U.S. Senate Committee on Environment and Public Works

Understanding the Presence of Microplastics in Water

27 February 2024

Testimony – Dr. Sherri A. Mason

Thank you, subcommittee Chairmen Merkley and Padilla, Ranking Members Mullin and Lummis, and other subcommittee members, for the opportunity to speak at this subcommittee hearing.

My name is Dr. Sherri Mason. I'm a chemist and currently the Director of Sustainability at the Erie campus of Penn State University.

The first scientific report of plastic pollution came from a group of researchers studying algae in the North Atlantic Ocean a year before I was born (1972). They published a simple one-page report on their by-catch of plastic particles. Despite this initial study, awareness of the issue of plastic pollution didn't emerge until the late 1990's and the dawn of the 21st century with a focus on the worlds' oceans and the impact on oceanic creatures.

While oceans are certainly important, the science has made it clear over the past decade that this is not an oceans-only problem, it is a water problem.

If I have any claim to fame it is this – in 2011, while sailing a tall ship in Lake Erie I wondered *we know about plastic pollution in the world's oceans, but what about freshwater?* The next year my research group was among the first to study plastic pollution in freshwater ecosystems, specifically the Great Lakes. Our first study provided the science upon which the Microbeads-Free Water Act of 2015 was based. Years later, we would also be the first research lab to examine wastewater treatment plant effluent, as well as the presence of microplastics within both tap water and bottled water. While our results were surprising, just last month we learned that bottled water has even higher concentrations of even smaller plastic particles called nanoplastics.

Today, here, I want to share those research findings with you, as well as sharing my thoughts on solutions to the plastic pollution problem.

My work in this field of research started in the Great Lakes, the largest freshwater ecosystem in the planet, holding 90% of the freshwater in the United States and 20% of the world's freshwater supply. If you have not been to the Great Lakes, you should. If you have not sailed the Great Lakes, you should. They are extraordinary. Our economy and our country are exceedingly fortunate to have this freshwater resource in our backyard. Like those that came before us, it is our duty to be stewards of this precious resource.

And, yet, over the five years I sailed and sampled all 5 of the Great Lakes, we established a hard and sad truth - as the water flows from one lake to another, the amount of plastic within that water increases. While some of that plastic is coming through the air, depositing plastics on the water's surface, the larger contributor is urban run-off. Research has established that each Great Lake is now harboring 1-5 billion plastic particles *each*.

While the counts of plastic particles are staggering, what shocked me more was the sizes of the particles – 97% of the particles are considered microplastics, being smaller than 5mm in size. Some of these

microplastics are produced and used as microplastics – microbeads are one such example – But most of these microplastics are formed from the breakage of larger, macro-plastic items to creating these microplastic particles.

This is an important point: The dominant degradation pathway for plastics is mechanical, not chemical, or biological. This makes plastic unique among other materials and is a primary driver for its ecological and human health impact. Plastics are synthetic, they are man-made, and as a consequence they don't readily biodegrade as natural materials do, and so they linger in the natural environment. As they linger, they are baked by the sun, and pummeled by wind, water, cars, and the like, causing them to break into ever smaller particles. One macroplastic item can form millions of microplastics, which break into billions of nanoplastics – particles so small, they easily move across the gastrointestinal track, are carried by the blood, and end up in our livers, kidneys, brains, various cells and organelles, and even crossing the placental boundaries to invade embryos.

What is the impact of these plastic particles on human health? This is the forefront of the research. Some things we know, others we don't. There are about 13,000 different chemicals used during the manufacturing of various plastic products. Many of these are known to be carcinogens &/or endocrine-disrupting chemicals, which means they mimic hormones, the chemical messengers of the body. By affecting the endocrine system, the chemicals within plastics are linked to fertility issues including lowered sperm counts, as well as being associated with obesity rates, autism, and other developmental issues. Understanding the impacts of the plastics polymers themselves is the real knowledge gap currently but initial studies have shown connections to inflammation, oxidative stress, Alzheimer's and other neurological issues. While we don't know everything, what we do know is concerning, and water, the necessary elixir of life, is a primary means for the movement of micro- and nano- plastics into people.

While wastewater treatment plants are fairly effective at "removing" plastics from wastewater – with efficiencies of 75 – 95% depending on the size of the particles – our study of 19 facilities across the United States still showed each releases an average of 4 million particles each day, 365 days a year. With 15,000 facilities across the United States, wastewater treatment plants provide a significant pathway in moving plastics from land to water. Further, even those particles that are "removed" do not go away. There is a basic tenant of science: the Law of Conservation of Mass. Things move, but they don't disappear. In the case of a wastewater treatment plant, these particles are moved from the water into the biosolids (aka sewage sludge) which is frequently applied to farmland as fertilizer given that it is so nutrient-rich. This application allows plastic particles within the sludge to be re-released into nearby waterways as run-off or move through the soil to end up in groundwater.

To that point, studies have found microplastics within groundwater reservoirs, though at lower levels than within tap water given that many locations utilize surface water for tap water. The Great Lakes, for example, serve as the tap water resources for 35 million Americans. Our study of 159 samples collected across the globe, including here in the United States, found an average of 5.5 plastic particles per liter of tap water. 99% of these particles were classified as microfibers, indicating that this isn't a water treatment issue – that is water treatment facilities are filtering the water – but rather that the particles are getting into the water through contact with the air.

Should one think that bottled water is a solution to plastic within tap water, it's not. Our study on bottled water found an average of 325 microplastics per liter of bottled water, 58 times the quantity within tap water. And just last month a new technique developed by Columbia University researchers to analyze for

nanoplastics was used in a proof-of-concept study conducted in collaboration with Rutgers University in which they focused on bottled water. This study found an average of 240,000 nanoplastic particles within bottled water – nearly three orders of magnitude higher than our microplastic study. Like our study they found that the main contributor of plastic to the water was from the bottle itself. The reverse osmosis filters used in filtering the water also contributed to the nanoplastic loading, highlighting the reality that we can't filter ourselves out of this problem.

So, what can we do? The reality is this – the problem of plastic pollution is multi-faceted and so are the solutions. I think the EPA Plastics Strategy touches on a number of them and provides a good starting point for discussions.

- SOURCE REDUCTION AND MITIGATION – the story told through the studies on wastewater treatment plants, tap water, and bottled water highlight that a key piece of the solution to this problem *HAS TO* include reducing the problem at its source.

  As a chemist, I can truly understand the attractiveness of plastic as a material. It is lightweight and moldable and resistant to degradation. But the reality is these same properties make it a bane for the environment and human health.

  Single-use, disposable plastics represent the largest piece of the plastics market. Several studies, including one that I am currently conducting in my community of Erie, PA, have shown that these are also the most common littered items, providing the primary macro-plastic starting point for the micro- and nano- plastics that we find downstream from the source.

  The EPA Plastics Strategy recommends creating a list of these single-use, unrecyclable, difficult to recycle, or frequently littered plastic products as such a list might encourage consumer shift. I think there is bigger role in this space that Congress can play. I want to echo the recommendations from a previous Congressional hearing on expanding refill and reuse infrastructure.

- EXTENDED CORPORATE RESPONSIBILITY – One of the recommendations from this prior hearing, and a key tenant of the Break-Free From Plastic Pollution Act that Senator Merkley has introduced to Congress, is Extended Corporate Responsibility (ECR). Within both Lead-acid battery recycling, as well as electronics recycling, ECR has proven itself to be a strong tool to orient our economic system to yield the outcomes we want. To be clear, this type of legislation works in conjunction with the economy, not against it; it simply provides the guardrails and levels the playing field to promote best management practices. ECR would work to promote recycle-ability, decrease usage of the most hazardous plastics (like PVC, whose production led to the train derailment in Palestine, Ohio, a year ago, just south of where I live), and encourage smarter plastics (like those being developed in our National Labs). ECR is the as the single biggest tool you all have to reduce the harm to people and planet that arises from plastics. Please use it.

- NATIONAL WASTE AND REYCLING PLAN – the last solution I want to suggest is to advance our national recycling strategy to a national waste management system.

  The role of government is to take care of its people. Among other directives, our national government should be acting to provide those services that are used by everyone. We have, for

example, a national highway system. We know we produce waste – we always have, we always will, and yet we don't have a national strategy for dealing with the waste we produce.

Our solid waste is actual a resource. Properly managed our solid waste can make us less reliant on international supply chains, making us not only safer, but more economically viable in the worldwide marketplace. We need to be thinking about this wholistically, managing this resource at a national, rather than local, level. Uniformity of rules would help tremendously to increase recycling, decrease contamination, and make the overall market more viable. Regarding plastics this is especially true when used in conjunction with ECR. As the incentives within ECR push the marketplace toward a narrowing of the types of polymers used within the plastics marketplace, uniformity of recycling rules and collection act to promote its circularity. A national waste management system, while no doubt complicated, is a win-win situation.

As solutions are implemented the only way to know their effectiveness is through continual monitoring. Financial support for a national monitoring and assessment system is a huge gap that currently exists. We need to continue to support the research and development efforts that have provided the understanding we currently have but also grow that support as there is still so much we do not know. Present and future generations rely on the foundations we lay down today.

Thank you greatly for your time and attention. I look forward to answering your questions.