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Written Testimony of Elsie M. Sunderland, Gordon McKay Professor of Environmental Chemistry, Harvard University

Forever Chemicals: Research and Development for Addressing the PFAS Problem

Thank you, Chairwoman Sherill and Chairwoman Stevens, for inviting me to testify today.

I appreciate the opportunity to speak with you about the diverse class of chemicals known as per- and polyfluoroalkyl substances (PFAS).

Some PFAS last forever in the natural environment because fluorine is such a unique element. It's the 13th most common element on Earth. However, until the 1950s, only a few rare plant species produced organofluorine compounds as a natural poison. Innovators then figured out how to use various high-energy manufacturing techniques to swap hydrogen with fluorine atoms in ***organic*** molecules. Unlike naturally occurring organic molecules, these fluorinated molecules are so strongly bonded that they persistent indefinitely in the environment and some accumulate in living tissues over time.

Since the 1950s, these chemicals have been widely used in modern commerce for their ability to repel both water and oil. Today, we find them in diverse consumer products such as food packaging, dental floss, carpet, furniture coatings, clothing, outdoor gear, and cosmetics. PFAS are used by industries such as textile companies, the metal plating industry, and plastics manufacturers. Airports and military bases across the country have also been contaminated by use of a product known as aqueous film-forming foam (AFFF). AFFF is extremely effective at fighting oil-based fires. The Department of Defense (DOD) currently supports research aimed at developing PFAS-free foams, but still requires PFAS in AFFF as part of military specifications.

Center for Disease Control (CDC) data show that 98-99% of Americans have detectable levels of at least one PFAS in their blood. A recent peer-reviewed study by the Environmental Working Group (EWG) estimated that 18-80 million Americans have concentrations of PFAS in their drinking water that exceed 10 ng/L (parts per trillion). This concentration is in the same range as where many of the states are setting maximum contaminant levels for drinking water.

Exposures to PFAS have been associated with many negative effects on human health. I think the former director of the National Institute of Environmental Health Sciences, Dr. Linda Birnbaum, summarized it best when she said at the opening of a scientific meeting on PFAS in 2019: "If you are a public health researcher, these are the chemicals for you because PFAS have now been associated with an adverse impact on every major organ system in the human body."

My colleague in the School of Public Health at Harvard, Dr. Philippe Grandjean, has been studying the effects of PFAS on the immune health of children for many years. In one of his early studies, he found that each doubling of these compounds in the blood of children at age 5 leads to a reduction by half of antibody production following routine vaccinations at age 7. This is one of the most potent immunotoxic responses ever observed for an environmental contaminant. Most recently, Dr. Grandjean found an association between the severity of Covid-19 and PFAS exposure. Many other adverse effects of PFAS have been reported, including evidence for increased risk of certain cancers and impaired cardiovascular health. Ongoing support for NIH and CDC/ATSDR research is essential for better understanding the full extent of health effects associated with PFAS exposure.

Industry has not been forthcoming with some of the health concerns associated with exposure to these compounds. Discovery documents from recent court cases have revealed that, on average, there was a 22-year lag between industry documents that first described some of the well-known health effects of PFAS and publication in the academic literature. Let me emphasize that industry had ***clear evidence*** of negative health impacts **decades** before the public. I believe it's worth asking whether we should expect innovators to be transparent about the chemical experiments that they are conducting on the public through their products.

Moving on to address this important public health issue, we now have two major tasks: 1) Remediate contaminated sites across the country to address the legacy pollution issue, and 2) control ongoing production and use of these compounds in our products by deciding where uses of PFAS are essential, and when PFAS could be replaced by better, less-toxic alternatives.

Support for the Federal agencies in addressing these broad challenges is essential for protecting public health. There are some major gaps in present understanding, that could be addressed by research and coordination among the Federal agencies.

We have insufficient data on PFAS exposure sources for the U.S. general population

Next to contaminated communities, drinking water is known to be the predominant exposure source. Efforts by the states and Federal agencies are successfully generating additional data on PFAS concentrations in drinking water and the effects of contaminated drinking water on health. This is where my own PFAS research has focused as part of an NIH Superfund center grant.

By contrast, we have only anecdotal evidence for understanding PFAS exposure sources for the U.S. general population. Major pathways of PFAS exposure include ingestion of food and drinking water, ingestion and inhalation of dust, and dermal uptake from personal care products and other sources. The relative importance of different exposure sources for the general population is unknown, impeding the development of effective risk mitigation strategies.

Dietary intake has been established as the predominant PFAS exposure source for the European general population. In the European Union, PFAS have frequently been detected in seafood, milk, various meats, and processed foods, particularly those that use packaging containing

PFAS. This has led to a ban of PFAS in food packaging in some countries such as Denmark and efforts to follow suit in some of our states.

By contrast, data on PFAS exposures in the U.S. food supply are extremely limited. The FDA recently undertook a total diet survey, but the number of samples and detection limits for their analysis were insufficient to characterize the food supply and risks to the population. In states such as Maine and Michigan, high levels of PFAS have been detected on farmlands due to use of biosolids mixed with industrial sludge that were used as fertilizer. These PFAS spread from the soils to hay and corn, then cows, and the farmers who drank the milk from their own animals. In one tragic case in Maine, the farmer and his wife had to close the dairy farm that had been in their family for more than 100 years.

Exposure research falls outside of the mandates of most ongoing U.S. PFAS research. The DOD supports a large portfolio of projects investigating the fate, transport, and remediation of these compounds. NIH focuses mainly on health outcomes associated with exposures. Typically, exposure research would fall within the mandate of EPA but both internal and extramural research have been substantially underfunded over the past decade. Joint research and unified public health advice from both EPA and FDA have been very effective in the past in areas such as fish advisories for contaminants and should be encouraged.

<u>Exposures to PFAS are underestimated due to limitations in measurement techniques</u>

Another major challenge for PFAS research is that limitations in current analytical methods mean we are systematically underestimating exposures to these compounds. The PFAS chemical family consists of thousands of different compounds, and industry is continuously inventing new PFAS that are introduced into our product stream. A large fraction of the compounds that are difficult to detect (known as precursors), degrade into other PFAS that are already known to pose risks to human health. Thus, is it essential to measure them in products, the environment, and humans.

New analytical tools are needed to detect PFAS precursors, and novel and emerging PFAS. Standard methods endorsed by EPA and NIST do not detect most compounds found in products and the environment. Commercially available standards needed for detection are unavailable for many PFAS found in modern AFFF and consumer products due to proprietary business information restrictions. You may hear the phrase “non-targeted mass spectrometry.” It is an essential component of our scientific toolbox ***but*** does not provide ***quantitative*** estimates that can be used for regulatory applications. It also requires highly trained analysts. For routine monitoring by communities and states, a simpler measurement technique is needed.

Several total fluorine and total organofluorine measurement methods have been developed by the academic community. Standardized methods and laboratory intercomparisons run by EPA and NIST are needed to ensure comparability of data generated across labs. Further developing these techniques could support regulations that screen for PFAS as a class, which would address the chemical whack-a-mole situation we are now experiencing. Support for partnerships between EPA and NIH are needed to better understand the toxicological and human health effects associated with exposure to novel and emerging PFAS.

<u>Comprehensive data on atmospheric and aquatic PFAS sources are needed</u>

In addition to detecting the broad suite of PFAS released into the environment, urgent action is needed to better characterize the sources of PFAS across the country. Databases such as EPA's Toxic Release Inventory (TRI) have only begun to be developed and efforts must be accelerated.

Most PFAS research has been on contaminated water, but it has become apparent that large quantities of PFAS are transported atmospherically away from some point sources and waste disposal sites. Following deposition, these atmospheric sources can contaminate water supplies and agricultural areas. Stack testing data and release estimates for major source categories are therefore urgently needed. USGS could further aid with monitoring of air and water across the country. Nationwide monitoring programs such as the National Atmospheric Deposition Program could provide the infrastructure needed to support an atmospheric surveillance network.

As a final note, the DOD currently supports the largest portfolio of PFAS research among the Federal agencies. However, DOD also caused PFAS contamination through use of fire-fighting foams at many sites across the country, which sets up a potential conflict of interest. While the DOD research program is commendable, it is essential that other Federal agencies develop comparable research portfolios to fill some of the research gaps described above.

I thank the committee for the opportunity to share my views on this subject.