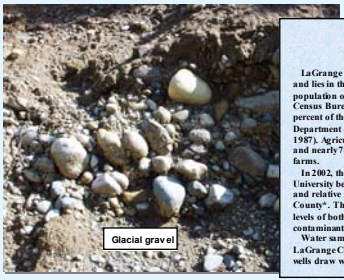
Evaluation of Ground Water in LaGrange County


Glacial gravel

Background

LaGrange County is located in northeastern Indiana and lies in the St. Joseph River Basin; the estimated population of the county in 2001 was 35,309 people (U.S. Census Bureau). Ground water is the source of 75 percent of the water withdrawn in the basin (Indiana Department of Natural Resources, Division of Water, 1987). Agriculture is the primary land use in the basin and nearly 78 percent of the acreage in the county is in farms.

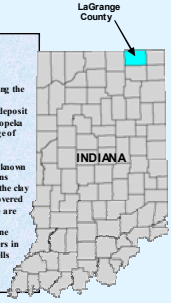
In 2002, the Indiana Geological Survey at Indiana University began a project to evaluate the chemistry and relative age of the ground water in LaGrange County*. The study was conducted to determine the levels of both naturally occurring and man-made contaminants in the ground water.

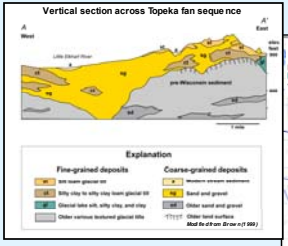
Water samples were collected from 50 wells in LaGrange County during the summer of 2002. These wells draw water from mixed deposits of gravel, sand, silt, and clay that were laid down by glaciers during the Ice Age.

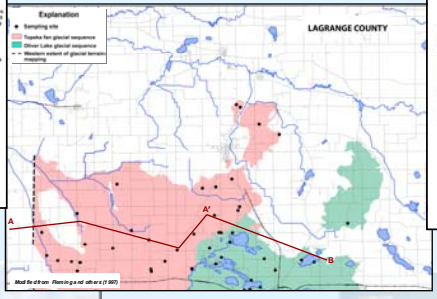
Some sampled wells draw water from a glacial deposit composed of sand and gravel and known as the Topeka fan. The Hawpatch Road follows the crest or ridge of this fan and the sand and gravel deposits slope northwestward toward Emma Lake and Topeka.

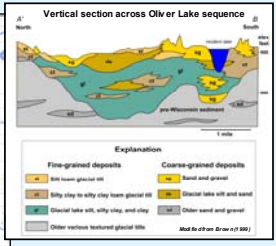
Other sampled wells draw water from deposits known as the Oliver Lake glacial sequence, which contains more clay and silt than the Topeka fan. Much of the clay and silt was deposited in glacial lakes that once covered parts of the landscape. Lakes such as Oliver Lake are much smaller remnants of these Ice Age lakes.

The intent of the sampling was to acquire baseline water-quality data for the ground water in aquifers in these two very different glacial sequences. The wells range in depth from 10 to 220 feet.

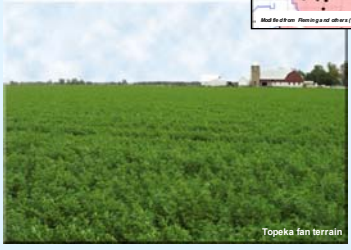








Glacial terrain map showing 2002 sampling sites


Topeka fan terrain

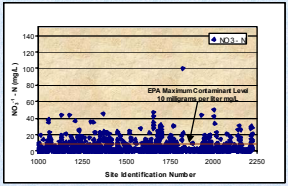

Modern-day Oliver Lake

Indiana University
Indiana Geological Survey

*This project is a cooperative study with the Indiana University Department of Geological Sciences and the LaGrange County Health Department and is co-funded by the Indiana Department of Environmental Management.

Evaluation of Ground Water in LaGrange County, *Continued*

Nitrate in Ground Water



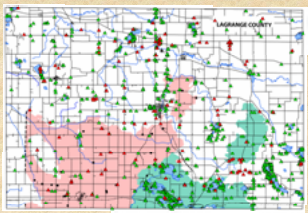
Nitrate data for water samples collected in LaGrange County from 1983 to 1998

Introduction — Nitrogen (N) is a biologically active element involved in chemical reactions that are important to life and that effect water quality. Decaying plant and animal materials release organic nitrogen, which combines with oxygen to form nitrate (NO_3^{-1}). Nitrate test results are expressed as either nitrate nitrogen (NO_3^{-1} - N) or as nitrate (NO_3^{-1}).

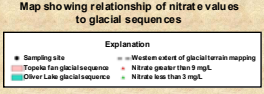
The nitrate data shown on the graph above and the map below are from a database compiled by the LaGrange County Health Department. This database contains information about nitrate concentrations found in ground-water samples from some of the many water wells in the county. To collect the data, the health department made water-sampling vials available to interested individuals, who then filled the vials with water from their wells. These water samples were analyzed for nitrates and the results were sent to the well owners and the health department.

Why is nitrate a concern? — The U.S. Environmental Protection Agency (EPA) has established a Maximum Contaminant Level of 10 milligrams per liter (mg/L) for nitrate nitrogen in drinking water. A condition known as methemoglobinemia in infants (blue baby syndrome) results when nitrate nitrogen concentrations in drinking water are above 10 mg/L. The nitrate interferes with the ability of infants' red blood cells to carry oxygen to the tissues.

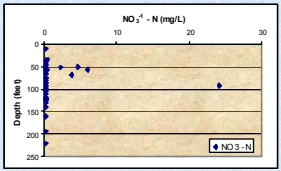
Spontaneous abortions (miscarriages) have been reported in women who obtained drinking water from nitrate-contaminated private wells. A report summarizing spontaneous abortions can be found on the Web site of the Centers for Disease Control and Prevention. Also, spontaneous abortions in livestock may occur when drinking water contains more than 10 mg/L nitrate nitrogen.



Map showing relationship of nitrate values to glacial sequences



Nitrate Concentrations — 2002 Data



Nitrate concentrations — The nitrate nitrogen concentrations in the ground water sampled and analyzed in 2002 were generally low; 42 of the samples had concentrations below the detection limit (<1 mg/L). Only one of the water samples had concentrations above the EPA Maximum Contaminant Level. Seven of the eight water samples containing measurable nitrate nitrogen were from wells in the Topeka fan glacial sequence. Nitrogen isotope values are used to identify the source of nitrates as either chemical fertilizer or of biological origin. Nitrogen isotope values determined for four sites ranged from 7.60 to 19.3 parts per thousand and indicate that the nitrate sources are largely animal or human waste.

Conclusions

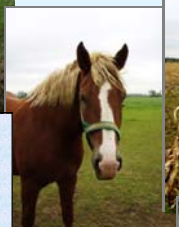
In regard to potential contamination, the nitrate data collected in 2002 suggest that the ground water in the Topeka fan area is more prone to man-made contamination. Tritium data suggest that 60 to 70 percent of the ground water in wells sampled in the Topeka fan and Oliver Lake areas in 2002 has been recharged since 1952. The coarse sand and gravel in this region facilitates the rapid flow of ground water. Placement of new water wells should consider the locations of other facilities on the property such as septic systems or farm animal storage areas.

2003 Water Sampling

During the summer of 2003, additional ground-water samples were collected from sites where high concentrations of nitrates in ground water have been reported in the past. These water samples are being analyzed for nitrogen isotopes to determine the sources of the nitrogen.

Nitrate Nitrogen Sources

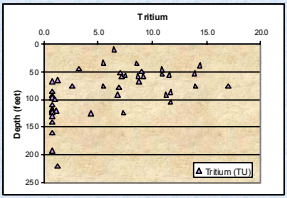
What are sources of nitrate nitrogen in drinking water? — Potential sources of nitrate nitrogen in the ground water are inorganic nitrogen-based fertilizer, animal waste, decomposing crop residues, septic systems, atmospheric deposition, and fixations of atmospheric nitrogen. The specific sources of nitrate nitrogen contamination can be identified by studying the proportions of nitrogen isotopes.



Many people think that septic failure happens only when the absorption field plugs. This type of failure is not common in LaGrange County. Here, most failures occur when septic systems are completed in coarse-grained deposits. Such failures can cause ground-water contamination.


Failed septic system

Tritium Concentrations — 2002 Data



Introduction — Tritium (^3H) is an unstable radioactive isotope of hydrogen with a half-life of 12.43 years. It is produced naturally in low concentrations by interaction of cosmic rays with nitrogen and oxygen in the atmosphere. The most significant source of tritium is from the atmospheric testing of nuclear weapons from 1952 to 1969. Tritium in the atmosphere is directly incorporated into the water molecule and is introduced to ground water through rainfall. Tritium is used to identify modern recharge to ground-water systems.

Tritium concentrations — In the water samples collected and analyzed in 2002, tritium concentrations ranged from below the detection limit (less than 0.8 TU) to 17.0 TU. Of the 50 samples, 35 had values above the detection limit. Tritium generally was not detected in waters from wells 100 feet or greater in depth. Water samples having higher concentrations of tritium are probably younger than 1952; waters having very low tritium concentrations predate 1952.

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