

Nitrates & Nitrites in Groundwater

Nitrates and nitrites are nitrogen-containing compounds that are commonly found in groundwater. Common sources of nitrates and nitrites in groundwater include agricultural activities, septic systems, animal and human fecal waste, and industrial processes (Ward et al., 2018).

Nitrates occur naturally in groundwater, but concentrations over 3 mg/L generally indicate contamination (Madison & Brunett, 1985). A more recent study found that concentrations over 1 mg/L are a result of anthropogenic pollution (Dubrovsky et al., 2010). Microorganisms that inhabit the soil, water, and sewage cause the change from nitrate to nitrite.

Nitrates and nitrites can leach into groundwater from:

- Agricultural fields where fertilizer and manure are used
- Septic systems through leaching or runoff.
- Animal waste, such as manure from feedlots or livestock operations
- Human waste from sewage systems
- Industrial processes, such as the production of nitric acid or the manufacture of explosives.

It is important to regularly test well water for nitrates and nitrites and to take steps to treat your water if elevated levels are found.



Health Impacts

According to Ward et al. (2018), exposure to high levels of nitrates and nitrites in drinking water can have serious public health impacts, including:

- **Infant methemoglobinemia (blue baby syndrome):** Nitrates can convert to nitrites in the body, which can interfere with the blood's ability to carry oxygen, causing this syndrome. Infants younger than 6 months are at most risk of developing serious health problems. Lack of oxygen can cause the infant to turn a bluish color. If untreated, infants can die from this condition.
- **Cancer:** Long-term exposure to nitrates and nitrites has been linked to an increased risk of certain types of cancer, such as gastric and bladder cancer.
- **Reproductive problems:** Exposure to nitrates and nitrites has been associated with decreased fertility and birth defects.
- **Endocrine disruption:** Nitrates and nitrites can interfere with the function of hormones, leading to various health problems.
- **Allergic reactions:** Some people can be sensitive to nitrates and nitrites and experience allergic reactions when they are exposed to these compounds.

Acute exposure to nitrates through consuming elevated levels of nitrite in drinking water can compromise the process of cellular respiration, impacting overall well-being.

If you are concerned about nitrates or nitrites in your drinking water, speak with a qualified water treatment professional or public health specialist.

If you have concerns about health problems that could be related to nitrates or nitrites in your well water, discuss them with your doctor.

Treating Nitrates and Nitrites in Groundwater

There are several methods that can be used to treat nitrates and nitrites in groundwater:

- **Ion exchange:** Removes nitrates and nitrites from the water by exchanging them with ions of another substance, typically sodium, through an ion exchange resin.
- **Reverse osmosis:** This is a physical filtration process that removes nitrates and nitrites by forcing the water through a semipermeable membrane.
- **Electrodialysis:** Uses an electric field to separate nitrates and nitrites from the water and is typically used in conjunction with reverse osmosis.
- **Chemical precipitation:** In this process, chemicals are added to the water to cause the nitrates and nitrites to precipitate out and be removed.
- **Denitrification:** This process uses bacteria to convert nitrates and nitrites into nitrogen gas, which is harmless and released into the atmosphere. This process can be achieved through various methods such as bioreactors, constructed wetlands, or deep-bed filters.

It is important to note that the most effective method of treatment will depend on the specific groundwater conditions, including the concentration of nitrates and nitrites, the presence of other contaminants, and the desired outcome. It is best to consult with a water treatment specialist to determine the best course of action.

Recommended Resources

- ToxFAQs for Nitrate and Nitrite | Agency for Toxic Substances and Disease Registry
- Nitrate in Drinking Water | Minnesota Department of Health
- Nitrate in Wells | Penn State University Extension

References

- Dubrovsky, N. M., Burow, K. R., Clark, G. M., Gronberg, J. M., Hamilton, P. A., Hitt, K. J., Mueller, D.K., Munn, M.D., Nolan, B.T., Puckett, L.J., Rupert, M.G., Short, T.M., Spahr, N.E., Sprague, L.A., &

Tips to Maintain a Healthy Well

- **Know** your private well and take pictures of the following to reference later if there is damage:
 - Storage or pressure tanks
 - Pump
 - Treatment system, including filters
 - Electrical components
- **Know** your well depth and pump setting if using a submersible pump.
- **Test** your water annually for coliform and nitrate, and every 3–5 years for a complete analysis to determine if there have been any changes to the water quality.
- **Check** your private well periodically for any damage or maintenance problems. Always hire a qualified professional well contractor to service your well.
- **Keep** the contact information for a licensed well contractor, local health department, university extension service, licensed electrician, and water testing laboratory handy.

Wilber, W. G. (2010). *The quality of our nation's waters—Nutrients in the nation's streams and groundwater, 1992–2004*. [Circular, 1350]. U.S. Geological Survey. <https://doi.org/10.3133/cir1350>

- Madison, R. J., & Brunett, J. O. (1985). Overview of the occurrence of nitrate in groundwater of the United States. US Geological Survey water supply paper, 2275, 93-105.
- Ward, M. H., Jones, R. R., Brender, J. D., De Kok, T. M., Weyer, P. J., Nolan, B. T., Villanueva, C.M., & Van Breda, S. G. (2018). Drinking water nitrate and human health: An updated review. *International Journal of Environmental Research and Public Health*, 15(7), Article 1557. <https://doi.org/10.3390/ijerph15071557>