PFAS risk and management in the water industry

Policy Position Statement

CIWEM Chartered Institution of Water and Environmental Management

Purpose and Executive Summary

This Policy Position Statement (PPS) sets out the position of The Chartered Institution of Water and Environmental Management (CIWEM) on per- and polyfluoroalkyl substances (PFAS) management and risk mitigation, particularly for the water and wastewater industry. Its purpose is to inform members on the lifecycle of PFAS in the water and wastewater sector and to support CIWEM's advocacy to policymakers and regulators.

PFAS are a series of highly resistant chemicals used for numerous purposes across industries, which do not biodegrade. PFAS are not produced by water processes, but can be found in fresh and wastewater as a result of contamination by consumer products and by industrial runoff.

Similar to micro- and nanoplastics, because of the wide range of uses of PFAS, they are now regularly found in the natural environment and in humans, at varying concentrations. Several PFAS compounds have been found to have adverse health effects or carcinogenic properties. Their risk to health is heightened by the capacity of PFAS to bioaccumulate in animals, including farm animals and humans.

Media and environmental regulators have been showing increasing concern over PFAS, particularly around its presence in water. It is worth noting that only part of our exposure to PFAS comes from drinking water (generally calculated to be under 20%). PFAS can also be picked up in food and food packaging, and in the indoor air we breathe. Nonetheless, PFAS can pose a problem at every step of the water and wastewater lifecycle.

This document sets out the policy positions of CIWEM on PFAS:

1. Implement a polluter-pays system for source control and remediation of contaminated sites and groundwater
2. Develop a standard for detecting and measuring PFAS
3. Ban PFAS based on usefulness as well as hazardousness
4. Fund appropriate research on health impact, remediation and substitution
5. Devise a system-wide approach to monitor and manage raw water pollution and biosolids contamination from PFAS
6. Share the Environment Agency (EA) PFAS risk map with water companies
7. Monitor PFAS levels in biosolids and regulate specific harmful compounds
8. Label consumer products which are made using PFAS

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Note: CIWEM Policy Position Statements (PPS) represent the Institution's views on issues at a point in time. It is accepted that situations change as research provides new evidence. It should be understood, therefore, that CIWEM PPSs are under constant review and that previously held views may alter and lead to revised PPSs. PPSs are produced as a consensus report and do not represent the view of individual members of CIWEM.

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CIWEM's Position

1. Implement a polluter-pays system for source control and remediation of contaminated sites and groundwater

When PFAS are found in drinking water, it is because it leached into groundwater or other sources of abstraction, after being released into the environment, usually by industrial processes. Water treatment does not create PFAS pollution. Similarly, PFAS can be found in wastewater and biosolids (treated sludge) due to contamination of the water or the waste before treatment.

Treatment and removal of PFAS from water and wastewater is extremely costly. In line with the polluter pays principle this cost should not be borne by water companies. PFAS producers and handlers should prevent any further pollution and if found responsible for the original release of PFAS into the environment, they should be held responsible for the cost incurred in decontaminating the soil and water.

2. Develop a standard for detecting and measuring PFAS

PFAS are a large group of chemicals used for various purposes. Current analyses do not consistently detect or measure all PFAS. An assessment of PFAS needs to be designed and agreed upon to observe and measure PFAS presence. The technology is rapidly evolving globally; this will need to be reflected in any standard agreed upon. The Drinking Water Inspectorate (DWI) and Environment Agency (EA) have a standard methodology for PFAS being assessed by water companies in drinking water, which is still evolving.

3. Ban PFAS based on usefulness as well as hazardousness

PFAS are useful molecules. Banning them completely would be unadvisable and could lead to harmful substitution. Some PFAS are used for medical devices or in key industrial processes. However, not all PFAS compounds are necessary.

The UK government could ban the use of PFAS except where a robust justification can be provided to gain an exemption. Alternatively, they could be subjected to sector-based restriction such as a ban on all PFAS in cosmetics and textiles.

Some countries have already banned some non-necessary uses of PFAS. Usage-specific PFAS ban can also reflect the risk of harmful exposure, such as banning PFAS in pesticides and food packaging to limit ingestion and bioaccumulation.

This approach may look as follows, with compounds changing category based on advances of toxicology and technology:

	Essential (only option)	Necessary (best option)	Necessary (possible substitution)	Additive or Non-necessary
Harmless	No ban, pollution control	No ban, pollution control	Possible sector-specific ban, pollution control	Possible ban, pollution control
Low health risk	No ban, pollution control	Possible sector-specific ban, pollution control	Sector-specific ban, pollution control	Complete usage ban
Medium health risk	Possible sector-specific ban, pollution control	Sector-specific ban, pollution control	Complete usage ban	Complete usage ban
High health risk	Sector-specific ban, pollution control	Complete usage ban	Complete usage ban	Complete usage ban
Unknown health risk	No ban, pollution control	Possible sector-specific ban, pollution control	Sector-specific ban, pollution control	Complete usage ban

4. Fund appropriate research on health impact, remediation and substitution

Funding should be allocated to the study of health impact of commonly used or found PFAS which have not yet been researched. Remediation-wise, further development of granular activated carbon (GAC) techniques is necessary to increase efficiency and reduce cost of treatment.

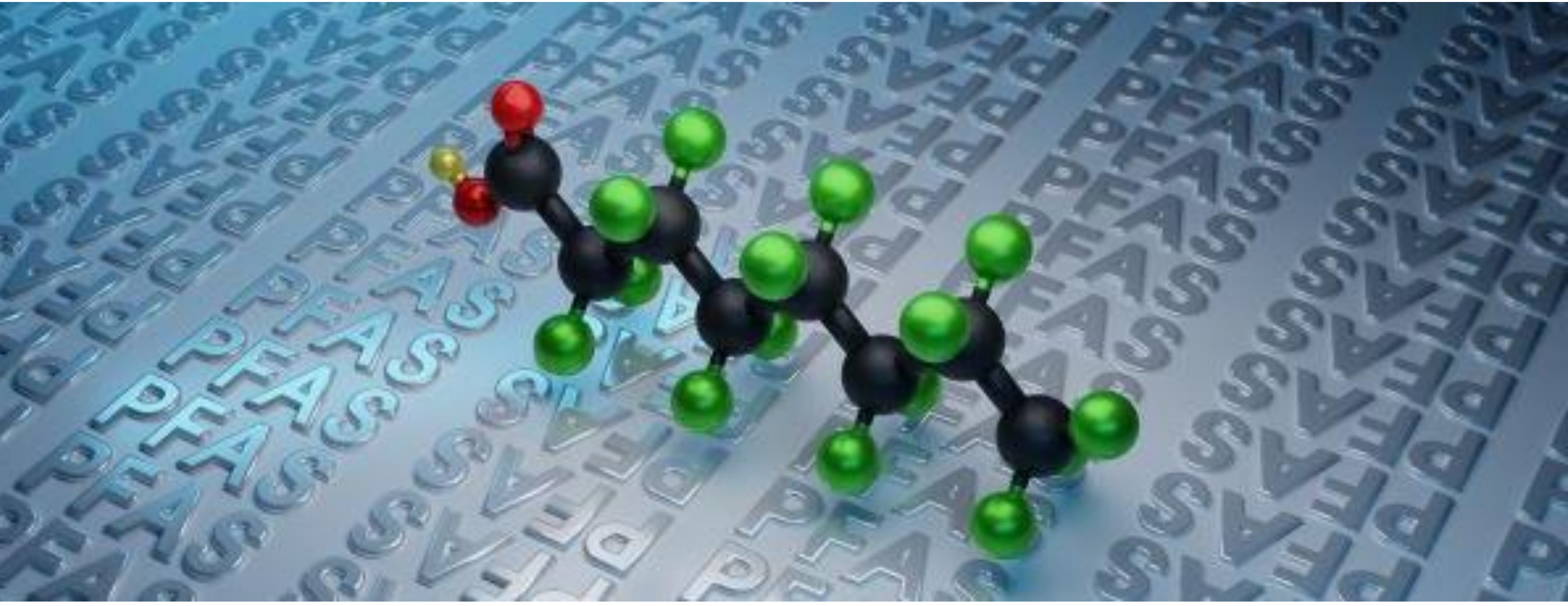
Innovative alternative techniques for removal, filtering, or destruction of PFAS should also be supported, as well as the study of gas released by thermal treatment processes of PFAS, including conversion of biosolids into biochar. Further research into bioaccumulation from water, biosolids and food sources would also help understand the risk better and manage it appropriately.

Alongside this research into toxicology and remediation, companies should be incentivised to develop substitutes to PFAS or when possible design their products to not require PFAS or alternatives.

5. Devise a system-wide approach to monitor and manage raw water pollution and biosolids contamination from PFAS

Microplastics, PFAS and other emerging contaminants must be considered together when designing solutions and regulations for the water and wastewater sector. They share a number of commonalities such as their widespread nature, the need for their control at the source and the diffuse risks they represent to health and the environment if and when they enter our water systems.

Within the wastewater sector, these emerging contaminants can be found in biosolids which has been spread to land. The approach to emerging contaminants need to be viewed holistically, with a view of the whole water cycle.



6. Share the Environment Agency PFAS risk map with water companies

The EA is establishing a map of the PFAS contamination risk, which is kept for internal use only. Though we understand that this data is sensitive, and that making it public may create public alarm, sharing it with water companies would be a good step towards harm reduction[1]. This would allow water companies to make informed decision on whether to abstract water in a location or not based on risk of raw water source pollution.

7. Monitor PFAS levels in biosolids and regulate specific harmful compounds

Further research is required to understand the risks from PFAS presence in wastewater biosolids and the sources of PFAS upstream of biosolids processes. Monitoring of a set of harmful PFAS should be mandated for biosolids before application to land.

Limits should be set for PFOS, PFOA and PFHxS levels in line with evidence of accumulation and spread, which should come in part through the chemical investigation programme 4 (CIP4). Regulations should be refined, modified, and expanded as our scientific understanding of PFAS toxicology, presence in and diffusion through agricultural runoff, and bioaccumulation in crops improves.

8. Label consumer products which are made using PFAS

Exposure to PFAS is not completely avoidable, however, a simplified understanding of key exposure pathways and clear labelling on consumer products containing PFAS could ensure consumers are making informed choices to limit their exposure and their contribution to PFAS pollution. This would be especially useful to limit non-essential PFAS in the absence of a ban.

Messaging needs to be straightforward, as consumers are increasingly struggling to sift through the information to make ethical and environmentally friendly choices.

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[1] In the meantime, Watershed has released a map showing known chemical pollution sites, including PFAS and PFOS ones: https://watershedinvestigations.com/home/find-out-whats-polluting-your-local-rivers-lakes-and-coast/

Context

PFAS toxicology

There is no consensus yet on which exact compounds are toxic and what are the mechanisms behind PFAS toxicity. Risks may depend on the type of PFAS, the bioaccumulation properties (long vs short chains), and the presence of precursors.

Existing epidemiological studies looking at health effects on populations exposed to PFAS via drinking water (e.g. DuPont USA, Ronnerby Sweden, etc) have suggested that exposure to different PFAS mixtures resulted in slightly different health impacts. Existing data shows that at least some PFAS compounds or mixtures can negatively affect the thyroid and liver, increase cholesterol levels, and increase risks of kidney and testicular cancer. Exposure during embryonic and foetal development has also been linked to adverse health effects.

The European Food Safety Authority (EFSA) established a Tolerable Weekly Intake (TWI) for the sum of four PFAS: PFOA, PFNA, PFHxS and PFOS at 4.4 nanograms per kilogram bodyweight per week (ng/kg bw/week).

The Committee on Toxicity of Chemicals (COT) concluded that this was acceptable as a first approximation for exposures to these four PFAS and produced a literature review (TOX/2022/67) which identifies health-based guidance values used by other regulators. This review lists guidance values for numerous specific compounds, and explains how each was calculated. COT has commissioned further work to look at the toxicokinetics of PFAS, to assess whether and how different PFAS can be grouped for assessment and to establish a Health Based Guideline value (HBGV) or a number of HBGVs as the data allow.

Technical context

PFAS as a class include compounds with diverse industrial uses and applications where desirable alternatives may not yet exist. As a result, PFAS are commonly found, especially in some brownfield land, and continue to be produced and to be released in the environment.

PFAS contamination itself does not originate from water sector operations, but rather stems from industrial releases and use of PFAS-containing products discharged into the water environment. This is a rapidly evolving issue with still many unknowns regarding, analysis, potential health impacts, and solutions for treatment or remediation.

PFAS are often used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water. These can be found in waterproof clothing, furniture, adhesives, food packaging, heat-resistant non-stick cooking surfaces, and electrical insulation. There have also been used in firefighting foams, making firefighter training grounds highly polluted sites.

Various methods exist to measure PFAS presence. Sensitive and accurate targeted methods using isotope-labelled internal standards only cover about 50 variants of PFAS, mostly PFCAs and PFSAs with perfluorinated alkyl chains of four or more carbon atoms. Sum parameter methods, such as total organic fluorine assays (e.g., adsorbable organic fluorine, AOF;

extractable organic fluorine, EOF), and total oxidizable precursor (TOP) assay, are increasingly being used to quantify the proportion of PFAS not captured by typical targeted analyses.

In the UK, granular activated carbon (GAC) is the main technology used for removing PFAS from water supplies. GAC is costly and does not destroy the PFAS, it simply retains it. Other removal techniques harnessing ion-exchange, flocculation, and adsorptive materials are being developed but are not currently widely used. Destructive technologies, such as oxidation using boron-doped diamond electrodes, are still largely in early stages of development.

Policy context

PFAS levels in drinking water

In the UK, there is no specific standard listed in the Water Quality Regulations for PFAS. In England, Wales and Northern Ireland, the DWI requires water companies to report concentrations of a set of PFAS compounds. DWI has devised a 'wholesomeness' guideline value of 100 ng/l for any of the individual PFAS. The Scottish regulation follows the EU combined limit.

The European Union (EU), Sweden, Denmark and Canada have established single guideline limits for combined PFAS in drinking water. The EU has limits of 100 ng/L for the sum of 20 PFAS and 500 ng/L for the sum of all PFAS in drinking water. Canada has developed its standards based on the potential of PFAS removal through electro-oxidation, defining the objective at 30 ng/L for a sum of 25 specific PFAS.

In April 2024, the U.S. Environmental Protection Agency (EPA) set legally enforceable levels in their national drinking water standards for PFAS chemicals (PFOA and PFOS: 4 ng/L each; PFNA, PFHxS and GenX: 10 ng/L each, and a special calculation for combined contamination by multiple compounds). This replaced individual states' standards, with large variations across the country. Full implementation of this regulation is in progress.

PFAS bans

Production of specific PFAS compounds (PFOS, PFOA and PFHxS) is prohibited by the Stockholm Convention, though there are still some exemptions in place for specific uses. In the EU, under the REACH regulation, the production of several specific PFAS compounds is banned or being phased out. The European Chemical Agency (ECHA) is working on an Universal PFAS restriction proposal, which would heavily restrict or phase out the manufacturing and sale of most PFAS with timelines based on essentiality of uses and availability of alternatives.

Several countries, such as Denmark, France and New Zealand have already banned non-necessary use of PFAS. This usually takes the form of sector-specific bans, such as bans in food packaging (Denmark), cosmetic products (France, New Zealand), and clothing – with the exception of protective equipment (France). UK REACH is also studying potential restrictions, early work seems limited to firefighting foam.

PFAS in biosolids

PFAS in wastewater biosolids is an emerging topic of concern, without much research evaluating the risks. There is no regulation or guidance on PFAS levels in biosolids in the UK at the moment.

UKWIR's Chemicals Investigation Programme 4 (CIP4) is trying to identify sources of PFOS in wastewater, and collecting data on a number of PFAS substances, as well as studying the impact of spreading biosolids to soils. This should help inform policymaking in the UK.

There is currently no regulation on PFAS in biosolids at the federal level in the US. However, some states have set regulations, which are still rapidly evolving, with Maine and Connecticut recently banning biosolids use on land due to fear of PFAS contamination.

Key Issues

Ongoing pollution, exposure and source control

PFAS have been utilised in numerous industrial and consumer products for decades. These include firefighting foams, water-repellent fabrics, anti-stick coverings, packaging, ski wax, pesticides and more. These result in multiple contamination sources ranging from manufacturing facilities and firefighting training areas to farmland and landfills.

The extreme persistence of PFAS means that historical contamination continues to impact environments long after their initial release. This persistence, combined with their mobility in water and soil, leads to ongoing pollution even when immediate sources are controlled.

A first step towards PFAS reduction and a contribution to the cost of treatment might be similar to the extended producer responsibility on packaging which, from 2025 onwards, demands that packaging producers and importers pay a fee per mass of packaging materials produced or imported.

Effective source control is hindered by the vast array of PFAS-containing products still in use and the difficulty in finding alternatives that offer similar performance characteristics. Many industries have become reliant on PFAS for their unique properties, making rapid transitions to PFAS-free alternatives challenging.

New PFAS compounds break down into various precursor compounds, further complicating source control strategies, requiring ongoing research and adaptive management to address this evolving class of contaminants.

Human exposure to PFAS has been found to come from a number of sources, including drinking water, food, food packaging, cosmetics and air pollution. Treating PFAS out of drinking water and wastewater alone would not solve the bulk of the issue, as long as we do not understand and control PFAS spreading into the environment.

Accurately assessing PFAS presence in water

PFAS contamination in water presents significant challenges for accurate assessment due to their complex chemical nature and widespread distribution. This large family of chemicals contains varying structures and properties. The sheer number of PFAS compounds, in the thousands, makes comprehensive testing difficult and expensive.

The evolving regulatory standards and the lack of standardised testing protocols across different regions and countries further complicates testing. As new PFAS compounds are continually being discovered and manufactured, and as PFAS breakdown into other products and precursors, testing methods struggle to keep pace. The ubiquity of PFAS in everyday products further increases the risk of sample contamination during collection and analysis.

Remediation: availability and affordability of current technologies

The management and removal of PFAS poses a challenge due to their complex chemical structures. A number of treatment options can be used to effectively remove PFAS from water and are used around the world. There is also increasing knowledge regarding the management and remediation of land contaminated with PFAS.

Various factors need to be considered when designing a treatment system including: the source of the PFAS; the effectiveness of the system to remove the target PFAS compounds; operational and capital costs; quality and quantity of any potential discharge to the environment; the treatment of any wastewater, and the long term sustainability of the solution.

The technologies best understood for drinking water treatment include high pressure membrane filtration systems, ion exchange systems and activated carbon systems. These technologies can be used at drinking water treatment plants of all sizes as well as for point-of-use devices in the home.

There is extensive ongoing research in the UK and worldwide investigating improvements to water treatment and land remediation options. There is also research into destruction techniques to breakdown and permanently destroy PFAS chemicals.

CIWEM would like to thank the members of the policy panels who contributed to the writing of this PPS, and the experts interviewed to gather all the necessary information.

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