

**UNDERSTANDING THE PRESENCE OF
MICROPLASTICS IN WATER**

JOINT HEARING

BEFORE THE

SUBCOMMITTEE ON CHEMICAL SAFETY,
WASTE MANAGEMENT, ENVIRONMENTAL JUSTICE,
AND REGULATORY OVERSIGHT

AND THE

SUBCOMMITTEE ON FISHERIES, WATER,
AND WILDLIFE

OF THE

COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

ONE HUNDRED EIGHTEENTH CONGRESS

SECOND SESSION

FEBRUARY 27, 2024

Printed for the use of the Committee on Environment and Public Works



Available via the World Wide Web: <http://www.govinfo.gov>

U.S. GOVERNMENT PUBLISHING OFFICE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

ONE HUNDRED EIGHTEENTH CONGRESS

SECOND SESSION

THOMAS R. CARPER, Delaware, *Chairman*
SHELLEY MOORE CAPITO, West Virginia, *Ranking Member*

BENJAMIN L. CARDIN, Maryland	KEVIN CRAMER, North Dakota
BERNARD SANDERS, Vermont	CYNTHIA M. LUMMIS, Wyoming
SHELDON WHITEHOUSE, Rhode Island	MARKWAYNE MULLIN, Oklahoma
JEFF MERKLEY, Oregon	PETE RICKETTS, Nebraska
EDWARD J. MARKEY, Massachusetts	JOHN BOOZMAN, Arkansas
DEBBIE STABENOW, Michigan	ROGER WICKER, Mississippi
MARK KELLY, Arizona	DAN SULLIVAN, Alaska
ALEX PADILLA, California	LINDSEY O. GRAHAM, South Carolina
JOHN FETTERMAN, Pennsylvania	

COURTNEY TAYLOR, *Democratic Staff Director*
ADAM TOMLINSON, *Republican Staff Director*

SUBCOMMITTEE ON CHEMICAL SAFETY, WASTE MANAGEMENT, ENVIRONMENTAL
JUSTICE, AND REGULATORY OVERSIGHT

JEFF MERKLEY, Oregon, *Chairman*
MARKWAYNE MULLIN, Oklahoma, *Ranking Member*

BERNARD SANDERS, Vermont	JOHN BOOZMAN, Arkansas
SHELDON WHITEHOUSE, Rhode Island	ROGER WICKER, Mississippi
EDWARD J. MARKEY, Massachusetts	DAN SULLIVAN, Alaska
JOHN FETTERMAN, Pennsylvania	SHELLEY MOORE CAPITO, West Virginia
THOMAS R. CARPER, Delaware (<i>ex officio</i>)	(<i>ex officio</i>)

SUBCOMMITTEE ON FISHERIES, WATER, AND WILDLIFE

ALEX PADILLA, California, *Chairman*
CYNTHIA M. LUMMIS, Wyoming, *Ranking Member*

BENJAMIN L. CARDIN, Maryland	KEVIN CRAMER, North Dakota
SHELDON WHITEHOUSE, Rhode Island	PETE RICKETTS, Nebraska
EDWARD J. MARKEY, Massachusetts	JOHN BOOZMAN, Arkansas
DEBBIE STABENOW, Michigan	DAN SULLIVAN, Alaska
MARK KELLY, Arizona	SHELLEY MOORE CAPITO, West Virginia
THOMAS R. CARPER, Delaware (<i>ex officio</i>)	(<i>ex officio</i>)

C O N T E N T S

	Page
FEBRUARY 27, 2024	
OPENING STATEMENTS	
Merkley, Hon. Jeff, U.S. Senator from the State of Oregon	1
Padilla, Hon. Alex, U. S. Senator from the State of California	3
Lummis, Hon. Cynthia, U.S. Senator from the State of Wyoming	4
WITNESSES	
Mullin, Hon. Markwayne, U.S. Senator from the State of Oklahoma	
Prepared statement	6
Brander, Susanne M., Ph.D., Associate Professor, Oregon State University, College of Agricultural Sciences, Department of Fisheries, Wildlife, and Conservation Sciences	8
Prepared statement	10
Mason, Sherri A., Ph.D., Director of Sustainability, Penn State Behrend	22
Prepared statement	24
Alspach, Brent, P.E., Vice President and Director of Applied Research, Arcadis	28
Prepared statement	30
ADDITIONAL MATERIAL	
Letter to Senator Merkley, Senator Padilla, Senator Mullin and Senator Lummis from the International Bottled Water Association (IBWA)	52

UNDERSTANDING THE PRESENCE OF MICROPLASTICS IN WATER

TUESDAY, FEBRUARY 27, 2024

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON CHEMICAL SAFETY, WASTE MANAGEMENT,
ENVIRONMENTAL JUSTICE, AND REGULATORY OVERSIGHT
JOINT WITH THE SUBCOMMITTEE ON
FISHERIES, WATER, AND WILDLIFE,
Washington, DC.

The subcommittees met, pursuant to notice, at 2:30 p.m., in room 406, Dirksen Senate Office Building, Hon. Jeff Merkley (chairman of the subcommittee on Chemical Safety, Waste Management, Environmental Justice, and Regulatory Oversight) presiding.

Present: Senators Merkley, Carper, Padilla, Mullin, Lummis, Whitehouse, Sullivan.

OPENING STATEMENT OF HON. JEFF MERKLEY, U.S. SENATOR FROM THE STATE OF OREGON

Senator MERKLEY. Good afternoon. Welcome, everyone. This joint hearing of the Environment and Public Works Subcommittees on Chemical Safety, Waste Management, Environmental Justice, and Regulatory Oversight and Fisheries, Water, and Wildlife on understanding the presence of microplastics in water will come to order.

As one of our witnesses today, Dr. Sherri Mason, said, normal humans looking at a sample of water, if there is visible plastic in it, they will be turned off. They do not realize it is actually the invisible plastics present that are the biggest concern. Thank you for sharing that line and allowing me to steal it from you. Those invisible plastics are why we are here today.

Like people shed skin cells, plastics shed particles of plastics. These can be big microplastics, which range from half a centimeter down to a micrometer, a micrometer being less than one-70th the size of a human hair, or they can be as small as nano plastics, which are even smaller than a micrometer.

Not surprisingly, we are finding microplastics everywhere: on top of mountains, at the bottom of the sea, in the food we eat, in the air we breathe, in drops of rain, and even drops of our own blood. Microplastics have been found in our livers, our lungs, and the breast milk we feed our babies.

Even when folks try to avoid using plastics, products like paper cups and aluminum cans now have plastic linings. This should set off public health alarm bells for everyone, because microplastics leech chemicals, chemicals like endocrine disruptors that affect the

reproductive system and are a major suspect in the decline of male fertility worldwide, chemicals that lead to weight gain, chemicals that lead to insulin resistance, chemicals that cause cancer.

Congress has taken important first steps to address plastics in our water, like the Microbead-Free Waters Act of 2015, based on the research of one of our witnesses, Dr. Mason. This legislation banned cosmetics with intentionally added plastic microbeads that did nothing for consumers but did pollute our waterways.

Since then, we have learned that the problem of plastic pollution is so much more extensive than microbeads, and so much smaller, too, in terms of micro and nano plastics.

Microplastics shed into our water every time we use plastic water bottles, every time we wash clothing made from a whole series of products that we may not even think of as plastics, but are plastics, nylon, polyester, other synthetic materials. Every time, it seems that water interacts with plastic.

Our water treatment systems filter out many harmful contaminants, but the filters have plastic components that could be inadvertently polluting the water with microplastics. We can not forget that biosolids from wastewater treatment and agricultural fertilizer also contain microplastics, and when those biosolids are put onto lands, they can run off into our streams and waterways, creating additional plastic challenges, which is why I have introduced the Research for Healthy Soils Act to make this a high priority research area for the Department of Agriculture.

We need to think better; we need to think bigger. We need to think about how to stop micro and nano plastics from getting into the water in the first place and how to filter them out when they already exist. Thanks to current research on microplastics and microfibers, including work led by one of our witnesses today, Dr. Brander, from Oregon State University, States are starting to act. Legislation was recently introduced in my home State of Oregon that would require all new washing machines sold in Oregon to include a built-in microfiber filtration system.

State-led efforts are important, but microplastics do not stop at the State border, so we also need national attention. Fortunately, we have been joined by a panel of experts today who can help us understand what those national solutions might look like.

Dr. Susanne Brander is an ecotoxicologist and Associate Professor at Oregon State University whose research focuses on microplastics and how they affect behavior and growth in fish and other water organisms. She is also a co-leader of the Pacific Northwest Consortium on Plastics.

Also joining us today is Dr. Sherri "Sam" Mason, Associate Research Professor and Director of Sustainability at Penn State Behrend in Erie, Pennsylvania. Her research on freshwater microplastics has led to plastics legislation here in the United States, as well as other places around the world.

We are also joined by Brent Alspach, Vice President and Director of Applied Research at Arcadis, where he oversees their water division's research on drinking water, recycled water, wastewater, and stormwater.

Thank you all for taking the time to share your expertise with us.

We will reserve the opportunity for Senator Mullin as Ranking Member to give his opening remarks, so when he is able to get here. I hear that he is on his way. He will also be followed by opening remarks from our colleagues on the fisheries subcommittee, and let me turn this over to Chairman Padilla.

**OPENING STATEMENT OF HON. ALEX PADILLA,
U.S. SENATOR FROM THE STATE OF CALIFORNIA**

Senator PADILLA. Thank you, Senator Merkley. Good afternoon, everybody, and thank you to my colleagues on both sides of the aisle for participating in this joint hearing between our respective subcommittees, mine being the Senate Environment and Public Works Subcommittee on Fisheries, Water, and Wildlife.

Today, we have the privilege of co-chairing this hearing, along with our Republican colleagues. This is going to be a substantive and important discussion. We are teaming up to examine the issue of microplastics, including nano plastics in our drinking water and in wastewater.

I want to just not brag too much, but call attention to my involvement in the issue since before I even joined the Senate. In fact, I was serving as California's Secretary of State in the year 2020 when I joined Senator Dan Sullivan from Alaska at a virtual event hosted by the Massachusetts Institute of Technology, focused on the dangers of plastic pollution, each of us sharing our work experience and legislative experience at that point.

As Senator Sullivan so eloquently articulated then, we knew that the issue truly can be an opportunity for bipartisan cooperation, especially as we support this emerging area of research. While the study of microplastics is in fact still emerging, one thing we do know beyond a shadow of a doubt is where we can find microplastics, because the answer is everywhere. It is all around us.

These tiny, sometimes microscopic shards and fragments of plastic less than 5 millimeters in length have been found in the clouds above our skies, in the depths of the oceans, and literally everywhere in between.

Just last summer, here is another, I am not trying to brag too, too much, but I participated in the 27th Annual Lake Tahoe Summit where the Governors and senators from both California and Nevada convened at the lake to talk about cooperation between our States and the Federal Government to protect this tremendous jewel, this tremendous natural resource.

I was reminded that even in a natural wonder like Lake Tahoe, given its high elevation, given its pristine, clear blue water, surrounded by nothing but scenic mountaintops and trees, with all the multi-State, multi-jurisdictional environmental protections, even there, microplastics is a problem. It is no surprise that if you can find them there, then you will find them in everyday products like plastic water bottles with "hundreds of thousands of bits of plastic per liter of water."

These findings should alarm us, folks. They should alarm us into action. Just how pervasive are microplastics in the water that we drink?

Well, I am proud to say that in California, we are trying to lead the way in trying to answer the question as the first government

in the world to set requirements for testing microplastics in drinking water. Our State is trying to lead the way. This serves as a model, by the way, that other States, as well as the Federal Government, can follow in the coming years.

We also know that microplastics are already so common that increasingly, we have found them in stomachs of sea animals, in our own food and water, and yes, even in human lungs and bloodstreams. While we continue to learn more and more about the presence of microplastics on the planet, the question must also become, what are the potential impacts of microplastics on human health?

To explore just that, I want to thank all of our witnesses for being here today. I am certainly looking forward to hearing more about the State of your research and how Congress can help protect the health of not just our environment, but our constituents and the future generations.

With that, thank you again, Senator Merkley. If I can now hand it over to the Ranking Member of our subcommittee, my friend and colleague, Senator Lummis.

**OPENING STATEMENT OF HON. CYNTHIA LUMMIS,
U.S.SENATOR FROM THE STATE OF WYOMING**

Senator LUMMIS. Thank you, Chairman Merkley, and thank you, Chairman Padilla.

As you were talking, I had a recollection and a mental image. I got to fly over Lake Tahoe in a very small plane back in 1977 when I was working for a rodeo contractor in Northern California. The plane was piloted by Joe Alexander, who was the world champion bareback bronco rider in the world, and we flew over and we buzzed Lake Tahoe.

It was unforgettable, unforgettable. You have such a beautiful State, and it is such a privilege for me to serve with you as Ranking Member on the Fisheries, Water, and Wildlife Subcommittee. Thank you as well, Chairman Merkley. We all come from the west, beautiful States, and this is an important topic to all of us.

Under the Safe Drinking Water Act, the EPA set regulations for over 90 different contaminants in public water. These supplies have such contaminants as arsenic, asbestos, lead, mercury, and many other substances that are proven to harm human health. The contaminants on this list did not appear overnight.

Generally, the process of adding contaminants to the National Primary Drinking Water Regulations is thorough, rigorous, and multifaceted. It is a years-long process based on solid, scientific data. Today's hearing focuses on the potential presence of microplastics in drinking water and wastewater. I am glad we have convened a panel of academic witnesses to discuss this topic.

The consensus on microplastics and their effect on human health is that there really is no consensus. We need to start diving into this and understanding it better, as members of the U.S. Senate. According to the American Water Works Association, while we are aware of the existence of microplastics in the environment, their occurrence in drinking water sources is not well defined.

Additionally, the effectiveness of treatment processes and removing them is not well understood, certainly by me, and perhaps by

others. Assessing the associated health effects has proven challenging.

Despite the large number of unknowns, there continues to be considerable public interest in this topic. While water utilities have their hands full with numerous challenges, including PFAS, lead contamination, infrastructure repair, and many others, I applaud the industry for continuing to further its research on microplastics.

Again, thanks to all our witnesses. I really appreciate your being here. I really appreciate the fact that I am going to get to learn a lot from you, and I look forward to this conversation.

Mr. Chairman, I yield back. Thank you.

Senator MERKLEY. Thank you very much, Senator Lummis.

Senator Mullin has offered to enter his statement for the record. Is there any objection? Hearing none, so ordered.

[The prepared statement of Senator Mullin follows:]

- Thank you, Chairman Merkley, Chairman Padilla, and Ranking Member Lummis. I would like to start by thanking our witnesses for attending this hearing, including Mr. Brent Alspach from Arcadis. We appreciate you taking the time to be with us today.
- As Ranking Member on the Chemical Safety, Waste Management, Environmental Justice, and Regulatory Oversight Subcommittee, our jurisdiction includes chemical safety policy and risk assessment oversight.
- I will be the first person to say, myself included, I don't think anyone wants to ingest plastic or thinks there is any health benefit from ingesting plastics.
- But the key question here for policymakers is - what are the actual risks that microplastics pose to human health?
- Recent studies have shown different levels of exposure to microplastics and the *potential* risks to human health.

- However, those studies have not yet proven the threshold where exposure poses a risk – meaning the likelihood of harm to human health.
- Considering there is not yet a consensus on the risk that microplastics pose to human health, it is unclear what an effective policy on the prevention of microplastic risk might look like, not only for policy makers, but also for industry.
- As science continues to advance, I am happy we are able to further this discussion on our understanding of the presence and *potential* adverse health risks of microplastics in water today.
- Thank you, Chairman, and I yield back.

Senator MERKLEY. We are now going to turn to our experts to actually get some insights here. We are going to start with Dr. Brander.

STATEMENT OF SUSANNE M. BRANDER, PH.D., ASSOCIATE PROFESSOR, OREGON STATE UNIVERSITY, COLLEGE OF AGRICULTURAL SCIENCES, DEPARTMENT OF FISHERIES, WILDLIFE, AND CONSERVATION SCIENCES

Ms. BRANDER. Thank you, Chairmen Merkley and Padilla, and Ranking Members Lummis and Mullin for the opportunity to testify today on the potential for microplastics in drinking and wastewater to have repercussions for environmental and human health.

I am an associate professor at Oregon State University and have been conducting research on microplastics and plastic pollution for nearly a decade, and on endocrine disrupting chemicals for over a decade. The issue of plastic pollution is a great environmental challenge, as has been mentioned.

It is also an expensive problem, estimated at about \$13 billion annually. Fragmentation of plastic products and waste into microplastics is of substantial concern to the Nation's water treatment sector, where contamination is widely documented.

Microplastics are now broadly defined by California as a solid polymeric material to which chemical additives or other substances may have been added. These are particles having at least three dimensions greater than one nanometer and less than five millimeters.

Formulations of plastics are estimated to use upwards of 13,000 chemicals, and microplastics are widely documented to harm aquatic and terrestrial wildlife. They can slow growth, alter behavior, and cause reproductive disruption. They also cause adverse effects in mammals, and particle presence is now confirmed in the human heart, placenta, and lung tissues, as well as in circulation in the bloodstream.

Microplastics in wastewater and in drinking water are, of course, originating from multiple sources. Influent to treatment plants contains synthetic microfibers shed from our laundry, breakdown of plastics from dishwashers, and plastic detergent pods.

Washing of one synthetic garment is estimated to generate over 100,000 microfibers, and an average load produces upwards of 9 million, and dryers emit them too, potentially on a larger scale. Dishwashers can also generate thousands of microplastics per cycle. A medium-sized town could emit over 300 million microplastics on a daily basis from a recent study.

The burden of dealing with these has really shifted to wastewater treatment plants and drinking plants. Wastewater treatment plants tend to retain most of these particles in the sludge, which is sterilized into biosolids and, as Senator Merkley mentioned, these are used as fertilizers, and those particles can be washed back. All of these discharges are unregulated.

While drinking water in the U.S. does contain fewer microplastics in comparison to wastewater, the U.S. does have among the highest prevalence of microfibers in its drinking water and the highest number of particles detected per liter, currently. Results on studies in rodents, which are used as human health models, sug-

gests the potential for impacts of this long-term exposure to markers like reproductive and microbiome health.

Far less is known about the occurrence and effects of tinier particles, which were also mentioned in the introductory remarks, these nano plastics. Tap water, like bottled water, was recently shown to contain high levels of nano plastics, but the methods for detecting these smaller sized fractions are expensive and limited, currently. The smaller particles have the capability to move around within the body following ingestion, and they can also potentially accumulate. Bottled water, which contains higher levels of microplastics, is disproportionately consumed by marginalized communities, as well.

Experts agree that source reduction of plastics is needed, but of course, this is challenging, given that these are deeply embedded as far as use goes in our daily lives, and that the shedding of microplastics is challenging to control. This challenge must be addressed across multiple sectors for progress to be made. We have accumulating evidence that as these microplastics degrade into smaller sizes, they can elicit inflammation, cellular toxicity, and myocardial damage.

A next step would be to take action to limit their presence in our waterways and in our bodies. Potential solutions include requiring microfiber filters on washing machines, as a bill has been introduced in Oregon and in California, as well. Also, catchments and rain gardens can significantly reduce plastic pollution from stormwater runoff.

Our Nation's waterways are intended to be protected by the Clean Water Act (CWA), which in 1972 established a framework for regulating pollutant discharges. However, the CWA has not yet been used, of course, as you know, to limit the discharge of microplastics. Given that microplastics and their precursors could be defined as originating from point sources, such as pellets, discharge of microplastics from treatment plants, or the recent vinyl chloride spill, the CWA provides the most direct route for potential regulation.

Long-term solutions are greatly needed, including better waste management strategies and a move toward globally touted approaches for circularity.

With that, thank you so much for the opportunity to testify today. I am pleased to answer any questions that may come up.

[The prepared statement of Ms. Brander follows:]

Written Statement of
Susanne M. Brander, Ph.D.
Associate Professor
College of Agricultural Sciences
Fisheries, Wildlife, and Conservation Sciences Dept
Coastal Oregon Marine Experiment Station
Oregon State University

Before The
Senate Committee on Environment and Public Work
Subcommittee on Chemical Safety, Waste Management, Environmental Justice, and
Regulatory Oversight and the Subcommittee on Fisheries, Water, and Wildlife

Thank you Chairmen Merkley and Padilla and Ranking Members Lummis and Mullin for the opportunity to testify today on the potential for microplastics in drinking and wastewater to have possible repercussions for environmental and human health. I am pleased to provide testimony today on the role university-based research can play in providing the committee with information and tools to better understand this issue.

I am an Associate Professor in the College of Agricultural Sciences at Oregon State University (OSU) and have been conducting research on microplastics and plastic pollution for nearly a decade. As part of these efforts, I have contributed to the understanding of occurrence in the environment in water, sediment and biota on both coasts of the United States, and have also conducted research and published findings on the toxicity and hazard of microplastics to aquatic organisms. We share this work with stakeholders and collaborators through the NSF-funded Pacific Northwest Consortium on Plastics. I have also contributed to regulatory efforts in the State of California on their recent microplastics strategy and plans to monitor drinking water for microplastics statewide, as well as contributing to ongoing efforts on developing standardized protocols for microplastics sampling and quantification. My group's research efforts have been supported at the federal level by the NSF, EPA, NOAA, and the DOE.

Microplastics in Drinking and Wastewater

The issue of plastic pollution has become one of the greatest environmental challenges of the Anthropocene. It has also emerged as one of the world's most expensive problems, with the economic impact of this pollution to fishing, tourism, and shipping estimated at \$13 billion annually (Lau et al. 2020) and estimated healthcare costs in the U.S. at a staggering \$249 billion in 2018 due to plastics-associated chemical exposures (Trasande et al., 2024). Without system-wide change, rates of global production and use will continue to increase at approximately 4% annually (Geyer et al., 2022), and a doubling of mismanaged plastic waste is predicted by 2050 (Lau et al., 2020). Therefore, it is not surprising that the fragmentation of these products into microplastics is of substantial concern to the nation's

water treatment sector, where microplastic contamination is widely documented during the treatment of wastewater from households as well as in the production of drinking water (Acarer, 2023; Carr et al., 2016; Geyer et al., 2022).

Microplastics are now broadly defined by the State of California as a solid polymeric material, to which chemical additives or other substances may have been added, which are particles having at least three dimensions that are greater than 1 nanometer (nm) and less than 5,000 micrometers (μm) (CA Water Boards 2020). These ranges are approximately from one millionth of a millimeter to 5 millimeters and includes a vast diversity of particle types encompassing fragments, fibers, films, foams, pellets, and spheres (Rochman et al., 2019), the formulation of which is estimated to use upwards of 13,000 chemicals as additives, fillers, dyes, etc. (UNEP 2023). Microplastics are widely documented to harm to aquatic and terrestrial organisms, slowing growth, altering behavior, and causing reproductive disruption (Cui et al., 2022; Cunningham et al., 2022; Siddiqui et al., 2022; Thornton Hampton et al., 2022). They also can cause adverse effects in mammals (Coffin et al., 2022; Prata, 2023; Szule et al., 2022). While research on human impacts from these particles is in earlier stages, microplastic particles presence is confirmed in the human heart, placenta, and lung tissues and they also circulate within the human bloodstream (Leslie et al., 2022; Lu et al., 2022; Persiani et al., 2023; Ragusa et al., 2021). Comparisons are now being made to the health effects caused by particulate matter and asbestos (Wieland et al., 2022).

Microplastics in wastewater and drinking water originate from multiple sources. In the gray water processed as influent to wastewater treatment plants, this includes the shedding of synthetic microfibers from textiles washed in domestic households and industrial facilities as well as the breakdown of plastic parts in dishwashers and washing machines, the fragmentation of plastic dishes, cups, lids, and cutlery, and detergents either containing or coated with plastics (Carr et al., 2016; Geyer et al., 2022; Sol et al., 2023). The washing of one synthetic garment alone can result in the shedding of over 100,000 microfibers, and on average a typical load of laundry washed in a machine lacking filtration creates upwards of 9 million microfibers (Figure 1) (Gao et al., 2023; Geyer et al., 2022). Dishwashers, which are present in 80% of households in North America, generate between 1067-1468 microplastics during a typical intensive washing cycle run at high heat. It is estimated that a town of approximately 220,000 residents could emit over 300 million microplastics from dishwashing alone in a single day (Sol et al., 2023). The burden of dealing with these microplastics is shifted to wastewater treatment plants, which can remove a majority from treated effluent, only to retain up to 99% of the particles in sludge and eventual biosolids.

These biosolids are then commonly applied to agricultural fields as fertilizers, allowing for the plastic fragments and microfibers they contain to be remobilized or to contaminate soils on which crops are grown and are connected to terrestrial ecosystems, also now documented to be widely contaminated with microplastics (Christian & Köper, 2023; Gao et al., 2023). Some of these particles are washed back into waterways with precipitation and irrigation, starting the cycle of pollution anew (Figure 2).

While drinking water in the US tends to contain fewer microplastics in comparison to wastewater, the U.S. has among the highest prevalence of microfibers in its drinking water globally (Figure 3, Trasande et al., 2024). Furthermore, a 2018 study found that in an analysis of 150 tap water samples collected from different parts of the world, that the USA had the highest number of particles detected per liter (33.9 microplastics / liter; Kosuth et al., 2018). While microplastic contamination of drinking water is concerning, given some of the results from studies on mice and rats, typically used as models for human health, showing the potential for impacts to reproductive and microbiome health (Coffin et al., 2022; Szule et al., 2022), far less is known about the occurrence and effects of long-term exposure to even tinier particles: nanoplastics (one millionth of a millimeter). It is likely that drinking water, like bottled water was recently shown to, contains high levels of microplastic's smaller counterpart, but analytical approaches for detecting smaller size fractions are currently expensive and limited (Qian et al., 2024). However, since drinking water tends to contain smaller particles due to treatment processes that capture larger microplastics, these smaller particles that have the capability to translocate (Prata, 2023; Wright & Kelly, 2017) are predominant in the water families depend on daily in their homes for drinking and cooking.

Access to clean water for drinking, cooking, and other household activities is a basic human right (UN 2010, Resolution 64/292). However, our inability to prevent the pollution of water from contaminants of emerging concern, which now include microplastics, threatens the health of people of every age and from every walk of life. Experts in the field agree that source reduction is desperately needed, but with plastic use embedded deeply in the fabric of our daily lives and the subsequent shedding of microplastics from plastic products being difficult to control, this is a challenge that must be addressed across multiple sectors simultaneously for progress to be made in reducing microplastic contamination. Given the accumulating evidence that microplastics continually degrade into smaller and smaller sizes, and that these smaller microplastics and nanoplastics can move from the gut to other organs and tissues within the human body (Figure 4; Prata, 2023), eliciting inflammation and cellular toxicity with the potential for causing fibrosis and

even myocardial damage (Persiani et al., 2023), a prudent next step would be to take action to limit their presence in our waterways and bodies. Potential solutions include requiring microfiber filters on washing machines, which is already done in countries such as Japan that rely heavily on septic systems (<https://www.forbes.com/sites/ariannajohnson/2023/09/27/>). Furthermore, catchments and rain gardens significantly reduce plastic pollution from stormwater run-off as it enters drains or combined sewer systems (Werbowski et al., 2021).

Our nation's waterways are intended to be protected by the Clean Water Act, which as amended in 1972, established a framework for the regulation of pollutant discharges to waters in the United States. This gave the EPA authority to implement and enforce pollution control programs such as the National Pollutant Discharge Elimination System. However, the CWA only applies to clearly defined point sources, and thus far has not been used to regulate the discharge of microplastics into water bodies. Given that microplastics or their precursors could be defined as originating from point sources at different stages within the plastics life cycle: in particular the emissions of plastic pellets (nurdles) from production facilities (Figure 5; Tunnell et al., 2020), discharge of microplastic fibers and fragments in the form of effluent or biosolids from wastewater treatment plants, or the recent vinyl chloride spill at the Pennsylvania / Ohio border; the CWA provides the most direct route for potentially regulating microplastics and related products from these documented and now common point sources. Longer term solutions are greatly needed, and include better waste management strategies such as improved recycling, chemical simplification and a move towards globally touted approaches for circularity and safely and sustainably designed materials and products.

Summary

This testimony summarizes the current state of the science on microplastic presence in drinking and wastewater, as well as what is known about potential impacts to ecosystems and to human health. Microplastics are an emerging contaminant of concern and thus this is an area of highly active and ongoing research in which findings that may influence our approach to handling this form of particulate pollution are being published on a monthly, if not more frequent, basis. Plastic pollution is of global concern and I appreciate that this issue is being explored and considered for further potential policy development. I thank the Committee and Subcommittees for the opportunity to testify and for their consideration of the information and data included in my written and spoken testimony. As a researcher, it is encouraging to see findings potentially translated to application and to play a role in the legislative thought process. I would be pleased to offer further information as needed, and to answer any questions you may have.

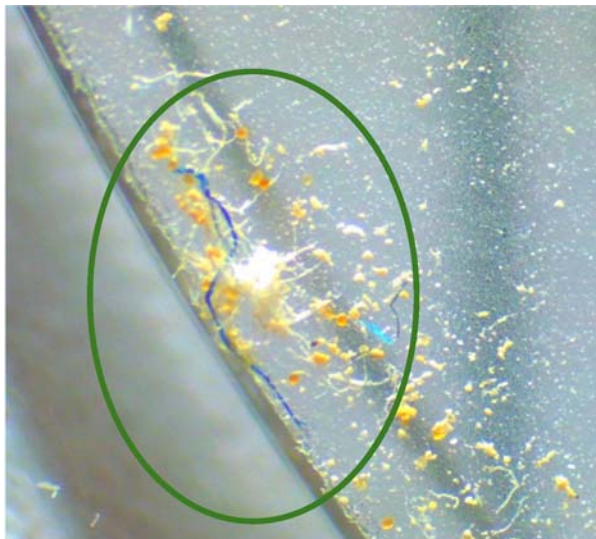
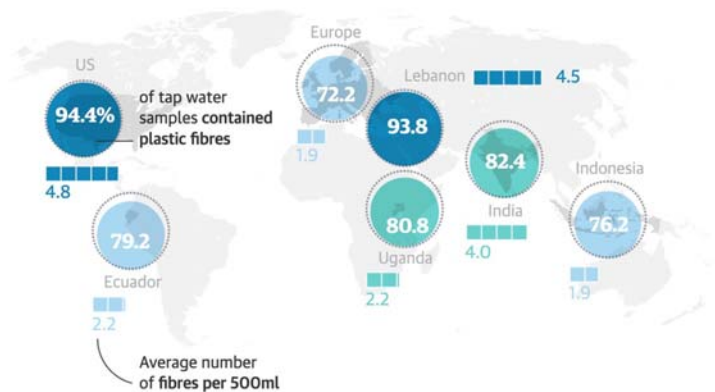


Figure 2. Blue, white, and clear fibers extracted from treated wastewater effluent sourced from an Oregon treatment plant, Leica stereoscope 16x. Credit: S. Arriola, OSU student



Guardian graphic | Source: Orb Media

Figure 3. Microfibers detected in tap water samples globally, 2017. Credit: Orb Media, The Guardian

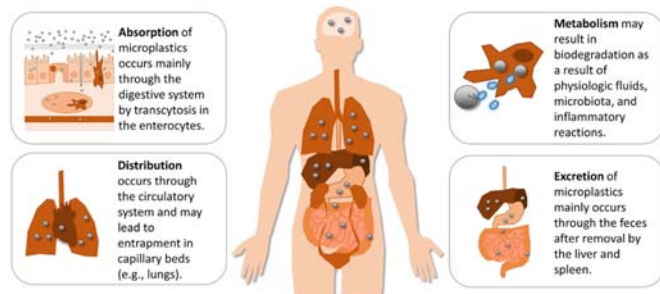


Figure 4. Summary of the pharmacokinetics of microplastics in the human body. Reprinted from Prata 2023, <http://doi.org/10.1080/10643389.2023.2195798>



Figure 5. Graphical abstract, *Measuring plastic pellet (nurdle) abundance on shorelines throughout the Gulf of Mexico using citizen scientists*, reprinted from Tunnel et al. 2020.

References Cited

- Acarer, S. (2023). Abundance and characteristics of microplastics in drinking water treatment plants, distribution systems, water from refill kiosks, tap waters and bottled waters. *Science of The Total Environment*, 163866.
- Carr, S. A., Liu, J., & Tesoro, A. G. (2016). Transport and fate of microplastic particles in wastewater treatment plants. *Water Research*, 91, 174–182.
<https://doi.org/10.1016/j.watres.2016.01.002>
- Christian, A. E., & Köper, I. (2023). Microplastics in biosolids: A review of ecological implications and methods for identification, enumeration, and characterization. *Science of The Total Environment*, 864, 161083.
<https://doi.org/10.1016/j.scitotenv.2022.161083>
- Coffin, S., Bouwmeester, H., Brander, S., Damdimopoulou, P., Gouin, T., Hermabessiere, L., Khan, E., Koelmans, A. A., Lemieux, C. L., Teerds, K., Wagner, M., Weisberg, S. B., & Wright, S. (2022). Development and application of a health-based framework for informing regulatory action in relation to exposure of microplastic particles in California drinking water. *Microplastics and Nanoplastics*, 2(1), 12.
<https://doi.org/10.1186/s43591-022-00030-6>
- Cui, W., Gao, P., Zhang, M., Wang, L., Sun, H., & Liu, C. (2022). Adverse effects of microplastics on earthworms: A critical review. *Science of the Total Environment*, 850, 158041.

- Cunningham, B., Harper, B., Brander, S., & Harper, S. (2022). Toxicity of micro and nano tire particles and leachate for model freshwater organisms. *Journal of Hazardous Materials*, 429, 128319.
- Gao, Z., Chen, L., Cizdziel, J., & Huang, Y. (2023). Research progress on microplastics in wastewater treatment plants: A holistic review. *Journal of Environmental Management*, 325, 116411.
- Geyer, R., Gavigan, J., Jackson, A. M., Saccomanno, V. R., Suh, S., & Gleason, M. G. (2022). Quantity and fate of synthetic microfiber emissions from apparel washing in California and strategies for their reduction. *Environmental Pollution*, 298, 118835. <https://doi.org/10.1016/j.envpol.2022.118835>
- Kosuth, M., Mason, S. A., & Wattenberg, E. V. (2018). Anthropogenic contamination of tap water, beer, and sea salt. *PLOS ONE*, 13(4), e0194970. <https://doi.org/10.1371/journal.pone.0194970>
- Lau, W. W. Y., Shiran, Y., Bailey, R. M., Cook, E., Stuchtey, M. R., Koskella, J., Velis, C. A., Godfrey, L., Boucher, J., Murphy, M. B., Thompson, R. C., Jankowska, E., Castillo Castillo, A., Pilditch, T. D., Dixon, B., Koerselman, L., Kosior, E., Favoino, E., Gutberlet, J., ... Palardy, J. E. (2020). Evaluating scenarios toward zero plastic pollution. *Science*, 369(6510), 1455–1461. <https://doi.org/10.1126/science.aba9475>
- Leslie, H. A., van Velzen, M. J. M., Brandsma, S. H., Vethaak, A. D., Garcia-Vallejo, J. J., & Lamoree, M. H. (2022). Discovery and quantification of plastic particle pollution in human blood. *Environment International*, 163, 107199. <https://doi.org/10.1016/j.envint.2022.107199>

- Lu, K., Zhan, D., Fang, Y., Li, L., Chen, G., Chen, S., & Wang, L. (2022). Microplastics, potential threat to patients with lung diseases. *Frontiers in Toxicology*, *4*, 958414.
- Persiani, E., Cecchetti, A., Ceccherini, E., Gisone, I., Morales, M. A., & Vozi, F. (2023). Microplastics: A Matter of the Heart (and Vascular System). *Biomedicines*, *11*(2), 264.
- Prata, J. C. (2023). Microplastics and human health: Integrating pharmacokinetics. *Critical Reviews in Environmental Science and Technology*, *53*(16), 1489–1511.
<https://doi.org/10.1080/10643389.2023.2195798>
- Qian, N., Gao, X., Lang, X., Deng, H., Bratu, T. M., Chen, Q., Stapleton, P., Yan, B., & Min, W. (2024). Rapid single-particle chemical imaging of nanoplastics by SRS microscopy. *Proceedings of the National Academy of Sciences*, *121*(3), e2300582121.
- Ragusa, A., Svelato, A., Santacroce, C., Catalano, P., Notarstefano, V., Carnevali, O., Papa, F., Rongioletti, M. C. A., Baiocco, F., Draghi, S., D'Amore, E., Rinaldo, D., Matta, M., & Giorgini, E. (2021). Plasticenta: First evidence of microplastics in human placenta. *Environment International*, *146*, 106274.
<https://doi.org/10.1016/j.envint.2020.106274>
- Rochman, C. M., Brookson, C., Bikker, J., Djuric, N., Earn, A., Bucci, K., Athey, S., Huntington, A., McIlwraith, H., Munno, K., De Frond, H., Kolomijeca, A., Erdle, L., Grbic, J., Bayoumi, M., Borrelle, S. B., Wu, T., Santoro, S., Werbowski, L. M., ... Hung, C. (2019). Rethinking microplastics as a diverse contaminant suite. *Environmental Toxicology and Chemistry*, *38*(4), 703–711. <https://doi.org/10.1002/etc.4371>

- Siddiqui, S., Dickens, J. M., Cunningham, B. E., Hutton, S. J., Pedersen, E. I., Harper, B., Harper, S., & Brander, S. M. (2022). Internalization, reduced growth, and behavioral effects following exposure to micro and nano tire particles in two estuarine indicator species. *Chemosphere*, 296, 133934.
<https://doi.org/10.1016/j.chemosphere.2022.133934>
- Siddiqui, S., Hutton, S. J., Dickens, J. M., Pedersen, E. I., Harper, S. L., & Brander, S. M. (n.d.). Natural and synthetic microfibers alter growth and behavior in early life stages of estuarine organisms. *Frontiers in Marine Science*, 9–2022, in revision.
<https://doi.org/10.3389/fmars.2022.991650>
- Sol, D., Menéndez-Manjón, A., Carrasco, S., Crisóstomo-Miranda, J., Laca, A., Laca, A., & Díaz, M. (2023). Contribution of household dishwashing to microplastic pollution. *Environmental Science and Pollution Research*, 30(15), 45140–45150.
- Szule, J. A., Curtis, L. R., Sharpton, T. J., Löhr, C. V., Brander, S. M., Harper, S. L., Pennington, J. M., Hutton, S. J., Sieler, M. J., & Kasschau, K. D. (2022). Early enteric and hepatic responses to ingestion of polystyrene nanospheres from water in C57BL/6 mice. *Frontiers in Water*, 4.
<https://www.frontiersin.org/articles/10.3389/frwa.2022.925781>
- Thornton Hampton, L. M., Bouwmeester, H., Brander, S. M., Coffin, S., Cole, M., Hermabessiere, L., Mehinto, A. C., Miller, E., Rochman, C. M., & Weisberg, S. B. (2022). Research recommendations to better understand the potential health impacts of microplastics to humans and aquatic ecosystems. *Microplastics and Nanoplastics*, 2(1), 1–13.

- Trasande, L., Krithivasan, R., Park, K., Obsekov, V., & Belliveau, M. (2024). Chemicals used in plastic materials: An estimate of the attributable disease burden and costs in the United States. *Journal of the Endocrine Society*, 8(2), bvad163.
- Tunnell, J. W., Dunning, K. H., Scheef, L. P., & Swanson, K. M. (2020). Measuring plastic pellet (nurdle) abundance on shorelines throughout the Gulf of Mexico using citizen scientists: Establishing a platform for policy-relevant research. *Marine Pollution Bulletin*, 151, 110794. <https://doi.org/10.1016/j.marpolbul.2019.110794>
- Werbowski, L. M., Gilbreath, A. N., Munno, K., Zhu, X., Grbic, J., Wu, T., Sutton, R., Sedlak, M. D., Deshpande, A. D., & Rochman, C. M. (2021). Urban Stormwater Runoff: A Major Pathway for Anthropogenic Particles, Black Rubbery Fragments, and Other Types of Microplastics to Urban Receiving Waters. *ACS ES&T Water*, 1(6), 1420–1428. <https://doi.org/10.1021/acsestwater.1c00017>
- Wieland, S., Balmes, A., Bender, J., Kitzinger, J., Meyer, F., Ramsperger, A. F., Roeder, F., Tengelmann, C., Wimmer, B. H., & Laforsch, C. (2022). From properties to toxicity: Comparing microplastics to other airborne microparticles. *Journal of Hazardous Materials*, 428, 128151.
- Wright, S. L., & Kelly, F. J. (2017). Plastic and Human Health: A Micro Issue? *Environmental Science & Technology*, 51(12), 6634–6647. <https://doi.org/10.1021/acs.est.7b00423>

Senator MERKLEY. Thank you very much, Dr. Brander.
Dr. Mason?

**STATEMENT OF SHERRI A. MASON, PH.D., DIRECTOR OF
SUSTAINABILITY, PENN STATE BEHREND**

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

My name is Dr. Sherri Mason. I am a chemist and currently the Director of Sustainability at the Erie Campus of Penn State.

When many think of plastic pollution as an issue, they think of mass collections of debris in the oceans. While oceans are certainly important, science has made it clear over the past decade that this is not an oceans-only problem; it is a water problem.

My research group was among the first to study plastic pollution in freshwater ecosystems. Our study formed the basis of 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 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 particles called nano plastics. My work in this field of research started in the Great Lakes, the largest freshwater ecosystem on the planet, holding 90 percent of the United States' freshwater supply and 20 percent of the world's freshwater supply.

Our economy and our Country are exceedingly fortunate to have this freshwater resource right in our backyard. Yet, over the 5-years that I sailed and sampled all five 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. Each Great Lake now harbors between one and five billion pieces of plastic each. Each lake has that much.

Ninety-seven percent of those plastics are what are classified as microplastics, whose origins are larger macroplastic items. The dominant degradation pathway of plastics is mechanical, not chemical nor biological. This makes plastics 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 do not readily biodegrade, 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 pieces. One macroplastic item can form millions of microplastics, which break into billions of nano plastics, particles so small they can easily move across the gastrointestinal tract, be carried by the blood, end up in our livers, kidneys, brains, even crossing the placental boundary into embryos.

There are about 13,000 different chemicals used during the manufacture of various plastic products. Many of these are known to be carcinogens or endocrine disrupting chemicals, which mean that they mimic hormones, the chemical messengers of the body. By affecting the endocrine system, these chemicals within plastics are linked to fertility issues, including decreased sperm counts, as well

as being associated with obesity rates, autism, and other developmental issues.

Understanding the impacts of the plastic polymers themselves is the real knowledge gap currently that initial studies have shown connections to inflammation, oxidative stress, Alzheimer's, and other neurological diseases.

While we do not know everything, what we do know is concerning. 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, even those particles that are removed end up in the biosolids, which are frequently applied to farmland.

This application allows plastic particles within the sludge to be re-released into nearby waterways as runoff or move through the soil into the groundwater. Studies have found microplastics within groundwater. Our study on tap water found an average of five and a half pieces of microplastic per liter.

Should one think that bottled water is a solution to plastic within tap water, it is not. Our study on bottled water found an average of 325 particles per liter, 58 times the quantity within tap water. Just last month, a new study found an average of 240,000 nano plastic particles within bottled water, nearly three orders of magnitude higher than our microplastic study. This study supported what our study found, which is we can not filter ourselves out of this problem.

What can we do? The problem of plastic pollution is multifaceted, and so are the solutions. I think the EPA plastic strategy, as well as the Break Free From Plastic Pollution Act, provide good starting points for discussions. Three solutions I want to highlight are source reduction and mitigation, extended corporate responsibility, and the creation of a national waste and recycling plan.

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

[The prepared statement of Ms. Mason follows:]

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 world's 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 RECYCLING 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.

Senator MERKLEY. Thank you very much for your testimony. Now, we will turn to our third witness. Welcome.

STATEMENT OF BRENT ALSPACH, P.E., VICE PRESIDENT AND DIRECTOR OF APPLIED RESEARCH, ARCADIS

Mr. ALSPACH. Good afternoon, Chairman Padilla, Chairman Merkley, Ranking Member Lummis, Ranking Member Mullin, and members of the subcommittees. Thank you for the opportunity to testify before you today on this important topic.

My name is Brent Alspach, and I am a Vice President and Director of Applied Research at Arcadis, a global engineering and consulting firm where I oversee a program that has conducted approximately \$30 million in drinking water, potable reuse, wastewater, and stormwater research.

I also serve on the American Water Works Association's (AWWA) Technical and Education Council, which works to advance practices and technologies that produce the best quality drinking water for the public.

It is in this capacity that I offer my testimony as a representative of the AWWA community and a subject matter expert on microplastics and drinking water. Accordingly, I am currently the principal investigator on two related projects funded by the Water Research Foundation, Developing Strategic Consumer Messaging for Microplastics in Drinking Water Supplies, Project 5155, and Fate of Microplastics in Drinking Water Treatment Plants, Project 5185.

Microplastics is a category of emerging contaminant that includes a wide variety of particulates with different physical characteristics, which may originate from the primary or secondary sources.

Primary microplastics are produced as small particles, microbeads, or nurdles, which serve as the raw material for manufacturing a wide variety of plastic products, whereas secondary microplastics are a product of the fragmentation of larger plastics, like plastic bags or bottles.

While generally characterized as measuring less than five millimeters in size, there is no formal scientific consensus on the definition of microplastics. Studies have shown that microplastics are nearly ubiquitous in the environment, having been detected everywhere from the upper atmosphere to the deepest ocean trenches, including potable water sources and treated drinking water supplies.

However, the science of characterizing occurrence in these supplies and understanding their impact while advancing quickly is still in its relative infancy, with many important questions remaining to be answered.

The most important step toward advancing this understanding is the development and refinement of standardized analytical methods. Along these lines, the California Water Resources Control Board has approved two analytical methods, which select water systems throughout the State will soon apply to evaluate real world samples.

Although these methods represent an important step in understanding occurrence, further research is needed to develop analyt-

ical techniques that are increasingly reliable, efficient, economical, and able to detect plastic particulates at the nanometer scale. Such advancements will facilitate the implementation of broader, more reliable occurrence, toxicity, and treatability studies.

The limitations of contemporary methods of microplastics analysis notwithstanding, it is still essential to understand occurrence and treatability to the extent possible with the best science currently available. Using these practices, a wide range of studies have demonstrated the ability of many drinking water treatment processes in common use across the Country to achieve significant reduction of microplastics, commensurate with other types of regulated particulates.

However, if toxicity studies ultimately demonstrate that some subset of microplastics poses a health risk via a drinking water vector, it will be important for water systems to adapt and optimize treatment as appropriate.

The extent to which microplastics may contribute to adverse health outcomes is likewise the subject of ongoing research and likely various microplastic attributes. Consideration may include the size, shape, and material composition of the ingested particulates, as well as the ingested quantity and the residence time in the human body.

Relevant human health effect studies are difficult to conduct, and such research has not yet established a clear indication that microplastics are toxic, a necessary precursor to any regulatory action under the Safe Drinking Water Act, which requires clear occurrence and health effects data. These statutory requirements help ensure that water systems can maintain high quality, affordable service in the context of their mandate to safeguard public health.

Accordingly, congressional support for research in these areas would be welcomed by the drinking water sector. In parallel with this research, exploring and enhancing opportunities to divert the sources of microplastics from entering the Nation's water supplies could be valuable preventative measures.

Thank you again for the opportunity to provide testimony on this important topic. I welcome any questions that you may have. Additionally, AWWA will be conducting an informational webinar on April 10th entitled Microplastics 2024: Practical State-of-the-Science in Drinking Water. Thank you.

[The prepared statement of Mr. Alspach follows:]

Testimony of Brent Alspach
Vice President and Director of Applied Research, Arcadis

United States Senate
Committee on Environment and Public Works
Subcommittee on Fisheries, Water, and Wildlife
And
Subcommittee on Chemical Safety, Waste Management,
Environmental Justice, and Regulatory Oversight

Microplastics in Water

February 27, 2024

Good afternoon, Chairman Padilla, Chairman Merkley, Ranking Member Lummis, Ranking Member Mullin, and members of the Subcommittees. Thank you for the opportunity to testify before you today on this important topic. My name is Brent Alspach, and I am a Vice President and Director of Applied Research at Arcadis, where I oversee a program that has conducted approximately \$30 million in drinking water, potable reuse, wastewater, and stormwater research. I also serve on the Board of Trustees for the American Water Works Association's Water Quality & Technology Division, as well as on the AWWA Technical and Education Council, which works to advance practices and technologies that produce the best quality drinking water for the public. It is in this capacity that I offer my testimony, as a representative of the AWWA community and a subject matter expert on microplastics in drinking water. Accordingly, I am currently the Principal Investigator on two related projects funded by The Water Research Foundation: Developing Strategic Consumer Messaging for Microplastics in Drinking Water Supplies (Project #5155) and Fate of Microplastics in Drinking Water Treatment Plants (Project #5185).

Microplastics is a category of emerging contaminant that includes a wide variety of particulates with different physical characteristics, which may originate from either primary or secondary sources. Primary microplastics are produced as small particles, microbeads, or nurdles, which serve as the raw material for manufacturing a wide variety of plastic products, whereas secondary microplastics are a product of the fragmentation of larger plastics, like plastic bags or bottles. While generally characterized as measuring less than 5 millimeters in size, there is no formal scientific consensus on the definition of microplastics.

Studies have shown that microplastics are nearly ubiquitous in the environment, having been detected everywhere from the upper atmosphere to the deepest ocean trenches, including potable water sources and treated drinking water supplies. However, the science of characterizing occurrence in these supplies and understanding their impact, while advancing quickly, is still in its relative infancy, with many important questions remaining to be answered.

The most important step toward advancing this understanding is the development and refinement of standardized analytical methods. Along these lines, the California Water Resources Control Board has approved two analytical methods which select water systems throughout the state will soon apply to

evaluate real-world samples. Although these methods represent an important step in understanding occurrence, further research is needed to develop analytical techniques that are increasingly reliable, efficient, economical, and able to detect plastic particulates at the nanometer scale. Such advancements will facilitate the implementation of broader and more reliable occurrence, toxicity, and treatability studies.

The limitations of contemporary methods of microplastics analysis notwithstanding, it is still essential to understand occurrence and treatability to the extent possible with the best science currently available. Using these practices, a wide range of studies have demonstrated the ability of many drinking water treatment processes in common use across the country to achieve significant reduction of microplastics, commensurate with other types of regulated particulates. However, if toxicity studies ultimately demonstrate that some subset of microplastics poses a health risk via a drinking water vector, it will be important for water systems to adapt and optimize treatment, as appropriate.

The extent to which microplastics may contribute to adverse health outcomes is likewise the subject of ongoing research and likely varies with microplastic attributes. Considerations may include the size, shape, and material composition of the ingested microplastics, as well as the ingested quantity and the residence time in the human body. Relevant human health effects studies are difficult to conduct, and such research has not yet established a clear indication that microplastics are toxic – a necessary precursor to any regulatory action under the Safe Drinking Water Act, which requires clear occurrence and health effects data. These statutory requirements help to ensure that water systems can maintain high quality, affordable service in the context of their mandate to safeguard public health.

Notably, AWWA's 2019 Water and Wastewater Rate Survey found that, even before the onset of the COVID-19 pandemic and the ensuing rise in costs, water rates were significantly outpacing inflation. Consequently, water systems are struggling to balance the need for infrastructure upgrades and new treatment technologies with a growing affordability crisis. It is important to underscore the importance of affordability as it pertains to regulatory oversight. EPA's most recent Drinking Water Needs Survey and Assessment estimates that drinking water systems alone will need to invest \$625 billion over the next twenty years just to maintain current levels of service. AWWA's "Buried No Longer" report, released in 2012, estimated this investment to be \$1 trillion over 25 years. These totals are in addition to the investments that systems will need to make in order to comply with pending regulatory actions like the Lead and Copper Rule Improvements and National Primary Drinking Water Regulations for six per- and polyfluoroalkyl substances (PFAS). According to cost estimates commissioned by AWWA, replacing every lead service line in the country – as outlined in the Lead and Copper Rule Improvements – could cost in excess of \$100 billion, while installing the treatment technology to remove PFAS could necessitate between \$50 and \$60 billion. Although some of this funding may come from federal programs, the majority will likely be paid through rate increases, the impact of which will be felt most acutely by economically disadvantaged communities.

With this in mind, it is essential to emphasize that much more information on occurrence, toxicity, and treatability is necessary before obligating water systems to divert their limited resources to address microplastics. Accordingly, Congressional support for research in these areas would be welcomed by the drinking water sector. In parallel with this research, exploring and enhancing opportunities to divert the

sources of microplastics from entering the nation's water supplies could be valuable preventative measures.

Thank you again for the opportunity to provide testimony on this important topic, and I welcome any questions that you may have. Additionally, AWWA will be conducting an informational webinar on April 10, entitled Microplastics 2024: Practical State-of-the-Science in Drinking Water.

Brent Alspach

Brent Alspach holds both Bachelor and Master of Science degrees in Civil and Environmental Engineering from Cornell University. Brent joined Arcadis in 1997 and serves as a Vice President and Director of Applied Research. He oversees a program that has conducted approximately \$30 million in drinking water, potable reuse, wastewater, and stormwater research funded by the Water Research Foundation, AWWA, the US Bureau of Reclamation, and NASA's Jet Propulsion Lab, among other organizations. Mr. Alspach is a past President of the American Membrane Technology Association (AMTA) past Chair of the AWWA Water Quality & Technology Division Board of Trustees. He also serves on the AWWA Technical & Education Council, as well as on the advisory / editorial boards for the publications *Journal AWWA*, *AWWA Water Science*, and *Opflow*. He has a wide range of water quality and treatment expertise, with a contemporary focus on microplastics in drinking water over that has made him one of the industry's most recognized authorities on the issues associated with this important emerging contaminant. Accordingly, he has been a featured speaker on microplastics at numerous industry conferences and serves as a peer-reviewer for microplastics literature for multiple technical journals. He has also been engaged in microplastics issues with both the Outdoor Industry Association's Sustainability Working Group and the Interstate Technology Research Council's (ITRC) Microplastics Outreach and Education group, also Chairing the Microplastics Consumer Messaging Workgroup under the California Water Quality Monitoring Council.

Senator MERKLEY. Thank you very much for your insights and testimony.

I am now going to turn to questions. I am going to start with the Chair of the Environment and Public Works, Senator Carper.

Senator CARPER. Thanks so much, Mr. Chairman. Welcome, one and all. I am going to ask the first question, I just want you to give me really short answers, OK? We will start with you, Dr. Brander.

You mentioned, I think, in your written testimony that the U.S. has the highest prevalence of microfibers in our drinking water compared to any other nation. That is pretty amazing. Why is that? Just very briefly, why is that?

Ms. BRANDER. That is a really good question. It may, in part, be because we buy an incredible amount of clothing, and a lot of this clothing is generated by companies that promote fast fashion. There have been studies showing that our consumption of clothing has increased rapidly over the past five to 10 years, and that could be contributing, but I do not think the exact cause is—

Senator CARPER. If we just buy, maybe, less clothing, we could maybe make a difference here. What do you think?

Ms. BRANDER. Like others have—

Senator CARPER. I say that with tongue in cheek.

Next question. In addition to our retrofitting technologies in our washing machines to capture microplastics from our clothing, are there other innovations that can reduce the amount of microfibers in our water systems?

I really like to find out what works and do more of that. If there are other countries and other places where they have figured out how to do this better and we could learn from them, what can we learn from them, and are there any actions that Congress should consider to reduce microfiber shedding? Thank you.

Ms. BRANDER. Sure. Is that an additional question?

Senator CARPER. It is a two-part question.

Ms. BRANDER. Sure.

Senator CARPER. You only get paid for one.

[Laughter.]

Ms. BRANDER. Yes, fair enough. A nonprofit that I collaborate with in California is actually looking into solutions such as textiles that shed less, as well as textiles that are produced from materials like kelp, producing textiles from sustainable materials that can also capture carbon. Those are solutions that are both being looked into currently that could potentially reduce microfiber shedding over the long term.

Senator CARPER. Anybody else want in on that second question? What can we learn from others with respect to this challenge, this problem? Again, I would like to say, find out what works, do more of that. Anybody out there, in another country, maybe, that is doing a better job than we are?

Ms. MASON. I do not know if there are other countries that are doing better. I think that there are people looking into it. Patagonia is another company that is looking into it heavily as well.

I think that there is some important science out there that is trying to understand kind of why the clothing sheds as much as it does, and are there things that we can do to mitigate that. Bio, natural-based polymers are another solution, although they still

have the same chemicals that are used in them, and so that is still a concern, because as they degrade, they biodegrade, but they are still toxic.

Senator CARPER. All right, thank you. Mr. Alspach, question for you, and maybe for our others. Are there any areas of research noted in the draft strategy that the Federal Government should prioritize, and are there any further topics for future studies on micro and nano plastics not included in the draft strategy that the Federal Government maybe should consider?

Mr. ALSPACH. Yes, I think probably the most important area that could require funding is the development of analytical methods, as I mentioned in my testimony. As several of the other speakers have mentioned as well, we really do not have a very good understanding about the occurrence of nano plastics in the environment and our water supplies, and until we understand that occurrence, we really can not conduct meaningful treatability or toxicity studies to really understand, in turn, how we should take action about microplastics.

Senator CARPER. OK. Dr. Mason, we are not going to let you get out of here without a question.

I think in your testimony, you described an extended producer responsibility policy as one of the most powerful tools that policymakers have to decrease plastic pollution, including the resulting microplastic pollution we see in our marine environment. Will you please expand on how extended producer responsibility policies can be an effective tool for reducing plastic pollution, and subsequently reduce microplastic pollution?

Ms. MASON. From my understanding of how they work, the companies are charged for the plastic that they utilize, that they produce. They are charged less if they choose a polymer that is more easily recycled, like polyethylene or polypropylene, versus something like polystyrene or polyvinylchloride that can not be recycled.

Obviously, if they switch away from using plastics at all, they are not paying for it. That money then also adds into infrastructure for the recycling system, which right now, is being borne by the taxpayers, and hence, is consistently underfunded.

This is one of the reasons why the recycling of plastics is so bad, because we need better funding mechanisms to support the infrastructure around recycling. This is a mechanism to provide that support for the recycling industry, while at the same time shifting the market to fewer polymers.

Right now, I mean, another issue we have with recycling of plastics is that there are thousands of different polymers that are on the marketplace. To recycle them, you have to separate them each from each other, and you can not do that through mechanical means. You would need FTIR, Fourier Transform Infrared Spectroscopy, you need scanners, you need a different type of mechanism, and our current recycling infrastructure does not have that in place.

One of the reasons why we have such a hard time recycling plastics is the separation of the different plastics from each other. If we can reduce the number of polymers that are on the marketplace, it enables better recycling, and on top of that, you have a

funding mechanism to support that recycling initiative. Then, you are using, you know, your roles to get the outcome that you want from the system that is in place, and that is ultimately what we can do.

As Congress, what you guys can do as Congress, is you have systems in place, but you can use your leverage, use your different levers in order to produce the outcome that you want. Right now, the recycling infrastructure is awful, so extended corporate responsibility is a good way to leverage to get the outcome that you are looking for.

Senator CARPER. Thanks to each of you.

Mr. Chairman, my wife studied at the University of Tennessee, undergraduate fibers and textiles, and later worked for DuPont for 30 some years in the same business, and then taught as a professor at the University of Delaware, actually, courses that relate to this as well. I do not know how many people tune in and look at the reruns of our hearings, but she is going to be tuning in tonight, and sends her best.

Thank you.

Ms. MASON. Thank you.

Senator MERKLEY. Thank you, Senator Carper.

Senator Mullin?

Senator MULLIN. You make me nervous that my wife is going to watch my hearings. She would scold me and correct me all the time. I love her, though, deeply, so if you are watching, they have been the best 26 years of my life, babe. Just wanted to put that one out there before I get myself in trouble.

Anyways, thank you guys for being here. I am sorry I came in a little late. I had an opening statement to thank you guys for taking the time out of your busy schedule to inform Congress.

I think we can all say that the desirable outcome is not to have microplastics in our water, right? That is what we would love to have, but at the same time, when we are starting to look at these studies, what we always say up here is follow the science, and science always changes.

As a licensed operator to operate waste and drinking water facilities, I understand the challenges that our municipalities have to meet today's regulations, which is very challenging.

Years ago, we had a company called Mullin Environmental, where we did a lot of the water treatments. It is constantly changing, and the different makeups of the water makes different challenges. You can literally go two miles down the road and have a complete different makeup of water, that you have completely different challenges to make them compliant with today.

As we are moving forward, looking at microplastics, we have to be careful that we are not getting ahead of, as we would say, the science and burden these municipalities that are trying to meet today's regulations to chase something that we do not even know the conclusion of, if it is actually causing what harm, or if it is causing harm at all.

I just caution all of us to understand that we have a lot of research to do, and I think that is what you guys are doing, right? That is what everybody here, we are researching, and we are here, and we are searching for what we need to do, but we have to be

cautious moving forward, too. By focusing so much on microplastics, which we should, I am not saying we should not, we can distract what these municipalities are trying to do right now is make sure it is clean and safe and not causing cancers or what chemicals we are introducing are not causing harmful reactions to the material that is already in the ground, like what we saw in Flint, Michigan.

I say all that because I want to make sure, as a committee, that we are moving with caution and we are going to actually pay attention to the science that is leading us down this path, which, once again, I repeat myself, thank you guys for the research that every one of you guys are doing.

I am going to call you Brent. I will not mess up on that one. Does that work?

Mr. ALSPACH. That is fine. Thank you, Senator.

Senator MULLIN. Thank you, and you can call me Markwayne, so that way, we do not have to use formal titles, there. Given the significant infrastructure investment needed to improve and maintain the compliance with current regulatory requirements, if water supplies and regulators were to shift their attention to microplastics, what other safety priorities might be impacted?

Mr. ALSPACH. I think, as you suggested, there are a number of priorities that utilities are currently contending with. A couple that come to mind that are most pressing presently, PFAS and lead. Both of those require significant amounts of attention and cost to utilities, which then is often passed on to their ratepayers, unless there are subsidies available to them.

Diverting attention to something, an additional contaminant, whether it is microplastics or anything else, would, by necessity, take some amount of energy, time, cost away from utilities meeting the regulatory requirements for things like that that we know are toxic and we know need to be addressed in a very expedient manner.

Senator MULLIN. Just to hit on the lead exposure, too, I understand every time we introduce, most of the lead that we have in drinking water, they were already coated, and we used to use a really natural water filtration system.

When we started having to get into a more regulatory environment where we were cleaning up a different type of water, we had to introduce more chemicals, and those chemicals then had a reaction to a lot of the piping that we have in the ground today. That is kind of my concern that we have today, because it erodes the protection coating that was over some of the lead piping that was there, and then exposes us. We have now more issues.

We tried to solve one issue, and we caused another problem. As I said before, we have to be really careful about the path that we are moving toward, because it can have a domino effect, especially small, rural areas where they just do not have the resources, which is what Senator Lummis and I, we represent rural areas.

We face this all the time in our rural communities. If they do not have the resources to just simply build a new water treatment plant, it just does not exist. Once again, thank you guys for being here, and with that, I yield back.

Senator MERKLEY. Thank you very much, Senator Mullin.

I am going to jump into a couple questions that I hope to get quick answers to, but I realize that is hard to do, because things are complicated, but a lot of people listening to this hearing right now are going, huh.

Senator MULLIN. All five?

Senator MERKLEY. All five of them.

Senator MULLIN. Six, it is six now.

[Laughter.]

Senator MERKLEY. Our wonderful audience here, and hopefully, our online folks as well.

Should I be getting a water in a plastic bottle? I see heads shaking no. Here is the thing: my understanding is, our paper cups, like the one Senator Lummis is drinking from at this moment, are also lined with plastic. My understanding is our aluminum cans are lined with plastic.

Over here, we have a blue, can you hold up your blue water bottle? I am not sure about that. If it is in fact the case that aluminum cans and paper cups are lined with plastic, and do they put off fewer particles, or should we be thinking just in terms of individual health? Is there some container other than glass that does not have a plastic lining?

Ms. MASON. Are you aiming this at whoever jumps in first? Is this a free-for-all?

Senator MERKLEY. Dr. Mason, please?

Ms. MASON. The coffee cups, because typically you are putting a hot beverage into that, is going to release more microplastics than if you were pouring a cold beverage into your container, which probably, if it is stainless steel, does not have a lining. Most reusable metal water bottles these days, most of them, do not have a lining.

Your soup at home usually has a lining; if you have orange juice, like I grew up on canned orange juice, yes, I remember, it tasted like metal because it wasn't lined with plastic. You have different extremes for sure, and I think there is more science that could be known on that, but preferring certain metals, certain containers over others, I think would be better.

Senator MERKLEY. I do not want to extend the time too much; I only have 5 minutes, so I will just take your answer. That is helpful.

I heard, basically, stainless steel may be the way to go. I will, for the record, I will followup with some other questions, because I would like to know if the amount of particles that comes from a paper cup lined with plastic or an aluminum can is different than those coming from a water bottle and so forth, but that is for the record.

I want to turn to the human health side of this. In your testimony, Dr. Mason, you referred to, did I hear you say myocardial damage? Ah, Dr. Brander. That is heart damage, I assume. Then also in the testimony, about the impact on sperm, on autism, on obesity, and Alzheimer's.

Are these simply things that we suspect, or are we able to have a scientific process now that has really kind of started to really give us insight on how much these particles are contributing to challenges of human health?

Ms. BRANDER. Just like we have done with other contaminants over many decades, we have begun using rodents as a model for human health for the study of micro and nano plastics. Recent studies are pointing to issues like cardiac toxicity, the potential for fibrosis, for example, in blood vessels created by the presence of these particles.

In addition to those issues, there is also the potential for impact on the microbiome that has been highlighted by a few studies. In a study that we did at Oregon State that was published in 2023, we dosed drinking water with a low level of nano plastics, and mice were exposed to this drinking water for 24 hours.

Just after that 24-hour period, we saw a significant different in the diversity of bacteria in the gut of the exposed mice. You can imagine what that might mean over a lifetime of exposure. Those are findings that have been published by my group and others.

Senator MERKLEY. For those of us who do not follow all the health issues, microbiome, we are talking about the bacterial growth in your intestines, I assume, and you are saying just in 24 hours, a low dose, you said, not some high dose.

Tell me how, you mentioned the impact on human reproduction, on sperm counts. We know sperm counts have dropped enormously for men, obviously for men, but around the world. Are we confident of this link between plastics, and is it the plastics themselves, or is it other chemicals that have been put into the plastic for hardness, brittleness, flexibility, color, and so forth?

Ms. BRANDER. Really good question, because in some ways, those are two separate issues. Being exposed to a plastic particle is a multiple stressor because you are being exposed to the chemicals, potentially, that are associated with the plastic, but also the particle itself.

A lot of the chemicals that are used in plastic, the 13,000 to 16,000 at this point, estimated, are endocrine disruptors and directly interact with hormone receptors, and that is shown to contribute to decreased sperm production and decreased fertility.

The plastic particles themselves, as Dr. Mason was saying earlier, they can cause oxidative damage. They can cause the production of reactive oxygen species, and I realize that is a lot of terminology, but long story short, that can cause cellular damage, and then tissue level damage if it gets bad enough. Those processes can also contribute to effects on reproduction, microbiome, other important endpoints.

Senator MERKLEY. Thank you very much. Senator Lummis?

Senator LUMMIS. Thank you, Mr. Chairman.

My daughter is a little obsessive about the containers that she uses in her house for my grandchildren, and I thought she was being a little obsessive-compulsive, and now I know she is not. This is a real thing, a real concern.

I want to try and bring it down, Mr. Alspach, to the water treatment level. Help me understand how we can do a cost—benefit analysis that maybe a small water treatment plant in a community in Wyoming can get their head around and use to help them address this issue.

Mr. ALSPACH. You ask a very important question, Senator. I firmly believe, as I have indicated in my testimony, that we just

need more research to be able to even answer that question. I do not believe, at this point, that a utility in Wyoming could do a meaningful cost-benefit analysis without much more information that informs what that analysis would ultimately tell them.

Senator LUMMIS. OK, so are groups like yours thinking about that, getting ready to help maybe a small water treatment plant analyze the cost and the benefits?

Mr. ALSPACH. Certainly, the cost of treating for microplastics is something we could quantify. Whether it is to an extent that would be meaningful for health reduction, again, that is an open question, but they are particulates, and we do have a very good understanding about how particulates, for the most part, are removed. Although microplastics have some different properties than other particulates. We could quantify that for any utility and give some indication of cost.

Again, that said, there may be other particulates on the nanoscale that we cannot yet detect and do not have any understanding, really, about how efficacious treatment processes are for removing those particulates.

Senator LUMMIS. Based on what you know now about this subject, how would you tackle it from a policy point of view? What would you do first that would have the biggest bang for the buck, and then scale it down from there?

Mr. ALSPACH. Yes, that is also an excellent question. I guess I would give some credit to the State of California, which I believe is doing a very good job of approaching this topic. I believe when the State passed its bill to give the regulators a mandate to look at this process, they didn't go in with the foregone conclusion that something should be done about microplastics, but with an open mind that it is an important question that needed to be addressed.

With that in mind, they went and developed a definition of microplastics, followed by methods, again, which have their own shortcomings, but nevertheless, are standardized to the best of our ability at this point in time, and with those methods in place, they are going to look at source waters to try to understand the occurrence.

With that, hopefully more health effect studies will be done in parallel, and then ultimately, when their monitoring program has run its course, we hope there will be enough information between the occurrence data, the treatability data, and the toxicity data to understand whether or not microplastics need to be looked at in a drinking water treatment context.

Senator LUMMIS. OK, I see the gentlewomen on the panel, your co-panelists, nodding. Could you address the same issue?

Ms. MASON. I think he makes a valid point. I think real solutions to this problem are much more upstream than the wastewater treatment or the water or wastewater treatments.

That is not where you tackle it. You do not tackle this problem when you are dealing with something that is nanosized. You deal with it when you are talking about something that is big.

That is why I point to source reduction and extended corporate responsibility and a waste and recycling plan. There, you are talking about macro items that are easy to gather and quantify and obtain, and you are reducing what is ending up in the water, the oc-

currence, and you are not looking at the water treatment facilities, telling them they need to clean it up, but I can keep doing whatever it is. I want to go into a coffee shop every morning and getting my latte in my plastic cup and then throwing it on the side of the road, the problem is that, right?

The problem is that when it is at the macro level, and that is when you really solve this. You always, when you are looking at a problem, you look as far upstream for a solution as you can. That is where the real solutions are.

Senator LUMMIS. Dr. Brander, would you like to weigh in?

Ms. BRANDER. Sure. I would say I completely agree with the comments of both of the other panelists. Source reduction is absolutely what we need to aim for. That is why the problem of plastic pollution is being discussed at a global level right now at the United Nations, and that is where the focus is, focusing on reducing the number of polymers that are being produced, simplifying, chemical simplification, and reducing what we are putting out there.

Once we have these nano-sized particles in the environment, you can not go out there with a vacuum cleaner and remove them from the environment. We really need to start at the larger scale, at the macro scale, to get at this problem.

Senator LUMMIS. This glass is made out of a natural trona. There are only two places in the United States that have natural trona mines. They are Wyoming and California. For my Chair and his Ranking Member, let us all use more glass from Wyoming and California.

Mr. Chairman, I yield back.

Senator MERKLEY. Thank you very much, Senator Lummis, and from Wyoming to California, we will make that transition.

Senator Padilla?

Senator PADILLA. Thank you, Mr. Chair. I wanted to just acknowledge some of the questions and some of the work that Senator Lummis and I are doing together, not just on addressing, we have talked about clean water, the need for safe water, but also water affordability and how a lot of rural communities or smaller agencies are able to finance these upgrade of infrastructure to address some of these issues.

Since you invoked the name of my State that I am proud to represent, let me brag a little bit more on what we are doing in California. I am proud to represent the State that tries to lead the Nation when it comes to environmental policy, as Mr. Alspach can well attest.

Plastics are certainly no exception. In California communities, plastics are pervasive, with single-use items like shopping bags acting like tumbleweeds when you find them in beaches and in parks, and frankly, just regular neighborhoods. That is why in 2014, the State of California took a step when it passed my first attempt at a statewide plastic bag ban. Since then, California has continued to lead on landmark plastic legislation like the current SB 54, which shifts plastic pollution responsibility from consumers to producers and bans Styrofoam in cities like San Diego and Los Angeles.

Now, California continues to pave the way in plastic monitoring. In 2022, we have been discussing this, the Ocean Protection Coun-

cil (OPC) released the first statewide monitoring program to manage microplastics. The roadmap includes setting standards for plastic levels in drinking water and testing for these compounds in certified labs across the State.

I know our witnesses are very well aware of the work, but I share that with my colleagues and for the record to tee up the following questions. No. 1, Dr. Brander, given your previous work with the OPC, what lessons can other States and the Federal Government learn from this pioneering monitoring program?

Ms. BRANDER. Absolutely, thank you for the question, Senator. I will mention that Oregon has also enacted an extended producer responsibility bill and has banned Styrofoam. I think that begins next year, so it is really—

Senator MERKLEY. Is it better than California's?

[Laughter.]

Ms. BRANDER. We will get back to California. From the OPC experience, what I think was critical there was that both scientists and stakeholders were involved from the beginning. That is really where we need to begin, I think, in every State, every discussion of this huge challenge.

In terms of involving scientists and stakeholders early on, I think that helps with the issue of people feeling like scientists are giving directives when we do not necessarily have the responsibility or the challenges of regulating a new contaminant on the ground. I think that was really important.

Then, the integration of all of the agencies across the State was incredibly impressive. Working with the Water Board, which is, of course, California's EPA, their Southern California Coastal Water Research Project, so many important agencies that were able to sort of cut down on the barriers and any silos that existed and able to work across any barriers that previously existed. I think that was incredibly important as well. I think it is a wonderful example to other States.

The challenge to other States, I think, is the availability of resources and being able to compile enough resources to tackle such a giant challenge.

Senator PADILLA. We certainly commend the State of Oregon for that being up.

Ms. BRANDER. Thank you.

Senator PADILLA. I encourage others to do, as well.

Dr. Mason, can you expand on the challenges that labs face in monitoring plastics in water, especially at scale?

Ms. MASON. Brent did a great job of kind of mentioning this earlier, but with plastics, the techniques that exist currently are very time and people intensive. As we go to smaller particles, which are a bigger concern when it comes to human health impact, that adds onto it an additional layer with regard to the analytical technique.

The study that came out of Columbia and Rutgers University on bottled water was developing a new Raman spectroscopy technique that allowed them to analyze nano plastics, and not just to see that there was a particle there, but to say that yes, it is plastic, and this is the type of plastic that it is. That was critical. We haven't had that technique until January 2024, but that is one technique, and it is really expensive.

We have the analytical abilities to analyze for particular plastics and identify them, and that is a huge expense on top of the fact that right now, we do not have an automated way to go about pulling microplastics out of water, so it is really human intensive, time intensive, and expensive.

Senator PADILLA. Thank you. I know my time is up, Mr. Chair. I just have one followup question for the Californian on the panel. Just briefly, Mr. Alspach, can you tell the committee a little bit more about the two methods that the California State Water Board has approved?

Mr. ALSPACH. Sure. The two methods are infrared spectroscopy and a Raman spectroscopy method. The major difference between those two in terms of practical application is the resolution, which is 50 microns for infrared and 20 microns for the Raman.

That is important because the smaller you can go with your resolution, the better able to detect those nano plastics, which are critical for our understanding about this issue in a more comprehensive way.

Senator PADILLA. Thank you all very much.

Senator MERKLEY. Thank you, and thank you for California's work on this issue.

Let's turn to another ocean State, Rhode Island, the Senator from Rhode Island, Senator Whitehouse.

Senator WHITEHOUSE. Thank you very much, Senator Merkley. Thank you to all of the witnesses. This has been a very helpful and productive hearing. I always appreciate it when a bipartisan panel can produce so much consensus and agreement on a particular issue. I thank you for all the work that has led to that being the case today, particularly you, Chairman Merkley.

The University of Rhode Island has done a study recently looking at the top five centimeters of the sediment in Narragansett Bay, which is our main resource and geographic feature. We are loaded with more than 16 trillion pieces of microplastic, which if we could sort it all out from the sediments around it, would be 1,000 tons. We also try to grow quahogs in that sediment, and catch fish that feed off of that sediment, and so forth. There is a pretty distinct likelihood of transit, particularly of nanoparticles, up through the food chain. This has a real Rhode Island resonance to it.

One of the things that I have been working on is trying to keep tabs with the U.S. effort in the U.N. negotiations that were discussed earlier, and I am interested in hearing your recommendations to the U.S. negotiators. Assuming that the Senate schedule allows, I will be going up to Ottawa for the next meeting. Then, there is the Our Oceans Conference coming up in Greece, which will, I am sure, have a fairly significant piece on this.

I remember when President Trump was all excited about getting plastics out of the ocean and mad at China for dumping it all and all of that, but every time you actually read a story, the story was all the other nations of the world complaining that the U.S. was the laggard, that we were the anchor that they had to drag, that of all the countries in the world, we were least productive, helpful and contrastive in those international negotiations, so that wasn't so great.

What would you give, what message would you like me to convey to the negotiators when I go and harass them more about what the key points are that you would judge as being success points or failure points in those negotiations?

Dr. Brander, let me start with you.

Ms. BRANDER. Sure. Thank you, Senator Whitehouse, for the question.

Senator WHITEHOUSE. I will just interrupt to say, I take it as a given what Dr. Mason said that bigger is better. You want to get it out of the system before it has become nanosized, but go on around that.

Ms. BRANDER. Absolutely correct. I am a member of the Scientists' Coalition, which is a group of international scientists that is advising the delegates to the U.N. negotiations.

Senator WHITEHOUSE. All of them? You are advising the entire delegate pool, not just the U.S. delegation?

Ms. BRANDER. That is correct.

Senator WHITEHOUSE. Correct, yes. Go ahead.

Ms. BRANDER. Yes. A lot of scientists from Europe and Asia and other parts of the world.

Senator WHITEHOUSE. Thank you for that.

Ms. BRANDER. Sure.

In terms of the main critical issues, really, chemical simplification, so reducing the enormous amount of chemicals that are used in the manufacture of plastics. I think I have already quoted the 13,000 to 16,000 number. That is really one of the biggest problems that we need to tackle. Simplifying the number of chemicals that are used will make circularity, which is one of the biggest goals of these negotiations, more feasible. Right now, given the number of chemicals that are contained in each of those plastics—

Senator WHITEHOUSE. It is highly improbable.

Ms. BRANDER. That is right, and then the new cocktails that are created from recycling them is a huge challenge.

There was a recent paper published that estimated healthcare costs from exposure to those plastics-associated chemicals in the U.S. is about \$249 billion annually, so not a small number. That I would say is one of the biggest challenges, as well as potentially banning polymers that are particularly problematic, like PVC and polystyrene.

Chemical simplification, polymer simplification, a better transparency in terms of corporations making data available on the composition of their products.

Senator WHITEHOUSE. With, for instance, a registry that anybody could go and look to?

Ms. BRANDER. Yes, a registry. An international registry has been proposed.

Additionally, there is a huge environmental justice issue here. Although these practices have been reduced, plastics are still being shipped to countries that do not have the waste management capabilities to deal with them. That is another, the environmental justice, human rights issue is a huge overriding issue.

I think what the feeling is on the perspective from the U.S. is that there is a lot of support for fossil fuel companies that are aim-

ing to shift their business from producing fuels to producing plastics, right?

Senator WHITEHOUSE. Right.

Ms. BRANDER. We know natural gas. That, I think, is one of the biggest challenges in the U.S., is that the perception, that we are supporting this shift in business strategy of fossil fuel companies to producing more single-use plastics.

Senator WHITEHOUSE. Well, the Chairman is familiar with my observation about the fossil fuel industry, that they have essentially two business strategies. One is to produce fossil fuel, and the other is to control Congress and manipulate politics so that they can do so, violating the laws of economics that would otherwise require them to put the price of their pollution into their product. Milton Friedman is scowling down at them.

Chairman, it is up to you. I have gone over my time already, if you wanted to allow the other two to answer, or if you want to wait for a second round, I am at your disposal.

Senator MERKLEY. If you have additional to answer on this question, and then I do have more questions, and I suspect you might as well?

Ms. MASON. I just support what she said.

Senator WHITEHOUSE. She covered it?

Ms. MASON. She covered it, yes.

Senator WHITEHOUSE. Mr. Alspach?

Mr. ALSPACH. Likewise, I am not nearly as familiar with this as Dr. Brander is, so I appreciate her comments.

Senator WHITEHOUSE. OK. I will flag one last thing, which is that there is, Unilever, it is quite a big company that we have worked with for a long time, and they have come up with a proposal that I think kicks in this coming year, where it will be their pledge, their plan, to remove from the ecosystem a pound of plastic for every pound of plastic that goes out into the world, which among other things, creates a market for that plastic.

To go to the places, to your point, Dr. Brander, about economic justice, to the places where this stuff is piling up so that they are knee-high wrack lines of plastic along shores and you have to push your boat out through floating seas of plastic to get out to clear water, suddenly, it makes a lot more sense to clear that up. Even if it is not being properly and fully recycled, at least it is out of those people's immediate experience.

To put money behind that, to be able to buy that waste plastic in order to make good on your pledge, seems like sort of the corporate front line on this, too. I hope American companies take the lead, follow, and match that.

Thank you, Chairman.

Senator MERKLEY. I was thinking about a couple years ago, when the Potomac River flowed over the walking path south of the U.S. Marines Monument, I noticed people out along the trail with these little pliers picking up. I got down and looked, and in any square foot, you could see like, 100 or 200 pieces of little plastic, indicating to me how much plastic there was in the Potomac River as it flushed out to sea, just a massive amount. These were the visible version of the world.

Then, I was also thinking as you were talking back when I was developing affordable housing and the spec plans called for copper pipe, and the contractor suddenly brought in plastic pipe. I said, wait, wait, wait, it is not specced that way. It is specced for copper.

I didn't have any indication, I had not thought about plastic as a pollutant to drinking water. Instead, I was concerned about whether a plastic pipe would hold up. They brought in a demonstration where they took a torch to the plastic pipe and showed it didn't melt, and so on and so forth, that it had all been cleared. It was hugely beneficial for human health, and now I am going, hmm, maybe not.

You just mentioned PVC. There is a slightly different version that is used for water supply pipes, but are water supply pipes made of plastic a good idea? If either of you have an insight on that.

Ms. MASON. You are going to put me in the hot seat, thanks. No. Senator MERKLEY. OK, no.

Ms. MASON. Short answer, no, not a good idea. Beyond Plastics, actually, has a really nice article out, a whitepaper, excuse me, out on this topic.

To be honest, I am not sure that it is the first thing that I would tackle with regard to this issue. It is a concern, and it is a legitimate concern. As pipes are being replaced because of the issues around lead, it would be preferable to replace them with copper over PVC or something similar.

Senator MERKLEY. As we are talking about this, it seems to me there is just a huge amount of research that needs to be done here. In different scenarios, different types are plastic are shedding different amounts. Different types of containers are shedding different amounts.

The type of plastic that is being shed is different. The ingredients that have been added to the plastic formulation for other qualities are different. For us to try to get a handle on the underlying question raised by our colleague from Wyoming of where do you get, that produce the most results per buck, if you will.

Is NIH, National Institute of Health, fully in gear in terms of investing in our health, understanding our health research? You mentioned, Dr. Brander, mouse models in a controlled setting where you can really measure the impact much more. You mentioned gut health being measured. Are some of the other impacts like obesity, Alzheimer's, heart disease, autism, sperm counts, are we starting to have studies of mice that start to give us a kind of really clear understanding of the health impacts?

Ms. BRANDER. Sure. I will say that the National Institute of Health did issue a statement, I believe it was about a year ago, saying that more resources were going to be devoted to better understanding the impacts of micro and nano plastics. That being said, most of the research that has been done on mammalian models, rodents, mice and rats, so far has been done in Asia or Europe, because there is more funding in those parts of the world for studies on human health.

It is still, I would say, in the U.S., studies using rodent models are still in their infancy. We have really just begun in the U.S. on answering some of those questions. We do have data from other

parts of the world that suggest reproductive, microbiome, digestive effects, and cardiovascular effects.

Senator MERKLEY. I think that is extremely important, because otherwise, any given observation on human health, there are so many influences, so we need that laboratory setting to gain understanding. Of course, that is why we have the National Institutes of Health, is to help invest in significant human health issues, and this is an area that really is in the beginning phase of understanding that there is a big connection here to be explored.

We are closing in on the end of a vote, but I really appreciate all three of you raising the issues.

Is he on his way here to the committee? Do we have staff for Senator Sullivan? How far out? How much time do I have on the vote? We will see if I can stall a little longer, but I can not miss the vote. It is not really stalling, because there is so much to be explored here.

Mr. Alspach, you mentioned developed systems for measuring the amount of micro and nano plastics. That seems critical to our understanding here of how particles are shed and how much gets into us. Dr. Brander and Dr. Mason, is it just in the last couple years that we have really had the tools to start to understand this shedding process and the amount that is getting into our human bodies?

Ms. BRANDER. I really think that it is just over the past couple of years that we have started to better understand human exposure and human occurrence. In part, that is because the technologies to measure nano plastics are slowly coming online, things like pyrolysis, GCMS, which is a fancy way of saying you are pyrolyzing a sample and measuring the mass of particles that might be in there.

Yes, it is a new area of study, and I think we are also just starting to understand how easily those particles can translocate and move within our bodies, as well.

Senator MERKLEY. Should we quit putting plastic pacifiers in our babies' mouths?

Ms. BRANDER. Probably, yes.

Senator MERKLEY. OK.

On that, Senator Sullivan has worked really hard on environmental ocean issues. As another ocean State Senator, you see a dominance of ocean State Senators raising issues and concerns here. Welcome, and we will turn it over to you. I may have to have you close up if I have to run to vote, if you wouldn't mind.

Senator SULLIVAN.

[Presiding.] No problem. Thank you, Mr. Chairman, for holding this open for me, a really important hearing.

I know that Senator Padilla was in here. He and I have been working on this issue before he even was a Senator, in a bipartisan way. I want to thank the panelists.

For those watching, we had a big announcement in Alaska last week. Hopefully, you heard about it. I want to make sure the Chairman hears about it before he leaves. In our Save Our Seas 2.0 legislation, that was legislation that a number of us got behind, Senator Whitehouse and I were the leads on that, the most comprehensive ocean cleanup legislation ever from the Congress.

One of the things is a Marine Debris Foundation. The Marine Debris Foundation is a congressionally chartered foundation that focuses on ocean cleanup, plastics, and other marine debris. Last week, I had the great pleasure of announcing that the Marine Debris Foundation would be headquartered in Juneau, Alaska in collaboration with our universities there that do already great ocean research. This will be a public-private partnership that can accept private dollars.

There is a lot of interest in this in the private sector. We want to make sure you guys all get a chance to come out as this foundation gets bigger, more prominent on the issues that we are all talking about, ocean debris, ocean plastics, and what we can do to keep our oceans clean.

This is a global challenge, I like to say, but also a solvable one, because we know that the estimates are anywhere from 60 to 70 percent of all the ocean debris in the oceans in the world come from a number of rivers, the estimates are ten or more, in Asia and Africa. It is very solvable.

Let me ask each of you, you know there is this idea of what we have banned, plastics or other things. Here is the big idea. By the way, this Marine Debris Foundation has as one of the elements in the law that we will have a Genius Prize that focuses on public-private university innovations in terms of technologies that can dramatically impact keeping our oceans clean.

One of the ideas I have always been pressing for is this idea of, you have a plastic bottle, somehow it gets in the ocean. You do not want it to be, but it is. It has water, it is how people drink clean water.

That bottle right now, they do not fully biodegrade. That is why we have microplastics in the water, but I know there are chemists in America who are working on the potential of a plastic water bottle to fully biodegrade. That would be a huge innovation. It wouldn't be coming from the government, but that is something that this Marine Debris Foundation, now in Alaska, with its mandate of many things, but one of which is a Genius Prize, would be something to undertake.

Let me ask all of you, what do you see, and since the Chairman left, I can ask questions as long as I want, so this is kind of nice, there is no one else waiting for me. What do you guys see as the technological advancements and innovations that can be leveraged to either detect microplastics or just get rid of them when they are in the ocean?

I will just ask each of you on that really important question. What do you see, and you are all top professors, applied researchers, this is the key, right?

A lot of times, we in the Senate, oh, the government is going to do this, the government is going to do that. My view is, this challenge, which is going to be solved, it is solvable, it is going to be through private sector innovations. This new Marine Debris Foundation, based in Alaska, is going to help encourage that.

Why do not we start with you, Dr. Brander?

Ms. BRANDER. Sure. That is really encouraging.

Senator SULLIVAN. Have you guys heard of the new Marine Debris Foundation in Juneau, Alaska? I hope you have. You have to

come out and visit it. We will wait for it to get a little bigger, but it is exciting.

Ms. BRANDER. It is really exciting that that foundation has been created. I agree that private sector solutions are needed, but I think that needs to happen under an umbrella of some regulation that allows for things to happen at an equitable level and at a similar speed nationwide, rather than happening State by State or region by region.

In terms of the development of a plastic bottle that could fully degrade—

Senator SULLIVAN. Or any other technological innovation that, if you had a magic wand, you think could be really important. That is one idea I have been pushing, but we want other ideas, right? What are the other ideas? This foundation is going to help encourage all of this thinking.

You are three of the top minds on this. What is your magic wand moment in terms of a technological innovation that could be really helpful?

Ms. BRANDER. I think if there was a technological innovation that could better advance chemical simplification in some of these plastic products that were being made, that would greatly reduce the number of toxic compounds that are being released into the environment that we are being exposed to.

Currently, we have been relying on so many different combinations of chemicals that even if something is fully biodegrading, that does not mean that it is not releasing those toxic compounds into the environment. Really the toxicity of the polymers and the products that are being used, or the chemicals that are being used to produce those products, needs to be tackled first before we aim at making things biodegrade faster or biodegrade completely.

Senator SULLIVAN. OK, good. That is a great answer.

What about you, Dr. Mason?

Ms. MASON. I concur with what you said, which is probably no surprise. We have been on the same page this whole day.

Senator SULLIVAN. Think big here. This is the moment, right? Any big innovation that, even if it is way out there, that you think, if somebody figured it out, would have a giant impact.

Ms. MASON. I think the problem needs to be, you missed earlier, which is fine, I am not criticizing you, I am just stating that, like earlier, I mentioned that the solution to this is before you get to the oceans and other freshwater systems, by the way, because this is not just an oceans problem, it is before you are dealing with microplastics and nano plastics.

Really solving it as almost the litter, before litter problem is the real innovation that needs to happen with a focus on the biggest piece of the market is packaging, and so thinking about alternatives to the packaging. I think there are some alternative, second-generation polymers that are being developed, and I think that that is encouraging to the point that Dr. Brander was making, the chemicals that are used in those are still an issue, and so those chemicals need to change.

I think those are especially exciting for something like cars or refrigerators, things that where the use of plastics, you know, cars are much more fuel efficient because of the plastics that have been

used in them. It is not a place that you can, you are not going to just eliminate the plastics, but coming up with a biodegradable, nontoxic plastic would be really helpful there. I think that that is the future.

They are also looking at hydrogels as a way of removing nano and microplastics as a potential. I think cleanup comes secondary to really solving the problem upstream from that.

Senator SULLIVAN. The Save Our Seas 2.0 Act focuses a lot, hopefully you have read it and seen it, focuses a lot on the upstream, so I do not disagree with you at all on that. Both of you are kind of saying biodegradability is important, but less toxicity is equally important. OK? Good, great.

Mr. Alspach, what about you?

Mr. ALSPACH. Thank you. I appreciate the information about Juneau, and I would take any available opportunity to visit Juneau anytime I can reasonably do so.

Senator SULLIVAN. Good. It is a beautiful place. I just spent the last 3 days there, and it is wonderful, and they are very excited about this new foundation and the leveraging.

We have a huge NOAA research facility in Juneau, we have the University of Alaska, Fairbanks, which has their College of Fisheries and Oceans, the University of Alaska Southeast. It is kind of becoming a big research hub on fisheries, on oceans, and this will add to that, which will now be on ocean debris.

You guys are all invited. In fact, everybody here is invited. Come on up to Alaska. We would love to have you.

Mr. ALSPACH. A couple points to your question. First, with respect to the biodegradation of something like a water bottle, I believe that the technology to do that probably already exists in a number of facets, but the problem is not the technology, in this case. It is the scalability of that technology for industrial processes that make it economical.

I believe the private sector can do that, as long as there is an economics market to make an incentive to do so.

Senator SULLIVAN. Don't you think, if you are the company, and I have said this a lot, if you are the company that actually, maybe it has already happened, but if you are the company that has cracked the code on less toxicity and full biodegradability, A, I think that would be very good for the environment, but B, that company is going to probably profit, which, as I have said, we are a capitalist society.

I think that is how you drive innovation. That is fine with me, right? That is a win-win, right? You help the environment, maybe you help build a company. The workers benefit, shareholders benefit. It seems to me it could be a potentially very lucrative place to actually be successful, not just for the environment, but for the economy, as well.

What do you think?

Mr. ALSPACH. I agree, unless they need to make it scalable so that it is able to be accomplished, correct. In terms of my wish list for technology—

Senator SULLIVAN. Yes, wish list.

Mr. ALSPACH. I sincerely appreciate that question a lot. We have talked on this panel a lot about nano plastics and the lack of meth-

ods to detect nano plastics. There is detection, period, and then there is making the method economical and reliable and efficient, and things that make it usable for us to actually detect nano plastics in the environment and in water supplies.

We will talk a little bit about, in my field, about the evolution of sensor technology and how if we were able to quickly, with some kind of, and I will use this word colloquially, Star Trek type technology, to scan a water sample or scan an air sample or a soil sample and detect the nano plastics that are present, that would give us a little—

Senator SULLIVAN. Does that technology exist right now, or not?

Mr. ALSPACH. To the extent that I have described it, no, but this is actually where I am going with this point. When I have conversations about these types of sensors with people in my field, they will say, well, we are so far away from that. That is not feasible.

We tend to think, as a society, in very myopic terms about what is possible and what is not. If you had asked something in, say, 1875 if we could put a man on the moon, they probably would have said there is no way that is ever going to happen, but yet, we did it.

I think we should not limit ourselves based on our knowledge of what is possible today what might be possible tomorrow. I feel like one way to accomplish that is to encourage cross-disciplinary collaboration among researchers and industry, because there could be limitations on a method to detect nano plastics that an industry that is not even thinking about nano plastics might have a solution for.

All you need to do is connect those dots to get those people talking to each other, and they might find they have a mutual solution that can solve the problem. If more of that cross-disciplinary collaboration occurs, we may solve that problem maybe before I retire, as opposed to when my daughter retires.

Senator SULLIVAN. Good. Well, look, what we are trying to do in Alaska, particularly in Juneau on this issue, is this kind of cross-disciplinary collaboration. We have the institutions right now, as I mentioned, between NOAA, our research universities, and this new foundation, the congressionally chartered Marine Debris Foundation, to do that.

Then the idea in the legislation with our Genius Prize, is to also do exactly that, to encourage people to press the limits on what they think is feasible from a technological standpoint, and then bring that period much sooner. To your point, 1875, getting to the moon less than a 100 years from that date is pretty remarkable.

Great. Any other thoughts on the technological side before I gavel out here, from our witnesses? It is a really important component. You guys have answered the questions really well.

With that, I want to close by again thanking our witnesses for appearing today and sharing their knowledge on microplastics. I would also like to thank Senators Merkley and Padilla and Mullin and Lummis for being the chairs of this joint hearing, which is important, on this important topic.

Before we adjourn, I ask unanimous consent to submit for the record a variety of materials that include letters from stakeholders

and other materials that relate to today's hearing. Without objection, so ordered.

[The referenced information follows:]



1800 Diagonal Road, Suite 600
 Alexandria, VA 22314
 Ph: 703-647-4618
www.bottledwater.org

February 26, 2024

Chairman Jeff Merkley
 Senate Environment and Public Works
 Subcommittee on Chemical Safety, Waste
 Management, Environmental Justice, and
 Regulatory Oversight
 531 Hart Senate Office Building
 Washington, D.C. 20510

Ranking Member Markwayne Mullin
 Senate Environment and Public Works
 Subcommittee on Chemical Safety, Waste
 Management, Environmental Justice, and
 Regulatory Oversight
 330 Hart Senate Office Building
 Washington, D.C. 20510

Chairman Alex Padilla
 Senate Environment and Public Works
 Subcommittee on Fisheries, Water, and
 Wildlife
 331 Hart Senate Office Building
 Washington, D.C. 20510

Ranking Member Cynthia Lummis
 Senate Environment and Public Works
 Subcommittee on Fisheries, Water, and
 Wildlife
 127A Russell Senate Office Building
 Washington, D.C. 20510

Dear Chairmen Merkley and Padilla and Ranking Members Mullin and Lummis:

The International Bottled Water Association (IBWA)¹ appreciates the opportunity to provide this written statement for your February 27, 2024, hearing on “Understanding the Presence of Microplastics in Water.” This is an important topic impacting all facets of our lives, and we look forward to working with Committee members as you consider this issue.

Nano- and Microplastics are Found Everywhere

Nano- and microplastic particles are found in all aspects of our environment – soil, air, and water. While many of the studies on microplastics (and now nanoparticles) have mentioned bottled water, it is important to note that bottled water is just one of thousands of food and beverage products packaged in plastic containers. The largest sources of microplastics in the environment are from erosion and abrasion of synthetic rubber tires, synthetic textiles (e.g., washing clothes made of polyester), and the breakdown of city and household waste.

¹ Founded in 1958, IBWA is the voice for the bottled water industry, which has an uncompromising commitment to the safety, environmental sustainability, and availability of bottled water products. We represent U.S. and international bottlers, distributors, and suppliers of spring, mineral, artesian, sparkling, and purified bottled water in products ranging from small-pack retail bottles to 5-gallon water cooler containers found in homes and offices. The majority of our member bottlers are small, locally owned companies, with 60 percent of members reporting less than \$2.6 million in annual gross sales and 90 percent reporting less than \$10 million in annual gross sales. Many members are local family entrepreneurs with deep roots and strong ties within their communities. Bottlers are committed to providing healthy hydration products to all consumers and highly sought-after jobs in the communities they serve.

Lack of Evidence Regarding Health Impact of Nano- or Microplastics

There currently is a lack of standardized testing methods and no scientific consensus on the potential health impacts of nano- and microplastic particles. Because there is no scientific evidence to suggest that nano- and microplastic particles pose a health risk, the U.S. Food and Drug Administration (FDA) has not issued regulations concerning these substances in foods and beverages. Any regulatory action concerning nano- and microplastic particles must be based on sound science, including demonstrating a correlation between the levels of this substance found in foods and beverages and any potential adverse health effects.

FDA recently stated the following regarding nano- and microplastics in our nation's foods, including bottled water:

“While there is evidence that microplastics and nanoplastics are entering the food supply ... there is a lack of evidence demonstrating that microplastics or nanoplastics occurrence in food poses a risk to human health.”

“This is an area where the FDA has not only been monitoring the research but also working to advance the science through analysis of testing methodologies and other related work, including participation in the United States Government Nanoplastic Community of Interest.”

“The FDA is not aware of scientific evidence that would support consumers being concerned about the potential level of microplastic or nanoplastic contamination in food, including bottled water.”²

In addition, after reviewing the available studies concerning water, food, and beverages, the World Health Organization (WHO) concluded that no adverse health effects could be drawn from dietary exposure to nano- and microplastic particles less than 10 microns due to minimal scientific research. WHO's recommendation is for more research to be conducted, as well as establishing standardized methods for measuring and quantifying nano and microplastics.³ IBWA agrees that more research should be conducted on this important issue.

Many of the studies on microplastics (and now nanoparticles) have used water samples (tap and bottled). That is because water is the least complex testing medium when compared to others. It has a very high purity and fewer interferences that can complicate the analyses. Therefore, conclusions that drinking water is a major route for oral intake of nano- and microplastics are not justified.⁴ In her 2021 paper, “Microplastics in drinking water? Present state of knowledge and open questions,” Barbara E. Ossmann of Germany's Bavarian Health and Food Safety Authority, cautions against jumping to unfounded conclusions:

² Bottled water found to contain tens of thousands of ‘tiny plastic particles’ in new study: Environmental group warns of ‘public crisis,’ but industry experts say no evidence of health risks. January 11, 2024. Fox News. Available at: <https://www.foxnews.com/health/bottled-water-found-contain-tens-thousands-tiny-plastic-particles-new-study>

³ Dietary and inhalation exposure to nano- and microplastic particles and potential implications for human health.” Geneva: World Health Organization; 2022. Available at: <https://apps.who.int/iris/bitstream/handle/10665/362049/9789240054608-eng.pdf>

⁴ Microplastics in drinking water? Present state of knowledge and open questions. Ossmann, B. E. (2021). Current Opinion in Food Science, 41, 44–51. Available at: <https://doi.org/10.1016/J.COFS.2021.02.011>

“Projections on the total intake of microplastics by humans via foodstuff should be made with care. Conclusions on the major intake pathways are not justified, yet. Instead, harmonized, valid methods and more research are needed to reliably determine microplastics in drinking water and more complex foodstuff.”

Concerns with a Recent Study on Nanoplastics in Bottled Water

A recent study by Columbia University researchers sampled three brands of bottled water (two bottles per brand) and claims to have found nanoplastic substances using a new test method due to a lack of currently available methods.⁵ This novel approach needs to be fully reviewed by the scientific community and more research needs to be done to develop standardized procedures for measuring and quantifying nanoplastics in our environment. Conclusions made in this study, which have not yet been verified, are currently being scrutinized by the scientific community.

Scientists who have reviewed the 2024 Columbia nanoparticle study have noted that a lot of the conclusions are speculations, not findings. They have raised the following concerns about this study:

- Only three brands of bottled water were sampled, out of the thousands of brands that are sold.
- The authors used a novel testing method that has not been replicated or validated.
- There are questions about whether nano- and microplastic particles (e.g., nylon) were properly distinguished from other commonly present organics, like proteins having similar chemical structures.
- There are additional questions concerning the potential contamination sources in the laboratory where this study was conducted and from the air, which is a well-known source of particles.
- There also are questions about how well the milled particles used as standards for comparison compared to the particles in the water being tested.
- What can be concluded from the fact that the laboratory-processed water used in the test sample preparation was found to contain nano- and microparticles.

These concerns further show the need for more research into this issue before policies are established to address microplastics in the environment. IBWA supports having more research conducted on this important issue.

Bottled Water is a Comprehensively Regulated Food Product

Bottled water is comprehensively regulated as a food by the FDA and is among the safest products on the market. This includes small-pack bottled water products sold at retail locations (e.g., half liter, liter, gallon) and larger 3- to 5-gallon bottles delivered to homes and offices that use water coolers.

Bottled water must comply with the general FDA Good Manufacturing Practices (GMPs) for foods (21 CFR Part 117); specific bottled water GMPs (21 CFR Part 129); bottled water standards of identity (21 CFR 165.110 (a)); and bottled water standards of quality, or SOQs (21 CFR 165.110 (b)). By law, the SOQs for bottled water must be as protective of public health as

⁵ Rapid single particle chemical imaging of nanoplastics by SRS microscopy. Qian et. al. Columbia University. January 8, 2024. Available at: <https://www.pnas.org/doi/10.1073/pnas.2300582121>

the Environmental Protection Agency's (EPA) regulations for tap water. And, in some cases, such as lead, bottled water regulations are more stringent.

Under the Food Safety Modernization Act (FSMA), bottled water companies (like all food and beverage companies) are subject to additional requirements, including preparation and implementation of food safety and food defense plans, verification of suppliers, expanded records maintenance, and access by government inspectors.

In addition to these federal requirements, the industry vigorously complies with all state and local laws and regulations to help ensure the health and safety of our products.

IBWA Members Follow Additional Standards and Practices to Help Ensure Product Safety

In addition to FDA regulations, IBWA member bottlers must adhere to the IBWA Bottled Water Code of Practice, which mandates additional standards and practices that in some cases are more stringent than federal and state regulations.⁶ A key feature of the IBWA Bottled Water Code of Practice is a mandatory annual plant inspection by an independent, third-party organization.

All bottled water products are produced utilizing a multi-barrier approach. From source to finished product, a multi-barrier approach helps prevent possible harmful contamination to the finished product as well as storage, production, and transportation equipment. Many of the steps in a multi-barrier system are effective in safeguarding bottled water from microbiological and other contamination. Measures in a multi-barrier approach may include one or more of the following: source protection, source monitoring, reverse osmosis, distillation, micro-filtration, carbon filtration, ozonation, and ultraviolet (UV) light.

Conclusion

The bottled water industry is committed to providing consumers with the safest and highest quality products. We appreciate the Subcommittees' focus on this important issue. Microplastics are found everywhere in the environment. There currently is a lack of standardized testing methods and no scientific consensus on the potential health impacts of nano- and microplastic particles. IBWA strongly supports more research being conducted on this issue.

Sincerely,

Cory Martin
Vice President, Government Relations

⁶ IBWA Code of Practice. At: <https://bottledwater.org/wp-content/uploads/2020/12/IBWA-MODEL-CODE-2020-Rev-2020-FINAL.pdf>

Senator SULLIVAN. Additionally, Senators will be allowed to submit written questions for the record for all of you through the close of business on Tuesday, March 12th. We will compile these questions for the record and send them to our witnesses, and we will respectfully ask all of you to try to reply to those no later than March 26th, Tuesday.

With that, again I want to thank the witnesses. We have a really good crowd here. It shows you the importance of this very important topic. I think we made some good progress today.

With that, the hearing is adjourned.

[Whereupon, at 4:31 p.m., the hearing was adjourned.]

