clay matrix. The bedrock aquifers (Cretaceous, Pennsylvanian, Mississippian, Silurian-Devonian, Ordovician, Cambrian-Ordovician or "Jordan," and Cambrian) are named for the geologic time period in which the deposits are found. These aquifers consist of limestone and sandstone and occur tens to hundreds, even thousands of feet below the land surface.

Iowa's Ambient Water Monitoring Program is monitoring the water quality of all of these groundwater sources throughout the state. In addition, water level changes in these

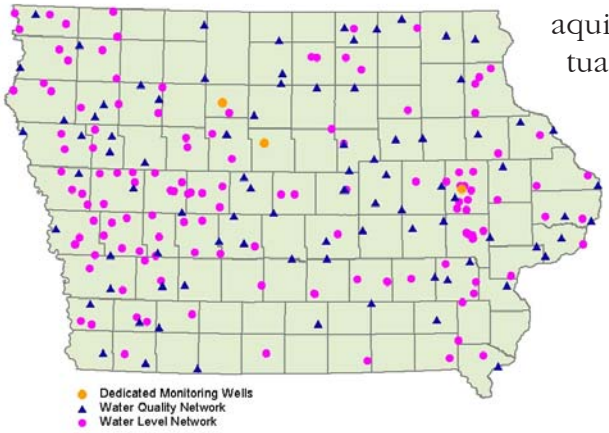


Figure 2. *Location of wells being monitored for the groundwater network.*

aquifers are being tracked to determine any fluctuations in the natural storage of groundwater.

Groundwater Levels

Groundwater levels naturally rise and fall in response to climate changes. Understanding the changes in groundwater levels over time gives information on the water quality of an aquifer. Since 1982, the Iowa Department of Natural Resources (IDNR) and the U.S. Geological Survey (USGS) have maintained a network of wells to measure groundwater levels from different aquifers across Iowa.

The groundwater level network in Iowa consists of water levels measured in 159 wells drilled in Iowa's principal aquifers, both bedrock (deeper limestone and sandstone) and shallow (sand and gravel) aquifers (Figure 2). Water levels in these wells are measured at least quarterly. Data from the groundwater level network are used to determine if pumping withdrawal of water exceeds the recharge or replenishment of water to an aquifer through rain and snowmelt and to assess the response of the aquifer systems to natural climate variations.

Monitoring Groundwater Quality

The Iowa groundwater quality monitoring program was initiated in 1982 by the IDNR, USGS, and University of Iowa Hygienic Laboratory. The monitoring program provides consistent data describing the chemical water quality of the principal aquifers in Iowa and determines possible trends in water quality.

The groundwater monitoring program was initiated to continue a program begun in 1950 by the State Health Department that consisted of periodic, nonspecific sampling of untreated water from approximately 250 municipal water supply wells. Because of the random pattern of sampling, trends in groundwater quality were difficult to determine from this data. In 1992, investigation of water-quality trends became the primary focus of the program. The well inventory was divided into categories based on aquifer type, well depth, and designations of "vulnerable" and "not vulnerable" to contamination based on the geological characteristics of the well. A total of 90 wells were sampled as part of this fixed network. From the 90 wells, 45 wells from the alluvial and glacial drift aquifers were sampled annually, while the other 45 wells (from the bedrock aquifers) were sampled on a rotational schedule based on aquifer vulnerability to contamination.

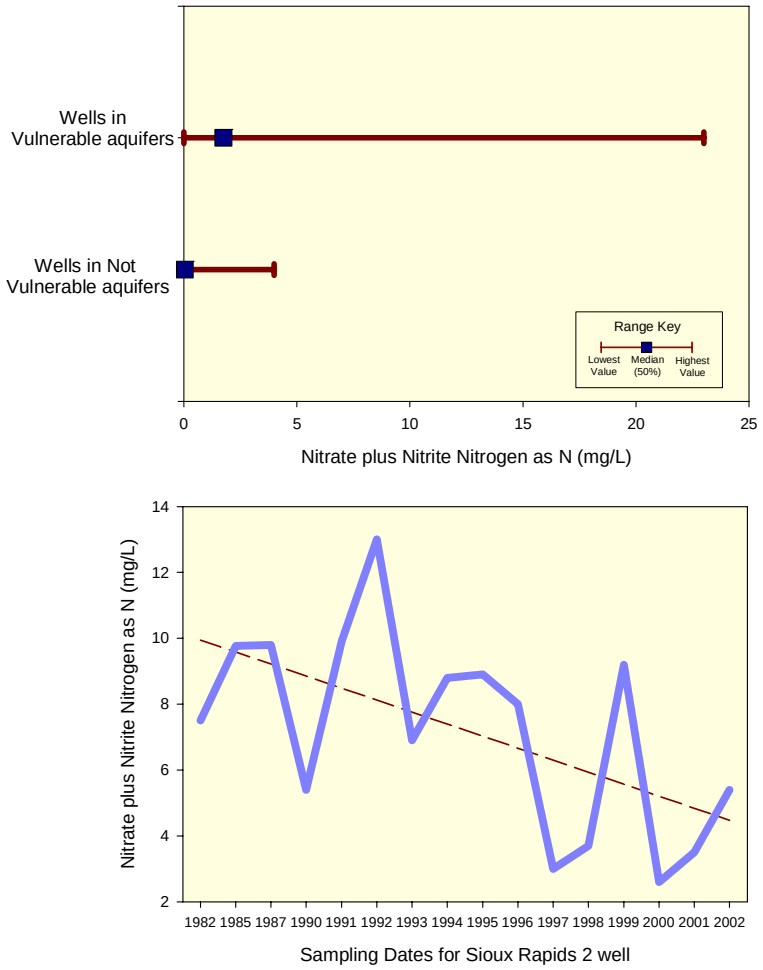


Figure 3. *(Upper) Median and range of nitrate plus nitrite nitrogen for wells classified as " vulnerable" and "not vulnerable," showing the median of nitrate is higher for the "vulnerable" wells. (Lower) Nitrate plus nitrite nitrogen data for Sioux Rapids 2 well over time including a trend line (dashed line).*

In 2001, Iowa's Ambient Water Monitoring Program recognized the importance of annual groundwater monitoring and began sampling all 90 wells annually for several parameters including common ions, nutrients, herbicides, insecticides, radionuclides and volatile organic compounds (Figure 2). Water quality data from these 90 wells can be used to examine the differences in water quality between vulnerable and not vulnerable aquifers or to observe trends in water quality over time (Figure 3).

Beginning in 2002, 60 additional wells from specific aquifers were rotated into the sampling routine. The rotating wells allow an in-depth investigation into the water quality of each primary aquifer in the state with each aquifer being investigated every five years. In 2002, the 60 rotating wells monitored were from the Mississippian and Cretaceous aquifers (32 Mississippian wells and 28 Cretaceous wells) and those for 2003 were from the Silurian-Devonian Aquifer (60 wells) (Figure 4). Rotating wells from alluvial aquifers are scheduled to be investigated in 2004.

Dedicated Groundwater Monitoring Network

A dedicated groundwater monitoring well network is being developed throughout the state to evaluate the ambient or background quality of aquifers in Iowa. The objective is to develop 60 well-nest sites, or about 180 monitoring wells. A well nest is two or more wells located in close proximity to each other where each well is completed to a different depth to tap specific aquifers used in the region. In most instances, this will include one or more bedrock sources, but will also include glacial drift and alluvial aquifers. Water is age dated from each well to indicate vulnerability. Annually, the water from each well is analyzed for mineral content and common parameters. For the first year after the wells are constructed, water levels are measured continuously to characterize each aquifer and

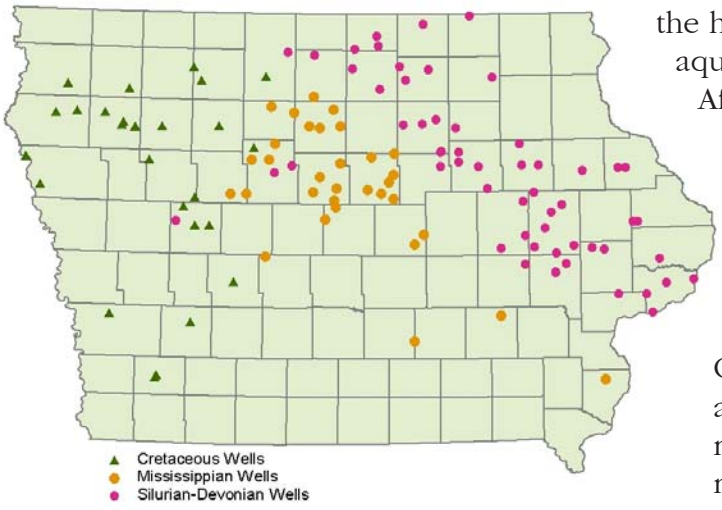


Figure 4. *Locations and aquifer designations of wells being rotated into the monitoring network each year. Mississippian and Cretaceous wells were sampled in 2002 and Silurian-Devonian wells were sampled in 2003.*

the hydraulic connection of that particular aquifer to aquifers located above and below it. After year one, water levels are measured less frequently.

Two well nests were completed in 2001 into the Mississippian Aquifer in north-central Iowa. These were located at Briggs Woods County Park in Hamilton County and Rutland Marsh county wildlife area in Humboldt County. In 2003, a well nest was completed into the Silurian-Devonian Aquifer at Westfield Elementary School in Linn County (Figure 2). Pump tests and geophysical tests assess the aquifer characteristics and a continuous rock core is obtained from each site as part of a stratigraphic reference collection. Development of these monitoring well nests provides important information for the overall management of groundwater in Iowa. This information enhances our understanding about the distribution and variability of rock units throughout the state, and their potential as future or expanded sources of groundwater for Iowans.

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Water Monitoring Program Web Site – wqm.igsb.uiowa.edu

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