Water Quality

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USDA Cooperating

# Nitrate and Indiana's Ground Water

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***Maximum Acceptable Levels for Public Drinking Water Supplies***

Nitrate-Nitrogen ($NO_3$-N): 10 ppm (mg/l)

Nitrate ($NO_3$): 45 ppm (mg/l)

Safe and abundant drinking water is one of Indiana's most valuable resources. More than 60 percent of the state's drinking water comes from ground water (wells) and about one third of this total comes from private wells. Overall, Indiana residents benefit from good quality of ground water for their drinking

All public drinking water suppliers in Indiana regularly test for bacterial and chemical contaminants, and are subject to federal health standards under the Safe Drinking Water Act. Less than 2 percent of public water supplies have recently tested higher than the drinking water standard for nitrate, according to the Indiana Department of Environmental Management (IDEM). Indiana citizens who get their water from public wells can, in most cases, be confident of the quality of their drinking water. On the other hand, no government agency monitors private wells, therefore less is known about the quality of private water supplies. People with private water supplies are responsible for the care of their drinking water.

The EPA drinking water standard for nitrate is 10 ppm (parts per million) measured on the basis of the nitrogen content of nitrate. It is often written as "nitrate-nitrogen" or "$NO_3$-N." This MCL is equivalent to 45 mg/l when expressed as nitrate ($NO_3$). Unless otherwise stated, nitrate levels usually refer only to the amount of nitrogen present.

Studies by the United States Geological Survey (1995) and the Indiana Farm Bureau Inc. (1994) found nitrate concentrations greater than the drinking water standard in 3.5 - 4.5 percent of the state's private wells. Although a concern for those households, particularly if an infant or expectant mother is present, more than 95 percent of private wells had water considered safe for nitrate.

## *Health Concerns*

Nitrate is a health concern particularly for young infants. Nitrate can cause a condition called methemoglobinemia, or "blue baby syndrome." A relationship between high nitrate levels and other health concerns (such as miscarriages) has been suggested but has not been proven conclusively. Because of the risk to infants however, any home with a private well where an infant is present or expected should test the water for nitrates.

## *Nitrate in Ground Water*

Some nitrate in ground water occurs naturally. But levels of Nitrate-N above 3 ppm usually indicate contamination from a source such as septic systems, fertilizers (applied to lawns, golf courses, or agricultural areas), biosolids or animal wastes.

Contamination of ground water depends on at least three factors:

1. the vulnerability of the ground water to contamination
2. the well itself
3. the availability of excess nitrate leaching to ground water

### 1. Ground Water Vulnerability

Nitrate is very mobile and easily moves with water through the soil. The downward movement is called leaching. How fast water moves through a soil influences how much nitrate leaches into ground water. For example, water moves more quickly through sandy soils than heavy clay soils. Therefore leaching occurs more readily in sandy soils than clay soil types.

The vulnerability of the geologic area of the well plays an important factor in determining risk of contamination. The map in Figure 1 shows the variability in aquifer vulnerability across the state. Geological areas highly vulnerable to ground water contamination occur in north central and northwest Indiana. Soil there is often sandy or gravelly. Vulnerable areas also include the valleys of Indiana's major rivers. Sinkholes in karst areas that provide direct access to ground water also raise concern. Areas underlain by glacial till or solid bedrock, including much of central and southern Indiana, are generally less vulnerable.

### 2. Well Depth and Construction

Well depth also influences a drinking water supply's risk to contamination. Shallow wells are more likely to be contaminated than deep wells, because the natural filtering ability of soil provides more protection to deeper wells. In the Farm Bureau study of private wells, 12.2 percent of the wells less than 50 feet deep exceeded the drinking water standard, while only 0.9 percent of the wells more than 100 feet deep exceeded it.

Contamination of a particular well can also depend on the well construction. In some cases, the top portion of the well is not adequately sealed and contamination occurs around the top of the wellhead. Dug wells are at greatest risk to contamination because they are shallow and poorly protected from contaminants that may leach from the surface. The casing in older wells can deteriorate and allow contaminants to enter the drinking water supply.

### 3. Potential Sources of Nitrate Contamination

Potential sources of nitrate entering ground water include septic systems, fertilizers, and livestock manure. Often the contamination results from several sources.

Septic systems, especially if poorly constructed or maintained, are a potential source of nitrate and bacteria.

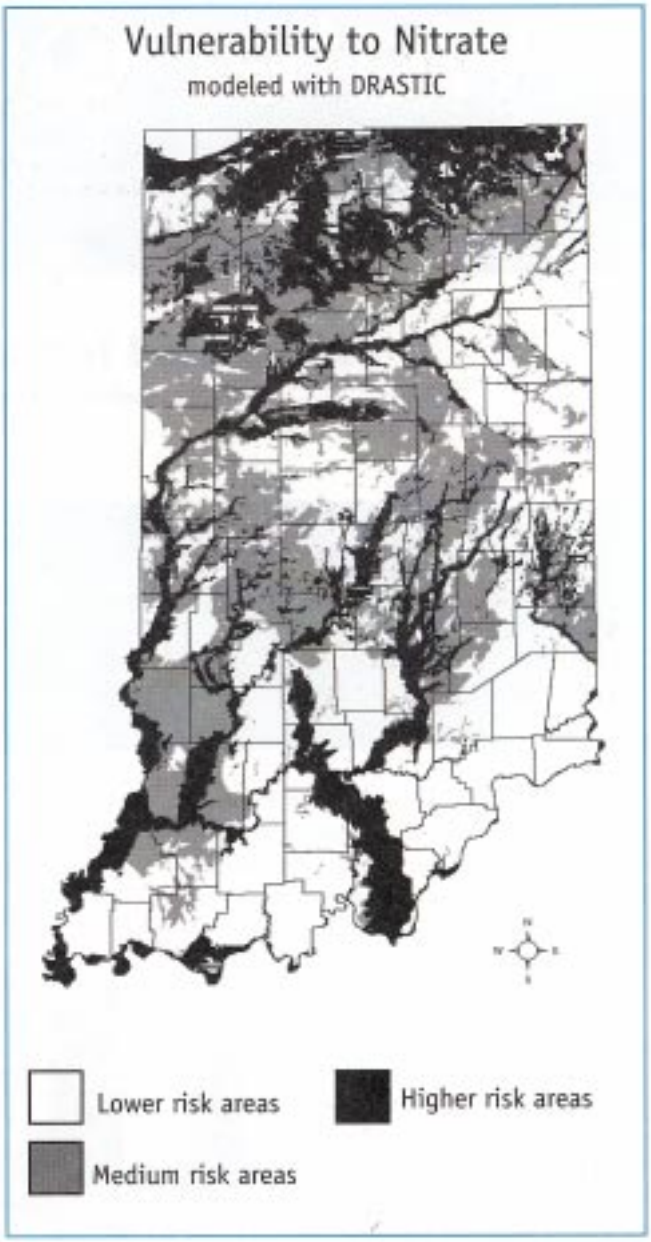


**Figure 1. Natural characteristics of an aquifer, such as depth from surface and permeability of the soil cover, determine the vulnerability of ground water to potential contamination. The map shows a statewide estimate of ground water vulnerability, developed using the EPA's DRASTIC model.**

A well located near any part of a septic system (tank, sewer lines or leach field) is at risk of contamination. Shallow wells, in sandy or gravelly soil, located downslope from the septic system, increase the risk of contamination. Indiana State Department of Health requires that septic tanks, dosing tanks, lift stations, and

soil absorption fields be at least 50 feet from private wells, 10 feet from water lines under pressure and 50 feet from water lines continually under suction.

Fertilizer and animal manure are also potential sources of contamination. Proper management practices, such as nitrogen application at recommended rates and times for crop utilization, reduce nitrogen leaching. IDEM requires all approved livestock facilities to locate manure storages at least 100 feet from wells and manure be applied further than 200 feet from a well.

### *Treatment*

Infants and other susceptible individuals should not consume drinking water with nitrate levels that exceed the 10 ppm standard. Bottled water or water from another safe source should be used. **Do not boil the water.** Boiling only concentrates the level of nitrate in water. Deionization, reverse osmosis, or distillation can effectively remove nitrate. However, these treatments are expensive and require careful maintenance. The bulletin WQ-6 "Buying Home Water Treatment Equipment" discusses water treatment systems and their maintenance. In some cases drilling a new well into a non-contaminated water supply may be the best, and in the long run, the least expensive remedy.

### *What We Can Do*

Ground water contamination by nitrate above the drinking water standard has rarely occured in Indiana. But our generally high water quality should not lead to complacency. Potential nitrogen sources such as septic systems, lawn and field fertilizers, and animal manure must be carefully managed to minimize nitrogen that leaches into the ground water. All well water should be tested at least once a year for nitrate.

### *For More Information:*

MWPS-14, Private Water Systems Handbook ($2.50) is available from the Agricultural and Biological Engineering Department, 765-494-1173.

The following publications are available from your Purdue Cooperative Extension office.

WQ-1 Water Testing Laboratories

WQ-2 What is Ground Water?

WQ-3 How to Take a Water Sample

WQ-4 Why Test Your Water?

WQ-5 Interpreting Water Test Reports

WQ-6 Buying Home Water Treatment Equipment

WQ-12 Distillation for Home Water Treatment

WQ-14 Reverse Osmosis for Home Treatment of Drinking Water

You may also access the National Water Quality Database for additional information at:

**http://hermes.ecn.purdue.edu: 8001/server/water/water.html**

### *References:*


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Wallrabenstein, L.K., R.P. Richards, D.B. Baker, and J.D. Barnett, 1994. Nitrate and Pesticides in Private Wells of Indiana. Indiana Farm Bureau Inc. and the Water Quality Laboratory, Heidelberg College.

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