State Water Resources Control Board
Division of Drinking Water

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FROM: Robert Brownwood, P.E.
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DATE: January 20, 2022

SUBJECT: Request for External Scientific Peer Review of the Scientific Basis of Microplastics Definition, Analytical Method, Monitoring & Reporting Order, and Health Effects Guidance Language

Microplastics Definition, Analytical Method, Handbook, and Health Effects Guidance Language

This request is regarding the draft Microplastics in Drinking Water Policy Handbook, adopted definition of `microplastics in drinking water`, proposed analytical methods to be used during required monitoring, and proposed health effects guidance language to aid consumers in interpreting findings of microplastics in drinking water. Our intended adoption hearing date of the proposed rule is March 15, 2022.

State Water Resources Control Board (State Water Board) staff requests that you initiate the process to identify external scientific peer reviewers for the microplastics monitoring order, per the requirements of California Health and Safety Code (HSC) section 57004.

Purpose of Review

In accordance with HSC section 57004, the State Water Board's Division of Drinking Water (Division) submits this request for peer review of the State Water Board's

adopted microplastics definition (Definition), proposed analytical methods for monitoring microplastics in drinking water (Methods), proposed four-year Microplastics in Drinking Water Policy Handbook (Handbook), and proposed health effects guidance language (Health Effects Language). These are the State Water Board's chosen definition of microplastics, standardized analytical methods to monitor microplastics in drinking water, four-year monitoring and reporting plan for microplastics in drinking water, and health effects guidance language to aid consumers in the interpretation of microplastics occurrence results.

The State Water Board has developed the Definition, Method, Handbook, and Health Effects Language to satisfy requirements of HSC section 116376. Section 116376 was added to the Health and Safety Code on September 28, 2018 when Senate Bill No. 1422 was filed with the Secretary of State, which requires the State Water Board to:

- On or before July 1, 2020: Adopt a definition of microplastics in drinking water[1];
- On or before July 1, 2021:
    - Adopt a standard methodology to be used in the testing of drinking water for microplastics;
    - Adopt requirements for four years of testing and reporting of microplastics in drinking water, including public disclosure of those results;
    - Consider issuing quantitative guidelines (e.g., notification level) to aid consumer interpretations of the testing results, if appropriate;
    - Accredit qualified laboratories in California to analyze microplastics in drinking water.

Health and Safety Code section 116376 allows the State Water Board to implement these tasks through the adoption of a Policy Handbook that is not subject to the Administrative Regulations and Rulemaking requirements of Government Code section 11340 *et seq*.

Microplastics is an extremely diverse contaminant suite in terms of sizes, shapes, compositions, and associated contaminants, and is thus challenging to define the contaminant suite, characterize the suite analytically, and determine human health effects. Prior to the State Water Board's adoption of the Definition on June 16, 2020, no universally agreed-upon, unambiguous definition of 'microplastics' existed. Further, at the time of writing this letter, no standardized methods to detect microplastics in drinking water other than the method developed by the State Water Board existed prior to the passing of Senate Bill 1422 in 2018. Evidence for the health effects of microplastics are rapidly developing. The State Water Board entered into two contracts (Contract No. 19-055-400; 19-078-270) with the Southern California Coastal Water Research Project (SCCWRP) to fill these knowledge gaps (schedule outlined in **attachment 1A**):

[1]The State Water Board adopted Resolution No. 2020-0021 on June 16, 2020 which adopts a definition of 'Microplastics in Drinking Water'. Resolution No. 2020-0021 states that the State Water Board intends to consider revisions to the definition in response to new information, including but not limited to toxicity and exposure to humans, standards adopted by other nations, regulatory agencies or authoritative bodies, as well as advances in analytical techniques and/or the standardization of analytical methods. Further, upon adoption of a standardized method as required by HSC section 116376, the definition may be revised.

- Conduct an independent peer review of the scientific basis of the Definition by March 1, 2020;
- Re-evaluate the Definition in response to new information by March 1, 2021;
- Develop standardized methods to detect microplastics in drinking water (final report March 1, 2021);
- Conduct an interlaboratory validation study of the standardized Methods (final report March 1, 2021);
- Convene an expert panel to evaluate the human health effects of microplastics (final report anticipated February 2021);
- Conduct a training for Environmental Laboratory Accreditation Program (ELAP) staff to accredit laboratories for the Method by March 21, 2021;

When References will be Available at the FTP Site

December 17, 2021.

Please note that several key documents are currently undergoing peer review at the scientific journals to which they have been submitted, and should therefore be considered confidential and subject to change.

Requested Review Period

We request that scientific peer review be accomplished within 30 days.

Necessary Areas of Expertise for Reviewers

Four (4) peer reviewers with expertise in one or more of the following areas are requested, which cover the assumptions and conclusions described in Attachment 2:

- A scientist with expertise in both polymer science and microplastics human health. In particular, familiarity with particle and chemical traits unique to synthetic polymers, including their interactions with human health are required, with some experience in polymer production and/or synthesis preferred.
  This expertise is needed for assessing the appropriateness of the Definition in protecting public health as described in assumption #1 and conclusion #1.
- An analytical chemist familiar with analytical methods for microplastics, including, but not limited to infrared spectroscopy and Raman spectroscopy. Specific expertise with respect to method development based on inter-laboratory performance studies is desirable and would include the knowledge in evaluating a method's performance, such as: specificity, selectivity, sensitivity, accuracy, precision, reproducibility, and robustness.
  This expertise is needed for evaluating the standard operating protocols for analyzing microplastics in drinking water, as described in Conclusion #2.
- A scientist with expertise in groundwater and surface water chemistry, hydrology, and microplastics. In particular, expertise in monitoring of microplastics or other particulate contaminants in water is required, with experience in drinking water treatment plant monitoring preferred. Experience or knowledge of sampling methods for microplastics is required.
  This expertise is needed for evaluating the proposed monitoring frequencies,

rationale for selection of sampling locations, sampling protocol, selection of required analytical methods, and selection of required rapid and inexpensive monitoring methods in the Handbook, as described in Conclusion #3.

- A toxicologist with expertise in microplastics and/or particle toxicity. In particular, experience with human health risk assessments for the purposes of drinking water is preferred.
  This expertise is needed for evaluating the proposed health-based guidance language for its scientific basis and potential impacts to health and wellbeing as described in Conclusion #4.

It is understood that a potential peer review candidate may (is likely to) have expertise in more than one of the above fields; the above description is meant to be qualitative.

Contact Information

Scott Coffin is the project manager: scott.coffin@waterboards.ca.gov, 916-323-0375.

Attachments

Attached please find:

1. Attachment 1: Plain English Summary.
2. Attachment 2: Scientific Assumptions, Findings, and Conclusions to Review.
3. Attachment 3: Individuals who Participated in the Development of the Proposal.
4. Attachment 4: References Cited.

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January 20, 2022
Date

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Attachment 1

Plain English Summary

The State Water Resources Control Board (State Water Board) has adopted a definition of 'Microplastics in Drinking Water' (Definition), and is proposing to adopt two detection methods for monitoring microplastics in drinking water using infrared and Raman spectroscopy (Methods), a four-year plan for sampling and analysis described in the draft Microplastics in Drinking Water Policy Handbook (Handbook), and health effects guidance language to aid consumers in the interpretation of microplastics occurrence results in drinking water (Health Effects Language). Resolution No. 2020-0021-ADOPTION OF DEFINITION OF 'MICROPLASTICS IN DRINKING WATER'' was adopted to satisfy the requirements of Health and Safety Code section 116376(a), which requires the State Water Board to adopt a definition of 'microplastics in drinking water' by July 1, 2021. The adopted Definition established a basis for: developing standardized methods to detect microplastics in drinking water (Methods); developing a four-year sampling and analysis plan to monitor microplastics in drinking water through the adoption of a policy handbook (Handbook); and developing health effects guidance language to aid consumers in the interpretation of occurrence results in drinking water (Language). The Method, Handbook, and Language will establish requirements for public water systems to monitor microplastics in drinking water and report results to customers, laboratories to use standardized methods to detect microplastics, and health effects language to be included in reporting requirements for public water systems. Board adoption of the Method, Handbook, and Language, as well as providing accreditation for laboratories through the Environmental Laboratory Accreditation Program (ELAP) will satisfy the requirements of Health and Safety Code section 116376(b).

Health and Safety Code section 116350 *et seq*. states that the State Water Board is responsible for the administration of provisions related to drinking water to protect public health. The California Safe Drinking Water Act authorizes the State Water Board to conduct research, studies, and demonstration programs to ensure provision of a dependable, safe supply of drinking water, which may include improving methods to identify and measure the existence of contaminants in drinking water and the source of the contaminants. The California Safe Drinking Water Act also grants the State Water Board the authority to implement regulations that may include monitoring of contaminants and requirements for notifying the public of the quality of the water delivered to customers.

On September 28, 2018, Senate Bill No. 1422 was filed with the Secretary of State, adding section 116376 to California's Health and Safety Code, and requiring the State Water Board to adopt a definition of 'Microplastics in Drinking Water' on or before July 1, 2020. Health and Safety Code section 116376 also requires the State Water Board

on or before July 1, 2021, to accomplish the following: (1) adopt a standard methodology to be used in the testing of drinking water for microplastics; (2) adopt requirements for four years of testing and reporting of microplastics in drinking water, including public disclosure of those results; (3) consider issuing a notification level or other guidance to aid consumer interpretation of results; and (4) accredit qualified California laboratories to analyze microplastics. Health and Safety Code section 116376(c) allows the State Water Board to implement these requirements through adoption of a Policy Handbook.

Definition

Plastic particles are a diverse contaminant suite and may be differentiated by a variety of criteria such as substance, state at a given temperature and pressure, dimensions, shape, and structure, and color. The influence of these parameters in the environmental fate, transport, and human health impacts of microplastics are not fully understood. Resolution No. 2020-0021 defines `microplastics` broadly to ensure that plastic particles with unknown environmental and human health impacts are not excluded.

Analytical Method

When Senate Bill 1422 was passed in 2018, no standardized methods for the detection of microplastics in drinking water existed. The State Water Board, in collaboration with the Southern California Coastal Water Research Project, developed and evaluated analytical methods through an inter-laboratory comparison study. Twenty-six laboratories received spiked samples containing known amount of microplastics and false positives and reported concentrations using standardized operating protocols. Analysis using infrared and Raman spectroscopy were deemed reliable for assessing particles larger than 20 microns in the majority of laboratories, with few labs capable of analyzing particles between 1 and 20 microns with confidence.

Handbook

The State Water Board intends to determine contamination of microplastics in waters used as sources for drinking water during the first two years of a four-year sampling and monitoring plan as described in the draft policy handbook made available on the State Water Board webpage on November 10, 2021[1]. During this first phase of monitoring, Wholesale water providers and raw water conveyance systems producing greater than

[1] The draft microplastics in drinking water policy handbook was posted on the State Water Board webpage on November 10, 2021 at https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/microplastics.html, was made open for public oral comments at the November 17 Board Workshop, and is open for written public comments until 12:00 noon on December 22, 2021.

10,000 MGD and water systems serving over 100,000 people will receive the majority of monitoring orders. Available information suggests groundwater wells are unlikely to contain substantive levels of microplastics, with higher levels expected in surface waters, therefore water systems utilizing surface waters as primary sources for drinking water will be prioritized for monitoring. Based on findings from the first two years of sampling and monitoring and contingent on the availability of proficiency testing samples to assess performance of laboratories to reliably quantify microplastics that can pass through treatment techniques (estimated ~5 microns in length), the State Water Board will expand monitoring orders to include treated drinking water, and may subject additional water systems to testing for microplastics in source waters used for drinking water.

During the November 17 Board Workshop, oral public comments were received from the Association of California Water Agencies and Metropolitan Water District suggesting the sampling method required in the draft policy handbook[2] has not been tested in a sufficient number and variety of water systems and may produce inaccurate or incomparable data if used without further validation. The State Water Board is considering several options to address these concerns, one of which would be a pilot sampling project in which three to seven drinking water systems will collect water samples for microplastics using the ASTM D8332-20 sampling method and the State Water Board will determine if additional guidance documents and/or training videos should be developed to assist water systems in using the sampling method properly.

Health Effects Guidance Language

Evidence concerning the hazards and exposure of humans to microplastics is nascent and rapidly evolving. The State Water Board contracted[3] with the Southern California Coastal Water Research Project (SCCWRP) to organize an expert workshop to identify the primary pathways by which microplastics affect biota, prioritize the microplastics characteristics (e.g., size, shape, polymer) that are of greatest biological concern, and identify critical thresholds for each at which those biological effects become pronounced. The expert workshop concluded that while probable effects from some forms of microplastics (e.g., polystyrene spheres smaller than 10 microns) occur in rodents, significant uncertainties prevent reliable assessments of risk to humans, and that the State Water Board should not develop a notification level or other health-based level that would require water systems to inform consumers of contamination outside of their annual consumer confidence report or perform additional actions. Workshop participants recommended characterizing exposure through drinking water, with a focus on identifying particle characteristics to reduce uncertainties. To aid consumers in

[2] ASTM D8332-20: Standard Practice for Collection of Water Samples with High, Medium, or Low Suspended Solids for Identification and Quantification of Microplastic Particles and Fibers.

interpreting findings of microplastics in drinking water, workshop participants developed qualitative health-based guidance language that is included in the draft policy handbook.

Attachment 2

Scientific Assumptions, Findings, and Conclusions to Review

The statutory mandate for external scientific peer review (Health and Safety Code section 57004) triggers a scientific peer review of the scientific basis for any rule proposed for adoption by any board, department or office within the agency and states that the reviewer's responsibility is to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices. DDW requests the reviewers make this determination for each of the following assumptions and conclusions that constitute the scientific basis of the adopted Definition, and the assumptions that constitute the scientific basis of the Methods, Handbook, and Health Effects Language.

To help with this review, an explanatory statement has been provided for each assumption and conclusion. In developing a definition of microplastics, the State Water Board followed the steps detailed in the Staff Report for the Definition (Coffin 2020). The Definition was subjected to peer review by five experts in microplastics and was facilitated through the Southern California Coastal Water Research Project (Definition Peer Review 2020), with additional consultation for the adopted Definition completed in 2021 (Peer Review Re-Examination 2021). Assumptions and conclusions for the Definition are supported by the literature references cited in the draft Staff Report for the Definition (Coffin 2020). The adopted Definition provides a basis for the human health effects assessment, analytical method development, and policy handbook.

Assumption #1 **Significant uncertainties in the occurrence and toxicity of microplastics preclude the development of a narrowly prescriptive definition**

Few studies are available regarding human exposure and health hazards of plastic particles, and significant data gaps remain. Plastic particles are a diverse contaminant suite and may be differentiated by a variety of criteria such as substance, state at a given temperature and pressure (e.g., solid at room temperature and standard pressure), dimensions, shape and structure (morphology), and color (Rochman 2019). The influence of these parameters in the environmental fate, transport, and human health impacts of microplastics are not fully understood. Due to these uncertainties, reliable assessments of risks to humans are not possible (Noventa et al 2021; Coffin et al. *submitted*).

Conclusion #1 Adopted Definition is Sufficiently Health-Protective and Appropriate with Respect to Scientific Uncertainties

Health and Safety Code section 116350 *et seq.*, California Safe Drinking Water Act requires the State Water Board to administer provisions related to drinking water to protect public health. To prioritize the protection of public health in light of significant scientific uncertainties, the adopted definition of 'Microplastics in Drinking Water' was defined broadly, and with as few exclusions as possible, to ensure that policies, regulations, and standardized methodologies based on the definition capture a wide diversity of plastic particle types (Coffin 2020; Coffin et. al 2021). Furthermore, while technological limitations in the measurement of plastic particles were considered to be informative to the definition, such limitations are likely transient and serve only as a rough guide for prospective technical and economic feasibility of sampling and monitoring. While there is currently no widely recognized definition (Hartmann et al. 2019), attempts were made to harmonize with additional regulatory bodies (Coffin 2020) with the understanding that this definition may be used by additional parties, and outside the intended scope of drinking water.

Peer reviewers should assess the appropriateness of the State Water Board's adopted definition with respect to the California Safe Drinking Water Act's mandate to protect public health. In particular, the adopted definition's *substance, state and dimensions* criteria are deemed to be sufficiently broad to protect public health in light of health uncertainties. Additionally, the definition's *substance* criteria are reflective of the general scientific consensus of plastic, that is, anthropogenic polymeric materials.

Primary Documents/Reports

Coffin, Scott. 2020. "Staff Report for the Proposed Definition of Microplastics in Drinking Water (June 3, 2020)." Staff Report. Sacramento, CA: State Water Resources Control Board. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/stffrprt_jun3.pdf.
Pages: 42

Coffin, Scott, Hans Bouwmeester, Susanne Brander, Pauliina Damdimopoulou, Todd Gouin, Ludovic Hermabessiere, Elaine Khan, et al. Submitted. "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.*
Pages: 64 (194 including supplementary information)

Coffin, Scott, Holly Wyer, and J C Leapman. 2021. "Addressing the Environmental and Health Impacts of Microplastics Requires Open Collaboration between Diverse Sectors." *PLOS BIOLOGY*, 15.
Pages: 15

Definition Peer Review 2020
Pages: 59
Definition Peer Review Re-Examination 2021
Pages: 8
Hartmann, Nanna B., Thorsten Hüffer, Richard C. Thompson, Martin Hassellöv, Anja Verschoor, Anders E. Daugaard, Sinja Rist, et al. 2019. "Are We Speaking the Same Language? Recommendations for a Definition and Categorization Framework for Plastic Debris." *Environmental Science & Technology* 53 (3): 1039–47. https://doi.org/10.1021/acs.est.8b05297.
Pages: 9
Noventa, Seta, Matthew S. P. Boyles, Andreas Seifert, Simone Belluco, Aracaeli Sánchez Jiménez, Helinor J. Johnston, Lang Tran, et al. 2021. "Paradigms to Assess the Human Health Risks of Nano- and Microplastics." *Microplastics and Nanoplastics* 1 (1): 9. https://doi.org/10.1186/s43591-021-00011-1.
Pages: 28
Rochman, Chelsea M., Cole Brookson, Jacqueline Bikker, Natasha Djuric, Arielle Earn, Kennedy Bucci, Samantha Athey, et al. 2019. "Rethinking Microplastics as a Diverse Contaminant Suite." *Environmental Toxicology and Chemistry* 38 (4): 703–11. https://doi.org/10.1002/etc.4371.
Pages: 9

Conclusion #2 **Standardized Analytical Methods (Methods) Considered for Adoption are Fit for Purpose for Assessing Microplastics Contamination in Source Waters Used for Drinking Water**

Characterizing microplastics contamination is technically and logistically challenging. A commonly utilized tool - light microscopy - allows quantification of larger particles but loses effectiveness as the size range decreases from millimeters to microns (Primpke et al. 2020). This is of particular importance to drinking water, as the majority of microplastics found are smaller than 10 microns (Novotna et al. 2019), and human health effects are not anticipated to occur for particles larger than this size (Wright and Kelly, 2017). Furthermore, self-contamination of samples is difficult to control, and measurements of microplastics can be easily confounded by other non-plastic materials, such as paper and natural plant material, that can be present in the same size ranges (Scopetani, *et al.* 2020). Spectroscopic techniques, including Raman and infrared, can accurately quantify the number and shape of microplastic morphologies and distinguish polymer types (Primpke et al. 2020). Despite these methods showing great potential, few standardization efforts have been attempted to date, and no harmonized method has received widespread use (Primpke et al. 2020).

The State Water Board contracted with the Southern California Coastal Water Research Project (SCCWRP) to develop standard operating protocols for assessments of microplastics in drinking water using Raman and infrared spectroscopy and evaluate their performance through an interlaboratory validation study (de Frond et al.

submitted)[1]. The Southern California Coastal Water Research Project assessed the following aspects in the interlaboratory validation study: 1) accuracy of the method, 2) repeatability/reproducibility within and among laboratories, and 3) resources necessary to perform the methods (i.e. people, equipment, time and consumables).

Recognizing that microplastics measurement techniques and instrumentation are rapidly evolving, and that myriad innovations exist and are yet un-validated, SCCWRP's study plan involved two components: 1) Study Core focused on assessing accuracy, reproducibility and cost for five analytical methods in four frequently-encountered matrices (clean water, dirty water, sediment, and tissue). Multiple laboratories from throughout the world performed these methods using a series of standard operating procedures; and 2) Study Augmentations in which smaller sub-study elements in which individual laboratories investigated how novel methods, or small permutations of the core study standard operating protocols, affect method performance (SCCWRP Microplastic Measurement Methods Evaluation Study 2020). The Study Augmentations leveraged the Study Core by using the same samples, as well as custom samples as applicable, to examine method variations.

Five analytical methods were performed in the Study Core for drinking water samples by a minimum of 6 and a maximum of 22 independent laboratories, including stereoscopy, stereoscopy with dye staining, Fourier-transform infrared spectroscopy, Raman spectroscopy, and pyrolysis-GC/MS (SCCWRP Microplastic Measurement Methods Evaluation Study 2020). Participating laboratories were sent blind identical samples created by a single laboratory that contained representative types of plastic particles varying in sizes, colors and morphologies as well as non-plastic materials intended to serve as false-positive controls (de Frond et al. *submitted*)[1]. Data received from participating laboratories were evaluated both quantitatively and qualitatively according to several sets of quality assurance quality control criteria developed specifically for microplastics (Brander *et al.* 2020; Koelmans *et al.* 2019) in addition to United States Environmental Protection Agency criteria for the evaluation of drinking water method performance for standardization purposes (Wendelken 2015), and criteria for interlaboratory validation of methods (Standard Methods 2019).

Peer reviewers should evaluate the standard operating procedures for draft methods developed by SCCWRP (Wong 2021a; Wong 2021b) with respect to their quality assurance and quality criteria reporting requirements and methods in light of challenges specific to microplastics. Peer reviewers are encouraged to refer to the manuscript which describes the findings of the inter-laboratory validation study[2] as well as

[1] De Frond et al. *Submitted.* "Monitoring microplastics in drinking water: an interlaboratory study to inform effective methods for quantifying and characterizing microplastics."
[2] De Frond et al. *Submitted.* "Monitoring microplastics in drinking water: an interlaboratory study to inform effective methods for quantifying and characterizing microplastics."

additional manuscripts detailing subsampling protocols for chemical verification[3] and details regarding performance for spectroscopic methods evaluated in the study[4] to evaluate the draft standard operating procedures. Note that these manuscripts are undergoing peer review with the respective journals to which they have been submitted and should be considered confidential and subject to change in response to journal reviewer comments.

Primary Documents/Reports

Brander, Susanne M, Violet C Renick, Melissa M Foley, Clare Steele, Mary Woo, Amy Lusher, Paul Helm, et al. 2020. "Sampling and QA/QC: A Guide for Scientists Investigating the Occurrence of Microplastics across Matrices." *Applied Spectroscopy*, 52. https://doi.org/DOI: 10.1177/0003702820945713.
Pages: 27

De Frond, Hannah, Anna O'Brien, and Chelsea Rochman. In Preparation. "Representative Subsampling Methods for the Chemical Identification of Microplastic Particles in Environmental Samples."
Pages: 26

De Frond, Hannah, Leah Thornton Hampton, Syd Kotar, Kristine Gesulga, Cindy Matuch, W Lao, Stephen B. Weisberg, Charles S. Wong, Chelsea M. Rochman. In Preparation. "Monitoring microplastics in drinking water: an interlaboratory study to inform effective methods for quantifying and characterizing microplastics."
Pages: 29

De Frond, Hannah, Gaurav Amarpuri, Steven M. Barnett, Susanne Brander, Silke Christiansen, Win Cowger, Dounia Elkhatib, Wenjian Lao, Eunah Lee, Amy Lusher, Maria Navas-Moreno, Bridget O'Donnell, Sebastian Primpke, Violet Renick, Keith Rickabaugh, Suja Sukumaran, Florian Vollnhals. In Preparation. "Chemical identification of microplastics using μRaman and μFTIR Spectroscopy is accurate and highly dependent on physical particle characteristics."
Pages: 30

Noventa, Seta, Matthew S. P. Boyles, Andreas Seifert, Simone Belluco, Aracaeli Sánchez Jiménez, Helinor J. Johnston, Lang Tran, et al. 2021. "Paradigms to Assess the Human Health Risks of Nano- and Microplastics." *Microplastics and Nanoplastics* 1 (1): 9. https://doi.org/10.1186/s43591-021-00011-1.
Pages: 28

Koelmans, Albert A., Nur Hazimah Mohamed Nor, Enya Hermsen, Merel Kooi, Svenja M. Mintenig, and Jennifer De France. 2019. "Microplastics in Freshwaters and Drinking Water: Critical Review and Assessment of Data Quality." *Water Research* 155 (May):

[3] De Frond et al. *Submitted. "*Representative subsampling methods for the chemical identification of microplastic particles in environmental samples."

[4] De Frond et al. *Submitted.* "Chemical identification of microplastics using μRaman and μFTIR Spectroscopy is accurate and highly dependent on physical particle characteristics."

410–22. https://doi.org/10.1016/j.watres.2019.02.054.
Pages: 13

Primpke, Sebastian, Silke H Christiansen, Win Cowger, Hannah De Frond, Ashok Deshpande, Marten Fischer, Erika Holland, et al. 2020. "Critical Assessment of Analytical Methods for the Harmonized and Cost Efficient Analysis of Microplastics." *Applied Spectroscopy*, 000370282092146. https://doi.org/10.1177/0003702820921465.
Pages: 100

Scopetani, Costanza, Maranda Esterhuizen-Londt, David Chelazzi, Alessandra Cincinelli, Heikki Setälä, and Stephan Pflugmacher. 2020. "Self-Contamination from Clothing in Microplastics Research." *Ecotoxicology and Environmental Safety* 189: 110036. https://doi.org/10.1016/j.ecoenv.2019.110036.
Pages: 7

SCCWRP. 2020. "SCCWRP Microplastic Measurement Methods Evaluation Study 2020.Pdf."
Pages: 129

Standard Methods. 2019. "Standard Methods: 1040 Method Development and Evaluation."
Pages: 4

Wendelken. 2015. "Protocol for the Evaluation of Alternate Test Procedures for Organic and Inorganic Analytes in Drinking Water." EPA 815-R-15-007. U.S. Environmental Protection Agency.
Pages: 26

Wong, Charles. 2021a. "Standard Operating Procedures for Extraction and Measurement by Infrared Spectroscopy of Microplastic Particles in Drinking Water." https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/microplastics/mcrplstcs_ir.pdf.
Pages: 32

Wong, Charles. 2021b. "Standard Operating Procedures for Extraction and Measurement by Raman Spectroscopy of Microplastic Particles in Drinking Water." https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/microplastics/mcrplstcs_raman.pdf.
Pages: 32

Wright, Stephanie L., and Frank J. Kelly. 2017. "Plastic and Human Health: A Micro Issue?" *Environmental Science & Technology* 51 (12): 6634–47. https://doi.org/10.1021/acs.est.7b00423.
Pages: 14

Conclusion #3 **Proposed Microplastics in Drinking Water Policy Handbook (Handbook) is an Appropriate and Sound Approach with Respect to Occurrence and Hazard Knowledge and Gaps and Consideration of Available Resources**

Health and Safety Code section 116350 *et seq.* requires the State Water Board to administer provisions related to drinking water to protect public health. Furthermore, Health and Safety Code section 116376 *et* seq., requires the State Water Board to develop requirements for four years of testing and reporting of microplastics in drinking

water which may be conducted through the adoption of a policy handbook that is not subject to the administrative procedure act. Based on the cost and availability of laboratories to conduct monitoring using the standardized method (see Assumption 2), and the determination of health effects by the expert panel facilitated by SCCWRP (see Assumption 4), a draft Microplastics in Drinking Water Policy Handbook (Handbook) has been developed to set forth requirements for conducting monitoring and reporting of microplastics in source waters used for drinking water and treated drinking waters for four years.

Microplastics are known to occur at a wide range of concentrations in drinking water (approximately 1 x 10^{-4} to 100 particles/L) (Koelmans *et al.* 2019). Microplastics are typically not found in groundwater, and if so, have only been found at extremely low levels on the order of 1 x 10^{-4} particles/L (Mintenig *et al.* 2019). Furthermore, removal of microplastics by treatment type varies dramatically. Conventional treatment using coagulation-flocculation removes between approximately 40 and 70% of microplastics, with greater removal from more advanced treatment techniques, (typical removal rates of 80-88%) (Pivokonsky *et al.* 2020). Microplastics originating from the deterioration of polymeric distribution systems (polyvinyl chloride, polypropylene, polyethylene) has been observed, albeit at low levels (Mintenig *et al.* 2019*;* Kirstein *et al.* 2020), however significant data gaps remain for understanding contributions from distribution systems.

Microplastics occurrence in water varies across temporal scales, and obtaining a representative sample requires the extraction of high volumes of water (1,000 L suggested as minimum) (Koelmans et al 2019). Sampling using in-line filtration methods reduces background contamination from atmospheric deposition and allows for high-volume extraction (Yuan et al 2022). Standardized sampling methods for microplastics in low- and high-turbidity waters have been promulgated and suggest extraction of high volumes of water (ASTM 2021). The proposed Handbook would require the use of the ASTM D883-20 method for collection of water samples, and analysis using infrared or Raman spectroscopy per SCCWRP methods (Draft Policy Handbook; Wong 2021a; Wong 2021b).

In recognition of the emerging nature of microplastics and the potentially challenging effects (economically, technically, etc.) ordering a designated water system to conduct monitoring may have on the water system and community served, the draft Handbook proposes an iterative monitoring plan to minimize the unnecessary use of resources while obtaining necessary occurrence and exposure information to allow for more reliable characterizations of risk. During the first phase of monitoring which will last two years, wholesale water providers and raw water conveyance systems producing greater than 10,000 million gallons per day and water systems serving over 100,000 people will receive the majority of monitoring orders, and will have the option of proposing

consolidated sampling sites representative of source waters for drinking water. Based on the findings from the interlaboratory validation study (De Frond et al *submitted*)[5], microplastics larger than 20 microns in length will be required for monitoring during the first phase as the majority of laboratories could not reliably quantify smaller particles using the standardized protocols. During the second phase which will also last two years, additional source sampling sites may be chosen, and sites with high concentrations of microplastics as determined in the first phase will require monitoring at a location post-treatment. The State Water Board anticipates that some qualified laboratories will be able to reliably characterize microplastics that pass-through treatment as small as 1 to 5 microns in length and will be able to test these laboratories' performance using proficiency testing samples. The State Water Board is working with the National Institute of Standards and Technology to develop microplastics proficiency testing samples.

Peer reviewers should review the proposed monitoring frequencies, rationale regarding the selection of sampling locations, sampling protocol, selection of required analytical methods, and selection of required rapid and inexpensive (also referred to as "surrogate") monitoring methods detailed in the Handbook[6] with consideration for the protection of public health in light of the anticipated and unknown health effects, and the overall scientific underpinnings of the prescribed sampling, extraction, and analysis methods.

Primary Documents/Reports

ASTM. 2020. "ASTM D8332-20 Standard Practice for Collection of Water Samples with High, Medium, or Low Suspended Solids for Identification and Quantification of Microplastic Particles and Fibers."
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[5] De Frond et al. *Submitted.* "Chemical identification of microplastics using μRaman and μFTIR Spectroscopy is accurate and highly dependent on physical particle characteristics."
[6] The draft policy handbook is open for public comment until December 22, 2021 and may change in response to public comments.

dependent on physical particle characteristics."
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Yuan, Chuqiao, Husein Almuhtaram, Michael J. McKie, and Robert C. Andrews. 2022. "Assessment of Microplastic Sampling and Extraction Methods for Drinking Waters." *Chemosphere* 286 (January): 131881. https://doi.org/10/gmhdsg.
Pages: 8

Conclusion #4 **The Health-Based guidance Language is appropriate with Respect to Occurrence and Hazard Knowledge and Gaps**

Human health effects of microplastics are largely uncertain, with limited hazard and exposure information available to assess risks (World Health Organization, 2019; Coffin et al. *Submitted*). Regardless, health effects of inhaled microplastics in humans have

been documented in occupational settings (Zarus *et al.* 2021), and various effects of ingested microplastics in rodents have been documented (Coffin *et al. Submitted*). An expert panel of toxicologists specialized in microplastics evaluated the state-of-the-science of health effects in humans through a workshop facilitated by SCCWRP and recommend that the State Water Resources Control Board do not adopt a notification level or other health-based level that would require water systems to inform consumers of contamination outside of their annual consumer confidence report or perform additional actions (Coffin *et al. Submitted*). The expert workgroup developed a short health-based guidance language statement that will be recommended for use by public utilities in informing consumers regarding findings of microplastics in drinking water in their annual consumer confidence reports and is included in the draft Handbook[7].

Peer reviewers should review the proposed health-based guidance language for its scientific basis and potential impacts to health and wellbeing (intentional and unintentional), including the validity of the underlying review of the science (Coffin *et al. Submitted*).

Primary Documents/Reports

World Health Organization. 2019. “Microplastics in Drinking-Water.” Geneva. http://edepot.wur.nl/498693.
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Coffin, Scott, Hans Bouwmeester, Susanne Brander, Pauliina Damdimopoulou, Todd Gouin, Ludovic Hermabessiere, Elaine Khan, et al. Submitted. “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.*
Pages: 64 (194 including supplementary information)

Zarus, Gregory M., Custodio Muianga, Candis M. Hunter, and R. Steven Pappas. 2021. “A Review of Data for Quantifying Human Exposures to Micro and Nanoplastics and Potential Health Risks.” *Science of The Total Environment* 756 (February): 144010. https://doi.org/10.1016/j.scitotenv.2020.144010.
Pages: 12

[7] See section 4.1.1 of the draft policy handbook (11-10-2021).

Attachment 3

Participants List

Names of participants involved in developing the Definition, Method, and Language

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Attachment 3, Participants List
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Carol Perkins, SWRCB Peer Review Request for Draft Microplastics Definition, Analytical Method, Handbook, and Health Effects Guidance Language

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Anna O'Brien	University of Toronto, Canada	Method

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