March 2, 2020

Darin Rice
Program Manager
Hazardous Waste and Toxics Reduction Program
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7696

Dear Mr. Rice:

We, the undersigned organizations, applaud the Department of Ecology (Ecology) for the work it has undertaken to develop this first list of priority consumer products for future regulation under Safer Products for Washington (RCW 70.365). We support inclusion of all of the products proposed by Ecology in its draft report and request that additional products be added to protect the health of people and the environment.

Under Safer Products for Washington, Ecology has the authority to take bold action to ban classes of chemicals or require disclosure. This is critically important because the classes of chemicals identified in the law are posing serious threats to health and the environment, particularly for sensitive populations and sensitive species. We request designation of the following products as priority to prevent these harmful classes of chemicals from contaminating our food, water, wildlife and people:

- Furniture upholstery and other textiles (drapes, tablecloths), floor treatments (waxes, polishes), apparel, and personal care products and cosmetics containing PFAS;
- Insulation containing organohalogen flame retardants;
- Personal care products, cleaning products, and food contact materials containing phthalates;
- Apparel and paint containing industrial phenolic compounds; and,
- Paints and dyes containing PCBs.

We would like to provide the following information that demonstrates additional products should be added as priority products for each chemical class.

PFAS

We support Ecology's proposal to identify carpet and carpet treatment as a priority product. However, in order to address other large sources of PFAS exposure in homes and workplaces, we ask that upholstery for furniture, textiles (tablecloths and other décor items), floor treatments and apparel be identified as priority products. In addition, personal care products and cosmetics containing PFAS should be identified a priority product (also see attached comments dated September 6, 2019).

- Toxic-Free Future recently completed a peer-reviewed study in partnership with Indiana University to look at PFAS in childcare centers. For key PFAS—those found in the highest concentrations—levels were higher in the childcares than those found in residential settings in North America. This was true for childcares without carpeting, indicating that other sources, including floor treatments, upholstery, and apparel are also important sources.

- Companies are adopting restricted substances lists for PFAS for many of these products and safer alternatives are being adopted.

- A 2018 analysis of personal care products and cosmetic ingredients identified 13 different PFAS chemicals in nearly 200 products from 28 brands, including cosmetics, shaving cream and sunscreen. Addressing these products is particularly important for women. Applying PFAS directly onto our bodies is particularly troublesome given the potential for hormone disrupting effects such as reduced fertility. At least 12% (1 in 8) women of reproductive age in the United States have difficulty getting pregnant or carrying a pregnancy to term.

- A new study provides important evidence that water repellent treatments containing PFAS degrade over time and release problematic PFAS, including volatile fluorotelomer alcohols and highly persistent acids.

Flame Retardants

We support Ecology's proposal to identify plastic device casings for electric and electronic equipment containing flame retardants as a priority product. Ecology should move quickly on organohalogen and other toxic flame retardants in plastic electronic enclosures for televisions for the following reasons:

- Ecology and the Department of Health have been working on flame retardants for the past decade and it is clear that plastic television enclosures continue to contain harmful organohalogen flame retardants. Toxic-Free Future completed two recent studies, Toxic TV Binge and Toxic TV Reality, demonstrating this.

- The Department of Ecology's 2008 report on safer alternatives for flame retardants in television housings concluded non-halogenated, safer substitutes were available.

- The Consumer Product Safety Commission put out a warning on organohalogen flame retardants in 2017 stating:

"To protect consumers and children from the potential toxic effects of exposure to these chemicals, the Commission recommends that manufacturers of children's

> *products, upholstered furniture sold for use in residences, mattresses (and mattress pads), and **plastic casings surrounding electronics** [emphasis added] refrain from intentionally adding non- polymeric, organohalogen flameretardants (''OFRs'') to their products."*

- Europe recently banned organohalogens in televisions and other electronic displays.

We also request that building insulation **(polystyrene insulation, polyisocyanurate insulation and spray foam insulation)** containing organohalogens be identified as a priority product.

- Organohalogen flame retardants are widely used in insulation for residential and commercial buildings.

- Safer alternative insulation without organohalogen flame retardants is available and can be found here: https://living-future.org/declare/?status=red_list_free

- A report by Natural Resources Defense Council and Healthy Building Network identified spray foam insulation as particularly problematic because it is often used in low-income housing retrofits. The report describes flame retardants and other chemicals in the insulation that can cause health problems for workers and residents. There are safer alternatives that can be used: https://www.nrdc.org/experts/michele-knab-hasson/new-prescription-healthy-building-retrofits

Phthalates

We support Ecology's proposal to identify vinyl flooring and cosmetic fragrances containing phthalates as priority products. These are important sources of exposure to people and the environment.

We do, however, request Ecology consider expanding the existing proposal and include additional products:

- Expand the cosmetic fragrance category to include all phthalates in cosmetics, personal care products, and cleaning products.

- Identify food packaging and food processing equipment and parts as priority products.

Vinyl flooring

We support Ecology's proposal to identify vinyl flooring as a priority product containing phthalates.

The three largest home improvement chains, Home Depot, Lowe's, and Menard's have eliminated phthalates in flooring, demonstrating the availability of safer alternatives. Regulatory action is needed to transition all companies to phthalate-free flooring.

Expand the cosmetic fragrance category to include all cosmetics, personal care products and cleaning that contain phthalates.

The use of phthalates in fragrance is well known. Phthalates in body sprays, perfumes, and colognes should rightfully be addressed by Ecology through Safer Products for Washington.

However, phthalates are in common use in many more beauty, cosmetic, and personal care products. Addressing phthalates for these products is particularly important for women and people of color. Women are more likely to be heavy buyers of beauty products. African American women purchase 9 times more ethnic hair and beauty products that other groups of women, and Asian Americans spend more than 70% more than the national average on skin care products.

In one study, African American women, who are more likely to use douches and other fragranced feminine cleansing products, had 150% higher exposures to diethyl phthalate.

This evidence supports our request that Ecology consider phthalates in all personal care products and cosmetics. Also see: The environmental injustice of beauty: framing chemical exposures from beauty products as a health disparities concern.

Many companies have adopted restricted substances lists for phthalates in personal care products, including Amazon, Costco, Walgreens, Walmart, Target, and Whole Foods. These companies are looking at the phthalates in a broader product category, and Ecology should take this approach as well.

Many cleaning products are fragranced, and fragrances commonly contain phthalates as solvents or as fixers. A walk down the cleaning product aisle at any supermarket reveals how common fragrances are used in cleaning products such as detergents.

Required disclosure of four phthalates (DEHP, BBP, DBP, and DEP) by manufacturers under the state of Maine's Kids Safe Products Act shows common use of the phthalates in cleaning products including bathroom cleaners, bathroom disinfecting cleaners, room deodorizers, glass cleaners, Scotchgard surface protector, copper and brass polish, cook top cleaner, stainless steel cleaner, carpet cleaner, and fabric and upholstery cleaner: https://www.ecocenter.org/healthy-stuff/reports/maine-phthalate-data-2016-report

Companies that have restricted phthalates in the cleaning products they sell include Target, Walgreen's, Costco and others.

Phthalates in Food Contact Materials

We request Ecology also list food-contact materials, i.e. materials and products used for food production, processing, and packaging, as a priority product for phthalates.

Primary product categories of concern in this area include dairy, production equipment, and processing equipment. Researchers have demonstrated that phthalates migrate out of dairy tubing into milk during mechanical milking. Studies have also shown that storage tanks on the farm can contaminate milk during the production process. Possible sources are sealants, gaskets, and milk meters.

Several studies have shown that dairy products can be contaminated with phthalates when they are processed, or the phthalates can accumulate in fattier end product such as creams and milks with higher percentages of fat. Phthalate contamination of milk product can occur in tanks, through contact with tubing and sealants in the plant. Phthalate migration is accelerated by heat, such as the heat of pasteurization, and phthalate concentrations increase when milk product is dehydrated.

Phenolic Compounds

We support Ecology's listing of food and drink cans and thermal papers as priority products under the Safer Products for Washington law based on their use of the priority chemicals bisphenols. These two product categories are thought to be the major source of human exposure to BPA. Ecology has clearly demonstrated that both products are a significant source of bisphenols in Washington, leaving many of our residents and our wildlife at risk of exposure.

Similarly, we support Ecology's listing of detergents for phenolic compounds, as they are known to be a major source. Given the high levels of exposure to alkylphenol ethoxylates (APEs) in the home and in the environment, we ask that Ecology also list apparel and paint, both product categories known to contain these chemicals.

Numerous companies have listed APEs on restricted substances lists including: Staples, Home Depot, Target (detergents and paints) and Levi Strauss & Co, Costco. Textile eco-labels such as Öko-Tex 1000 do not allow the use of APEs.

PCBs

We support Ecology proposing inks containing PCBs and request that dyes and paints be added.

Since these chemicals were banned 30 years ago, levels in our bodies have declined. And yet, we still face levels that could be causing harm—decades after regulatory action—and PCBs are still found in products. PCBs are also a major contaminant in Puget Sound where they are found at very high levels in salmon and in endangered orca whales.

- Puget Sound's endangered orcas have accumulated PCBs to the point that they rank among the most contaminated marine mammals in the world.
- Levels in orcas already exceed those needed to cause health effects such as immune system depression.

Thank you for your consideration. If you have any questions, please contact Laurie Valeriano at 206-200-2824.

Sincerely,

Laurie Valeriano
Executive Director
Toxic-Free Future

Michelle Chow
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Attachment
PFAS Priority Product Recommendations
Toxic-Free Future
September, 2019

1. Carpets and Upholstery

Recommendation: Carpets, carpet-care products, upholstery, and upholstery-care products should be named as a priority product and uses phased out.

Estimated volume in the consumer product

According to the USEPA, textiles, together with carpets and carpet-care treatments constitute the first and second largest categories of the global fluorotelomer market, estimated at 20 million pounds in 2006.[1] In modeling completed by the government of Switzerland, including production and use and end-of-life, carpet protection was estimated to emit 37% and textile treatments (including upholstery) 19% of total PFOA emissions.[2]

Estimated volume or number of units of the consumer product sold or present in the state

In the United States, 2017 market data shows carpets and rugs constituted 57% by volume of the 19.7 billion square foot floor covering market, with uses in both residential and commercial settings.[3] Washington can be estimated to constitute a share proportionate to its population (2.3% of the U.S. population), or approximately 450,000,000 square feet carpet purchased in 2017.

Potential for exposure by sensitive populations or sensitive species

Children are exposed to PFAS when they are used to treat carpets and upholstery. As noted above, carpets and upholstery are one of if not the top use for PFAS in most homes. As such, they are expected to be the largest contributor to airborne PFAS, which have been associated with serum PFAS concentrations.[4, 5] In a large study cohort, researchers found that sleeping in a room with carpet or rug was associated with higher serum PFAS levels.[6]

Treated textile products have been found to emit fluorotelomer alcohols (6:2, 8:2, and 10:2 FTOHs) into air, with outdoor apparel emitting up to approx. 600 ng ∑FTOHs per hour.[7] Indoor air has approximately two orders of magnitude higher concentrations of FTOHs than outdoor air, with concentrations in recent studies showing mean levels of ~13 ng/m^3 in residences and up to ~400 ng/m^3 in retail shops including outdoor, furniture, and carpet retailers.[7-9] Based on testing of various indoor environments including offices, outdoor retailers, and carpet retailers, researchers have concluded that carpets and textiles are likely the dominant indoor source of

these compounds.[7] Airborne FTOHs can degrade biotically or abiotically to perfluorocarboxylic acids (PFCAs), so their presence in indoor air contributes to exposure to PFCAs such as PFOA when FTOHs are transformed biotically after inhalation or after they are transformed to PFCAs in the indoor environment.[10] There is considerable uncertainty regarding the extent of transformation of FTOHs to PFCAs in the human body, so exposure estimates for this route vary depending on assumptions. They indicate, however, that depending on the indoor environment, inhalation of FTOHs may constitute the largest or one of the largest PFAS exposure routes, equivalent to or exceeding exposure from food.[7] This conclusion is supported by evidence of the association between FTOH concentrations in indoor air and serum PFCA levels. For example, Fraser et al. found that concentrations of FTOHs in air accounted for ~36% of the variation in serum PFOA levels.[5]

Elevated levels of precursors to perfluorosulfonic acids (PFSAs) have also been found in indoor air in furniture, carpet, and outdoor retailers.[9] As with FTOHs, these compounds are also transformed biotically and abiotically, and humans are exposed to both the precursors and the persistent transformation products.

Children are also exposed to PFAS before birth through placental transfer and in infancy through breastfeeding, so pregnant women are also a sensitive population. Their exposure in homes and workplaces is also relevant, and carpets and upholstery are expected to be major sources in both environments.

Some populations may have greater than average exposure, including residents living in areas where drinking water is contaminated by landfill leachate or biosolids, workers in manufacturing or retail of carpets and upholstery, or those eating food contaminated by application of biosolids, reclaimed water, or manufacturing emissions.[11, 12]

PFAS have been detected in surface water in Washington and may impact sensitive species including Chinook and Southern Resident Killer Whales. PFAS have been show to affect the immune system at low levels of exposure, and have been implicated in illness and die-offs of marine mammals.[13, 14]

Potential to be found in the outdoor environment

Wastewater is a major route of transfer of PFAS to the outdoor environment, estimated at 85% of releases for PFOS.[15] Carpets and upholstery are a likely source of PFAS to wastewater treatment plants through the laundry water pathway, when PFAS in dust or air adsorb to clothing.[16] They may also enter wastewater when carpets or upholstery are cleaned. Landfilled carpets contribute to the high levels of contamination of landfill leachate, which in many cases is directed to wastewater treatment plants. The mass of measured PFAS from landfills in the U.S. to wastewater treatment plants has been estimated at 563 to 638 kg for one year.[17] PFAS are not destroyed in the wastewater treatment process; the process is a source of volatile PFAS to air, and higher concentrations of terminal breakdown PFAS are typically seen in effluent as degradation occurs during the process.[18] Polymeric PFAS of the type currently used to treat

carpets and upholstery (side-chain fluorinated polymers) have also been detected in high concentrations in biosolids-amended soil.[19]

Regulatory action by another state or nation

The state of California has proposed PFAS in carpets and rugs as a priority product, and accepted comments on its product-chemical profile in 2018.[20]

The availability and feasibility of safer alternatives

A number of alternatives are currently in use in carpets and rugs. Sulfonation of carpet and rug fibers is used to provide a stain-blocking function by companies such as the major carpet manufacturer Interface. California's Priority Product Proposal for PFAS in Carpet provides details on specific brands using PFAS-free treatments for stain prevention.[20] The Danish Environmental Protection Agency reviewed alternative stain-repellent treatments for textiles and published its analysis of their hazards.[21] In addition, California's report states the shape of the yarn can be modified to achieve stain-repellency, with a wider lobe making the carpet more durable and stain-resistant, without an additional treatment.[20] The Home Depot has just announced it will not sell PFAS-containing carpets and rugs after December 31, 2019.

For upholstery, alternative treatments may include silicone-based treatments, dendrimers, and nanotechnology-based treatments. A number of companies market silicone-based treatments, advertising water- and/or stain-repellency.[22] Some dendrimer-based products are also on the market, though fluorine-free products do not appear to offer oil repellency.[23] A number of companies are now marketing fluorine-free water- and stain-protection, such as Chemours' Teflon EcoElite, the nanotechnology-based GreenShield, and Crypton's C-Zero.[24-26] Upholstery fabrics that are PFAS-free have been identified and listed by the Center for Environmental Health and Clean Water Action in their *Environmentally Preferable Furniture* resource.[27] Healthier Hospitals also maintains a list of furniture and fabric options that are PFAS-free.[28] Organizations that have a policy to prefer PFAS-free upholstery include the States of Minnesota and New York, Harvard, Yale, the City and County of San Francisco, the City of Portland, Kaiser Permanente, and many others.

A directory of PFAS-free upholstery and carpet products has been compiled by Green Science Policy Institute, avaialable at https://pfascentral.org/pfas-basics/pfas-free-products/. PFAS-free products on this list include:

- IKEA, all furniture products.
- Healthier Hospitals Furniture List, all products, includes multiple brands.
- Engineered Floors carpeting, all products.
- Interface carpeting, all products.
- Shaw carpeting, all products.
- Tarkett carpeting, all products.

Identification in a chemical action plan or other reports or information

Carpets, rugs, and upholstery have been identified as key products in the Draft Chemical Action Plan.

2. AFFF Firefighting Foam

Recommendation: All uses of fluorinated firefighting foam should be phased out, with a clear timeline and plan for restricting the remaining uses.

Estimated volume in the consumer product

AFFF is sold as a concentrate to be mixed with water for use. The fluorinated content of foam is likely at the percent level, in the form of fluorosurfactants.

Estimated volume or number of units of the consumer product sold or present in the state

The draft Chemical Action Plan (CAP) estimates that 386,688 gallons of fluorinated firefighting foams are maintained in Washington State by fire departments, civilian airports, military installations, petroleum storage and transport, and road tunnels.

According the draft CAP, about 37,000 gallons are estimated to be used each year.

Table 6 – Estimated AFFF quantities in Washington State

AFFF use sector	Estimated AFFF quantity	Estimated annual use
Fire departments	118,577 liters	7% or 2,218 liters
Fire extinguishers*	Not able to estimate*	Unknown
Civilian airports	61,867 liters	12% or 7,424 liters
Airport hangars	332,476 liters	9% or 29,923 liters
U.S. Military installations	121,131 liters	10% or 12,113 liters
Petroleum refineries	295,262 liters	12% or 35,431 liters
Other petroleum facilities	388,003 liters	12% or 46,560 liters
Merchant ships/Oil cargo tankers*	189 to 3,785 liters per vessel*	Unknown
Oil response storage	57,879 liters	12% or 6,945 liters
Seattle tunnels	88,579 liters	None
TOTAL storage	**1,463,774 liters**	**140,614 liters** (11%)

*not included in total

Sale to several of these users is still permitted under Washington's laws, including civilian airports, military airports and ships, refineries, and other petroleum facilities.

Potential for exposure by sensitive populations or sensitive species

Use of PFAS-containing firefighting foam creates significant potential for exposure by sensitive populations and species. The following should be considered:

1) Firefighters have a higher risk for certain cancers than the average population. The National Institute for Occupational Safety and Health assessed cancer incidence in firefighters from three cities, and found they had increased incidence of several cancers, especially those associated with the respiratory and digestive systems.[29] A meta-analysis of 32 studies, published in 2006, found an association of firefighting with increased incidence of cancers including multiple myeloma, prostate cancer, and non-Hodgkins lymphoma.[30] The personal protective equipment (PPE) does not prevent all toxic exposures, with gaps in the hood, pants, gloves and boots allowing penetration.[31] In addition, the PPE often contains PFAS.

2) All workers at airports, refineries, and chemical plants likely also face higher exposures given fluorinated foams are used widely for vapor suppression, not only for fire response.

3) The contribution of firefighting foam to drinking water contamination is well documented.[32] Pregnant women, children, the elderly and men and women of reproductive age constitute sensitive populations who are exposed through contaminated drinking water.

Potential to be found in the outdoor environment

Firefighting foam is primarily used outdoors and is therefore released directly to the outdoor environment. The product contains precursors, mostly unknown, that transform in the environment to intermediates and terminal breakdown products that can be measured. As a result of the outdoor use and this transformation, the use of AFFF has been associated with contamination of soil, groundwater, and surface water.

Regulatory action by another state or nation

In January 2018, the Australian state of Queensland became the first governmental body in the world to ban fluorinated firefighting foams, with no exemptions. In the United States, states have taken the lead in addressing fluorinated foam use. Washington State passed the first law in the nation restricting the sale of fluorinated foams in 2018 and prohibiting their use in training, with exemptions for oil terminals and refineries, chemical plants, and where required by federal law. Colorado, New York, and New Hampshire passed similar laws in 2019. The states of Virginia, Kentucky, Minnesota, Georgia, and Arizona all passed laws in 2019 that ban the use of fluorinated foams in training but exempt other uses.

On the federal level, the U.S. FAA Reauthorization Act of 2018 directed the FAA to eliminate the requirement for civilian airports to use PFAS-containing firefighting foams.

Congress is now considering the National Defense Authorization Act for fiscal year 2020, which contains provisions in both the House and Senate versions to end the military use of fluorinated foams.

The availability and feasibility of safer alternatives

Fluorine-free foams are in widespread use around the U.S. and the world, including at airports and refineries. IC2's 2019 report identifies 100 products from 24 manufacturers.[33] In a July 2019 article in International Airport Review, Dr. Ian Ross listed 20 major international airports that have switched to fluorine free, including London Heathrow, Paris Charles de Gaulle, Copenhagen, Stuttgart, and Melbourne.[34] He states, "Environmental and public health concerns, regarding PFASs, developing since 2000, has stimulated significant innovation to create F3 foams, meaning that over the last 20 years, fire-fighting foams and their delivery systems have evolved to be far more effective, without a need for PFASs in most circumstances." The article also notes tests conducted in 2018 at Dallas Fort Worth found that with compressed air foam (CAF) application, fluorine free foams can effectively extinguish fire at half the usual application rate. With a lower cost by volume for fluorine free foams compared to PFAS-containing foams, switching also creates a significant cost savings.

Major oil companies have had a program to actively test firefighting foams, including fluorine-free foams, for a number of years via the consortium known as LASTFIRE. LASTFIRE is “A consortium of international oil companies developing best industry practice in storage tank Fire Hazard Management through operational feedback, networking, incident analysis, and research.”[35] It currently includes 19 oil company members. The consortium tracks incidents and provides information on prevention and mitigation, and has created its own foam test specific to large atmospheric storage tanks. Most recently, it conducted tests showing fluorine-free foam using a compressed air foam (CAF) pourer, achieving extinguishment of a 40 m pan at half the NFPA application rate.[35] In 2016, the consortium issued a position paper on foam that details response strategies including defensive, controlled burn down, or offensive, with foam application through fixed systems or monitor equipment.

LASTFIRE generally does not make its results public, but in an interview, its director Niall Ramsden stated the following:

" In our testing, driven by end users and not foam companies, we have achieved good performance with fluorine-free foam on fairly large hydrocarbon fires. We have extinguished 35 foot diameter tank fires with fixed systems and Monitor attack using fluorine-free foams at standard NFPA application rates. Some companies have already adopted the use of fluorine-free foams for certain types of incidents at refineries and tank farms. It is incorrect to say this foam will not work but LASTFIRE recognizes[36] that further work is required to assess their performance for some major scenarios—as indeed is the case for some new generation C6 based products."[37]

Refining New Zealand converted to fluorine-free in 2010 after testing a product and finding it to be adequate, due mostly to concern about the nearby aquatic environment.[38] In the decade since, the refinery has maintained its focus on prevention and used fluorine-free foam to put out several process fires, cited by the refinery's fire chief as the most dangerous type of refinery fire.

In Queensland, Australia, 85-90% of AFFF, at petroleum facilities throughout the state, has been switched out for fluorine-free foam under the state policy banning PFAS-containing foams.[39] Australia's largest oil company, Caltex, is currently transitioning to fluorine-free at all facilities in Australia for all uses outside of crude oil tanks.

Identification in a chemical action plan or other reports or information

AFFF has been identified in the draft Chemical Action Plan as a major use resulting in environmental contamination, and, as noted above, has been addressed by the Washington State Legislature.

3. PFAS in Apparel

Recommendations

- PFAS chemical use in all children's and adult apparel should be phased out, with a clear timeline. PFAS chemical use in work wear should be phased out unless there are no clear substitutes that provide essential functions in the work place.
- The Department of Ecology should request information on product ingredients from manufacturers of products that are known or suspected to contain PFAS, such as performance wear, in order to better understand major product categories PFAS are used in.

PFAS are used in many types of apparel that are designed for the outdoors because of their rain, oil, and dirt repelling properties. Typical items of apparel that PFAS chemicals are used in include raincoats, rain pants, skiwear, snowsuits, umbrellas, and outdoor footwear. However, the use of PFAS in performance outdoor wear for running, walking, and biking – such as lightweight jackets, pullover tops, and running pants – is increasing.[40] [41] Chemours (formerly Dupont) promotes on its website (2018) products that have a Teflon finish (https://www.chemours.com/Teflon/en_US/NIK/wheretobuy_fabric.html?src=to_TFP_wtb_from_TFP_discover). Example products include Craftsman brand workwear, long pants, short pants, jackets, short sleeved shirts, as well as pet beds, diaper bags, and backpacks.

PFAS are used in apparel in three ways. First, fluoropolymers including PTFE are used as a laminate for highly porous fabrics for breathable water proofing (for example Gore-Tex). Often the PTFE layer is under the outermost fabric layer of the garment. Second, water-, dirt-, and oil-

proofing of apparel is done with a fluorinated side chain polymer that is applied to the fibers. If applied as a liquid impregnating agent, the textile is soaked with the product and is then dried and cured.[42] Sometimes fluoropolymer laminates and applied fluorinated side chain polymers are both used in the same garment. Third, liquid PFAS impregnating product can be readily purchased in spray bottles and applied to apparel by the consumer for waterproofing after the apparel has been used.[40]

Estimated volume in the consumer product

The Swedish Chemicals Agency (KEMI) states that when PFAS are used in textiles they contribute 2 – 3% of the fiber weight,[40] while the Federal Environment Agency of Germany (Umweltbundesamt) states that when side-chain fluorinated polymers are used they contribute 0.2 – 0.5% by weight to the fiber.[42] According to the EPA PFAS action plan, "textiles and apparel account for approximately 50 percent of the volume of fluorotelomers" and, "apparel makes up about 10 percent of total fluoropolymer use, based on total reported production volume."[1]

Estimated number of units of the consumer product sold or present in the state

There is no market data publicly available on the numbers of different types of outdoor wear Washington state residents purchase or own. We estimate the number of units of apparel containing PFAS sold or present in Washington to be at least 2,750,000, based on data in two product testing studies carried out on outdoor wear purchased in the US.[43] [44] The percentage of children's outdoor wear and other children's products that contain PFAS was estimated by the Danish EPA to be lower.[45] Using this smaller estimated percentage, the estimated numbers of children in Washington with PFAS in their outdoor gear would still be substantial: 23,000 – 69,000 children ages 5 and under with PFAS in outdoor wear, and 83,000 – 250,000 children and youth with PFAS in outdoor wear. The assumptions and calculations for these estimates are given in the appendix.

Babies' and children's bibs are another apparel item that often contains PFAS. In a study done on apparel purchased in North America (Canada, USA, and Mexico), 14 out of 29 (48%) of bibs tested contained PFAS chemicals.[43] Assuming 100% of babies in Washington state wear bibs every day and almost 88,000 babies are born in Washington every year (https://www.cdc.gov/nchs/fastats/state-and-territorial-data.htm), this would mean that approximately 42,000 babies every year use bibs containing PFAS in Washington.

Potential for exposure to priority chemicals by sensitive populations or sensitive species

The potential for sensitive populations or sensitive species as a result of PFAS use in apparel is similar to that given above for carpeting and upholstery:

Exposure of people to PFAS used in textiles can occur during the production process or during use.[42] Babies, children, pregnant women, and workers with occupational exposure to PFAS in textiles are sensitive populations. Volatile PFAS can be emitted into indoor air and expose

children and workers (see above discussion on PFAS in indoor air). Based on testing of various indoor environments including offices, outdoor retailers, and carpet retailers, researchers have concluded that textiles as well as carpets are likely the dominant indoor source of these compounds.[46] Researchers have demonstrated that outdoor wear made of textiles emit FTOHs into the air.[46]

Children can accidentally ingest PFAS when they mouth PFAS containing textiles. In a 2017 study on North American products, researchers looked at PFAS migration into artificial saliva from two baby bibs, a children's rainsuit, and a waterproof baby changing mat – all of which were known to contain PFAS.[43] Artificial saliva from all products tested contained PFAS, with the total PFAS (31 chemicals) results ranging from 0.50 – 7.8 ng/g.[43] In the 2015 Danish EPA study, eight of the 15 children's outdoor wear products analyzed for PFAS chemicals were used in an artificial saliva migration test.[45] All eight tested had PFAS in the artificial saliva samples with the total PFAS (37 chemicals) results ranging from 0.13 – 2.87 ug/m^2 of textile.

Household fabric spray treatments can also be a source of exposure to babies and young children when the products are used in the home, when a spray bottle is spilled, or a child inadvertently handles a bottle. Researchers in the US detected 372 ng/g total FTOHs in one household carpet/fabric treatment product, while the other sample tested was below the practical quantification limit.[44] Researchers in Japan analyzed 9 samples of fabric and textile spray for PFAS chemicals and their precursors.[47] All 9 samples contained total PFAS (32 chemicals) with concentrations ranging from 32 – 30,000 ng/g (highest found was in the oldest product purchased in 1990's). These researchers did not analyze for FTOHs but they did analyze for other precursors of PFOS and PFOA; these precursors were in 100% of samples. Researchers in Germany analyzed 16 samples of impregnating sprays, 100% contained FTOHs[48] and other PFAS. FTOHs were at the highest levels, with the highest detection in this study being 8:2 FTOH at 719,300 ng/g.

Almost 100% of people in the US carry PFAS chemicals in their bodies, including pregnant women. PFAS can be transferred to babies from their mothers in utero or through mothers' breast milk – mothers in turn are exposed to PFAS in textiles they use or have in their homes.

Workers can experience exposure to PFAS during manufacture of PFAS-containing textiles and apparel, or when they are in frequent contact with PFAS-containing apparel as part of their job.

<u>Retail and other workplace exposures:</u> In a study of indoor air in 11 workplace sites (carpet shop, office interiors, car interior, outdoor and sportswear shops, shoe shops, kitchen, and metal shops), indoor air in shops selling outdoor textiles, carpets, and sportswear had the highest FTOHs levels.[46] Based on this study, researchers have concluded that carpets and textiles are likely the dominant indoor source of these compounds.[46] Diet is often considered the major route of PFAS exposure to people; however, these authors found that for people living or working in indoor environments with slightly elevated FTOH levels in the indoor air, estimated PFOS exposures via diet and indoor air were in the same order of magnitude.[46]

Health care: PFAS chemicals are commonly used in textiles in health care settings. This includes textiles used for disposable hospital gowns, surgical gowns and masks, and hospital uniforms (and other uses such as curtains and upholstery).[49] Five out of five samples (100%) of treated nonwoven medical garments tested in one study contained FTOHs ranging from 419 – 1460 ng/g total FTOH.[44]

Firefighting: Testing of firefighters turnout gear has shown that new gear tested by Graham Peaslee of Notre Dame University has up to 1 – 4% of fluorinated PFAS in the textile (unpublished data) https://station-pride.com/2017/09/07/fire-gear-pfoa-the-data-the-real-cancer-in-your-gear-follow-up/.

Data collected by Washington state's Department of Ecology under Washington's 2018 PFAS firefighting foam and gear law, indicates numerous companies are using PFAS for firefighting turnout gear. This includes:

- Tencate Fabrics – PFAS in firefighter gear outer shells and barrier fabrics.
- FireCraft Safety Products - PFAS in some gloves made for firefighters.
- Fire-Dex – PFAS in turnout gear, gloves, hoods.
- CrewBoss – PFAS in turnout gear with the number "12" in the product number.
- Globe Manufacturing – PFAS in turnout gear and boots.
- Lion Protects – PFAS in turnout gear.
- Shelby Specialty Gloves – PFAS in gloves.
- True North Gear – PFAS in wildland fire gear.

Military: A report for Defence Canada provided the following instances of military personnel using PFAS-treated apparel:[36]

Commercially available fluorine-based coatings for apparel used by military personnel include:

- StainSmart by Miliken & Company – used in US Coast Guard Operational Dress Uniform and in the US Marine Corps optional dress white cover.
- NUVA N1811 by Arachroma (formerly Clariant) – used in military uniforms.
- Lurotex Duo by BASF.
- Asahi Guard E-series by AGC Chemicals America – used for work clothes and uniforms in emergency response and military sectors.
- Ruco-Guard AFC6 by Rudolf GmBH – used in military clothing.
- Nansosphere by Schoeller Technology AG – used in the military and police markets.
- EverShield by UltraTech International Inc. – used by the US Army.
- Fluorolink P56 by Solvay.
- Scotchgard Protector from 3M.
- Unidyne TG-5601.

Other: Occupational exposures may also occur from the use of PFAS in sportswear for athletes and coaching staff, outdoor work wear, protective gear used in industry and for emergency response personnel other than firefighters. Sears' Craftsman brand work wear with Teflon is promoted on Sears' website (https://www.sears.com/search=teflon) and includes work wear

such as carpenter pants, painter pants, long and short sleeved shirts, coveralls, bib overalls, jeans, reflective sweatshirts, and utility jackets.

Because children are also exposed to PFAS before birth through placental transfer and in infancy through breastfeeding, pregnant women are also a sensitive population.

Some populations may have greater than average exposure, including residents living in areas where drinking water is contaminated by landfill leachate or biosolids, workers in manufacturing or retail sales of apparel, or those eating food contaminated by application of biosolids, reclaimed water, or manufacturing emissions.[11, 12]

PFAS have been detected in Washington state in surface waters of urban lakes, in wastewater treatment plant effluent, freshwater fish fillets and fish livers, and in osprey eggs.[50] PFAS have been detected in the surface waters of Puget Sound[51] and in Puget Sound sediments.[52] PFAS may impact sensitive species including Chinook salmon and Southern Resident Killer Whales.[53] PFAS have been shown to affect the immune system at low levels of exposure, and have been implicated in illness and die-offs of marine mammals.[13, 14]

Potential to be found in the outdoor environment

The potential for PFAS chemicals to be found in the outdoor environment as a result of PFAS use in apparel is similar to that given above for carpeting and upholstery:

Wastewater is a major route of transfer of PFAS to the outdoor environment, estimated at 85% of releases for PFOS.[15] Studies of wash water from laundered outdoor wear have shown that PFAS release into the water[42, 43] and therefore are a likely source of PFAS to wastewater treatment plants. Landfilled apparel contributes to the high levels of contamination of landfill leachate, which in many cases is directed to wastewater treatment plants. The mass of measured PFAS from landfills in the U.S. to wastewater treatment plants has been estimated at 563 to 638 kg for one year.[17] PFAS are not destroyed in the wastewater treatment process; the process is a source of volatile PFAS to air, and higher concentrations of terminal breakdown PFAS are typically seen in effluent as degradation occurs during the process.[18] Side-chain fluorinated polymeric PFAS used to treat apparel have also been detected in high concentrations in biosolids-amended soil.[18]

Regulatory action by another state or nation

Washington state passed a law in 2018 that requires manufacturers of PFAS-containing firefighting gear to notify anyone purchasing the gear that it contains PFAS chemicals. Washington state also has a requirement that manufacturers of children's products, which includes apparel, report to the state if products they sell in Washington contain PFOA and related substances and PFOS and its salts. Vermont requires manufacturers of children's products to report to the state if products they sell in Vermont contain PFOA or PFOS and a fee is charged to the manufacturer to report. Oregon requires manufacturers of kids' products to

report to the state if products they sell in Oregon contain PFOS and a fee is charged to report. California added PFOA and PFOS to the Proposition 65 list of chemicals.

The availability and feasibility of safer alternatives

A directory of PFAS-free apparel products has been compiled by Green Science Policy Institute and is available at: https://pfascentral.org/pfas-basics/pfas-free-products/. PFAS-free products in this directory include:

- Columbia Outdry products - includes jackets, pants, and footwear.
- Jack Wolfskin, all products – includes pants, jackets, gloves, scarves, and more.
- Marmot EVODry products – includes jackets and rain pants.
- Nikwax, all products – includes spray on and wipe on waterproofing after care products.
- Paramo, all products – outdoor clothing, use Nikwax waterproofing treaments.
- Benneton apparel.
- Burberry apparel, all products.
- C&A apparel, all products.
- Esprit apparel.
- Levi Strauss & Co. apparel, all products.
- H&M apparel, all products.
- Mammut apparel, sports climbers and urban use products.
- Adidas footwear, all products.
- AllBirds footwear, Mizzle products.
- Keen footwear, all products.
- Reebok footwear, all products.

The Danish Environmental Protection Agency reviewed alternative stain-repellent treatments for textiles and published its analysis of their hazards. Alternatives included silicone or paraffin chemistries, polymer coatings such as PVC or polyurethane, and dendrimer-based chemistries.[21] Dendrimers are repetitively branched molecules leading to monodisperse, tree-like structures. Dendrimer-based nanotechnology alternatives are relatively new so companies making them do not disclose details. There has been some use of this new technology in the marketplace. The Danish EPA concludes that these alternatives do not match PFAS for all characteristics but they do provide adequate water repellency. In terms of health and the environment, the Danish EPA states that there is limited information available on dendrimer-based chemistries.

Additional alternative water repellency treatments for textiles include plasma treatments and sol-gel treatments[41]. Plasma, the fourth state of matter, is achieved when energy is added to gases that are then ionized and go into the plasma state. Plasma treatment of textiles modifies the surface chemically and/or physically.[41] The sol-gel process synthesizes nanoporous gels and nanoparticles and enables the production of thin films that can impart multiple protections for textiles.[41] Chemours is promoting on its website (2019) a non-fluorinated fabric treatment for durable water repellency called Teflon EcoElite. This fabric treatment is plant based and is said

to be up to three times more durable than other non-fluorinated water repellants. It is bluesign approved and approved for GOTS (Global Organic Textile Standard) certified textiles (https://www.chemours.com/Teflon_Fabric_Protector/en_US/products/teflon_ecoelite.html). The safety of textile treatments of the newer chemistries and technologies has not been adequately assessed.

Commercially available fluorine-free coatings include:[36]

- Epic by Nextec – silicone based polymer, used by the US military.
- Texfin RS-WR by Texchem UK Ltd – silicone emulsion based, used in work uniforms.
- POLON-MK-206 by Shin-Etsu Chemical Co. Ltd. – silicone emulsion based.
- Zelan R3 by Huntsman International LLC – made from plant-based sources, used in Chemour's Teflon EcoElite.
- Altopel F^3 by Bolger & O'Hearn Inc. – made from bio-based chemical ingredients.
- ChemStik by Green Theme Technologies LLC – based on hydrocarbon hydrophobic polymers.
- Arkophob FFR by Archrona – encapsulated wax based coating, is in the military uniform market.
- Ecorepel by Schoeller Technology AG – made of long paraffin wax chains, is in the military and policy market.
- Eco Dry by HeiQ Materials AG – made of hyper-branched hydrocarbons with polyurethane backbone.
- Aquapel by Nanotex Inc. – made of permanently attached hydrocarbon whiskers.
- OrganoTex by OrganoClick AB – made of 3D-structure of organic fatty polymers.
- H2O Repel by Devan Chemicals – made of a hydrophobic polymer.

Identification in a chemical action plan or other reports or information

Washington state's Department of Ecology, in the 2019 Interim Chemical Action Plan for Per- and Polyfluorinated Alkyl Substances, has identified textiles (which includes apparel) as a possible source of PFAS in the home.[50] In the paragraph on identifying sources of PFAS in the home, the Departments state that the sources that present the greatest exposure to PFAS should be identified, and to identify strategies to reduce these exposures.

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Appendix: Estimation of Number of People in Washington with Outdoor Gear

Assume approximately 50% of people in Washington state own outdoor wear:

- This number is based on data showing that almost 50% of people in the US participated in an outdoor activity at least once from 2006 – 2017 [54].
- Also, assume that 50% of people in Washington own raingear (this takes into account that many Washingtonians are committed non-raingear-owning individuals).
- There were 7,536,000 people in Washington state (https://www.census.gov/quickfacts/fact/table/WA/PST045218), therefore it is estimated that 3,768,000 people in Washington own outdoor wear. In a recent testing project carried out on apparel purchased in 2017 in North America, 73% (66 out of 90 items) of outdoor wear items tested (childrens' and adults' combined) contained PFAS [43]. 31 PFAS chemicals were analyzed for in this study. This study did not analyze for FTOHs, however. FTOHs are one of the important building blocks used to synthesize side-chain fluorinated polymers. They are especially used in durable water repellant clothing[55].
    - The combination of chemicals detected varied for different items tested, with the highest total PFAS detected being 780 ng/g in adult outdoor jackets. Given the above assumptions, this would mean that over 2,750,000 Washingtonians own outdoor gear that contains PFAS chemicals.
    - Of particular concern are the FTOH forms of PFAS (see discussion in section above on carpeting and upholstery). In an earlier study on consumer products purchased in the US, researchers report that 9 out of 12 samples of treated apparel contained FTOHs ranging from 308 – 464 ng/g[44]. This would mean that an estimated 2,826,000 Washingtonians own outdoor gear that contains FTOHs. Also, 5 out of 5 samples (100%) of treated nonwoven medical garments tested in this study contained FTOHs ranging from 419 – 1460 ng/g total FTOH[44]. This demonstrates the potential for occupational exposure to FTOHs.
- The percentage of children's outdoor wear and other children's products that contain PFAS chemicals was estimated by the Danish EPA to be lower: 10-30% of snowsuits, gloves/mittens, ski wear, rain wear, and covers for prams. Their estimate for other items was <10% for backpacks/school bags, soft-shell jackets, hats, sun canopies for prams, strollers, baby carriers, and changing bags[45]. These estimates were based on surveys of companies and internet searches. However in this 2015 study the Danish EPA tested for PFAS chemicals in 22 children's clothing items (snow suits, rain suits, infant sleeping bags, rain jacket, gloves, and mittens)[45]. 15 of the items were selected to analyze further. They all contained PFAS chemicals with total concentrations ranging from 18 – 407 ug/m^2, with sum of concentrations of all FTOHs ranging from 14.9 – 402.6 ug/m^2.

- Using this smaller estimated percentage of outdoor gear containing PFAS from the Danish EPA, the estimated numbers of children in Washington with PFAS in their outdoor gear would still be substantial:
    - There are almost 460,000 children in Washington state ages 5 and under, and over 1,665,000 children and youth in Washington ages 18 and under. Assuming 10 – 30 % of childrens' outdoor wear contains PFAS, and assuming 50% of children and young people in Washington have outdoor wear, there would be 23,000 – 69,000 children ages 5 and under with PFAS in outdoor wear, and 83,000 – 250,000 children and youth ages 18 and under with PFAS in outdoor wear in Washington.