



Nitrates in Groundwater

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Nitrates are naturally occurring compounds generated from human and animal waste, as well as high-nitrogen fertilizers. In areas where nitrogen runoff is high, nitrates can accumulate in groundwater, leading to an increased risk of adverse health effects to those that rely upon the groundwater as a drinking source. Wisconsin law establishes standards for the concentration of nitrates in groundwater and provides for a range of responses if concentrations exceed the standards. Additionally, the state administers compensation programs for eligible parties impacted by nitrate contamination.

SOURCES AND PREVALENCE OF NITRATES

Nitrate concentrations in water supplies are the result of the accumulation of nitrates in the environment, as well as the structure of the environment itself. Nitrates themselves are typically not directly applied to the landscape. Rather, nitrates form when nitrogen-rich substances, such as ammonia, interact with oxygen in the environment. Agricultural activities, such as the handling of manure or the application of ammonia-based fertilizers, commonly affect nitrate levels. Contamination also depends on environmental factors that define the groundwater reservoir, such as type of bedrock, depth to bedrock, depth to water table, soil characteristics, and characteristics of surface-level deposits. Areas high in sand and gravel, such as central Wisconsin, are generally more susceptible to groundwater contamination.¹

Nitrates are the most common groundwater contaminant in Wisconsin, identified in 70 percent of private well tests.² Nitrate levels have increased in 74 out of 607 municipal systems statewide, and 10 percent of private wells exceed the maximum concentration enforcement standard. In agricultural areas, such as central Wisconsin, approximately 20 to 30 percent of private wells exceed this standard. According to the Department of Natural Resources (DNR), groundwater nitrate levels will continue to rise throughout the state, particularly in areas vulnerable to nitrate contamination.

HEALTH EFFECTS OF NITRATE

Water containing high nitrate concentrations can lead to various health concerns, regardless of age or prior health. Infants under six months are particularly susceptible to nitrate poisoning, and can develop a condition called methemoglobinemia, or “blue-baby syndrome.”³ This condition is caused by nitrates interfering with oxygen absorption of the blood, causing anemia-like symptoms and in some cases death.⁴ Additional studies have linked nitrate ingestion in pregnant mothers to adverse birth outcomes, and have also found that prolonged consumption of nitrates can lead to increased risk of cancer.⁵

REGULATION OF GROUNDWATER NITRATE CONTAMINATION

The concentration of nitrates in public drinking water systems is regulated under federal standards developed by the Environmental Protection Agency (EPA), pursuant to the Safe Drinking Water Act (SDWA). As such, state concerns regarding nitrates in drinking water often center on private wells. Wisconsin’s groundwater protection law provides for the adoption of enforcement standards and preventive action limits for various groundwater contaminants. Groundwater enforcement standards are developed by the Department of Health Services and the DNR, often using drinking water standards developed by the EPA. In turn, preventive action limits are based upon a percentage of an established enforcement standard and are generally used to inform the DNR of potential contamination issues.

An exceedance of a groundwater enforcement standard or a preventive action limit for nitrates can result in a range of DNR responses, depending upon the severity and location of contamination. Responses may include requiring alternative methods of waste management, prohibiting actions that negatively

affect nitrate levels, and closing or abandoning a facility or practice. State law does not require the DNR to prohibit an action or close a facility if an enforcement standard is exceeded, in whole or in part, due to naturally high nitrate levels, and if the addition of nitrates does not represent a public welfare concern.⁶ If background nitrate levels are above the enforcement standard, DNR may grant a response exemption if a facility, practice, or activity is designed and implemented to achieve the lowest possible nitrate contamination that is technically and economically feasible and the increase in concentration does not present a threat to public health or welfare.⁷

ASSISTANCE FOR NITRATE CONTAMINATION

State law directs DNR to administer a well compensation grant program, under which the department provides funding to eligible individuals to address contaminated wells.⁸ Eligibility requirements are based on a variety of criteria, including the use of a well by people or livestock, the extent of a well's use, the level of contamination in a well, and a grant applicant's income. Grants awarded through the well compensation program can be used to cover costs associated with additional testing for contamination, remediation, or construction of another private well.⁹ Grants may cover up to 75 percent of eligible costs, with a maximum payment of \$12,000.¹⁰

Beginning in August 2022, an individual may also request financial aid through the American Rescue Plan Act (ARPA) Well Compensation and Well Abandonment Grant Programs. The new programs provide \$10 million in financial assistance to address private well water contamination and will continue to accept applications until funding is exhausted. The programs also expand the eligibility criteria beyond those for the Well Compensation Grant Program under state law, with changes including:

- Reducing the level of nitrate contamination required for grant eligibility to 10 mg/L (the current groundwater enforcement standard).
- Removing the requirement that a well be used for livestock in order to receive a grant relating to nitrate contamination.
- Increasing the income eligibility threshold from \$65,000 to \$100,000.
- Providing that non-community public water systems are also eligible for funding.

For the programs described, applicants must provide results of two water samples, taken at least two weeks apart, that confirm nitrate levels above the state's enforcement standard. Sample analysis must be performed within the last two years of the application date and must be conducted by a certified laboratory.¹¹

¹ Wisconsin Groundwater Coordinating Council Report to the Legislature, Wisconsin Department of Natural Resources (2022), <https://dnr.wisconsin.gov/sites/default/files/topic/Groundwater/GCCGWQuality/Nitrate.pdf>.

² Groundwater Quality, Wisconsin Department of Natural Resources, <https://dnr.wisconsin.gov/topic/Groundwater/GCC/groundwaterQuality.html>.

³ Cattle that drink nitrate-rich water may similarly develop methemoglobinemia and are also at risk of death if nitrate concentrations become too high.

⁴ Kross, B C et al. "Methemoglobinemia: nitrate toxicity in rural America." *American family physician* vol. 46(1) (1992): 183-8. <https://pubmed.ncbi.nlm.nih.gov/1621630/>.

⁵ Lisa A. Croen, Karen Todoroff, Gary M. Shaw, "Maternal Exposure to Nitrate from Drinking Water and Diet and Risk for Neural Tube Defects," *American Journal of Epidemiology* vol 153(4), (2001): 325-331, <https://doi.org/10.1093/aje/153.4.325>;

Brender, Jean D et al. "Prenatal nitrate intake from drinking water and selected birth defects in offspring of participants in the national birth defects prevention study." *Environmental health perspectives* vol. 121(9) (2013): 1083-9. doi:10.1289/ehp.1206249; Blaisdel, Julie et al. "Prenatal exposure to nitrate in drinking water and the risk of congenital anomalies." *Environmental research* vol. 176 (2019): 108553. doi:10.1016/j.envres.2019.108553.

⁶ s. NR 140.26, Wis. Adm. Code.

⁷ s. NR 140.28, Wis. Adm. Code.

⁸ s. 281.75, Stats.

⁹ s. 281.75 (6) (a) and (12), Stats.

¹⁰ s. NR 123.24 (1) (b), Wis. Adm. Code. 2017 Wisconsin Act 69 raised the maximum eligible costs from \$12,000 to \$16,000.

¹¹ s. NR 149.19, Wis. Adm. Code.