



PFAS: Perfluoroalkyl and Polyfluoroalkyl Substances

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What are Perfluoroalkyl and Polyfluoroalkyl Substances?

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a group of more than 9,000 synthetic (human-made) chemicals that have been in use worldwide since 1940, primarily in industry and numerous commercial and consumer products.

Here is a list of some common PFAS and their abbreviations (**Abbreviation:** Chemical Name)

PFOS: Perfluorooctane sulfonic acid

PFOA (or C8): Perfluorooctanoic acid

PFNA: Perfluorononanoic acid

PFDeA (or PDFA): Perfluorodecanoic acid

PFOSA (or FOSA): Perfluorooctane sulfonamide

PFHpA: Perfluoroheptanoic acid

MeFOSAA (or Me-PFOSA-AcOH): 2-(N-Methyl-perfluorooctane sulfonamido) acetic acid

Et-FOSAA (or Et-PFOSA-AcOH): 2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid

PFHxS: Perfluorohexane sulfonic acid

HFPO-DA (also known by the trade name **GenX** chemicals): Hexafluoropropylene Oxide (HFPO) Dimer Acid

Among the thousands of individual PFAS, the two that are most well-known and studied are perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS).

What are the Major Uses of PFAS?

Some unique properties of PFAS—like remarkable stability, water and oil repellency, and heat resistance—have led to their extensive use in various industrial and consumer applications. Although some types of PFAS are no longer used, many products may still contain PFAS:

- food packaging materials (e.g., microwave popcorn bags, pizza boxes)
- nonstick cookware (polytetrafluoroethylene [PTFE])
- stain-resistant carpet treatments
- water-resistant clothing
- cleaning products
- paints, varnishes, and sealants
- firefighting foam
- some cosmetics
- some dental floss

Why Should We Be Concerned About PFAS?

The widespread use of PFAS for the past several decades has raised concerns because of their persistence, tendency to accumulate in living organisms, and potential adverse health effects.

Here are a few important points:

- The widespread occurrence of PFAS in the environment (soil, water, air, etc.) worldwide—including remote regions like the Arctic—is now well-established.
- Many PFAS are highly resistant to degradation or breakdown and persist in the environment for unusually long periods; they are sometimes referred to as “forever chemicals.”
- The existence of PFAS in humans, wildlife, and fish has been reported worldwide.
- PFAS are **bioaccumulative**, meaning our bodies accumulate more PFAS than expelled or excreted. This is why much higher levels are detected in people and wildlife rather than in food/feed, soil, air, and water.
- Some PFAS can stay in the human body for a lifetime.
- Certain PFAS are known to cause various adverse health effects on humans and wildlife.

What are the Major Routes of Exposure to PFAS?

PFAS contamination may be found in drinking water, food, indoor dust, some consumer products, and workplaces. Certain populations may face elevated exposure risks, such as individuals living near industrial sites or military bases where PFAS-containing firefighting foams were used. Figure 1 illustrates some potential routes of human exposure to PFAS.

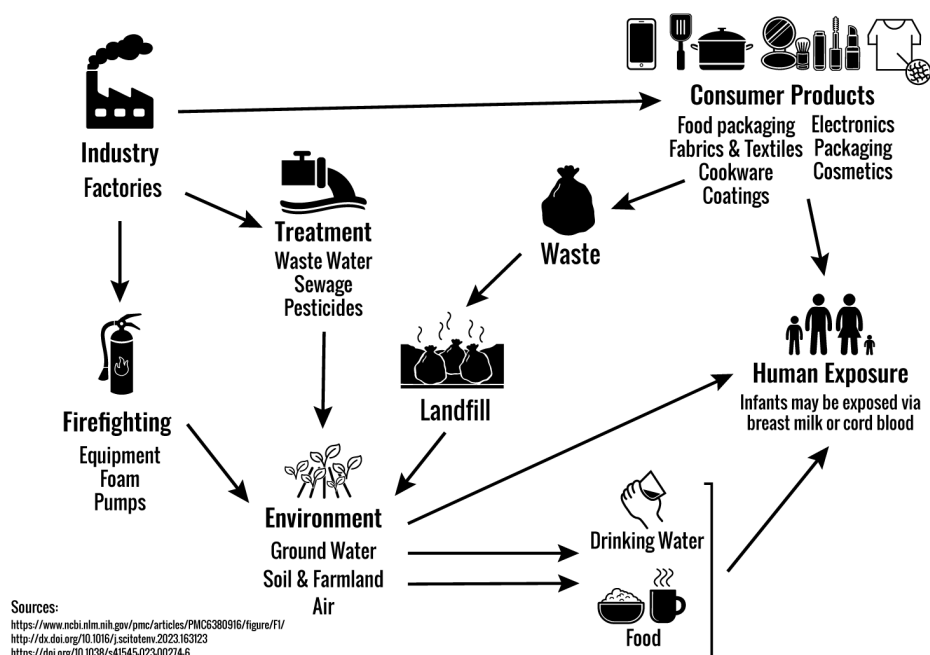


Figure 1. Some Potential Routes of Human Exposure to PFAS.

What Can You Do to Minimize Exposure to PFAS?

Avoid using nonstick cookware or use it safely (e.g., avoid high heat and scratches).

- Choose products made of PFAS-free materials certified by the U.S. Environmental Protection Agency's (EPA) Safer Choice program (<https://www.epa.gov/saferchoice>).
- Support policies and efforts prioritizing PFAS reduction and sustainability.

Learn what you can about PFAS from many different reliable sources (see the References section) and take actions that best fit your situation. If you have questions about the products you use in your home, you can contact the Consumer Product Safety Commission at 800-638-2772.

What are the Potential Human Health Effects of PFAS?

The potential for adverse health effects in humans is one of the primary concerns associated with PFAS exposure. The National Center for Environmental Health/Agency for Toxic Substances and Disease Registry, part of the U.S. Centers for Disease Control and Prevention (CDC), work with various partners to better understand how exposure to PFAS might affect people's health—especially how exposure to PFAS in water and food may be harmful.

Although more research is needed, some studies in people have shown that certain PFAS could be linked to (see Figure 2):

- Impaired growth, learning, and behavior of infants and older children
- High blood pressure or preeclampsia in pregnant women (PFOA, PFOS)
- Thyroid disease (PFOA, PFOS)
- Interference with the body's natural hormones
- Impaired immune system, e.g., a decreased immune system response to vaccines (PFOA, PFOS, PFHxS, PFDeA)
- Reduced fertility in women; reduced chance of getting pregnant (PFOA, PFOS)
- Liver damage (PFOA, PFOS, PFHxS)
- Increased cholesterol, especially total cholesterol and LDL cholesterol (PFOA, PFOS, PFNA, PFDeA)
- Small decreases in infant birth weight (PFOA, PFOS)
- Development of certain types of cancer, in particular kidney and testicular cancers (PFOA)

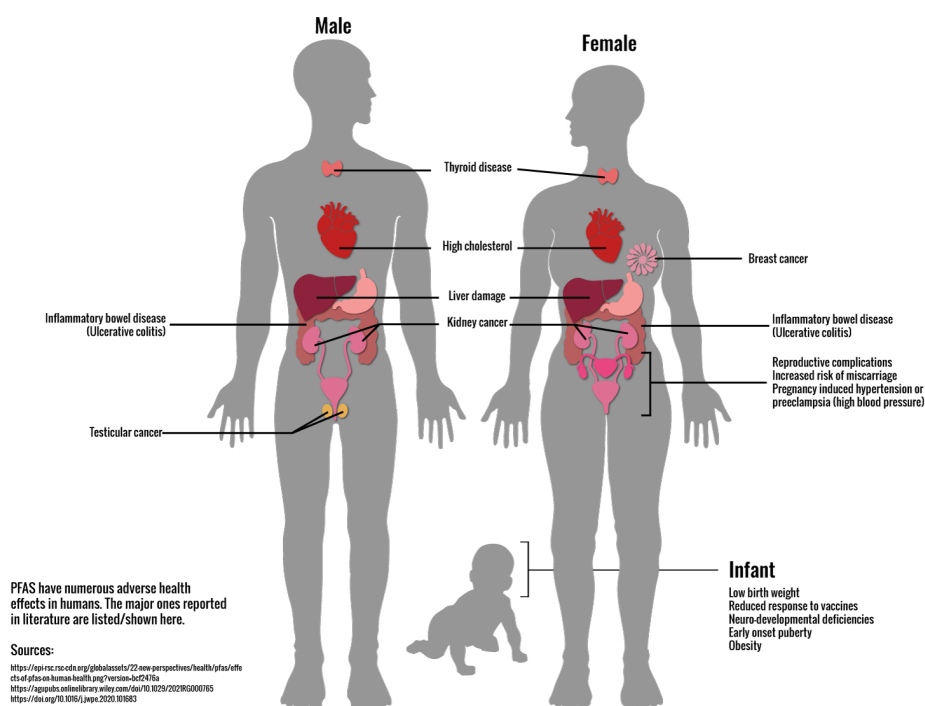


Figure 2. Potential Human Health Consequences of PFAS Exposure.

Currently, scientists are still learning about the health effects of exposures to mixtures of PFAS.

What About PFAS in Public Water Systems?

On April 10, 2024, the EPA announced the final National Primary Drinking Water Regulation for PFAS, which sets limits for five individual PFAS and a hazard index level for mixtures of two or more of four different PFAS (see Table 1).

Table 1. EPA's Established Limits for Selected PFAS in Drinking Water.

Chemical	Maximum Contaminant Level Goal	Maximum Contaminant Level
PFOA	0	4.0 ppt
PFOS	0	4.0 ppt
PFNA	10 ppt	10 ppt
PFHxS	10 ppt	10 ppt
HFPO-DA (GenX chemicals)	10 ppt	10 ppt
Mixture of two or more of PFNA, PFHxS, HFPO-DA, and PFBS	Hazard Index of 1.0	Hazard Index of 1.0

Hazard Index (HI): The Hazard Index is a long-established approach that the EPA regularly uses to understand health risks from a chemical mixture (i.e., exposure to multiple chemicals). The HI (which is unitless) is made up of a sum of fractions; each fraction compares the level of each PFAS measured in the water to the health-based water concentration:

Hazard Index = HFPO-DA ppt 10 ppt + PFBS ppt 2000 ppt + PFNA ppt 10 ppt + PFHxS ppt 10 ppt

The EPA has specified that public water systems should calculate Hazard Index values based on quarterly water samples; the running annual average of quarterly samples should not exceed 1.0.

These values are subject to change as new guidelines are announced.

Where Can I Submit Samples for PFAS Testing in Georgia?

As of this publication's date, the University of Georgia Agricultural and Environmental Services Laboratories (<https://aesl.ces.uga.edu>) is **not** equipped for testing PFAS. **However, several** accredited private laboratories in Georgia offer this testing service.

For a referral to these private laboratories, reach out to your county Extension agent: call 1-800-ASK-UGA1 (1-800-275-8421) or 706-542-5350; or email your request to soiltest@uga.edu.

Removal of PFAS From Drinking Water

The EPA recommended several water treatment technologies to remove or reduce the six PFAS known to occur in drinking water, namely PFOA, PFOS, PFNA, PFHxS, PFBS, and HFPO-DA. These water treatment technologies include granular activated carbon (GAC), ion exchange resins, reverse osmosis (RO), and nanofiltration. PFAS filters can be for point of use (i.e., at the point water is used, such as a faucet) or point of entry (i.e., a unit that filters all water entering your home).

Make sure a GAC filter has been certified to meet the **NSF/ANSI Standard 53** and an RO

Note. Maximum Contaminant Level Goal (MCLG): the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and **are not enforceable public health goals** for public water systems.

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. **MCLs are enforceable standards** for public water systems.

ppt: parts per trillion, or nanograms (10^{-9} g) per liter; 1 ppt = 10^{-3} µg/L

filter has been certified to meet the **NSF/ANSI Standard 58** for reduction of total PFAS as well as individual PFAS (namely PFOA, PFOS, PFNA, PFHxS, and PFHpA). However, using a certified filter does not completely ensure it will work as claimed for PFAS reduction or removal.

Testing your treated water after installing a filter can help verify that PFAS are reduced to levels below their respective MCLs. It is also important to follow the manufacturer's maintenance guide for the continued effectiveness of the filter over time.

What Do We Know About the Occurrence of PFAS in Georgia?

The Georgia Environmental Protection Division (EPD) has actively monitored some common PFAS in both public water systems and surface waters. The first comprehensive monitoring effort that addressed levels of PFAS in public water systems throughout Georgia occurred during 2013–2015, which included testing for PFOA, PFOS, and PFBS. Georgia EPD continued its survey of drinking water PFAS levels during 2021–2023, and there is an ongoing survey for 2023–2025.

For most public water systems sampled in Georgia, the levels were acceptable (below MCL) for the three PFAS surveyed, although some systems throughout the state exceeded EPA-established MCLs for PFOA and PFOS. The Georgia EPD also has been assessing surface waters since 2012 to determine the extent of potential PFAS contamination.

The results of all of these monitoring efforts are being presented on maps on a publicly available website

(<https://gaepd.maps.arcgis.com/apps/MapSeries/index.html?appid=e8f2c6a51c1c41088002350f1eabe598>).

Visit Georgia EPD's website (<https://epd.georgia.gov/pfas-information>) for general information about PFAS in Georgia.

Where Can I Get More Information About PFAS?

CDC:

- CDC-info resources website (<https://www.cdc.gov/cdc-info/>) or call 800-232-4636
- PFAS and Your Health (<https://www.atsdr.cdc.gov/pfas/index.html>)
- National Report on Human Exposure to Environmental Chemicals (<https://www.cdc.gov/exposurereport/index.html>)

U.S. EPA:

- Research on PFAS (<https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances->

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U.S. Food and Drug Administration (FDA):

- Environmental Contaminants in Food—PFAS
(<https://www.fda.gov/food/environmental-contaminants-food/and-polyfluoroalkyl-substances-pfas>)

National Toxicology Program:

- Immunotoxicity Associated with Exposure to PFOA or PFOS
(<https://ntp.niehs.nih.gov/pubhealth/hat/noms/pfoa/index.html>)

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