POLICY HANDBOOK ESTABLISHING A STANDARD METHOD OF TESTING AND REPORTING OF MICROPLASTICS IN DRINKING WATER

August 9, 2022

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1. INTRODUCTION

The purpose of this Policy Handbook Establishing a Standard Method of Testing and Reporting of Microplastics in Drinking Water (Policy Handbook) is to implement Health and Safety Code section 116376 by setting forth the requirements for conducting monitoring and reporting of microplastics in drinking water. The Policy Handbook includes an iterative, two-step, four-year plan for monitoring and reporting microplastics in a systematic and harmonized manner. To date, no government in the world has required monitoring for microplastics in drinking water, and the data obtained through the efforts detailed in this Policy Handbook will provide valuable insights for determining exposure to consumers through drinking water.

The State Water Resources Control Board (State Water Board) recognizes the emerging nature of microplastics and the potentially challenging effects (economically, technically, etc.) ordering a designated public water system to conduct monitoring may have on the public water system and community served. The State Water Board intends to use its monitoring authority carefully to minimize the unnecessary use of resources while obtaining necessary occurrence and exposure information to allow for more reliable characterizations of risk. The monitoring approach outlined in this Policy Handbook is informed by the method utilized by the United States Environmental Protection Agency's Unregulated Contaminant Monitoring Rule (UCMR) program.

This Policy Handbook includes flexibility for adaptation to the rapidly developing science and technology for monitoring microplastics.

2. PURPOSE AND OBJECTIVE

This Policy Handbook is adopted for the State Water Board's implementation of Senate Bill No. 1422 (2017-2018 Reg. Session) (SB 1422), which was approved by the Governor and filed with the Secretary of State on September 28, 2018. SB 1422 added Health and Safety Code section 116376 to require the State Water Board on or before July 1, 2020 to adopt a definition of microplastics in drinking water; and on

or before July 1, 2021,[1] to:

- Adopt a standard methodology to be used in the testing of drinking water for microplastics;
- Adopt requirements for four (4) years of testing and reporting of microplastics in drinking water, including public disclosure of those results;
- Consider issuing a notification level or other guidance to aid consumer interpretation of testing results; and
- Accredit qualified California laboratories to analyze microplastics.

Health and Safety Code section 116376 allows the State Water Board to implement these requirements through adoption of a policy handbook that is not subject to title 22 of the Government Code, division 3, part 1, chapter 3.5, commencing with section 11340.

This Policy Handbook does not address areas outside the scope of the legislative directive.

3. DEFINITION OF 'MICROPLASTICS IN DRINKING WATER'

The term 'microplastics' in this Policy Handbook refers to the definition of 'Microplastics in Drinking Water' adopted by the State Water Board on June 16, 2020, which is as follows:

3.1. 'Microplastics in Drinking Water' are defined as solid polymeric material to which chemical additives or other substances may have been added,[2] which are particles which have at least three dimensions that are greater than 1 nanometer and less than 5,000 micrometers. Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis) are excluded.

3.1.1. 'Solid' means a substance or mixture which does not meet the definitions of liquid or gas.

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[1] The COVID-19 emergency created challenges to complying with the July 1, 2021 deadline.

[2] Note that analytical methods used in this monitoring plan do not require analysis or reporting of plastic-associated chemicals. While the presence of such chemicals may cause spectroscopic interferences to the identification of microplastics, it shall not be used as justification to avoid reporting of contamination.

3.1.2. ‘Liquid’ means a substance or mixture which:

3.1.2.1. At 50 degrees Celsius (˚C) has a vapor pressure less than or equal to 300 kPa;

3.1.2.2. Is not completely gaseous at 20˚C and at a standard pressure of 101.3 kilopascal (kPa); and

3.1.2.3. Which has a melting point or initial melting point of 20 ˚C or less at a standard pressure of 101.3 kPa.

3.1.3. ‘Gas’ means a substance which:

3.1.3.1. At 50 ˚C has a vapor pressure greater than 300 kPa (absolute); or

3.1.3.2. Is completely gaseous at 20 ˚C at a standard pressure of 101.3 kPa.

3.1.4. ‘Polymeric material’ means either (i) a particle of any composition with a continuous polymer surface coating of any thickness, or (ii) a particle of any composition with a polymer content of greater than or equal to 1% by mass.

3.1.5. ‘Particle’ means a minute piece of matter with defined physical boundaries; a defined physical boundary is an interface.

3.1.6. ‘Polymer’ means a substance consisting of molecules characterized by the sequence of one or more types of monomer units. Such molecules must be distributed over a range of molecular weights wherein differences in the molecular weight are primarily attributable to differences in the number of monomer units. A polymer comprises the following:

3.1.6.1. a simple weight majority of molecules containing at least three monomer units which are covalently bound to at least one other monomer unit or other reactant;

3.1.6.2. less than a simple weight majority of molecules of the same molecular weight.

3.1.7. ‘Monomer unit’ means the reacted form of a monomer substance in a polymer.

3.1.8. ‘Monomer’ means a substance which is capable of forming covalent bonds with a sequence of additional like or unlike molecules under the conditions of the relevant polymer-forming reaction used for the particular process.

3.1.9. Size-based nomenclature within the dimensions’ limits include:

3.1.9.1. “nanoplastics” (1 nanometer to <100 nanometers);

3.1.9.2. “sub-micron plastics” (100 nanometers to <1 micrometer);

3.1.9.3. “small microplastics” (1 micrometer to < 100 micrometers);

3.1.9.4. “large microplastics” (100 micrometers to <5 millimeters).

4. BACKGROUND

4.1. Monitoring Authority

Health and Safety Code sections 116271 and 116400 provide authority to the State Water Board to issue monitoring orders to public water systems[3] in accordance with conditions specified by the State Water Board, which shall be reported on a quarterly basis, unless the State Water Board finds that reasonable action requires more or less frequent analysis. Furthermore, Health and Safety Code section 116530 grants the State Water Board authority to issue monitoring orders to public water systems[3] to submit technical reports including, but not limited, to water quality information in the form and format and at intervals specified by the State Water Board.

4.2. *Health Effects*

Health and Safety Code section 116376, subdivision (b)(3) requires the State Water Board to consider issuing a notification level or other guidance to aid consumer interpretations of testing results for microplastics. State Water Board staff, in collaboration with the Southern California Coastal Water Research Project (SCCWRP) and subject matter experts, conducted research regarding the human health impacts of microplastics, and determined that there was insufficient evidence to issue a notification level or other numerical guidance for microplastics due to significant data gaps with respect to the concentrations at which effects occur in mammals, toxicity effect mechanisms (which are necessary to generalize across different particle shapes, sizes, and chemistries), and exposure through food and other potentially significant sources.[4] While numerical guidance could not be developed, this research determined that microplastics smaller than 10 micrometers in length have an increased likelihood of causing adverse health effects in mammals and should be prioritized for monitoring when possible.[4] While available analytical methods reliably quantify microplastics as small as 20 micrometers in length (Attachment D), such data is useful for estimating concentrations of smaller particles that are more relevant

[3] Public water systems are defined in Health and Safety Code section 116275, subdivision (h).

[4]Coffin S, Bouwmeester H, Brander S, Damdimopoulou P, Gouin T, Hermabessiere L, et al. 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. 2022.

for human health through the application of well-conserved size distributions.[5] [4] Although a notification level or other numerical guidance was not developed, State Water Board staff developed qualitative health-based guidance language to aid consumers in their interpretation of monitoring results.

4.3. Methodology

4.3.1. Analytical Methods

State Water Board staff, in collaboration with the SCCWRP, conducted an inter-laboratory comparison study ("Method Study") to standardize methodologies for extracting and analyzing microplastics in drinking water. Two standardized analytical methods were developed through this study, which have undergone revisions since their introduction[6].

4.3.1.1. Infrared spectroscopy (Attachment C)
4.3.1.2. Raman spectroscopy (Attachment D).

The Method Study consisted of twenty-two laboratory participants and assessed precision, repeatability, cost, and other factors. Methods for sampling extraction via filtering/sieving, optical microscopy, infrared spectroscopy, and Raman spectroscopy were evaluated. Each laboratory received three spiked samples of simulated finished drinking water and a laboratory blank. Spiked samples contained known amounts of microplastics in four size fractions (1-20 micrometers, 20-212 micrometers, 212-500 micrometers, >500 micrometers), four polymer types (polyethylene, polystyrene, polyvinyl chloride, and polyethylene terephthalate), and six colors (clear, white, green, blue, red and orange).

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[5]Microplastics size distribution data and their applicability to human health are detailed in Kooi M, Primpke S, Mintenig SM, Lorenz C, Gerdts G. Characterizing the multidimensionality of microplastics across environmental compartments. Water Research. 2021;24. and in Mohamed Nor NH, Kooi M, Diepens NJ, Koelmans AA. Lifetime Accumulation of Microplastic in Children and Adults. Environmental Science. 2021;55(8):5084–96.

[6]Analytical methods were first released on September 24th, 2021 on the State Water Board website (https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/microplastics.html) and were revised on May 27th, 2022.

Spiked samples also included false positives (natural hair, fibers and shells) that may be mistaken for microplastics. Overall, participants demonstrated excellent average recovery and chemical identification for particles greater than 20 micrometers and 50 micrometers in size using Raman spectroscopy and infrared spectroscopy, respectively, with opportunity for increased accuracy and precision through training and further method refinement.[7]

Additional method-harmonization efforts are ongoing at the time of writing this Policy Handbook, such as those being conducted by ASTM International, the European Commission's Joint Research Centre, Wageningen University and Research, and the Bundesanstalt für Materialforschung undprüfung (German). Methods developed through these or other efforts may be approved for use for required monitoring through an official request to the State Water Board. To demonstrate method equivalency, the method in question must be validated through an inter-laboratory comparison exercise and have an application for an Alternate Test Procedure using the format and guidance promulgated by the United States Environmental Protection Agency.[8]

4.3.2. Surrogate Methods

The Method Study determined that costs and analysis time for microplastics analysis using the standardized methodologies are higher than many unregulated and regulated contaminants.[7] Method Study participants evaluated the potential for inexpensive, rapid surrogate monitoring methods to indicate the presence of microplastics, which may be utilized to determine if additional monitoring using Raman or infrared spectroscopy is appropriate. While additional research is needed to determine the reliability of potential surrogates, examples of potentially

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[7] Findings from the Method Study are reported in De Frond H, Thornton Hampton L, Kotar S, Gesulga K, Matuch C, Lao W, et al. Monitoring microplastics in drinking water: An interlaboratory study to inform effective methods for quantifying and characterizing microplastics. Chemosphere. 2022 Jul;298:134282.

[8] Alternate Test Procedure details and application may be found on the United States Environmental Protection Agency website https://www.epa.gov/dwanalyticalmethods/drinking-water-alternate-test-procedure-program

viable methods include techniques that are already commonly used in public water systems including: total organic carbon, turbidity analysis, and total suspended solids (Attachment B).

4.3.3. Laboratory Accreditation

At the time of writing this Policy Handbook, no government has required monitoring for microplastics, and there are few commercial or utility laboratories capable of monitoring microplastics.[9] Additionally, there are no commercial suppliers of proficiency testing samples representative of microplastics in finished drinking water, drinking water sources, or other aqueous matrices to independently assess the performance (e.g., recovery, precision, accuracy, etc.) of laboratories. Despite a lack of proficiency testing samples, laboratory performance for microplastics larger than 20 micrometers in length can be reliably assessed using quality assurance criteria developed through the Method Study in combination with commercially available laboratory fortified blank sample materials.

4.4. Sample Collection

At the time of Policy Handbook adoption, the State Water Board is aware of one standardized method for collecting samples for microplastics, which has been promulgated by ASTM International: "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."[10] A significant drawback of the ASTM D8332-20 method in its dependence on open-air sieve stacks, which presents opportunities for contamination and therefore requires the collection of a field blank to determine atmospheric and self-

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[9] At the time of writing, the State Water Board is aware of at least four independent laboratories seeking ELAP accreditation for microplastics analysis with the intention to analyze samples associated with this sampling and analysis plan. Anticipated laboratory capacity is factored into decisions regarding the number and frequency of samples required for monitoring pursuant to this plan. The State Water Board anticipates that additional laboratories will become available for microplastics analysis following the first phase of monitoring. Monitoring orders will include extension clauses for monitoring requirements of public water systems in the unlikely case that no accredited laboratories are available.

[10] ASTM D8332-20 may be obtained from https://www.astm.org/Standards/D8332.htm

contamination. As part of the Pilot Phase, the State Water Board is evaluating the suitability of an alternative sampling methodology described in the scientific literature but that has not yet undergone a formal rigorous evaluation by an authoritative body that utilizes in-line filtration—therefore eliminating the possibility of contamination during sample collection and the need for a sample blank (Yuan et al. 2022).[11] If the State Water Board deems this alternative sampling method described in Yuan et al. (2022) to be superior to the ASTM D8332-20 method in terms of feasibility and quality control, the State Water Board will issue a detailed guidance manual and provide training (including online materials and in-person interactive training sessions) for sample collectors to use this method, and will require its use during Phase I. The guidance manual and subsequent sampling requirements will pay particular attention to feasibility (e.g., time required to sample, accessibility, etc.).

4.5. Monitoring Plan

The State Water Board recognizes the rapidly evolving science regarding microplastics, including the limited laboratory capacity and lack of proficiency testing samples, and the relatively high amount of resources required to sample and monitor for microplastics. The State Water Board anticipates capacity for monitoring and assessing laboratories using proficiency testing samples will be developed as a result of required monitoring.

Research conducted by State Water Board staff suggests there is a high probability for the occurrence of microplastics as large as 5,000 micrometers in length in surface waters, and that several commonly used drinking water treatment technologies incidentally remove microplastics larger than 20 micrometers in length. Additionally, groundwaters typically have low detection frequencies and surface waters typically have high detection frequencies of microplastics. Microplastics concentrations vary spatially and temporally and depend on a number of known and unknown factors.

The State Water Board will employ a two-phase iterative approach for monitoring microplastics to obtain sufficient information to estimate risk through exposure via

[11] Yuan C, Almuhtaram H, McKie MJ, Andrews RC. Assessment of microplastic sampling and extraction methods for drinking waters. Chemosphere. 2022 Jan;286:131881.

drinking water. Each step will last two (2) years, with an interim period to allow for State Water Board staff to assess results from the first phase and plan the second phase of monitoring accordingly. For both phases, the State Water Board will issue orders to public water systems and/or wholesaler providers to monitor microplastics in source waters and/or treated drinking water. In Phase I, monitoring will focus on characterizing occurrence of microplastics larger than 20 or 50 micrometers in length in source waters used for drinking in accordance with the specifications in the method employed by the laboratory (Attachments C and D. Phase II monitoring will be directed towards characterizing occurrence of microplastics both smaller than and larger than 20 micrometers in length in treated drinking water.

4.5.1. Process for Laboratory Accreditation

The Environmental Laboratory Accreditation Program (ELAP) will offer accreditation to qualified laboratories to monitor for microplastics in drinking water as follows:

4.5.1.1. Laboratories wishing to become accredited for monitoring microplastics in water must apply through the online process[12] and list the appropriate field of accreditation corresponding to one of four microplastics analytes[13] in non-potable water and drinking water matrices using one of the approved analytical methods (Attachments C and D) with the corresponding instrumentation (i.e., Raman or infrared spectroscopy).

4.5.1.2. ELAP will provide accreditation of qualified laboratories for the two approved microplastics analysis methods listed in this Policy Handbook (Attachments C and D).

4.6. *External Scientific Peer Review*

In accordance with Health and Safety Code section 57004, the State Water Board requested external scientific peer review for the scientific components of

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[12] Application information for ELAP is available on the State Water Board webpage: https://www.waterboards.ca.gov/drinking_water/certlic/labs/apply.html

[13] Microplastic analytes listed in ELAP's field of accreditations include: "microplastics > 500 micrometers"; "microplastics 500 to 212 micrometers"; "microplastics 212 to 20 micrometers"; and "microplastics 212 to 50 micrometers."

the draft policy handbook,[14] the definition of microplastics in drinking water adopted by the State Water Board,[15] analytical methods for monitoring microplastics developed by the State Water Board for the purposes of this Policy Handbook,[16] proposed health effects guidance language,[17] and underlying literature review.[18] Peer review comments received from four external experts[19] were used to inform the revised Policy Handbook and its underlying components (e.g. definition, analytical methods), the development of the pilot phase, research projects conducted by the State Water Board, and coordination with stakeholders (e.g. Microplastics Subcommittee of the Water Quality Monitoring Council). Revisions made in response to peer review comments received include the following:

4.6.1. The State Water Board is developing an open-source reporting tool to maximize usage of complex monitoring datasets and ensure data are reported in a harmonized manner that is consistent with the definition.[20] The reporting tool addresses a number of concerns from peer reviewers

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[14] Draft Microplastics in Drinking Water Policy Handbook (November 10, 2021). https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/microplastics/mcrplsts_plcy_drft.pdf

[15] Resolution 2020-0021 adopted on June 16, 2020. https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2020/rs2020_0021.pdf

[16] "Standard Operating Procedures for Extraction and Measurement by Raman Spectroscopy of Microplastic Particles in Drinking Water" (September 24, 2021); "Standard Operating Procedures for Extraction and Measurement by Infrared Spectroscopy of Microplastic Particles in Drinking Water" (September 24, 2021).

[17] Section 4.1.1 of Draft Microplastics in Drinking Water Policy Handbook (November 10, 2021). https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/microplastics/mcrplsts_plcy_drft.pdf.

[18] Coffin S, Bouwmeester H, Brander S, Damdimopoulou P, Gouin T, Hermabessiere L, et al. 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. 2022.

[19] Peer reviewer letters were received by Dr. Alan Hubbard, Dr. Denise Mitrano, Dr. José Carlos Pinto, and Dr. Tony R. Walker and are available on the State Water Board website: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/microplastics.html

[20] The microplastics data harmonization and reporting protocol is being developed by the State Water Board in collaboration with the Moore Institute for Plastic Pollution Research, San Francisco Estuary Institute, and The People Lab.

regarding the importance of data granularity in assessing human health risks, ensuring comparability between laboratories, and improving feasibility of following the definition.

4.6.2. The State Water Board provided additional clarification regarding the definition and how it pertains to the sampling and monitoring plan.[21]

4.6.3. Guidance for sampling protocols and requirements for sampling volumes will be provided based on evaluation and optimization research conducted by the State Water Board.[22]

4.6.4. Analytical methods (Attachments C and D) will undergo additional inter-laboratory validation using real-world water samples during the Pilot Phase. Laboratories seeking ELAP accreditation may volunteer to participate in this additional validation exercise.

4.6.5. Analytical methods were revised following guidance from peer reviewers and public comments.[23] Revisions include stricter requirements for laboratories to spectroscopically confirm the polymer identity of particles, expansion of the types of acceptable spectroscopic instruments to be used with each method, additional details regarding variability reporting, correction of several typos, and additional minor edits.

5. PLANNED AND ONGOING WORK

5.1. The State Water Board is conducting additional research and performing work to resolve scientific and logistical challenges related to monitoring. These efforts do not count towards the four years of monitoring and reporting required by Health and Safety Code section 116376 subsection (b)(2). Work related to these efforts are planned to occur between Summer 2022 and Summer 2023 and are referred to as the "Pilot Phase."

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[21] This version of the policy handbook was revised to ensure the size-based classifications in the definition are synonymous with Resolution 2020-0021, and clarity surrounding "…chemical additives or other substances…"

[22] Details regarding planned research by the State Water Board to refine sampling protocols and provide guidance and training to operators is described in the Pilot Phase section of this Policy Handbook.

[23] Revised analytical methods were released on May 27th, 2022 on the State Water Board website. (https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/microplastics.html)

5.1.1. The primary goals of the Pilot Phase are to build infrastructure for monitoring and advance science to optimize utility of the subsequent phases.

5.1.2. The State Water Board has initiated a contract with the SCCWRP to accomplish the following scientific research goals:

5.1.2.1. Evaluate the reliability and feasibility of the ASTM D8332-20 sampling method alongside an in-line filtration method described in Yuan et al. (2022)[24] using environmental samples at a select number of volunteer public water systems;

5.1.2.2. If appropriate, develop a standardized sampling protocol using an in-line filtration based on an optimized method described first in Yuan et al. (2022)[4];

5.1.2.3. Measure microplastics levels and targeted potential surrogates in water samples from a small number of volunteer California public water systems, including treated and raw water samples;

5.1.2.4. Determine optimal sampling volumes based on source water characteristics, data quality objectives, and feasibility (e.g., ensuring sample collection times are achievable given documented time constraints of water system personnel);

5.1.2.5. If appropriate, determine if a field reagent blank should be included in the sampling protocols based on the quality control and quality assurance guidelines associated with the chosen optimized sampling protocol as described above (e.g., in-line filtration would effectively eliminate the possibility of contamination and therefore eliminate the need for a field reagent blank);

5.1.2.6. If appropriate, designate an upper limit of total particle concentrations for final samples.

5.1.3. Additional logistical and infrastructure-building goals of the Pilot Phase include:

5.1.3.1. Providing in-person and virtual training (e.g., videos, documents) to public water system operators in California for either sampling protocol that is determined to be most reliable and feasible as described above;

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[24] Yuan C, Almuhtaram H, McKie MJ, Andrews RC. Assessment of microplastic sampling and extraction methods for drinking waters. Chemosphere. 2022 Jan;286:131881.

5.1.3.2. Developing guidelines and protocols for reducing sample interferences (e.g., sample digestion) from water with high organic content or non-plastic particulates (e.g., minerals);

5.1.3.3. If appropriate, developing guidance for surrogates correlated to microplastics concentrations;

5.1.3.4. Allowing time and providing resources for laboratories to become accredited through ELAP; conducting additional inter-laboratory validation using environmental water samples obtained through the aforementioned contract work; and developing a harmonized data reporting protocol using open-source code.[25]

5.1.3.5. Developing tools for communicating risks of microplastics to consumers.[26]

5.1.3.6. Providing resources and guidance for laboratory accreditation and monitoring.

5.1.4. Any monitoring conducted during the Pilot Phase will be optional and voluntary.

6. MONITORING AND REPORTING REQUIREMENTS

Health and Safety Code section 116376 directs the State Water Board to set forth requirements for public water systems to conduct monitoring of microplastics in drinking water. Monitoring orders will be issued to specific public water systems in two phases, requiring monitoring for a period totaling four (4) years. Those systems that receive an order shall be required to sample consistent with the following requirements:

6.1. Water System Selection

Public water systems have been selected for potential monitoring based on concepts utilized by the United States Environmental Protection Agency's UCMR program (Attachment A). The UCMR program establishes monitoring requirements for priority unregulated contaminants in drinking water for all large

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[25] The microplastics data harmonization and reporting protocol is being developed by the State Water Board in collaboration with the Moore Institute for Plastic Pollution Research, San Francisco Estuary Institute, and The People Lab.

[26] Consumer guidance tools as well as laboratory accreditation and analysis resources are being developed by the State Water Board in collaboration with voluntary stakeholders through the Microplastics Subcommittee of the California Water Quality Monitoring Council. Anyone may participate in the Microplastics Subcommittee.

public water systems serving greater than 10,000 people, all small public water systems serving between 3,300 and 10,000 people, and a representative sample of small public water systems serving fewer than 3,300 people.[27]

Due to significant uncertainties regarding risks of microplastics through drinking water and substantial costs to reliably monitor microplastics, an adapted version of the UCMR approach will be utilized to minimize impacts to public water systems, while obtaining sufficient data to estimate general occurrence and potential human exposure through drinking water. Accordingly, in the first phase of monitoring, a small number of public water systems will be required to monitor, with a focus on characterization of sources which serve the greatest number of consumers and optimization to reduce the total number of sources necessary to obtain adequate representation of contamination in source waters in the state. Large community water systems and wholesale water systems that provide water to greater than 100,000 people will receive the vast majority of monitoring orders in Phase I. Public water systems that depend primarily on purchased water will not receive monitoring orders during Phase I. Additional factors included in the selection of public water systems included geospatial representation, treatment capabilities, and primary water sources (e.g., surface water, groundwater, groundwater under direct influence of surface water). The State Water Board will evaluate findings from Phase I to determine sampling locations for Phase II.

6.2. Sampling Requirements

6.2.1. Testing Phase[28]

6.2.1.1. *Phase I* (Fall, 2023 – Fall, 2025)

6.2.1.1.1. Public water systems potentially selected to monitor during Phase I (Attachment A) will test for microplastics occurring in drinking water sources using one of the approved standardized methods (Attachment C, Attachment D).

[27] Additional information regarding the United States Environmental Protection Agency's UCMR can be found on their website https://www.epa.gov/dwucmr/learn-about-unregulated-contaminant-monitoring-rule

[28] Dates listed are approximate, are not binding, and are subject to change.

6.2.1.1.2. Prior to issuing monitoring orders, State Water Board staff will hold a public workshop[29] with systems listed on Attachment B to discuss and agree upon monitoring details, including but not limited to: specific sampling locations; quality assurance and quality control protocols; sample holding times; procedures for reviewing, approving, and uploading data.

6.2.1.1.3. At minimum, laboratories must report concentrations of microplastics that are 50 micrometers long or the minimum size listed in the standardized method used by the laboratory (see Attachments C and D) – whichever is smaller. Monitoring for shorter microplastics is strongly encouraged.

6.2.1.1.4. Unless otherwise stated in monitoring orders issued to public water systems, monitoring will be limited to drinking water sources only.

6.2.1.1.5. Unless stated otherwise in monitoring orders, drinking water source samples shall be collected at the same location(s) where *Cryptosporidium* and *Giardia* are typically collected.

6.2.1.1.6. The potential surrogate techniques listed as being 'required' in Attachment B will be required for monitoring.

6.2.1.1.6.1. To reduce contamination of surrogate monitoring samples, identical quality assurance protocols as stated in Attachments C and D, and further detailed in forthcoming sampling guidance issued by the State Water Board, shall be implemented during sampling.

6.2.1.1.7. Testing is required for a period of two (2) years.

6.2.1.1.8. Public water systems, in cooperation with other agencies or water suppliers, may develop and submit a plan to the State Water Board that identifies sampling site(s) for (a) drinking water source(s) that is (are) shared by multiple public water system

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[29] Workshop anticipated to occur in Fall/Winter 2022 and will be open to the public. Water systems on draft list (attachment A) will be invited to submit oral and written proposals for planned sampling locations. Consolidation of monitoring between systems will be considered if sufficient evidence is provided detailing shared water sources. When available, details regarding workshop will be posted on the State Water Board website: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/microplastics.html

treatment plants and is representative of a drinking water source that is further treated and distributed to consumers. To make this demonstration, a public water system shall submit information to the State Water Board regarding the location and distribution of each sampling site, and water quality information for each sampling site. The State Water Board will use this information to determine whether the drinking water sources are used to produce finished drinking water through multiple public water system treatment plants. Upon approval of a submitted plan by the State Water Board, public water systems shall monitor at the identified sampling site(s). Monitoring conducted through an approved plan may be used to satisfy monitoring requirements upon approval by the State Water Board.

6.2.1.2. Phase II (Fall, 2026 – Fall, 2028)

6.2.1.2.1. Following a six-month interim between Fall, 2025 and Spring 2026, the State Water Board will issue additional monitoring orders for public water systems required to test subject to Phase II methodology. Public water systems subject to monitoring may include the same systems required during Phase I as well as additional systems.

6.2.1.2.2. For public water systems selected to monitor during Phase II, the system will test for microplastics occurring in finished drinking water as small as 5 micrometers in length, or the smallest microplastics for which ELAP provides accreditation at the time of the monitoring order issuance.

6.2.1.2.3. Unless stated otherwise in monitoring orders, finished drinking water samples shall be collected at the same location(s) where *Cryptosporidium* and *Giardia* are typically collected or following the final stage of treatment before entering the distribution system.

6.2.1.2.4. Public water systems without any detections of microplastics during Phase I may be exempt from monitoring during Phase II.

6.2.1.2.5. Testing is required for a period of two (2) years.

6.2.1.3. General Requirements

6.2.1.3.1. Public water systems who have been selected for monitoring shall submit a quality assurance project plan, standard operating

protocol for sampling, and a plan for monitoring to the State Water Board for approval prior to conducting monitoring.

6.2.1.3.2. Exact sampling locations will be listed in monitoring orders issued to public water systems at a later date.

6.2.1.3.3. Unless specified otherwise in a monitoring order, public water systems shall utilize the standardized protocol for collecting water samples for microplastics as determined by the State Water Board[30].

6.2.1.3.4. Unless specified otherwise in a monitoring order, public water systems shall utilize one of the two (2) standardized protocols for analyzing samples of drinking water sources or finished drinking water for microplastics: infrared spectroscopy (Attachment C) or Raman spectroscopy (Attachment D).

6.2.1.3.5. Alternative analytical methods may be approved for use through an official request to the State Water Board. To demonstrate method equivalency, the method in question must be validated through an inter-laboratory comparison exercise and have an application for an Alternate Test Procedure using the format and guidance promulgated by the United States Environmental Protection Agency.

6.2.1.3.6. Public water systems must analyze samples with laboratories accredited by ELAP using an approved standardized methodology defined in the monitoring order.

6.2.1.3.7. Unless specified otherwise in a monitoring order, public water systems must submit water quality data for required surrogates and standard water quality monitoring parameters in Attachment B, including temperature, turbidity, total organic carbon, total dissolved solids, and total suspended solids collected during the same day of the microplastics sample at the same location. Water flow rate entering the treatment plant shall also be reported. Public water systems are encouraged to either collect

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[30] The standardized operating protocol for sampling microplastics is under development at the time of writing and will be posted on the State Water Board webpage https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/microplastics.html and will also be attached to monitoring orders.

samples in parallel using these surrogate monitoring methods (if possible) or collect and report these surrogate parameters at the start and finish of sample collection. Regardless of how surrogate parameters are collected, public water systems shall identify how such samples were collected. Public water systems are encouraged (but are not required) to report surrogate data from additional techniques listed in Attachment B.

6.2.1.3.8. Unless specified otherwise in a monitoring order, public water systems are not required to collect replicate samples for analysis of microplastics. Laboratory analytical variability shall be assessed through the use of laboratory fortified reagent blanks as specified in Attachment C and Attachment D.

6.2.1.3.9. All blank contamination and root cause, if known, shall be reported to the State Water Board through the manner specified in the monitoring orders.

6.2.1.3.10. Raw data shall be uploaded without blank correction alongside quality control and quality assurance data, or as specified in the analytical methods required for use.

6.2.1.3.11. Due to the known relatively low occurrence of microplastics in groundwaters used as drinking water sources,[31] monitoring orders will be directed primarily for surface waters used as drinking water sources.

6.2.1.3.12. Unless stated otherwise in monitoring orders, samples shall be collected twice between October – April (rainy season) and twice during May – September (dry season) of each year to determine the relative influence of rain and stormwater influence as well as atmospheric deposition. Accordingly, for each sampling location a minimum of eight (8) samples will be analyzed over the two-year period.

6.2.1.3.13. Analyses required pursuant to this Policy Handbook shall be performed by laboratories accredited by the State Water Board to perform such analyses pursuant to Health and Safety Code,

[31] Viaroli S, Lancia M, Re V. Microplastics contamination of groundwater: Current evidence and future perspectives. A review. Science of The Total Environment. 2022 Jun 10;824:153851.

division 101, part 1, chapter 4, article 3, commencing with section 100825.

6.2.1.3.14. Sample collection shall be performed by personnel trained to perform such sample collections and/or tests by:

6.2.1.3.14.1. The State Water Board;

6.2.1.3.14.2. A laboratory accredited pursuant to Health and Safety Code section 100825, subdivision (a);

6.2.1.3.14.3. An operator certified by the State Water Board pursuant to Health and Safety Code section 106875, subdivisions (a) or (b).

6.2.1.3.15. Public water systems shall take all samples during normal operating conditions, which exclude those circumstances covered under the California Code of Regulations, title 22, section 64533.5, subdivision (b).

6.3. Reporting Requirements

6.3.1. Monitoring results shall be reported to the State Water Board by the analyzing laboratory using the Electronic Deliverable Format in accordance with California Code of Regulations, title 22, section 64469 and in compliance with the format specified by the State Water Board.[32]

6.3.2. Analytical results shall be reported no later than the 10th day of the month following completion of the analysis.

6.3.3. Public water systems, as defined in Health and Safety Code section 116275, shall include positive detections of microplastics in their annual Consumer Confidence Report pursuant to Health and Safety Code section 116470, subdivision (a)(4). If monitoring data is available for finished drinking water samples, such data shall be reported in addition to data for drinking water source samples. Additionally, as stated in Health and Safety Code Section 66480, a community or non-transient, non-community water systems (NTNC)[33] that sells water to another community or NTNC water system shall deliver the required monitoring data to the purchasing system

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[32] Specific guidance regarding reporting format, metrics, classifications, and metadata will be provided in monitoring orders issued to public water systems. The State Water Board is currently developing a harmonized data reporting tool to assist laboratories and public water systems.

[33] Community and NTNC water systems are defined in Health and Code section 116275.

by no later than April 1 of each year or on a date mutually agreed upon by the seller and the purchaser, and specifically included in a contract between the parties.

6.3.3.1. Unless stated otherwise in a monitoring order issued by the State Water Board or other regulation, public water systems shall include or provide a reference to health-based guidance language developed by the State Water Board to aid consumer interpretations of findings of microplastics in finished drinking water (or drinking water sources), which is as follows:

6.3.3.2. "Studies of rodents exposed to some types of microplastics through drinking water indicate potentially adverse effects, including on the reproductive system. However, more research is needed to understand potential impacts on human health, including determining concentrations at which effects may occur. California is monitoring microplastics in drinking water to understand its occurrence and is supporting ongoing research."

6.3.4. A microplastics detection is a positive finding of a quantifiable amount above the minimum reporting level[34] established by the analytical laboratory.

6.3.5. Public water systems subject to monitoring shall analyze samples taken at the same location and date as the samples collected for microplastics monitoring using the required surrogate monitoring techniques in Attachment B and submit surrogate monitoring data to the State Water Board alongside microplastics monitoring results. Public water systems are encouraged but not required to monitor for additional surrogates listed as optional on Attachment B.

6.3.6. For all samples collected from a reservoir, the reservoir depth and turnover rates shall be reported.

6.3.7. Blending rates must be reported (when applicable).

6.3.8. Sampling volume shall be reported.

6.4. Timeline

To assist public water systems and laboratories in preparing for monitoring and reporting of microplastics, a general timeline is provided here. Note that dates are approximate and are subject to change under the microplastics monitoring

[34] The method for calculating a minimum reporting level for microplastics is detailed in Attachments C and D.

orders.

6.4.1. Summer, 2022: Environmental Laboratory Accreditation Program will offer accreditation to qualified laboratories for microplastics in non-potable water and drinking water fields of accreditation.

6.4.2. Fall, 2022: State Water Board will issue monitoring orders in accordance with Phase One of planned monitoring, with monitoring requirements applicable between Fall 2023 – Fall 2025.

6.4.3. Fall, 2025 – Spring 2026: Interim period in which State Water Board staff will assess results from Phase One and determine best approach for Phase Two.

6.4.4. Spring, 2026: State Water Board will issue monitoring orders in accordance with Phase Two of planned monitoring with monitoring requirements applicable between Fall 2026 – Fall 2028.

6.4.5. Fall 2028: Completion of Phase Two of planned monitoring.

List of Attachments

ATTACHMENT A – List of water systems potentially subject to monitoring during Phase I

ATTACHMENT B – Non-exhaustive list of potential surrogate monitoring methods for microplastics

ATTACHMENT C - Standard Operating Procedures for Extraction and Measurement by Infrared Spectroscopy of Microplastic Particles in Drinking Water: May 27th, 2022 [SWB-MP1-rev1]

ATTACHMENT D - Standard Operating Procedures for Extraction and Measurement by Raman Spectroscopy of Microplastic Particles in Drinking Water: May 27th, 2022 [SWB-MP2-rev1]

ATTACHMENT A – List of water systems potentially subject to monitoring during Phase I

pwsid	Water System Name	Primary Water Source Type	Population Served	CITY	Rationale for Inclusion
CA1910087	METROPOLITAN WATER DIST. OF SO. CAL.	Surface Water	18,962,000	LOS ANGELES	Largest Providers
CA1910067	LOS ANGELES-CITY, DEPT. OF WATER & POWER	Surface Water	4,070,679	LOS ANGELES	Largest Providers
CA3810001	SAN FRANCISCO REGIONAL WATER SYSTEM	Surface Water	2,600,600	SAN FRANCISCO	Largest Providers
CA4310027	SANTA CLARA VALLEY WATER DISTRICT	Surface Water	1,540,360	SAN JOSE	Largest Providers
CA0110005	EAST BAY MUD	Surface Water	1,438,500	OAKLAND	Largest Providers
CA3710020	SAN DIEGO, CITY OF	Surface Water	1,400,016	SAN DIEGO	Largest Providers
CA4310011	SAN JOSE WATER	Surface Water	1,007,514	SAN JOSE	Largest Providers
CA3410020	CITY OF SACRAMENTO MAIN	Surface Water	884,060	SACRAMENTO	Largest Providers
CA4910020	SONOMA COUNTY WATER AGENCY	Groundwater	600,000	SANTA ROSA	Groundwater with low filtration
CA1010007	CITY OF FRESNO	Surface Water	542,148	FRESNO	Geographically Diverse Systems
CA3010001	CITY OF ANAHEIM	Surface Water	450,000	ANAHEIM	Largest Providers
CA3010092	IRVINE RANCH WATER DISTRICT	Surface Water	422,000	IRVINE	Largest Providers
CA1910128	COVINA IRRIGATING CO.	Surface Water	382,349	COVINA	Surface Water with Low Filtration
CA3610050	UPLAND, CITY OF	Surface Water	375,509	UPLAND	Largest Providers
CA0110001	ALAMEDA COUNTY WATER DISTRICT	Surface Water	351,000	FREMONT	Largest Providers
CA3410021	SAN JUAN WATER DISTRICT	Surface Water	334,669	GRANITE BAY	Largest Providers
CA3310031	RIVERSIDE, CITY OF	Groundwater UDI Surface Water	312,214	RIVERSIDE	Largest Providers
CA3610129	MOJAVE WATER AGENCY	Groundwater	292,449	APPLE VALLEY	Groundwater with low filtration
CA0110010	ZONE 7 WATER AGENCY	Surface Water	226,840	LIVERMORE	Largest Providers

CA4810003	CITY OF FAIRFIELD	Surface Water	140,259	FAIRFIELD	Surface Water with Low Filtration
CA3710006	ESCONDIDO, CITY OF	Surface Water	137,941	ESCONDIDO	Geographically Diverse Systems
CA0710001	CITY OF ANTIOCH	Surface Water	113,061	ANTIOCH	Geographically Diverse Systems
CA1910045	ANTELOPE VALLEY EAST KERN WATER AGENCY	Surface Water	110,286	PALMDALE	Surface Water with Low Filtration
CA3610019	SAN BERNARDINO VALLEY WD	Groundwater	109,608	SAN BERNARDINO	Groundwater with low filtration
CA4510005	CITY OF REDDING	Surface Water	87,548	REDDING	Geographically Diverse Systems
CA1910225	LAS VIRGENES MWD	Surface Water	75,384	CALABASAS	Geographically Diverse Systems
CA3410004	CARMICHAEL WATER DISTRICT	Groundwater UDI Surface Water	37,897	CARMICHAEL	Groundwater under direct infiltration with low filtration
CA1503341	TEJON CASTAC WD - I5 & LAVAL RD	Surface Water	30,250	LEBEC	Surface Water with Low Filtration
CA1510055	CWS - NORTH GARDEN	Surface Water	24,313	BAKERSFIELD	Geographically Diverse Systems
CA3110001	NORTH TAHOE PUD - MAIN	Surface Water	5,300	TAHOE VISTA	Geographically Diverse Systems

ATTACHMENT B Non-exhaustive list of potential surrogate monitoring methods for microplastics

Potential Surrogate Method	Relative Availability	Pre-separation step required?	Can distinguish microplastics?	Required during Phase I?
Temperature	Common	No	No	Required
Treatment plant flow rate (to calculate particles entering plant)	Common	No	No	Required
Turbidity	Common	Yes	No	Required
Total organic carbon	Common	Yes	No	Required
Total suspended solids	Common	Yes	No	Required
Total dissolved solids	Common	Yes	No	Required
Total particle count (particles/mL)	Uncommon	No	No	Optional
Microbalance	Common	Yes	No	Optional
Thermogravimetric analyzer - Differential scanning calorimeter	Uncommon	Yes	No	Optional
NIOSH Method #5040 (elemental and organic carbon)	Uncommon	Yes	No	Optional
Imaging hemocytometer	Uncommon	Yes	Likely	Optional
Microscopy with nile red	Uncommon	Yes	Yes	Optional
SiMPore transmembrane pressure filtration	Novel	Unclear	No	Optional
Flowcam and cytometry with or w/o staining	Novel	Yes	Likely	Optional
Lucendi device	Novel	Unclear	Likely	Optional
Spectral Flow Cytometer	Novel	Yes	Likely	Optional