

Nitrate in Drinking Water

What is nitrate?

Nitrate is a naturally occurring oxide of nitrogen and is an essential component of all living things. It is the primary source of nitrogen for plants, and it occurs naturally in soil and water. But if the levels of nitrate get too high, it can pose a potential health risk. Sources of excess nitrate in water include fertilizers, septic systems, wastewater treatment effluent, animal wastes, industrial wastes, and food processing wastes. By applying nitrogen fertilizers, burning fossil fuels, and replacing natural vegetation with nitrogen-fixing crops, humans have doubled the rate of nitrogen deposition onto land over the past 50 years.

Nitrate levels can be high in streams and rivers due to runoff of nitrogen fertilizer from agricultural fields and urban lawns. Groundwater is susceptible to contamination from many different chemicals, including nitrate fertilizers, especially where the water table is shallow and there are no confining units to reduce migration downward. Most of these contaminated groundwaters flow into streams and rivers, causing elevated nitrate levels in those water bodies downstream.

Water samples collected from both private and public wells in Oregon over the past twenty years show that nitrate levels in some wells may approach or exceed the historic level considered safe for drinking water. United States Geological Survey studies indicate that about 20% of the wells in agricultural areas of the United States exceed the maximum contaminant level (MCL) set by the United States Environmental Protection Agency (EPA). Oregon has designated three Groundwater Management Areas (GWMAs) because of elevated nitrate concentrations in groundwater. These include the Lower Umatilla Basin GWMA, the Northern Malheur County GWMA, and the Southern Willamette Valley GWMA. Each one has developed a voluntary action plan to reduce nitrate concentrations in groundwater.

High nitrate levels in surface water contribute to algae blooms and may result in elevated levels of disinfection by-products in treated drinking water. Disinfection byproducts have been linked to increased cancer and reproductive health risks in humans as well as liver, kidney and central nervous system problems.

How much nitrate is dangerous?

Nitrate levels of up to 3 parts-per-million (ppm) in well water may be naturally-occurring or possibly indicates some low level of contamination, but are considered to be safe for consumption. The EPA has set an MCL of 10 ppm for nitrate (NO₃-N) for drinking water. Nitrate levels above 10 ppm may present a serious health concern for infants and pregnant or nursing women. Adults receive more nitrate exposure from food than from water. Infants, however, receive the greatest exposure from drinking water because most of their food is in liquid form. This is especially true for bottle-fed infants whose formula is reconstituted with drinking water with high nitrate concentrations. Nitrate can interfere with the ability of the blood to carry oxygen to vital tissues of the body in infants of six months old or younger. The resulting illness is called methemoglobinemia, or "blue baby syndrome".

Pregnant women may be less able to tolerate nitrate, and nitrate in the milk of nursing mothers may affect infants directly. These persons should not consume water containing more than 10 ppm nitrate directly, added to food products, or beverages (especially in baby formula).

Little is known about the long-term effects of drinking water with elevated nitrate levels. Some research has suggested that nitrate may play a role in spontaneous miscarriages, thyroid disorders, birth defects, and in the development of some cancers in adults. Recent human epidemiologic studies have shown that nitrate ingestion may be linked to gastric or bladder cancer. The most likely mechanism for human cancer related to nitrate is the body's formation of N-nitroso compounds (NOC), which have been shown to cause tumors at multiple organ sites in every animal species tested, including neurological system cancers following transplacental exposure. Nitrite, the reduced form of nitrate, reacts in the acidic stomach to form nitrosating agents that then react with certain compounds from protein or other sources such as medications to form NOCs. In humans, it is the nitrosamines and NOCs that are suspected brain and central nervous system carcinogens. Additional epidemiologic and research studies are needed to verify these links and identify any other potential nitrate-related cancer risks. Links to supporting information are provided at the end of this document.



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One associated human health concern is that water supplies showing nitrate contamination have the potential for other contaminants, such as bacteria and pesticides, to reach groundwater along with the nitrate. In a 2009 report on the quality of water in domestic wells, the U.S. Geological Survey found that contaminants such as nitrate (nutrients) co-occurred with other contaminants in 73 percent of wells tested in the study.

What should I do?

- If your well is contaminated by high levels of nitrate (10 ppm or above), infants, pregnant/ nursing women, and other sensitive individuals should stop drinking well water. If you are using infant formula, make sure that it is prepared with bottled water, or use pre-mixed formula.
- Boiling water does not help because it actually concentrates the nitrate. Charcoal filters, water softeners, or use of chlorine do nothing to remove nitrate from water.
- If you choose to treat your water to remove nitrate, use systems with reverse osmosis, distillation, or ion exchange. Remember that these treatment systems require careful maintenance for effective operation.
- If a treatment system is to be used, one with National Sanitation Foundation (NSF) certification should be selected. For additional information on these options, contact the Drinking Water Section of the Oregon Health Authority at (971) 673-0405.
- Monitor your nitrate levels at least once per year (in the spring or summer) and keep records. To protect the health of your family, annual water tests should also be made for bacteria. For more information on laboratories in Oregon that can test your water, contact the Drinking Water Section of the Oregon Health Authority at (971) 673-0405.
- Water containing high nitrate levels can be safely used for bathing, cleaning dishes, washing laundry, or other uses where water is not ingested.
- Identify any potential sources of nitrate on your property and find ways to manage those sources.

Levels of nitrate in your well above 3 ppm indicate that shallow groundwater drawn by your well may be vulnerable to other types of contaminants moving through the soil, including pesticides. Examine your property and the surrounding area for sources of other contaminants. Consider testing for these chemicals if you think your water may be at risk.

Where do I look for more information?

For more information on nitrate and groundwater protection, consult these websites or contact the resources listed on the right side of page 1.

For general information on groundwater:

<http://www.deq.state.or.us/wq/groundwater/grounderwater.htm>

For information on private wells and well water treatment:

<http://wellwater.oregonstate.edu/>

http://www.epa.gov/safewater/privatewells/pdfs/household_wells.pdf

<http://www.deq.state.or.us/wq/dwp/wellowners.htm>

<http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SourceWater/DomesticWellSafety/Pages/index.aspx>

For information on septic systems and groundwater contamination:

http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_septic.pdf

For information on drinking water and maximum contaminant levels:

<http://www.epa.gov/safewater/contaminants/index.html>

For information on Oregon's Groundwater Management Areas:

<http://www.deq.state.or.us/wq/groundwater/gwmas.htm>

<http://gwma.oregonstate.edu/>

For information on state and federal efforts to evaluate nutrient pollution:

<http://www.epa.gov/waterscience/criteria/nutrient/nitreport.pdf>

For information on the most recent cancer-related research:

http://deainfo.nci.nih.gov/advisory/pcp/annualreports/pcp08-09rpt/PCP_Report_08-09_508.pdf

For information on national USGS research on nutrients:

<http://water.usgs.gov/nawqa/nutrients/>

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