PFAS Site Profile

PFAS Site Profiles were developed as part of the Environment Agency PFAS Risk Screening Project and represent an understanding of PFAS uses and occurrences from specific industry sectors at the time of writing in March 2024. This profile focuses on Paper and Cardboard Manufacturing.

Paper and Cardboard Manufacturing

1. INTRODUCTION

1.1 Overview

Per- and poly-fluoroalkyl substances (PFAS) are a broad group of more than 12,000 synthetic fluorinated organic chemicals. PFAS have been used in a wide variety of consumer products and industrial applications since the 1940s because of their unique chemical and physical properties, including oil, water and stain repellence, temperature and chemical resistance, and surfactant properties. These properties mean they are also extremely persistent in the environment. Some PFAS are bio-accumulative and toxic, and/or highly mobile.

Increasing awareness of the widespread presence of PFAS has heightened regulatory concerns about their potential risks to human health and the environment. To ensure effective actions are implemented the Environment Agency needs to better understand the potential sources of PFAS, the mechanisms of transport (pathways) and the relative significance of these substances in the environment.

As part of the Environment Agency PFAS risk screening project (Phases 1 to 4 carried out between 2020 to 2025) Jacobs developed individual site profiles for several potential high risk site types. They focus on specific industry sectors, representing potentially important sources of PFAS, whether from use or manufacture, with the potential for release into the environment.

The primary aim of these profiles is to help those parties involved in the regulation, investigation and remediation of sites where these problem chemicals present a risk to health and the wider environment. These are not definitive studies, but they introduce some of the technical considerations that need to be borne in mind when assessing a particular type of facility. Representing an understanding of PFAS at the time of writing (March 2024) and with published literature notably increasing continuously as practitioners and regulators seek to improve their understanding of PFAS, users must make their own appropriate assessments with current knowledge and specific to their site.

The reader is referred to Ross and Hurst (2019) and ITRC (2023) for more detailed information on PFAS chemistry, properties, fate and transport, risk assessment and remediation, to Glüge et al. (2020) for a review of the diversity of uses of PFAS, and to Ross (2023) for an overview of the uses of PFAS to assist with identification of sites of concern.

1.2 Site Profile Selection and Preparation

The site types for which site profiles have been developed in this project have been selected to represent potentially important users and sources of PFAS release to the environment in terms of quantity, frequency and historical records available.

Technical and scientific publications, fact-sheets, regulations, product websites, articles and online newspaper reporting interviews on the PFAS discussions were researched and reviewed to obtain information on the use of PFAS, with particular reference to the United Kingdom.

Each site profile includes site background information focused on PFAS use and identification of specific zones (where applicable), description of the processes involving PFAS, types of PFAS likely to be present, and an indication of the impact to water and soil. Brief examples and case studies from the literature are also provided.

For each site type a number of zones or activities have been identified where PFAS may be used. It should be recognised that not every site of this type will have all the activities identified. For example, a fire station site may be anything from a building where fire tenders containing Aqueous Film-Forming Foam (AFFF) are based (but filling, maintenance and training happen elsewhere) to a hub with a wide range of activities such as fire practice training, concentrate storage etc. in addition to vehicle storage.

Site profiles have been created for the following site types identified as potentially important potential sources of PFAS release to the environment:

- Civil and Military Airfields and Airports;
- Control of Major Accident Hazards (COMAH) Regulated Sites;
- Fire-fighting Grounds and Fire Stations;
- Landfills;
- Metal Manufacturing and Finishing;
- Military Bases (other than Air Transport Sites);
- Oil and Gas Industry (onshore exploration and extraction operations);
- Paper and Cardboard Manufacturing;
- Refineries and Fuel Sites;
- Textiles, Upholstery, Leather, Apparel and Carpets (TULAC) Manufacturing; and
- Waste Water Treatment Works.

Additional site profiles which do not relate directly to a particular site type have been developed for the following subject areas, which have potential applications within many different site types:

- Aqueous Film-Forming Foam (AFFF); and
- Fire Suppression Systems.

1.3 Methodology for Calculating Source Potential

For the purposes of the risk prioritisation project for which these site profiles were originally developed, an overall source potential has been developed for each site profile, based on professional judgment informed by the literature review. The source potential is constructed considering the magnitude and likelihood of PFAS presence and use in site profile zones.

The magnitude has been developed with a score of 1–5 (1 – low; 5 – high) based on the expected quantum of PFAS in the activity in the zone. For example, fire training practice using AFFF is recorded as high magnitude, because of the high volume and concentration of PFAS in this activity. Aircraft maintenance using hydraulic fluids containing PFAS is low magnitude because of the relatively low volume and concentration.

The likelihood for each activity is scored 1–5 (1 – low; 5 – high) based on the likelihood of a release to the environment occurring, taking into account frequency of activities where release may occur, and likelihood of loss of containment. For example, fire training practice using AFFF is likely to take place regularly at the same location over a period of years, with potential loss to ground or surface water, so is scored high. Although aircraft maintenance is likely to be undertaken all the time, significant accidental loss of containment is likely to be infrequent, so this is scored low.

The magnitude and likelihood are then multiplied to give the source potential (scored 1–25). It should be noted that these scores are generic and subjective and are based on professional judgment and should continue to be refined as more information becomes available. Further refinement could include expansion to consider changes in practice over the years as pollution prevention practices have improved.

2. BACKGROUND TO PAPER AND CARDBOARD MANUFACTURING

This site profile covers the occurrence of PFAS related to the manufacturing of paper and cardboard. It does not cover the occurrence of PFAS in imported paper and cardboard materials manufactured outside of England, and their subsequent recycling or disposal.

PFAS from paper and cardboard are of particular interest because there have been some well publicised examples in Germany and the USA of widespread contamination of agricultural land related to paper manufacturing (detailed further in the case studies in section 3). These appear to be associated with PFAS-contaminated sludge from paper manufacturing having been used for land spreading as a soil conditioner.

Information from the Nordic Council of Ministers (NCM) (2017) states that PFAS have been used by the paper and cardboard manufacturing (PCM) industry since the 1950s. Approximately 20–25 different coatings are used by the PCM industry to coat paper and cardboard materials that come into contact with foods. One estimate suggested that 32 to 60 tonnes of PFAS were being used in the UK PCM sector per year in the early 2000s (RPA Ltd., 2004). Another estimate suggested that approximately 160 tonnes of PFOS-related compounds were used in the paper industry within the EU in 2000 (German Environment Agency, 2020). However, by 2010 production of paper using PFOA had reduced by 95%.

According to a position statement on perfluorinated compounds (PFCs) published by the UK Confederation of Paper Industries (CPI) in 2017: "The vast majority (99%+) of paper packaging manufactured in the UK, including by CPI Member Companies, does not use PFCs. In the small number of specialist applications where PFCs are used, UK manufacturers have ceased using PFOA and PFOS" (CPI, 2017). An updated position statement (CPI, 2023) states that "The vast majority (99%+) of paper and packaging manufactured by CPI Member Companies do not intentionally add PFAS substances" and that based on available evidence, state that "the sector is not likely to be a significant source of PFAS in the environment. UK mills look like being a much smaller potential source than reported in other literature".

2.1 Uses of PFAS

The properties of PFAS lend their use within the PCM industries as an oil, water and temperature repellent, or resistant coating. In addition, it is also used in printing inks and as a moisture barrier (Nordic Council of Ministers, 2017). It is estimated that up to 17% of foods are packaged in paper and cardboard, with food ingestion thought to be one of the main sources of human exposure to PFAS (Nordic Council of Ministers, 2017). ITRC (2023) note PFAS have been used as grease-proofing agents on food contact materials (FCM) to prevent oil, grease, and moisture from foods from leaking through the packaging. This includes coated paper and cardboard such as pizza boxes, microwavable popcorn bags, parchment paper, fast food wrappers, paper cups, pet food bags, and other items. Other applications of PFAS within PCM include surface coatings on non-food paper packaging, e.g. carbonless copy paper and masking paper.

With respect to FCM, there are two main types of barriers to grease, fats and liquids for paper and cardboard. Firstly, a physical barrier (e.g. plastic film and aluminium film lamination in the paper) and secondly a chemical barrier added to the paper/cardboard. A chemical barrier can be added to the pulp or as a surface treatment of the cardboard (Nordic Council of Ministers, 2017). 'Internal' chemical barriers within the pulp require greater amounts of the agent, which subsequently forms a barrier during the pressing and drying process. 'External' chemical barriers are added after production of the paper as a direct coating or mixed with varnish as a lacquer. In the 1970s the application process moved from an acidic pH process to an alkaline process due to paper degradation. There was also a move towards shorter chain PFAS. Approximately 1–1.5% fluorochemical (by weight of dry fibres) is needed for paper protection (Danish Ministry of the Environment, 2005), but 4% by weight can be used when mixed into the pulp (Nordic Council of Ministers, 2017).

A report by 3M (1999) provides a US view of the fluorochemical use in the PCM industry in the 1990s. The use of fluorochemicals in the products impart grease, oil and water resistance to paper and paperboard substrates. They are used for food contact applications (plates, food containers, bags and wraps) and non-food applications (folding cartons, containers and carbonless forms and masking papers). The 3M overview stated that the fluorochemicals can be applied to paper and paperboard during the manufacturing process or converting operation, as summarised below:

- Paper mills use fluorochemicals to treat paper fibres during the paper or paperboard manufacturing process. The application points for the fluorochemical at the paper mill can include wet end of the paper machine, size press, calendar stack or clay coating; and
- Converters, convert fluorochemically treated paper and/or paperboard into wraps, bags, cartons, etc., for desired end use.

The 3M overview notes that approximately 95% of the fluorochemicals used in the paper and packaging industry are applied during the papermaking process at the paper mill. It is estimated that 73% of the fluorochemicals used by US paper mills is applied via the size press (3M, 1999).

A general review on how PFAS were applied to the PCM process is presented by 3M (1999). The fluorochemical products arrive at the paper mill receiving dock and are stored in a designated area. For use in treating paper webs, the fluorochemicals are moved near the makedown area for pumping into a tank. In some cases, direct pumping of the fluorochemical to a size press operation occurs. The fluorochemical is typically applied in a 0.5 to 1% (fluorochemical w/w) concentration in a starch/water solution. After the paper web is treated, the water is evaporated via numerous steam heated dryer cans and collected on a reel. The reel is then transported to a converting line, where the parent reel is slit down to a converting size roll for shipment to the converter. For wet end applications, the fluorochemical product is directly pumped to the pulp slurry prior to forming. Forming is the process of retaining fibres and draining water to form a usable article or web. Following forming, the manufacturing process includes pressing and drying, similar to that described above (molded articles do not go through the converting operation). During this process there is the potential loss of fluorochemicals to ground or drainage network and subsequent release to the water environment.

A 2004 report on PFOS by Risk and Policy Analysts Limited (RPA) (2004) provides some insight into information that may be available with regards to past use of PFAS (and specifically PFOS) in the paper manufacturing industry. They found that even though paper was reported as representing 15% of the UK PFOS market (prior to the withdrawal of PFOS by 3M), none of the trade associations contacted by RPA were able to identify UK applications of PFOS, or possible users. RPA (2004) also stated that it was believed that the majority of the PFOS related substances that were used were replaced by unspecified non-PFOS based fluorochemical alternatives, although applications may have been limited by the cost of the chemicals. Studies in the Netherlands indicated that much of the paper and board treatment actually took place outside the Netherlands, and the treated paper was subsequently imported, which may also be the case in the UK.

According to Glüge et al. (2020), side-chain fluorinated acrylate polymers derived from perfluoroalkane sulfonamide alcohols or fluorotelomer alcohols have become the most widely used polymers in FCM due to their good oil, grease, and water repellence. Additionally, perfluoropolyether-based phosphates and fluoropolymers have become widely used treatments for food contact paper and paper packaging. Glüge et al. (2020) also report that several PFAS have been detected in paper and packaging for food-contact articles.

Toilet paper has also been identified as a potential source of PFAS, particularly relevant to Waste Water Treatment Works. A recent study by Thompson et al. (2023) analysed samples of toilet paper from four world regions for 34 PFAS. All the samples contained detectable PFAS, with by far the largest single PFAS among those detected being 6:2 diPAP, representing 91% ±8% of the total mass of PFAS on average. The paper notes that PFAS are a known wetting agent used to increase the efficiency of the pulping process as well as being used elsewhere in paper production and that toilet paper is often manufactured from recycled paper fibres (which may themselves contain PFAS).

The UK CPI position statement (CPI, 2017) acknowledged that PFCs, which include specific variants such as PFOA (perfluorooctanoic acid) and PFOS (perfluorooctane sulfonate), have historically been used in a variety of industrial applications including liquid resistance in packaging. The position paper stated that the vast majority (99%+) of paper packaging manufactured by CPI Member Companies, does not use PFCs of any sort. There are some minority speciality applications, such as greaseproof papers and medical non-packaging, which do use PFCs. However, these are an extremely small percentage of total paper packaging or are not packaging (and will be destroyed at end of life) (CPI, 2017). The UK CPI updated position statement (CPI, 2023) confirmed that "the vast majority (99%+) of paper and packaging manufactured by CPI Member Companies do not intentionally add PFAS substances" and "there are a few minority speciality applications which use PFAS, where the PFAS provide either water or grease resistance which are needed for the products to deliver their technical requirements. Both companies involved are actively looking for replacement processes, but suitable alternatives are proving difficult to identify. However, it is worth noting that these two products are extremely unlikely to be present in recycling streams and so are unlikely to be a source of PFAS in recycled product or packaging".

CPI (2023) also describes the findings of an Environment Agency funded sampling study at five UK sites. A total of 65 samples were taken from the paper representing a variety of operational scales, type of input paper, and geographic locations in England. The samples included input paper, crumb, input water, effluent, and output product samples in order to provide data on both the inputs and outputs of the processes. All 65 samples are reported to have had concentrations of PFAS well below 1 mg/kg. When identified above the limit of detection PFOS, PFOA and PFHxS were <0.001 mg/kg. Polyfluoroalkyl phosphate esters (PAPs) were identified in several samples but further work is required to quantify the concentrations. PFAS were detected at low concentrations in some of the input water samples and it is acknowledged that paper mills are a discharge point for a small amount of PFOS, PFOA and PFHxS. However, based on the sampling data, it was concluded that the PFOS, PFOA and PFHxS originated in the input water rather than the recycled wastepaper stream and may be concentrated into effluent and crumb during the process. The key message concluded from this study by the CPI is that the UK paper and packaging sector appears unlikely to be a significant source of PFAS in the environment.

According to the CPI, the UK has 47 paper mills, with operations spread throughout England, Scotland, Wales and Northern Ireland. These mills produce around four million tonnes of product per year with almost a million tonnes exported, either directly or as packaging around UK manufactured goods.

The multi-industry analysis conducted by the United States Environmental Protection Agency (US EPA) (2021) gives an overview of PFAS uses in the USA for paper and cardboard. The research conducted by the US EPA stated that PFAS have been, and continue to be, used by pulp, paper, and paperboard facilities in the USA, however, only a small subset of facilities is actively applying PFAS and it appears the production of paper products containing PFAS at these facilities is a small percentage of the overall production. The use of PFOA and PFOS was phased out approximately 10 years prior to the time of reporting, but the industry continues to use approved short-chain PFAS in limited quantities in the manufacture of food contact packaging and specialty paper products. PFAS may be in additives mixed with the pulp prior to forming it into paper or in coatings applied to the surface of the paper after the paper is formed to enhance resistance to water, oil, and grease. The US EPA did not identify any pulp, paper, and paperboard facilities employing waste water treatment systems known to effectively reduce PFAS in industrial waste water. The USA paper industry reports that the application of PFAS to pulp, paper, and paperboard products is typically a dry or closed-loop process and may not generate a waste water stream, however, the US EPA documented that PFAS, including legacy long-chain PFAS and replacement PFAS, are present in waste water discharges from pulp, paper, and paperboard facilities to surface waters.

3. CASE STUDIES

Three case studies identified from a literature review are presented in Table 1 relating to PFAS and the PCM industry.

4. PROCESS

Two main processes are found using PFAS in the manufacturing of paper:

- cardboard mixed with the pulp as additives before it is formed into paper; and
- coatings containing PFAS applied to the finished paper.

According to the multi-industry analysis conducted by US EPA (2021), where coatings containing PFAS are applied to the paper, a closed-loop, recirculating system is used and excess coating is captured and reused.

In the process where PFAS treated paper is made starting from the pulp, PFAS contaminated process water can be generated and discharged.

In both processes, PFAS concentrates may be stored and handled at the paper mill or paper treatment manufacturing facility.

Table 1. Case studies.

1. Paper product production identified as the main source of PFAS in a Norwegian lake
Research conducted by Langberg et al. (2021) in 2015 on Lake Tyrifjorden in Norway found elevated PFOS concentrations in perch livers from fish caught in the lake. Follow-up investigations identified two suspected major PFAS sources to the lake: a fire station that opened in the 1980s and used AFFF until 2007 (refer to the site profiles for AFFF (CL:AIRE, 2025l) and Fire Suppression Systems (CL:AIRE, 2025m)), and a closed factory that produced paper products from 1964 to 2013. The fire station and former factory are located on the banks of a river flowing into the lake, with the fire station located 11 km upstream from the river mouth, and the factory a further 15 km upstream. The entirety of the sediment bed in Lake Tyrifjorden was found to be contaminated by PFAS. Concentrations and profiles of targeted PFAS in the water and sediment samples from the two suspected sources (fire station and paper production) varied. Water from the storm water system of the fire station was dominated by C5 – C8 PFCA and perfluoroalkyl sulfonic acids (PFSA), while sediments were dominated by PFOS in addition to perfluorohexane sulfonate acid (PFHxS), and 6:2 FTS. Relatively minor levels of C9 and C10 PFSA and PFCA, other PFOS precursors compounds (FOSAA, EtFOSAA) and 8:2 FTS were detected, likely reflecting impurities, or that small amounts of different AFFF products have been used. PFAS profiles in the fire station storm water and sediments were consistent with profiles previously reported for AFFF impacted areas. Water from the creek downstream of the paper factory landfill contained PFOA, PFOS and EtFOSAA as well as a smaller proportion of C5 – C7 and C9 PFCA, FOSA, and FOSAA. Sediment samples from the creek were dominated by 8:2 FTS and 10:2 FTS, smaller fractions of EtFOSAA and 12:2 FTS, in addition to some 14:2FTS, FOSAA, EtFOSE, and PFOS. The paper plate made in the factory was dominated by C6 – C10 PFCA with smaller proportions of C12 – C14 PFCA, 8:2 FTS, and 10:2 FTS. Concentrations and profiles in sediments and biota indicated that emissions originating from the former factory that produced paper products were the main source of pollution in the lake, while no clear indication of fire station emissions was found. Ratios of linear- to branched-PFOS increased with distance from the factory, indicating that isomer profiles can be used to trace a point source. A dated sediment core contained higher concentrations in older sediments and indicated that two different PFAS products have been used at the factory, referred to as Scotchban and FTS mixture. The research paper concluded that production of paper products may have been a major PFAS point source, that had generally been overlooked. It is hypothesised that paper fibres released from such facilities are important vectors for PFAS transport in the aquatic environment (Langberg et al., 2021).

Table 1. Case studies (continued).

2. A German case study
A research project on the Remediation Management for Local and Wide-Spread PFAS Contamination conducted by the German Environment Agency (2020) stated that in the paper industries after PFOS related compounds were phased out, only substances listed in the recommendations of the Germany Federal Institute for Risk Assessment have been used. However, in the past other compounds were used and in agricultural areas treated with compost containing paper sludge PFBA, PFPA, PFHxA, PFHpA, PFOA and PFOS could be found in soil eluates. PFBS, PFNA and PFHxS could also be measured except for a few samples. In addition, traces of PFDA and PFPeS were found in some eluates. PFOS and PFOA are not used directly in the paper industry but occur together with FTOH as impurities or as conversion products in the products.
3. PFAS paper mill lawsuit in Maine (USA)
According to an online news article published by the National Law Review (2021), on March 5, 2021, a class action lawsuit was filed in Maine by residents of Fairfield, Maine, in which they allege that a paper mill company polluted residential land with PFAS and exposed residents to risk of harm to their health, necessitating costly remediation of the contaminated land. The Skowhegan paper mill is a pulping and papermaking facility that manufactures various paper products, including coated paper, grease-proof packaging paper, and bleached chemical pulp. The paper mill has an annual production of 970,000 tonnes of coated paper and 525,000 tonnes of bleached chemical pulp. This paper mill, like many other paper mills across the globe, produces biosolid waste as a result of cleaning and chemically preparing materials for use in the mill's finished product. The biosolid waste is a sludge material that must be disposed of. The waste includes a variety of materials, including waste water sludge, woodyard waste, trash, demolition debris, and ash from boilers. According to the news article (National Law Review, 2021), the paper mill obtained licenses from the state of Maine to spread the sludge material on nearby farms, as it also has fertilising properties that are beneficial to farmers. Since 2020, the Maine Department of Environmental Protection has been investigating PFAS contamination in Fairfield, where at least 29 wells have levels exceeding the US Environmental Protection Agency's maximum limit of 70 parts per trillion (ppt). According to pleadings in the case, in January 2021, one well measurement for one of the named plaintiffs was 12,910 ppt (National Law Review, 2021).

5. KEY PFAS CONTAMINANTS OF CONCERN

The main suppliers and brand names of fluorochemicals used by the paper industry include: 3M, Bayer, Ciba (BASF), Clariant, DuPont, Scotchban®, Baysize®, Lodyne®, Cartafluor® and Zonyl® (UNEP, 2011).

Historical use of PFOS, PFOA, PFSA and PFCA has been identified in the PCM industry (Schaider et al., 2017). However, PFOS-related substances have largely been phased out in OECD countries in favour of fluorotelomer-based substances, phosphates and mechanical processes (UNEP, 2011). A further report by Buck et al. (2011) also identified the use of fluorotelomer-based polymers and polyfluoroalkyl phosphoric acid monoesters. PCM FCM must comply with European legislation on materials and articles coming into contact with food, superseding some of the requirements of REACH.

CONCAWE (2016) reports that historical use of PFAS in the paper and food packaging industry included the following compounds: PFOS, POSF, PFOA, FOSE, FOSA, PFOSE, PFOSA, FTOH, PAP, fluorocarbon resins and EtFOSE.

The Norway Lake case study summarised above identified PFOA, PFOS and EtFOSAA as well as a smaller proportion of C5 – C7 and C9 PFCA, FOSA, and FOSAA within surface waters downstream of the paper mill.

ITRC (2023) report the use of both polymeric and non-polymeric PFAS in paper and packaging. Polymers include side-chain fluorinated polymers in which the PASF- or fluorotelomer-based alcohols or their acrylate or methacrylate esters are attached on side chains. Non polymer PFAS include phosphate ester salts PFPEs.

A study by Thompson et al. (2023) of toilet paper from around the world found 6:2 diPAP as the predominant PFAS.

6. SOURCE POTENTIAL FOR PAPER AND CARDBOARD MANUFACTURING

Following the methodology set out in section 1.3, source potential has been developed for each site profile zone and detailed in Table 2 on the next page.

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IMPORTANT NOTES FOR READERS OF THE PFAS SITE PROFILES

The PFAS Site Profiles are based on available online literature and review of readily available technical publications at the time of writing (2020-2024). The authors recognise that additional information may be available that has not been used in this study.

The published literature on PFAS occurrence and distribution is vast and continually expanding. For example, the Interstate Technology and Regulatory Council web resource cited in the PFAS Site Profiles as "ITRC (2023)" was substantially updated in January 2026.

PFAS Site Profile

Table 2. Site Profile Zone Source Potential.

Site Profile – Zones	Magnitude	Likelihood	Source Potential	PFAS presence and use
Process water	5	3	15	Potential release of process effluent. This will be discharged either to sewer or through a site discharge consent to surface water.
Waste water system	3	5	15	May include process waste water and drainage water from working areas. On-site effluent treatment processes unlikely to reduce PFAS content. May be tankered for off-site disposal to WWTW.
Chemical mixture preparation area	5	2	10	Leaks can occur and if good practices are not in place PFAS can reach the drains or surface watercourses via direct runoff.
Waste management area	3	3	9	Release to the ground in areas where production waste/waste water containing PFAS are stored before collection for disposal.
Landfills	3	3	9	On-site landfills which may have received paper waste materials. Leachate can contain PFAS and potentially impact the groundwater.
Concentrates storage area	5	1	5	Leaks can occur and if good practices are not in place, the substance can reach the drains or surface watercourses via direct runoff.
Concrete or other hardstanding areas where PFAS have been used or stored	1	2	2	Past adsorption of PFAS to concrete or other semi-porous surfaces. Slow release of PFAS from concrete can potentially impact surface water and groundwater.

The purpose of the PFAS Site Profiles is to provide regulators and other interested parties with researched advice on how to assess problem sites that may be impacted by legacy use or release of PFAS. The profiles do not seek to address the specific circumstances of each site as these will be unique. As such, the PFAS Site Profiles should be read with the following reservations in mind:

- Practices can vary between different sites and therefore individual sites may not have been exposed to the typical PFAS contaminants of concern as detailed in each site profile;
- Site exposure to PFAS contaminants of concern may vary based on practices and equipment used on site; and
- Given the longevity of PFAS in the environment, site profiles may refer to practices which are no longer followed, and subsequently may omit current practices which avoid contamination.

DISCLAIMER

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PFAS Site Profile

ACRONYMS AND ABBREVIATIONS

Note: this list of acronyms and abbreviations includes those used across all the site profiles and therefore may include some acronyms and abbreviations not used within this profile.

General Acronym / Abbreviation	Definition	General Acronym / Abbreviation	Definition
AFFF	Aqueous Film-Forming Foam	HSE	Health and Safety Executive
ALARP	As Low As Reasonably Practicable	ITRC	Interstate Technology and Regulatory Council
AR-FFFP	Alcohol resistant film-forming fluoroprotein foam	LCMS	Liquid Chromatography Mass Spectrometry
BOW	Bilge and oily waste water	LPG	Liquified Petroleum Gas
CA	Competent Authority	MAPP	Major accident prevention policy
CAS	Chemical Abstracts Service	MILSPEC	Military Specification
CAFS	Compressed Air Foam System	MSDS	Material Safety Data Sheets
CDOIF	Chemical and Downstream Oil Industries Forum	NAPL	Non Aqueous Phase Liquid
CIMAH	Control of Industrial Major Accident Hazards	NCM	Nordic Council of Ministers
CIP	Chemicals Investigations Programme	NIHHS	Notification of Installations Handling Hazardous Substances Regulations
CLP	Classification Labelling and Packaging	NORM	Naturally occurring radioactive material
CO_2	Carbon dioxide	OECD	Organization for Economic Cooperation and Development
COMAH	Control Of Major Accident Hazards	ONR	Office for Nuclear Regulation
CPI	Confederation of Paper Industries	PCM	Paper and Cardboard Manufacturing
DoD	Department of Defence (Australia)/Defense (USA)	PNEC	Predicted No-Effect Concentrations
DoE	Department of Environment	PPB	Parts Per Billion
DWS	Drinking Water Standards	PPE	Personal protective equipment
ECF	Electrochemical fluorination	RAAF	Royal Australian Air Force
EOF	Extractable Organic Fluorine	REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
EPA	Environmental Protection Agency (for Denmark)	STM	Surface treatment of metals
EPR	Environmental Permitting Regulations	TOP	Total Oxidisable Precursor
EQS	Environmental Quality Standard	TULAC	Textiles, Upholstery, Leather, Apparel and Carpets
EU	European Union	UBA	Umwelt Bundesamt (German Environment Agency)
FCM	Food Contact Material	UK WIR	United Kingdom Water Industry Research
FFF	Fire-Fighting Foam	UMD	University of Maryland
FFFP	Film-Forming Fluoroprotein	US EPA	United States Environmental Protection Agency
FP	Fluoroprotein	WWTP	Waste Water Treatment Plant
FPP	Fire Prevention Plans	WWTW	Waste Water Treatment Works
FRS	Fire and Rescue Service		

PFAS Site Profile

ACRONYMS AND ABBREVIATIONS

Note: this list of acronyms and abbreviations includes those used across all the site profiles and therefore may include some acronyms and abbreviations not used within this profile.

PFAS Acronym / Abbreviation	PFAS Definition	PFAS Acronym / Abbreviation	PFAS Definition
10:2 FTOH	10:2 Fluorotelomer alcohol	HFPO-DA	Hexafluoropropylene oxide-dimer acid
10:2 FTS	10:2 Fluorotelomer sulfonate or sulfonic acid	HFPO-TA	Hexafluoropropylene oxide-trimer acid
10:2 FTUCA	10:2 Fluorotelomer unsaturated carboxylic acids	MeFOSAA	Methylperfluorooctanesulfonamidoacetic acid
11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	PAP	Polyfluorinated alkyl phosphates
12:2 FTS	12:2 Fluorotelomer sulfonate or sulfonic acid	PASF	Perfluoroalkane sulfonyl fluoride substances
14:2 FTS	14:2 Fluorotelomer sulfonate or sulfonic acid	PFA	Perfluoralkoxy polymer
12:2 FTAB	12:2 Fluorotelomer sulfonamido betaine	PFAA	Perfluoroalkyl acid
4:2 FTS	4:2 Fluorotelomer sulfonate or sulfonic acid	PFAS	Perfluoroalkyl and Polyfluoroalkyl Substances
5:3 FTCA	5:3 Fluorotelomer carboxylic acid	PFBA	Perfluorobutanoate or Perfluorobutanoic acid
6:2 FTAB	6:2 Fluorotelomer sulfonamidoalkyl betaine (see also CMDFPAH)	PFBS	Perfluorobutyl sulfonate or Perfluorobutyl sulfonic acid
6:2 FTCA	6:2 Fluorotelomer carboxylic acid	PFC	Perfluorinated Compound
6:2 FTOH	6:2 Fluorotelomer alcohol	PFCA	Perfluoroalkyl carboxylic acid
6:2 FTS	6:2 Fluorotelomer sulfonate or sulfonic acid (see also TDFOSA)	PFDA	Perfluorodecanoate or Perfluorodecanoic acid
6:2 FTUCA	6:2 Fluorotelomer unsaturated carboxylic acids	PFDoA	Perfluorododecanoate or Perfluorododecanoic acid
6:2 diPAP	6:2 Fluorotelomer phosphate diester	PFECA	Perfluoroalkyl ether carboxylic acid
8:2 Cl-PFESA	8:2 Chlorinated perfluoroalkyl ether sulfonic acid	PFECHS	Perfluoroethylcyclohexane sulfonate
8:2 FTOH	8:2 Fluorotelomer alcohol	PFESA	Perfluoroalkyl ether sulfonic acid
8:2 FTS	8:2 Fluorotelomer sulfonate or sulfonic acid	PFHpA	Perfluoroheptanoate or Perfluoroheptanoic acid
8:2 FTUCA	8:2 Fluorotelomer unsaturated carboxylic acids	PFHpS	Perfluoroheptane sulfonate or Perfluoroheptane sulfonic acid
9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	PFHxA	Perfluorohexanoate or Perfluorohexanoic acid
ADONA	4,8-Dioxa-3H-perfluorononanoic acid	PFHxS	Perfluorohexane sulfonate or Perfluorohexane sulfonic acid
CMDFPAH	Carboxymethyldimethyl-3-[[(3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl)sulphonyl]amino]propylammonium hydroxide; a synonym of 6:2 FTAB used in UKWIR reports	PFNA	Perfluorononanoate or Perfluorononanoic acid
EtFOSA	N-ethyl-perfluorooctane sulfonamide	PFOA	Perfluorooctanoate or Perfluorooctanoic acid
EtFOSAA	N-ethyl-perfluorooctane sulfonamido acetic acid	PFOS	Perfluorooctane sulfonate or Perfluorooctane sulfonic acid
EtFOSE	N-ethyl-N-(2-hydroxyethyl) perfluorooctane sulfonamide	PFOSA	Perfluorooctane sulfonamide (FOSA)
F-53B	Trade name for chlorinated polyfluoroalkyl ether sulfonic acids (9Cl-PF3ONS and 11Cl-PF3OUdS)	PFOSE	Perfluorooctane sulfonamido ethanol
FASA	Perfluoroalkane sulfonamide	PFPA	Perfluoropentanoate or Perfluoropentanoic acid
FBSA	Perfluorobutane sulfonamide	PFPE	Phosphate ester salts
FOSA	Perfluorooctane sulfonamide	PFPeA	Perfluoropentanoic acid
FOSAA	Perfluorooctane sulfonamidoacetic acid	PFPeS	Perfluoropentane sulfonate or Perfluoropentane sulfonic acid
FOSE	Fluorooctane sulfonamido ethanol	PFPS	Perfluoropentane sulfonate
FTCA	Fluorotelomer carboxylic acid	PFSA	Perfluoralkane sulfonic acid
FTMAC	Fluorotelomer methacrylate	PFUnDA	Perfluoroundecanoate or Perfluoroundecanoic acid
FTOH	Fluorotelomer alcohol	POSF	Perfluorooctane sulfonyl fluoride
FTS	Fluorotelomer sulfonate	PTFE	Polytetrafluoroethylene
FTSA	Fluorotelomer sulfonic acid	TDFOSA	3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluorooctane-1-sulfonic acid; a synonym for 6:2 FTS used in UKWIR reports
Gen-X	Trade name for HFPO-DA		