



UNIVERSITY OF WISCONSIN WATER RESOURCES INSTITUTE

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Nitrate in Groundwater

NITRATE IS A COMPOUND that is the most common groundwater contaminant in Wisconsin; in 2007, an estimated 11 percent of the state's wells exceeded the safe drinking water standard of 10 parts per million (10 ppm). Several municipal water systems in the state also exceeded this standard and required treatment. High levels of nitrate can affect the ability of blood to carry oxygen, potentially leading to serious health problems, especially for infants and young children. In addition, nitrate consumption has been linked to increased risks of certain cancers.

Nitrate Problem Areas

An estimated 200 million pounds of nitrate-nitrogen enters Wisconsin's groundwater each year—up to 90 percent from agricultural applications. Other sources include on-site sewage systems and lawn fertilizer. Nitrate contamination is a statewide problem, affecting groundwater and private wells in every county. Forty-seven municipalities with a combined

population totaling more than 290,000 people have had to take corrective actions—such as blending water, constructing new wells, reconstructing existing wells or installing water-treatment technology—to address nitrate contamination in their public water systems. These communities are spread among 21 counties in Wisconsin.

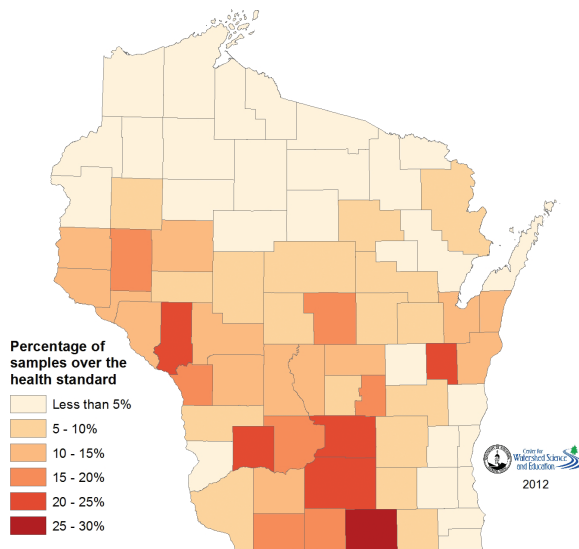
Costs and Risks of Nitrate Contamination

In 2012, the Wisconsin Department of Natural Resources (DNR) determined that municipalities affected by nitrate contamination of their public drinking water systems spent a combined total of more than \$32.5 million in capital costs to address the contamination (up from \$24 million in 2004), while incurring more than \$100,000 in annual maintenance costs. In addition, private well owners in nitrate-contaminated areas also incur costs for regular well testing and on-site treatment, or for

WELLS THAT EXCEED NITRATE STANDARDS

Nitrate contamination of groundwater is a statewide problem with an estimated 11 percent of wells exceeding the safe drinking water standard of 10 parts per million. The darker-colored counties have a greater percentage of wells exceeding the nitrate safe drinking water standard.

Percentage of Samples over the Health Standard of 10 ppm for Nitrate-Nitrogen by County



*Results based on 111,572 samples submitted from private wells through 2012. More detailed information can be found by accessing the online WI Well Water Viewer.



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WHAT MORE NEEDS TO BE DONE

- Help farmers improve the efficient use of nitrogen fertilizer to minimize nitrate losses from the root zone to groundwater.
- Educate municipalities on the importance of reducing nitrogen inputs within the wellhead protection areas of their wells.
- Investigate opportunities and research methods to use animal wastes in more effective ways, to account for nitrogen inputs from these wastes, and to reduce applications of inorganic nitrogen fertilizers.
- Develop markets for less nitrogen-intensive crops.

the purchase of bottled drinking water or construction of new wells to draw water from uncontaminated aquifers. Capital costs for on-site treatment of private well water, not including maintenance and operation costs, range from \$300 to \$1,200; replacing a well can cost homeowners up to \$15,000.

Studies supported by agencies of Wisconsin's Groundwater Coordinating Council (GCC) have shown that nitrate contamination of Wisconsin's groundwater continues to worsen. Accordingly, these treatment costs can be expected to continue growing as more public and private wells are affected by nitrate contamination.

Treatment is necessary to address the serious public health risks for individuals exposed to nitrate-contaminated water that fails to meet federal drinking water standards. Ingestion of nitrate can reduce the blood's ability to carry oxygen, which in infants under six months can lead to methemoglobinemia, or "blue baby syndrome," a potentially fatal condition. Concerns have also been raised about the effect of nitrate on thyroid function, diabetes and cancer. Moreover, health effects are not limited to humans, as nitrate-contaminated water can also be a concern for livestock. Groundwater that is rich in nitrate also feeds streams as baseflow and may affect aquatic organisms such as developing trout.



How the GCC is Responding

Given this significant threat, the agencies forming the GCC have funded research and monitoring on the origins and extent of nitrate contamination to meet state agency needs including protecting public health. Some of the most significant GCC-supported projects include:

- A 1992 DNR-funded study in the Central Sands region which found that, in addition to fertilizers, septic systems contribute to nitrate contamination in groundwater, leading the DNR to advise regular water quality sampling in wells near septic fields.
- A 2004 UW–Stevens Point study which found that increasing use of nitrogen fertilizer over the last half century suggests nitrate pollutant loads in groundwater will continue to increase in the future.
- A 2004–05 DNR-funded project which determined that concentrations of nitrates in the surface waters in a watershed in southwest Wisconsin will likely increase before finally stabilizing because of the time it takes groundwater to penetrate the aquifer and reach discharge locations.
- A 2008 UW–Oshkosh study which showed that elevated nitrate concentrations slowed the growth of sediment-dwelling organisms that are important components of food webs in stream ecosystems.

- A 2008–10 UW–Madison study which revealed that one Wisconsin family in nine (11 percent) obtains their drinking water from a private well that has not been tested for bacteriological or nitrate contamination. Nearly 150,000 children are at risk in this population, which shows the importance of renewed outreach efforts about fee-exempt testing available to rural communities.

What is the GCC ?

Established in 1984, Wisconsin's GCC is a multi-agency institution that has served as a model for other states. It is charged with advising and assisting state agencies on groundwater research and monitoring efforts.

The GCC consists of representatives from the departments of Agriculture, Trade and Consumer Protection; Safety & Professional Services; Health Services; Natural Resources; and Transportation, as well as the University of Wisconsin System, Wisconsin Geological and Natural History Survey, and the Office of the Governor.

Over the past two decades, the GCC has coordinated the use of approximately \$15.5 million in state funds, leveraged with additional local and federal monies, to support more than 375 groundwater research and monitoring projects.

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For More Information

Visit the University of Wisconsin Water Resources website, wri.wisc.edu or the Groundwater Coordinating Council website, <http://1.usa.gov/OXpqbk>.

For more information about nitrate, visit <http://1.usa.gov/OXp0SE>.

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