Toxics Free Australia

PFAS IN AUSTRALIA - BRIEF- July 2024

Summary of concerns

1. PFAS or per- and poly-fluoroalkyl substances (PFAS), referred to as the '*forever chemic*als' due to their carbon-fluorine bond, do not degrade in the environment. An estimated 14,000 PFAS are in commercial use today.

2. PFAS chemicals travel the globe via air and water and contaminate oceans and ecosystems, even in the most remote regions. They are global, transboundary pollutants.

3. PFAS have been shown to damage the endocrine, reproductive and immune system of humans and wildlife. PFOA is listed as a human carcinogen by the IARC while PFAS increase cholesterol, suppress the immune system, interfer with hormones and the developmental effects in children. PFAS have demonstrated intergenerational harm yet, the Australian government claims *"There is also limited to no evidence of human disease or other clinically significant harm resulting from PFAS exposure at this time."*[1]

4. Australian blood supplies are contaminated with PFAS as Australian Red Cross Lifeblood does not have a specific deferral for PFOS or PFOA[2]

5. PFAS are used in a wide range of building and consumer products, including plastics, stain and water treatments, carpets, textiles and clothing (school uniforms), non-stick cookware, paints and coatings, make up/mascara, dental floss, waxes and food packaging (moulded fibre, paper bags, teabags). Exposure from these uses can occur through household dust and indoor air, skin absorption and oral routes, eg lipstick and children's sucking behaviour. Contamination from product use may end up in waste water treatment plants, which cannot remove all PFAS.

6. PFAS have been used in AFF fire-fighting foams resulting in contamination of Australian soil, surface water and drinking water.

7. Pesticides found to be PFAS under 2021 changes to the definition are used in Australian agriculture.

8. There are no facilities in Australia that have conducted successful trials to destroy PFAS using incineration.

9. Despite the 2001 warning of the dangers by the USEPA, Australia's PFAS policy responses are woefully inadequate due to the following:
    - focus on only 3 PFAS chemicals with reference to direct and indirect precursors,
    - guidelines for PFAS in drinking water and daily tolerable intakes are set very high and do not acknowledge that there is 'no safe level of exposure',
    - failure to monitor Australian blood and breastmilk PFAS levels,
    - inadequate monitoring and failure to address PFAS in drinking water and food,
    - ongoing distribution of PFAS contaminated biosolids on agricultural land,
    - failure to introduce financial model (eg Superfund) for PFAS contaminated site cleanup and seek legal redress from 3M, the PFAS producer, and
    - failure to address imported products and the multiple sources of PFAS exposure, eg single use food packaging, imported consumer products (eg makeup, clothes), fluorinated pesticides.

Changing Definition of PFAS

The 2021 OECD criteria defined PFAS as '*fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it), that is, with a few noted exceptions, any chemical with at least a perfluorinated methyl group (–CF3) or a perfluorinated methylene group (–CF2–) is a PFAS.'*

The OECD criteria highlights that many more PFAS are in commerce today, approximately 14,000 plus, including up to 200 fluorinated pesticides. However, Australian regulations focus primarily on just three historical PFAS; *perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorohexane sulfonate (PFHxS), and their direct and indirect precursors.* These are rapidly being replaced with other PFAS, which have little or no toxicology or eco-toxicology data.

The three are listed on the *Stockholm Convention on Persistent Organic Pollutants* 2001. Australian government has not ratified their inclusion but has stated it will ban their import, manufacture and use by July 2025.

The next PFAS POPs

The class of long chain perfluoroalkyl carboxylic acids (PFCAs) has been assessed by the POPs Review Committee of the Stockholm Convention and recommended for elimination. In 2018, PFCAs were detected in more than 80% of the 30 surface seawater samples from the North Pacific to Arctic Ocean.[3] Perfluoroalkyl ether carboxylic and sulfonic acids (PFECAs and PFESAs) have been found in surface waters in China, US, UK, Sweden, Germany, Netherlands and Korea, indicating ubiquitous dispersal and distribution in global surface waters.[4]

Production of some fluoropolymers, used extensively in consumer products are linked to the emissions of legacy and novel PFAS used as polymer processing aids. There are serious concerns regarding the toxicity and adverse effects of fluorinated processing aids on humans and the environment while the production and use of fluropolymers is increasing.[5]

Short-chain PFAS are rapidly replacing long-chain PFAS and are increasingly detected in groundwater, surface water, ocean and snow melt.[6] In 2022, U.S. EPA released new health advisories for two short chains PFAS; Perfluorobutane sulfonic acid (PFBS) at 2000 ng/L

and GenX at 10 ng/L as both demonstrate health impacts and require more effective treatment in drinking water.

Five European national authorities (Netherlands, Germany, Denmark, Norway and Sweden) have called for a ban on production, use and placement on the EU market of all per and polyfluoroalkyl substances.[7] Australian governments have not supported this call.

PFAS litigation – USA, Australia, Sweden

Since 1998, multiple lawsuits have been filed in US courts against chemical company DuPont in relation to PFOA used to produce Teflon. Local farmers, residents and company workers claimed illnesses linked to PFOA pollution from DuPont's Parkersburg plant in West Virginia.

In one class action lawsuit settled in 2005, DuPont agreed to provide up to $235 million for medical monitoring of over 70,000 people - the world's largest epidemiology study of people exposed to PFOA. The resultant C8 Science Panel, a joint initiative of the US government, the affected community and the PFAS industry concluded that there was a probable link to PFOA exposure for diagnosed high cholesterol, ulcerative colitis, thyroid disease, testicular cancer, kidney cancer and pregnancy-induced hypertension.[8] This resulted in numerous individual lawsuits from victims of PFOA-related diseases.

In February 2017, DuPont settled over 3,550 lawsuits for $671 million. In 2022, a US federal appeals court has upheld a $40 million verdict for a cancer survivor who sued E.I. du Pont de Nemours and Co after years of exposure to a toxic chemical that it manufactured.[9]

In June 2023, manufacturer of PFAS, 3M, reached a US$10.3 (AUD19) billion settlement with several US public water system operators to test and treat PFAS contamination. [10]

In Australia, class actions were commenced by landholders claiming loss of house and land value against the Department of Defence based on its use of PFAS fire fighting foam (AFFF).

In 2020, residents in Katherine, Williamtown and Oakey settled for $215.5m and in 2023 a settlement was concluded for $132.7m for the 30,000 residents located near Australian military bases including Royal Australian Air Force bases at Richmond and Wagga Wagga in NSW, Bullsbrook in Western Australia, Darwin in the Northern Territory, Edinburgh in South Australia, Townsville in Queensland and Wodonga in Victoria.

In 2024, the Swedish Supreme Court ruled that residents who have high levels of PFAS in their blood as a result of PFAS-contaminated drinking water, have suffered personal injury within the meaning of their national Product Liability Act.[11] The drinking water from the Brantafors waterworks in Ronneby municipality contained very high levels of PFAS from the use of firefighting foam in fire drills. More than 150 residents filed a lawsuit against the municipal water company, for compensation for personal injury.

According to the Product Liability Act,, damages must be paid for personal injury caused by a safety defect in a product, such as drinking water. The damages may relate to costs, loss of income and physical or mental suffering caused by the personal injury. The ramifications for drinking water providers and those that insure them could be significant.

Once released into the environment PFAS cannot be managed

Once released from waste sites, manufacturing facilities, sewerage treatment works, fire-fighting operations and from the use of fluorinated pesticides, PFAS are extremely persistent in the environment and mobile, travelling via air and water currents. PFAS also migrate out of consumer products such as all-weather clothing, carpets and camping gear into the air and household dust.

In the air, volatile PFAS (eg polyfluorinated fluorotelomer alcohol (FTOH) and sulfonates) are transported thousands of kilometres and others are carried by suspended particulate matter, which is eventually washed out and deposited in rain and snow.

PFAS are now found in food, soil, ground and surface water, as well as aquatic and terrestrial wildlife. PFAS contaminate ecosystems from the remote Arctic to the tropics to the Antarctic. In recent sampling of snow in remote locations and water from mountain lakes, PFAS were present in nearly all the samples.[12]

In Australia, PFAS has been found in soil, groundwater, surface water associated with airports, defence bases, fire fighting practices and waste facilities. Australian researchers collated PFAS concentration data for over 45,000 surface and groundwater samples from around the world. The data suggests Australia, China, Europe and North America are hotspots relative to the world. Importantly, Australia has no PFAS manufacturing sites.[13]

PFAS in Australian Drinking Water

In 2011, PFAS was found in drinking water collected from Australian capital cities and regional centres. PFOS and PFOA were the most commonly detected; 49% and 44% of all samples respectively. While the maximum concentration in any sample was for PFOS with a concentration of 16 ng /l, the second highest maximums were for PFHxS and PFOA measured at 13 and 9.7 ng/l.[14]

The highest levels from the 2011 study were seen at Glenunga in inner-city Adelaide, where PFOS was nearly quadruple the US four ppt enforceable limit. Glenunga's water supply is not currently monitored for forever chemicals.

In 2024, Tap water across parts of Sydney, Newcastle, Canberra, Victoria, Queensland and the tourist havens of Rottnest and Norfolk islands has been found to contain PFAS.[15]. Even drinking water sourced from desalination plants e.g., Rottnest Island was contaminated with PFAS.

Polyvinylidene fluoride (PVDF) ultrafiltration membranes are one the most common material used in the membrane industry for water treatment. The European Union is banning the use of PVDF as it is produced from PFAS monomers. [16]

Discharges from Australian wastewater treatment plants

Discharges from wastewater treatment plants (WWTPs) include PFAS as they are often the final destination for forever chemicals waste from consumers and industry. WWTPs are only partially effective at removing PFAS from wastewater, which is then released back into the environment risking contamination of the food chain and drinking water supplies.[17] National loads of PFOA and PFOS in effluent were estimated at 65 kg and 26 kg per annum respectively.[18]

PFAS also exit the WWTP via biosolids (sludge), which are a by-product of the wastewater treatment facilities. While treatment reduces pathogens, it does not remove all PFAS chemicals. Australia produces almost 400,000 dry tonnes of biosolids per year, [19] the majority of which is applied to agricultural land or used in landscaping and land rehabilitation. Melbourne Water alone provides biosolids that are used on 30,000ha of farmland per year.

A 2022 Victorian Friends of the Earth Freedom of Information request [20] revealed that the vast majority of biosolids in Victoria exceeded Victorian EPA Guideline levels and would require *"dilution"* to achieve compliance. The highest PFOA levels were detected in a 2016 biosolid sample at 550 times over the 0.004mg/kg EPA Guideline level. PFOS was found at 250 times.

The results of degradation tests and field monitoring data support the conclusion that no biodegradation of PFOA or PFOS occurs, and they do not undergo any abiotic or biotic degradation under any relevant environmental conditions. Any release of PFAS can only add to the current unsustainable burden of PFAS environmental contamination.

PFAS in Australian Waste Facilities

Waste management plays a major role in the spread of PFAS into the environment through disposal (i.e., landfill and incineration) and through the recycling and downcycling of recovered waste resources. For example, waste disposal facilities in Wellesley, Vasse, Tamala Perk and Red Hill in Western Australia have contaminated associated groundwater.[21]

PFAS are not being monitored in the Australian waste streams nor consideration given to the many downstream uses of waste materials containing PFAS. In effect PFAS is concentrated into new products involving recycled textiles, plastic products and electronic waste.

In addition, incineration of PFAS waste has shown to generate PFAS contaminated waste ash and air emissions. The reuse of such ash has potential to be a major route of PFAS to the environment.[22]

PFAS Health Impacts and Australian Government's Denial

In 2021, international researchers reviewed epidemiological studies[23] confirming associations between exposure to specific PFAS and a variety of health effects, including altered immune and thyroid function, liver disease, lipid and insulin dysregulation, kidney disease, adverse reproductive and developmental outcomes, and cancer. These findings were supported by experimental animal data for many of these effects. They also noted that health effects data existed for a relatively few PFAS compounds, while hundreds are used in commerce lacking any toxicity data.

These findings were consistent with many international research bodies including the U.S. National Toxicology Program whose evaluation[24] of PFAS exposure and immune-related health effects concluded both PFOA and PFOS are an immune hazard to humans.

PFAS exposure were also linked with worse COVID-19 outcomes.[25] People with elevated blood levels of perfluorobutanoic acid (PFBA) had an increased risk of a more severe course of COVID-19 (e.g., hospitalisation, death)

In 2023 the International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization (WHO), released their evaluation of the carcinogenicity of perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). They classified

PFOA as *carcinogenic to humans* (Group 1) and PFOS as *possibly carcinogenic to humans* (Group 2B).[26]

Yet, Australian governments continue to claim that there is *"limited to no evidence of human disease or other clinically significant harm resulting from PFAS exposure at this time."* [27]

Endocrine Disruptors and Intergenerational Equity

PFOS, PFOA, PFHxS are endocrine disrupting chemicals,[28] mimicking estrogen and their exposures were associated with altered pubertal timing in children, measured by age at menarche in females and serum testosterone concentrations in males.[29]

A 2023 study demonstrated that exposure to PFAS interferes with several critical biological processes including the metabolism of fats and amino acids in adolescents and young adults. The disruption of these processes can increase susceptibility to a variety of illnesses, such as developmental disorders, cardiovascular disease, cancer and metabolic diseases like diabetes.[30]

PFAS may remain in the human body for years, accumulating primarily in the blood, kidneys and liver. For women, those residues are directly passed onto the next generation in utero and in breast milk.

PFAS may affect future generations via germ cells, the precursors to sperm and ova. When exposure occurs in a pregnant woman, her developing fetus is exposed, as are the germ cells within the fetus that become the grandchildren, thereby, three generations may be exposed. Mice exposed to PFOA during pregnancy developed problems with milk production. Their daughters, exposed during gestation, had stunted mammary gland development. [31] [32]

Changes in germ cells can result in epigenetic changes that alter the way DNA is regulated. These changes can be inherited over one or more generations.[33],[34] The evidence of PFAS impacts on DNA methylation is growing.[35],[36]

A 2022 paper[37] critically reviewed current evidence from human epidemiological, in vitro, and animal studies, including mammalian and aquatic model organisms. The studies identified the associations between PFOS or PFOA exposure and epigenetic changes in both adult populations and birth cohorts.

Skin Absorption of PFAS

Researchers using 17 different PFAS compounds were able to measure the proportion of the chemicals that were absorbed by the skin. [38] They found human skin took in "substantial" amounts of 15 PFAS, including 13.5% of PFOA, one of the most toxic PFAS. With a longer application, skin absorbed a further 38% of the PFOA dose.

Industry is replacing long chain PFAS like PFOA with smaller "short-chain" PFAS that are now more commonly used. These were absorbed at higher levels with nearly 60% of one short chain compound dose absorbed by the skin. The shortest carbon chain compounds examined, PFPeA (58.9 %) and PFBS (48.7 %) had the highest absorbed fractions of PFCAs and PFSAs respectively, with absorbed fractions of PFAS decreasing with increasing carbon chain length.

As PFAS are used in a range of makeup and creams applied direct to the skin this research is very relevant to assessing human exposure.

Australian National University (ANU) PFAS Health Study

The ANU studies [39] into community health effects was limited by lack of exposure data and other factors but still found cancer outcomes in three affected communities between 1983–2017 were higher than the general population. Katherine had estimated higher-than-expected rate of prostate cancer while Oakey had a higher incidence of laryngeal cancer and Williamtown had a higher incidence of kidney and lung cancers.

In the ANU Blood Serum Study blood, 2,587 people in three PFAS Management Areas were compared with 702 people in comparison communities. Exposed communities had higher levels in their blood of both PFOS and PFHxs; 29% to 42% of participants from the exposed communities had an elevated serum PFOS concentration and 48% to 55% had an elevated serum PFHxS concentration.

Exposed communities measured PFOS at 4.9 to 6.6 nanograms per millilitre (ng/mL), PFHxS 2.9 to 3.7 ng/mL and PFOA 1.3 to 1.8 ng/mL. While comparison communities returned blood levels of PFOS 2.5 to 3.3 ng/mL, PFHxS 0.7 to 1.2 ng/mL and PFOA 1.2 to 1.4 ng/mL.

Conflicting Standards and guidelines

In 2020, the European Food Safety Authority (EFSA) based on decreased immune responses observed in children, set a tolerable weekly intake (TWI) threshold for the sum of PFOA, PFOS, perfluorononanoic acid (PFNA), and perfluorohexanesulfonate (PFHxS) of 4.4 nanograms per kilogram of body weight per week.[40]

Australians, by comparison, are told they can tolerate far more PFAS in their bodies, in fact approximately 280 times more or 1260ng/ nanograms per kilogram of body weight per week.[41]

In July 2022, in response to human epidemiology data, U.S. regulators concluded that for PFOA and PFOS, *some negative health effects may occur at concentrations that are near zero and below our ability to detect at this time*. [42]

In 2024, the US Environmental Protection Agency (EPA) significantly reduced their Health Advisory levels for PFAS in drinking water: [43]

- 4 parts per trillion for PFOA
- 4 parts per trillion for PFOS

A standard based on the hazard of a mixture of four PFAS chemicals: PFNA, PFHxS, PFBS, and HFPO-DA (commonly known as Gen X)

- 10 parts per trillion for PFNA
- 10 parts per trillion for PFHxS
- 10 parts per trillion for HFPO-DA

The EU has limits of 100 nanograms per litre (ng/L) for the sum of 20 PFAS and 500 ng/L for the sum of all PFAS in drinking water. While, one of the most restrictive recommendations for drinking water is Health Canada's, with the sum of all PFAS being less than 30 parts per trillion. [44]

In comparison, Australian water guidelines remain at 70 ng/L (70ppt) for combined PFOS/PFHxS and 560 ng /L (560ppt) of PFOA. [45]

In defiance of the evidence of harm, Australian governments also increased the 'acceptable' levels' for PFAS in recreational waters, rivers, creeks and lakes. Australia's Recreational Water Quality Value for PFOS/PFHxS levels were doubled to 2,000 ng/L and PFOA 10,000 ng/L. In comparison, the EU restrict PFOS in inland surface water to 0.65ng/L.[46]

Australian Wildlife contaminated

PFAS accumulate in the blood, liver and kidney of wildlife including dolphins,[47] birds [48], fish,[49] turtles.[50] and other marine wildlife .[51] In Australia, sampling associated with HMAS Albatross, on the south coast of NSW, found high levels of PFAS in yabbies, mosquito fish, Australian bass and cattle serum.[52] Elevated levels of PFAS have also been found in fish, eels and ducks from a Gippsland wetland in eastern Victoria connected to the East Sale RAAF base.[53]

PFAS chemicals are toxic to aquatic organisms. Declines in survival rates of zebra fish following PFOS-exposure, were evident over generations.[54] In addition to traditional PFASs, (e.g., PFOS, PFOA, PFHxS, PFBS), over 330 other fluorinated chemicals have been detected in fish livers overseas.[55]

Fish Consumption

Fish consumption is a major source of human PFAS exposure. [56] A review of PFAS concentrations in wild fish from the Norwegian mainland, Svalbard, the Netherlands, the USA, the North Sea, English Channel and the Atlantic Ocean as well as farmed fish on the Dutch market was compared to the current European Food Safety Authority Tolerable Weekly Intake (4.4 ng kg-1b.w. per week). The data showed that using recent tolerable intake or reference dose values in the EU and the USA that even limited fish consumption would lead to exceedance of these thresholds. This was despite most concentrations falling below the EU environmental quality standard and would not be defined as polluted in the EU.

In Australia, frequent consumption of wild fish could pose health risks to some local populations. In the 27th Australian Total Diet Study, PFOS was found in canned tuna (0.070 µg/kg), prawns (0.018 µg/kg), saltwater fish fillets (0.011 µg/kg) [57] Cooking seafood does not reduce PFAS concentrations and in some cases can increase dietary exposure. PFOS, PFHxS and PFOA concentrations in school prawn effectively doubled after boiling while baking some fish also increased PFOS concentrations.[58]

In NSW EPA Investigations[59] found varying levels of PFAS in multiple fish species in Botany Bay and the Georges River and set dietary guidelines that restrict the consumption of Mulloway, Estuary Perch, Dusky Flathead, Silver Trevally, Tailor, Luderick, Sea Mullet.

Due to the elevated levels of PFAS in Australian Salmon (Arripis Trutta) caught in Botany Bay, it is recommended that this species is catch and release only. Numerous other fish advisories exist for other areas in NSW Including the Shoalhaven River, Saltwater Creek South West Rocks, Lake MacQuarie.[60]

Currently EPA Victoria warns not to eat the fish or eels from the Gippsland area's Lake Kernot, , Heart Morass Wetland, and areas of the Skeleton Creek Lower Catchment and Maribyrnong River catchment . [61]

Contaminated sites in Australia

By 2018, more than 90 high priority sites were being investigated for PFAS contamination in Australia including 26 Defence sites.[62] By 2024, NSWEPA had identified 51 contaminated sites in NSW alone.

The highly contaminated firefighting training centre at Fiskville in Victoria was the first PFAS-contaminated site to be publicly identified. In 2015, it was permanently shut down due to tests showing high PFOS levels in water. A farmer adjacent to the site was forced to cease selling animal produce after PFOS was found in the soil and sheep. High levels were also found in the farmer's blood and that of his children.[63]

Other PFAS-contaminated sites included metropolitan and regional airports, rural and urban firefighting stations, landfills and industrial sites. Twenty airports are being investigated for PFAS contamination.

Airservices Australia is responsible for airport firefighting at 56 sites which used 3M Light Water firefighting foam containing PFOS between the 1980s and 2000s. In 2003, Airservices switched to another foam, Ansulite, wrongly arguing it did not contain PFAS. In 2008 it began a program of preliminary site assessments for contamination. Areas around airports including Sydney, Melbourne, Perth, Gold Coast, Tamworth, Darwin are highly contaminated. Airservices moved to a PFAS-free alternative, Solberg RF6, at most airports in 2010.

While, the Federal Government was aware of serious contamination issues at the Gold Coast Airport as early as 2008 it did not inform the public until a decade later. Sampling in 2016 of groundwater at the airport detected high concentrations for PFOS ranging from 17.9 to 527 µg/L and PFOA concentration of 2.23- 37.1 µg/L. [64]

What to do with PFAS waste ?

In February 2019, destruction of solid and liquid wastes containing PFASs, PFOS and PFOA were trialed in a high temperature hazardous waste incinerator in South Australia wbut ere not successful.[65]

During a representative trial burning liquid PFASs waste, PFBA, PFOA and PFPeA were detected in the stack. Some PFAS were also detected in the bottom ash and leached into the quench waters. The trial failed the destruction requirements of the Stockholm and Basel Conventions. During the solid waste burning trial, PFAS (PFBA and PFPeA) were found in the stack emissions and a high number of PFAS compounds were found in the bottom ash.

In the cement kiln PFAS trials, relatively low destruction and removal efficiency for some of PFASs suggest that significant quantities of PFAS compounds were released to atmosphere. On this basis, the trial of PFAS incineration was not successful.

Australia currently has no effective destruction method for the 'Forever Chemicals'.

What needs to be done ….

Australian governments must :

- Address PFAS as a class with an aim to restrict and eliminate the use of all PFAS.
- Update Australian drinking water guidelines to reflect United States drinking water standards and the finding that there is 'no safe level of PFAS exposure'.
- Substantially improve water treatment at point of distribution, ensuring all water providers use BAT/BEP to achieve PFAS contamination as close to zero as possible.
- Ratification of the three Stockholm Convention PFAS and support the proposed global ban on the PFCAs as recommended by the POPRC
- Immediately remove PFAS from food packaging
- Address PFAS in imported consumer products with a priority focus on personal products and children's products.
- Eliminate PFAS in pesticides and pesticide containers
- Increase environmental monitoring and resultant the information that is provided to the community regarding contamination
- Initiate a claim against 3M to help finance.
- Substantially improve Australia's regulatory system so that Australia no longer allows the import and use of chemicals and products that we know nothing about.

Endnotes

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