PER- AND POLYFLUORINATED ALKYL SUBSTANCES

Key Takeaways

PFAS chemicals have been found to be widespread in the environment. They have been detected in Wisconsin groundwater, in some areas at very high levels. Given the severity of PFAS there is a real need to determine the extent of PFAS contamination of Wisconsin's groundwater, and to assure that in areas of concern individual residents and public utilities test water supplies to ensure they are safe.

GCC member agencies are working on multiple initiatives related to reducing PFAS levels in groundwater (see groundwater management sections – DHS, DNR, UW)

For actions to address PFAS contamination in groundwater, see the Recommendations Section of the report.

Sections in this document

What are PFAS?

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a large group of human-made chemicals that have been used in industry and consumer products worldwide since the 1940s. Their ability to repel water and oil and withstand high temperatures has made these chemical compounds a particularly useful ingredient in industrial and commercial products, including non-stick products, stain- and water-repellent clothing, and aqueous film forming foams (AFFFs). These chemicals do not easily break down in the environment and have been known to accumulate in the environment and humans.

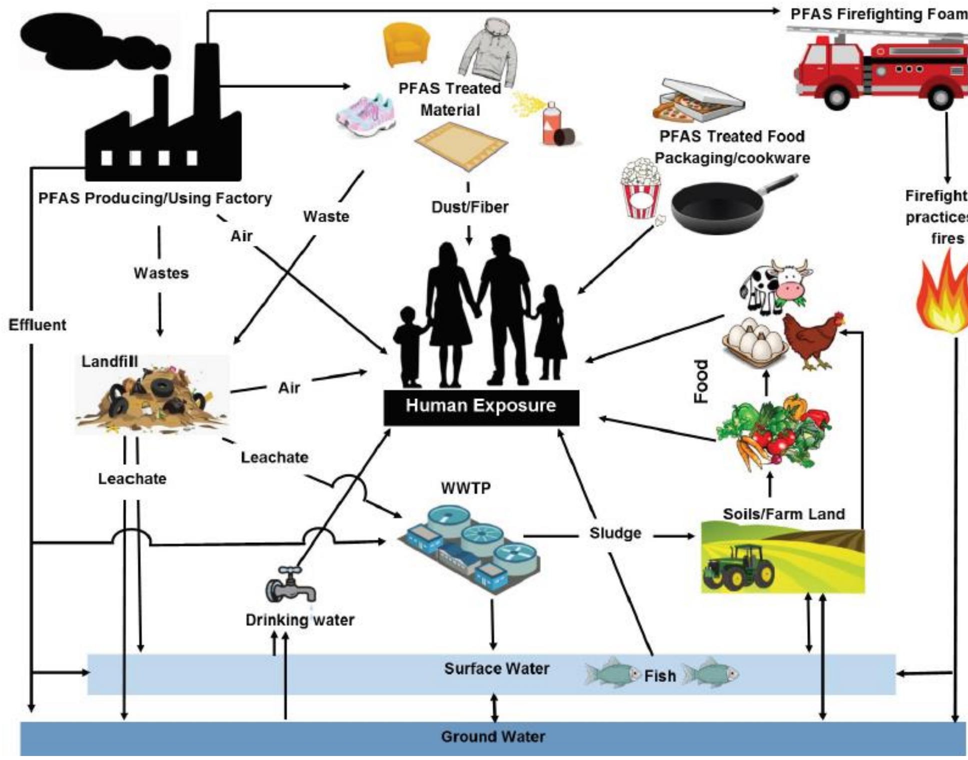
How might I come in contact with PFAS?

One of the main ways people come into contact with PFAS is by drinking contaminated water. Read What are PFAS to learn more.

What are the sources of PFAS and how can I be exposed?

Sources of PFAS and modes of human exposure.

Image credit: Maine Drinking Water Program, Service Connection newsletter, Volume 25, Issue 4[1]



What are the human health concerns?

Although PFAS have been used extensively since the mid-20th century, in recent years the scientific health research community has made progress to better understand their potential impacts to human health. This understanding continues to evolve based on ongoing research. Perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) are the two most-studied individual PFAS chemicals. Current studies of these PFAS suggest exposure may:

- affect childhood development,
- decrease female fertility,
- increase the risk of high blood pressure in pregnant women,
- increase cholesterol levels,
- increase the risk of thyroid disease,
- and decrease antibody response to vaccines.
- EPA research suggests that some PFAS may have the potential to cause cancer, but the topic requires further research.

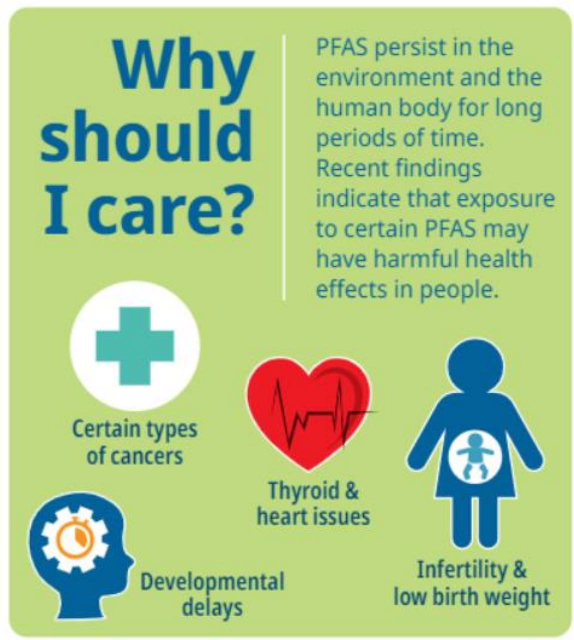
On April 10, 2024, EPA announced the final National Primary Drinking Water Regulation (NPDWR) rules for six PFAS chemicals: PFOA, PFOS, perfluorohexane sulfonic acid (PFHxS), perfluorononanoic acid (PFNA), hexafluoropropylene oxide dimer acid (HFPO-DA, commonly known as GenX Chemicals) and perfluorobutane sulfonic acid (PFBS). Under the NPDWR, public water supply system maximum contaminant levels (MCLs) were established for the six PFAS in drinking water.

Individual MCLs were established for five PFAS: PFOA, PFOS, PFHxS, PFNA and HFPO-DA, and a Hazard Index MCL was established for any PFAS mixture containing at least two or more of: PFHxS, PFNA, HFPO-DA and PFBS. This Hazard Index MCL accounts for the health risk associated with the combined and co-occurring levels of these PFAS in a drinking water supply. (A Hazard Index (HI) is a long-established approach that EPA regularly uses to understand the health risk associated with a chemical mixture. The PFAS HI is a calculated sum of fractions, each fraction being determined by dividing the concentration of a relevant PFAS, measured in a water supply sample, by a health-based water concentration established for that specific PFAS compound).

The established federal public water system MCLs for PFOA and PFOS are 4.0 parts per trillion (ppt). The established MCLs for PFHxS, PFNA and HFPO-DA are 10 ppt. The calculated HI MCL for any PFAS mixture containing at least two or more of: PFHxS, PFNA, HFPO-DA and PFBS, is 1 (unitless).

Should you be concerned about PFAS?

There is a growing public health concern over PFAS which do not occur naturally and are widespread in the environment. They are found in people, wildlife and fish all over the world. Because PFAS do not break down easily in the environment, and some PFAS can stay in the body for a long time, they are referred to as "forever chemicals." Read the DNR PFAS brochure to learn more.



The federal PFAS NPDWR rule also requires that public drinking water systems monitor for these PFAS, with the system having three years to complete initial monitoring (by 2027), and then, as required conduct ongoing compliance monitoring. Water systems are also required to provide the public with information on the levels of the six regulated PFAS in their drinking water beginning in 2027.

Public water systems have five years (by 2029) to implement solutions that reduce regulated PFAS if monitoring shows that system drinking water concentrations exceed MCLs. Beginning in five years (2029), public water systems that have PFAS in their drinking water which violates one or more of the new NPDWR PFAS MCLs must take action to reduce levels of these PFAS, and must provide notification to the public of the MCL violation.

In 2020, for the "Cycle 11" ch. NR 140 rulemaking effort, the WI Department of Health Services (DHS) recommended state public health groundwater quality enforcement standards for 18 PFAS compounds. These recommended standards serve as state drinking water health advisory levels (HALs). DHS has also recommended a hazard index (HI) cumulative risk assessment approach drinking water HAL for PFAS. The DHS PFAS HI takes into consideration all PFAS that have a recommended groundwater enforcement standard. The DHS PFAS HI is the summation of individual PFAS hazard quotients (HQs). The HQ is the ratio of the drinking water sample concentration (exposure dose) for: DONA, PFBS, PFHxS, PFNA, PFDA, PFTeA, PFUnA, PFDoA, PFODA, HFPO-DA , PFBA or PFHxA, or the combined concentration of NEtFOSE, NEtFOSAA, NEtFOSA, FOSA, PFOA, and PFOS, divided by their respective recommended public health enforcement standard. If the PFAS HI exceeds 1.0, DHS recommends that the water not be consumed.

Following EPA's April 2024 announcement of final NPDWR MCLs for the six PFAS chemicals (PFOA, PFOS, PFHxS, PFNA, HFPO-DA and PFBS) the DNR formally requested that DHS review the technical information considered when the federal numbers were established and recommend state groundwater quality enforcement standards for those six PFAS compounds.

Based on DNR's request, DHS will conduct a review of the federal MCLs and develop recommendations for groundwater quality enforcement standards for these six PFAS compounds based on statutory requirements. Once the DHS recommendations are received, the DNR plans to begin rulemaking to establish state groundwater quality enforcement standards and preventive action limits for these substances in ch. NR 140, Wis. Adm. Code.

The DNR, under Chapter 292, Wisconsin Statutes, has authority to require parties that release PFAS to the air, land, and waters of the State to take action to restore the environment to a practicable level. If no numerical clean-up standards are in place, such as currently for PFAS in groundwater, the responsible party works with the DNR to develop a site-specific plan to clean up the contamination following the requirements outlined in NR 722.09, Wis. Adm. Code.

DNR's Water Quality Program has authority, under Chapter 283, Wisconsin Statutes, to regulate the "discharge of pollutants" to the waters of the state from any point source. New DNR administrative rules went into effect in 2022 to establish PFOS and PFOA surface water quality criteria and to gradually phase in PFAS monitoring requirements for wastewater discharges to surface water. In cases where discharges have reasonable potential to cause or contribute to an exceedance of surface water standards for PFOS or PFOA, these new regulations require municipal wastewater treatment facilities to develop plans to reduce PFOS or PFOA at the source (i.e., pretreatment industries or inflow/infiltration of contaminated groundwater into sanitary sewers).

While the DNR awaits finalization of EPA's risk assessment for PFOS and PFOA in municipal wastewater sludge (biosolids), the agency has developed an Interim Strategy for permittees to use when considering disposal of PFOS or PFOA impacted municipal or industrial sludge. The DNR Interim Strategy for Land Application of Biosolids and Industrial Sludges Containing PFAS is an advisory document intended to assist municipal and industrial wastewater treatment facilities in decision-making on how to manage the land application or other disposal of municipal biosolids and industrial sludges that are significantly impacted by PFAS. The Strategy includes biosolids/sludge PFAS sampling, PFAS source identification and reduction efforts, and restrictions on biosolids/sludge land application and land application rates based on the concentrations of PFAS measured in the material to be land applied.

How widespread are PFAS in Wisconsin?

The DNR has conducted some sampling initiatives for PFAS in drinking water and ambient groundwater. These efforts included voluntary municipal drinking water sampling, open to all municipal systems, and a groundwater research study sampling private wells. Both projects were based on voluntary participation.

PFAS in public water systems

In 2022 the DNR established state public water system MCLs, in ch. NR 809, Wis. Adm. Code, for PFOA and PFOS at 70 ppt (for each compound individually and for both combined). The rule requires public water systems to begin compliance monitoring for these PFAS compounds and, if monitored levels exceed MCLs, provide public notice and a corrective action schedule.

In April of 2024, the EPA announced final federal NPDWR MCLs for the six PFAS compounds: PFOA, PFOS, PFHxS, PFNA, HFPO-DA and PFBS. The DNR has informed state public water systems of the new federal PFAS MCLs, and that Wisconsin has approximately three years to promulgate these new standards into state rules. The DNR has also offered potential funding opportunities, such as the Emerging Contaminants in Small or Disadvantaged Communities (EC-SDC) grant program, available to other-than-municipal (OTM) and non-profit non-transient non-community (NN) public water systems, and Bipartisan Infrastructure Law (BIL) funding, available to municipal community (MC) systems.

As of March 10, 2024, 1,858 active public drinking water systems have submitted PFAS compliance samples; 30% (567) of those systems had a PFAS detection; 2% (33) of systems exceeded the DHS HI of 1 and a public notice was required; 0.2% (3) of systems had an MCL violation, based on annual average of PFOA+PFOS >70 ppt, and 5% (90) had a detect at an active entry point exceeding EPA's new PFAS MCLs.

PFAS Ambient Shallow Groundwater Study

In June 2022, the DNR, in collaboration with the UW-Stevens Point Center for Watershed Science and the WI State Laboratory of Hygiene, began a project to sample for PFAS and other water quality parameters in 450 private wells, spaced apart geographically across the entire state. The main objective of this statewide PFAS monitoring research study was to determine concentrations of PFAS present in shallow, ambient groundwater, that is, in groundwater that is "shallow", from a well drawing water from the uppermost 40 feet of the uppermost continuous local aquifer, and that is "ambient", groundwater from a well in a location that is not near a known high concentration release of PFAS. Another objective was to evaluate the usefulness of several potential source indicator chemicals, chemicals that might be used to pinpoint what the source(s) of PFAS to groundwater may be in an area. Potential PFAS source indicators used for the study included some PFAS compounds that are environmental transformation products of fluorotelomer polymers, some inorganic compounds including nitrate and chloride, and some non-PFAS organic compounds including metabolites of the herbicides alachlor and metolachlor and a suite of human waste indicators that included two artificial sweeteners and two commonly used pharmaceuticals.

The study included samples from 450 homes, with shallow private wells, that were analyzed for 44 individual PFAS compounds, general water quality parameters, and indicators of human waste and agricultural influence. At least one PFAS compound was detected in 71% of the study samples, and 22 of the 44 PFAS analytes were detected in one or more samples. Levels of PFAS detected in the study site home water supplies were generally very low, however, PFOA and/or PFOS exceeded the new federal 4.0 ppt MCLs for those compounds in approximately 4% (17) of the 450 study samples, and 2 of the study samples showed PFHxS above the new 10 ppt federal MCL value. The samples above the new federal PFAS MCL levels tended to be associated with both developed land (areas of relatively high rural housing density) and human waste indicators (artificial sweeteners and pharmaceuticals). Most rural housing in WI utilize an on-site septic system for wastewater treatment/disposal. Human waste indicators such as artificial sweeteners and pharmaceuticals can be released to groundwater via septic system discharge.

Based on a review of land use information it appears that some of the study samples with relatively high PFOA, PFOS, and/or PFHxS levels are located in areas where municipal wastewater biosolids and/or industrial waste material is allowed to be land applied on agricultural fields. As some municipal wastewater biosolids and industrial waste materials have been found to contain PFAS, the land application of these materials on agricultural fields could be a source of elevated PFAS in groundwater in some locations. Overall, the study results suggest that human waste sources, septic systems in particular, may likely be a significant source of PFAS, especially those PFAS with less than 8 perfluorinated carbons, in shallow groundwater in WI.

PFAS contamination in the Town of Stella

Analysis of PFAS in one of the home water supplies sampled for the study showed extremely high PFAS levels. The home is located in the small unincorporated community of Starks, in the Township of Stella, in Oneida County. Total PFAS in the home water sample was more than 12,000 ppt. Additional home water supply PFAS sampling was conducted, both in the community of Starks and in the Town of Stella surrounding the community (area within approximately 2½ miles of Starks). As of March 2024 results of PFAS sampling of 134 home water supplies within this area showed PFAS being detected in approximately 69% (93) of the samples, and approximately 42% (56) of the samples having PFAS levels above WI DHS drinking water HALs. The highest PFAS results reported from this sampling showed total PFAS ppt concentrations in the tens of thousands. The highest PFOA level was reported at more than 45,000 ppt.

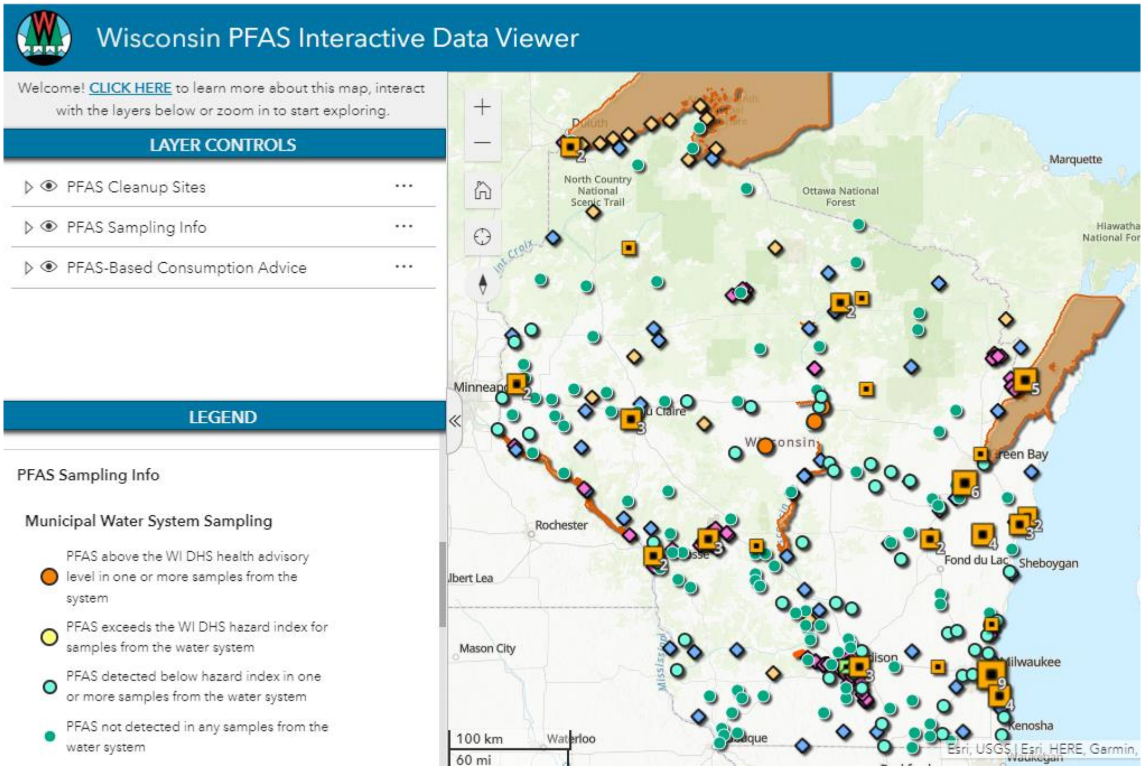
The homes that use private water supply wells in the Town of Stella with elevated PFAS concentrations appear to be located near agricultural fields where various waste materials (wastewater biosolids, septage, paper mill sludge) have been land applied. This raises the possibility that the land application of PFAS containing waste material may be the source of PFAS in groundwater in the area. The DNR, in conjunction with the US EPA, is currently investigating the possible sources of elevated PFAS in groundwater in the Town of Stella. DNR funded PFAS sampling analysis in the area has been expanded to an area extending out to approximately 3 miles from Starks.

PFAS contaminated site investigations

In the past several years, much work on PFAS in Wisconsin has focused on contaminated site investigations. As of July 2024, there are 99 open site investigations statewide (DNR Bureau for Remediation and Redevelopment BRRTS Tracking System at dnr.wi.gov/topic/Brownfields/botw.html where one or more PFAS have been identified as a contaminant). Note that 41 PFAS investigation sites have now been closed (6 Environmental Repair Program cases and 35 NR 708 spill cases). PFAS related contaminated site investigations include former firefighting training areas (civilian, corporate and military), industrial facilities, landfills, and an area where biosolids were land applied.

The latter two types of sites are secondary sources, where PFAS were not produced or used directly but rather released to the environment due to their presence in consumer products or other waste streams. Among landfills, older unlined landfills may present a higher risk to groundwater. The environmental stability and lack of effective treatment of PFAS in municipal sewage plants may lead to their presence in biosolids, which might threaten the practice of biosolids land spreading as a beneficial reuse of municipal waste. In areas without municipal sewerage, PFAS may also be released to groundwater from septic systems due to their presence in numerous commercial products.

The DNR maintains a Wisconsin PFAS Interactive Data Viewer a mapping tool that incorporates datasets from several DNR programs to show locations throughout Wisconsin that have been impacted by PFAS.



Where PFAS are discovered in groundwater and attributed to a responsible party, the site investigation and required remedial actions may result in a multi-year cleanup process, and for larger and more complex sites cleanup activities may take decades. This work includes all impacted media, not just groundwater. Despite the fact that PFAS are exclusively created by industrial production and they do **not** occur naturally, PFAS have been found at relatively low levels in surface water (dnr.wi.gov/topic/PFAS/SWFish.html), soil[2] and precipitation (in a study focused on Indiana and Ohio[3]; a Wisconsin-specific study of PFAS in precipitation was published in 2022[4]).

Studies indicate that PFAS at low concentrations are present in ambient groundwater in WI. The statewide study of drinking water, from homes with a private water supply well, showed PFAS detected in 71% of the home water supplies tested. Approximately 30% of public water supply wells in WI that have tested have had a detection of PFAS. There are thousands of PFAS chemicals, used in a wide variety of consumer, commercial and industrial products. It appears that disposal of both municipal and industrial wastes may be a likely source of PFAS to groundwater. To protect our vital underground sources of drinking water studies are needed to identify the fate and transport of PFAS from waste disposal sources through environmental pathways. The GCC, through its Joint Solicitation groundwater research solicitation effort, has funded some of this important research.

Further Reading

- DNR PFAS page
- DHS groundwater quality standard recommendations
- Interstate Technology and Regulatory Council fact sheets
- US Agency for Toxic Substances and Disease Registry PFAS page
- US Environmental Protection Agency PFAS page

References

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3. Pike, K.A., Edmiston, P.L., Morrison, J.J., Faust, J.A., 2021. Correlation Analysis of Perfluoroalkyl Substances in Regional U.S. Precipitation Events. Water Research 190, 116685. *https://doi.org/10.1016/j.watres.2020.116685*

4. Pfotenhauer, D.; Sellers, E.; Olson, M.; Praedel, K.; Shafer, M. PFAS Concentrations and Deposition in Precipitation: An Intensive 5-Month Study at National Atmospheric Deposition Program – National Trends Sites (NADP-NTN) across Wisconsin, USA. *Atmospheric Environment* 2022, *291*, 119368. *https://doi.org/10.1016/j.atmosenv.2022.119368*.