Global Chemicals Monitoring Programme

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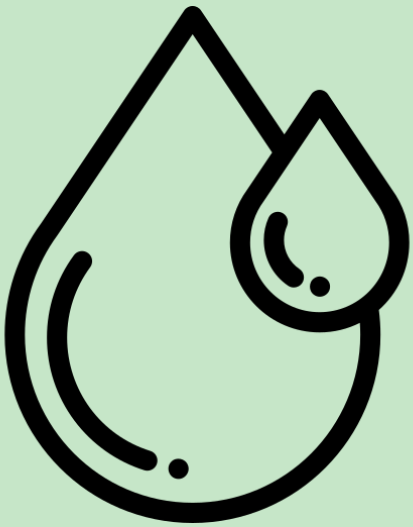
Passive Sampling of Per- and Polyfluoroalkyl Substances (PFASs) in Water Methodology and Procedure



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This document has been prepared by:

This Standard Operating Procedure (SOP) has been developed under the Global Environment Facility (GEF)-funded programme entitled “Global Chemicals Monitoring Programme to Support Implementation of the Stockholm and Minamata Conventions (GCMP)” (GEF ID 11534), including its global and regional child projects. To support harmonized monitoring of persistent organic pollutants (POPs) and mercury under the GCMP, a series of SOPs has been developed. These SOPs cover the core matrices of air, human milk, and water for POPs, and air for mercury.

The document is based on the guide for Microporous Polyethylene Tube (MPT) Passive Sampling deployment procedure developed by the University of Queensland and has been adapted by the Chemicals Science and Policy Unit, Chemicals and Health Branch, Industry and Economy Division, United Nations Environment Programme (UNEP), in collaboration with the University of Queensland.

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ABBREVIATIONS

GEF	Global Environment Facility
GCMP	Global Chemicals Monitoring Programme
GMP	Global Monitoring Plan
ID	Identification
ISO	International Organization for Standardization
MPT	Microporous Polyethylene Tubes
PFASs	Per-and polyfluoroalkyl substances
POPs	Persistent Organic Pollutants
SOP	Standard Operating Procedure
UNEP	United Nations Environment Programme

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1. INTRODUCTION

Water has been identified as a core matrix under the Global Monitoring Plan (GMP) of the Stockholm Convention exclusively for fluorinated persistent organic pollutants (POPs), i.e. per-and polyfluoroalkyl substances (PFASs), based on evidence that it serves as the primary transport medium for these chemicals in the environment. This designation is supported by extensive research demonstrating the feasibility of detecting these substances in water and the availability of standard methods for their analyses.

Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorohexanesulfonic acid (PFHxS), and the long-chain perfluorocarboxylates (**C9-C18 long-chain perfluorocarboxylic acids (LC-PFCAs)** are noted for their relatively high water solubility, especially compared to their neutral analogues. Consequently, these substances are recommended for monitoring in water as a core matrix under the Stockholm Convention (United Nations Environment Programme (UNEP) and Stockholm Secretariat (2025)).

This standard operating procedure (SOP) provides practical guidance on monitoring PFASs in water using passive sampling to support the Global Chemicals Monitoring Programme (GCMP) and its Child projects in different UN regions. The programme includes six Child projects involving participating countries in Africa, Asia and Pacific Islands, and Latin America and the Caribbean, with financial support from the Global Environment Facility (GEF).

1.1. Microporous polyethylene tubes (MPT) water passive samplers

Passive sampling for anionic PFASs is feasible with microporous polyethylene tubes (MPT) passive samplers calibrated for PFASs sampling (Kaserzon et al. 2019; Gardiner et al. 2022). These samplers have been tested for sampling PFASs in water under varying conditions, such as deployment time, water temperature, and flow velocity (Dunn et al. 2023).

Passive sampling offers the advantage of time-averaged concentration measurements over several weeks, thereby reducing the impact of episodic events (e.g., extreme weather, spills, or industrial releases), in addition to providing relatively low limits of detection, being cost-effective, and allowing flexible and straightforward deployment (Kaserzon et al. 2019). Compared with grab water sampling, this method also reduces shipping costs and avoids import/export restrictions on natural water samples (UNEP 2021).

2. SAMPLING: CONSIDERATIONS OF LOCATION AND MATERIALS

For sampling at the national level, a guidance document was developed outlining the recommended requirements for the selection of sampling sites and analysing PFASs in water (Weiss et al. 2015). The guidance document recommends active (i.e. grab) sampling, at defined integrative locations, often at the mouths of large rivers or estuaries. However for time-integrated purposes, passive sampling using an open-frame system is a more suitable option. Passive samplers for PFASs, such as MPT passive samplers, are a technology developed by University of Queensland, Australia (Kaserzon et al. 2019).

2.1. Sampling location

Water sampling sites should be located sufficiently far from urban centres, harbours, industrial wastewater inputs, and other direct sources of POPs (particularly PFASs) to ensure that the concentrations measured are representative of a larger area around the site (UNEP 2025). The sampling report should include GPS coordinates, pictures of the sampling sites, and a satellite image (e.g. from Google Maps or an equivalent web map) to document the selected sampling location and its immediate surroundings.

A previous study on PFASs monitoring in surface waters, based on a survey conducted across 22 developing countries (Baabish et al. 2021), provides valuable guidance and can be used as a reference. Important recommendations for PFASs sampling frequency and selection of sampling period are:

a. Sample at the selected site two times a year (using the same site and method);

b. Carefully determine sampling occasions based on optimal conditions, preferably consistent between years (e.g., during high-water and during low-water periods), avoiding drought or freezing conditions.

Ideally, passive sampler housings (see Figure 1) should be deployed in open lake waters, with access to the sampling location by boat whenever possible. If this is not feasible, deployment in river waters is also acceptable. Positioning the equipment away from the shore reduces the likelihood of interference from the public and helps ensure that the sampling location remains distant from direct contamination sources.

If deploying along the shoreline, a pier, jetty, dock, or quay should be used to ensure that

the sampler is positioned as far into the water as possible. The risk of vandalism or theft should be considered, and appropriate measures should be taken to minimize this risk (e.g. by hiding, camouflaging, using secure areas, or using locks).

Finally, according to the recommendations set out in the Water Guidance Document (Weiss et al. 2015), the sampling location should be chosen taking into account the following key characteristics:

- The location should be in the open lake water, at the mouth of a larger river or estuary;
- It should be easily accessible, e.g., from the border of the water body, by boat, or from a bridge;

2.2. Sampling frequencies and periods

The exposure (or deployment) time for each sampling period is six months. There will be two sampling periods per year, resulting in a total sampling duration of two years.

All participating countries should, where possible, deploy samplers on the same dates, as specified in the sample information form.

Six-month deployment periods in stagnant or low-flow waters may promote biofouling, which can reduce samplers' uptake rates and potentially lead to an underestimation of PFASs accumulation. In such cases, it is recommended to implement biofouling mitigation measures, such as verifying the effectiveness of protective cages or conducting periodic inspections.

During each sampling period, one set of samples will be deployed for six months. Each set of samplers includes two MPTs and one field blank. The samplers will be deployed according to the proposed sampling schedule:

Table 1. *Seasonal sampling schedule for two sampling years*

Period	First sampling year-2027	Second sampling year-2028
1st Period	Early January to early July 2027	Early January to early July 2028
2nd Period	Early July 2027 to early January 2028	Early July 2028 to early January 2029

2.3. Materials

List of parts that make up the passive water sampler:

1. Container/cooler bag with deployment equipment (deployment container).

2. Microporous Polyethylene passive sampling (MPTs) devices (at least 2 replicates per deployment site) for deployment.

3. MPT passive sampler field blanks (one per year of sampling per site).

4. Chain or fisherman weights.

5. Stainless-steel chains for deployment or ropes without PFASs (e.g. polypropylene, nylon ropes). Ensuring the length is sufficient for the deployment scenario. If a chain is not used a weight will be required (e.g., fisherman's weight) to keep the MPT passive sampler submerged in the water column.

6. Sampling gloves suitable for PFASs sampling (e.g. powderless nitrile gloves).

7. Cable ties.

8. Stanley knife and /or scissors to cut cable ties.

9. Permanent marker/pen.

10. A sample information (Chain of Custody) form, to annotate all the details about deployment and retrieval site name, time and dates, and other important remarks.

11. Large biosafety waste bag and cable ties for disposal of any waste items (cable ties, used gloves, tubing parts etc.).

12. Laminated signage.

The figure below is a scheme showing the different parts of the PAS and the way to assemble them:

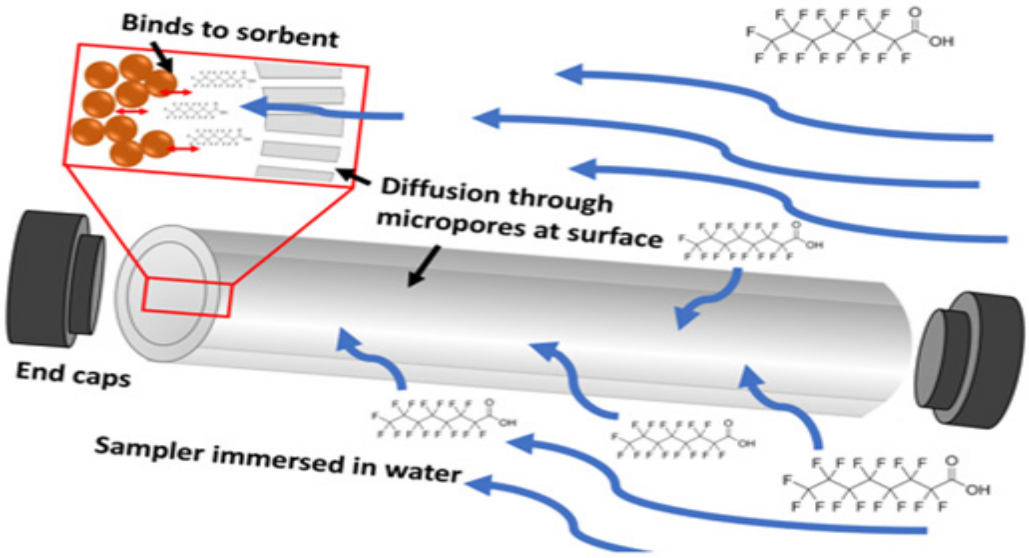


Figure 1. *Schematic of the MPT water passive sampler.*

2.4. Instructions for deploying MPT passive samplers

1. Wear provided powder PFASs-free gloves when handling samplers. Please DO NOT wear hand lotions, perfumes, insect repellent or powdered gloves. Suitable gloves are provided with your field kit.

2. Remove from the deployment rope/chain from the deployment container/cooler bag. Secure the deployment rope/ chain to the permanent structure or buoy above the sampling location, aiming to site the samplers at mid-depth in the water column. **They should remain submerged in all reasonable flow conditions but not rest on the bottom**. **Figure 2** shows suggested deployment techniques.

3. Gently REMOVE the passive samplers from the plastic containers (see **Figure 3**, the sampler should include 2 MPT pieces) and discard the purified water from inside the holder. Place the plastic holder in the deployment container/bag for the respective site for when samplers are retrieved.

4. Attach the MPT passive samplers to the desired location on the deployment rope using cable ties secured firmly (after testing the rope length and deployment position). Check all cable ties are firmly secured to the deployment rope/chain. If a chain is not used a weight will be required (e.g., fisherman's weight) to keep the MPT passive sampler submerged in the water column.

5. Lower the complete set of samplers into the water.

6. Keep field blank passive sampler containers inside the deployment bag. Nothing should be done to field blanks as their purpose is to assess potential contamination from sampling procedures only.

7. Record your deployment and retrieval site name, time and dates and other important remarks on the sampling information form (Chain of Custody).

8. Collect all sampling equipment and place any sampling waste (e.g. cable ties, ropes, chains, used gloves etc.) in a 'Biohazard or waste bag' in your sampling pack and, return all waste with you for safe disposal.

9. If available, mark the sampling location with a buoy.

10. If using a flotation/buoy device, attach laminated signage with information about the sampling and contact details to the buoy or sampling rope anchor point with a cable tie.

11. Take photographs during the sampling and MPT installation, including of the sampling site.

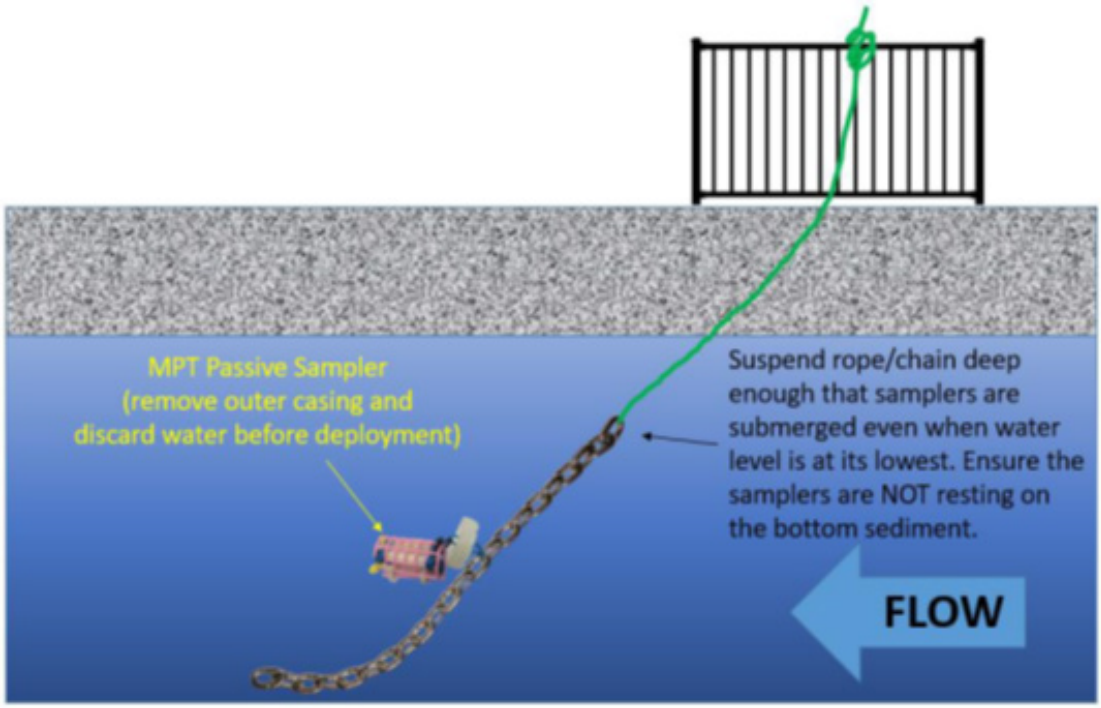


Figure 2. *Deployment scheme showing the rope and chain with attached MPT passive samplers. Make sure samplers are deployed in a position where they will be continuously submerged*

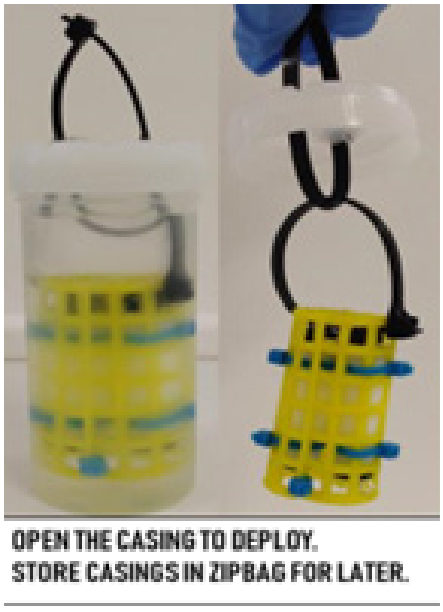


Figure 3. *MPT passive samplers deployed.*
In yellow deployment mesh inside the plastic deployment container (left) and removed from the plastic container (right) for deployment

2.5. Instructions for retrieval of MPT passive samplers

1. Wear provided powder PFASs-free gloves when handling samplers. Please DO NOT wear hand lotions, perfumes, insect repellent or powdered gloves. Suitable gloves are provided with your field kit.

2. Ensure you have the appropriate deployment container/cooler bag when retrieving samplers.

3. Remove the rope/chain containing samplers from the water, shaking to remove excess water and adhering suspended solids.

4. Cut or remove the passive samplers off the rope/chain.

5. Place the passive sampler device back into the LABELLED passive sampling container with ice bricks and/or store them in a cold room or freezer until transport to the laboratory for extraction and analysis.

6. Field blank MPT passive samplers should be sent to the laboratory for analysis alongside deployed samplers.

7. Record retrieval time and date on the sampling information form.

8. Take another photograph of the samples post deployment.

9. Place the bagged and labelled ropes/chains in bag for disposal/re-use.

10. Collect all sampling equipment and place any sampling waste (loose tubing, cable ties, ropes/chains, used gloves etc.) in the 'Biohazard / waste bag' in your sampling pack and return all waste with you for safe disposal.

11. Make sure the site is left clean with no waste items left behind.

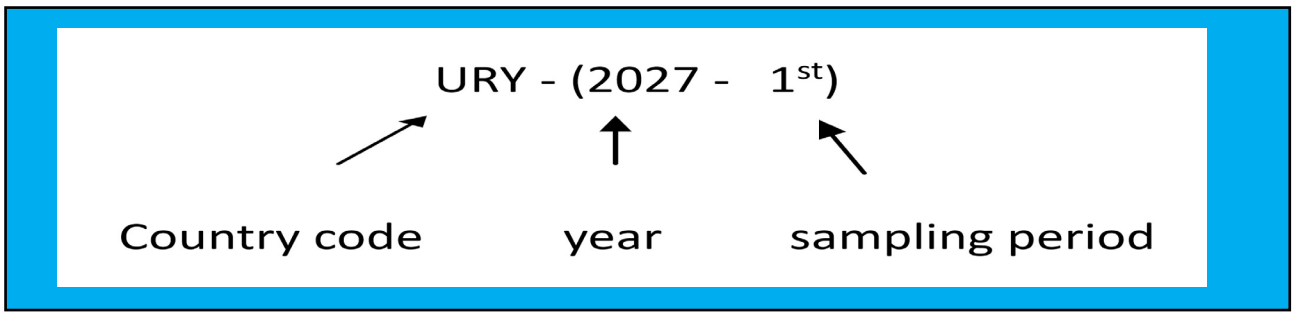
2.6. Identification of samplers

All MPT passive samplers will be assigned a unique identifier. The lettering and numbering system for the MPT passive samplers is based on the labelling system used for the air samplers.

In order to properly identify the samplers, a UNEP code format has been defined, consisting of a combination of letters and numbers that unequivocally identifies: the country where the samplers are deployed, the sampling year, as well as the sampling period within that year.

Accordingly, a UNEP code format is composed of a three-letter country code, followed by a hyphen, followed by the sampling year and period in parentheses.

An example of identification code format:



The first set of three letters corresponds to the country's abbreviation according to ISO code used by the UN (see http://unstats.un.org/unsd/methods/m49/m49alpha.htm).

The number after the hyphen corresponds to the sampling year and period. The sampler will remain at the sampling site for a period of six months.

3. STORAGE, PACKAGING AND SHIPMENT

The ziplock bags containing the MPT water passive samplers are to be stored in a freezer at the national laboratories until analysis or shipment to the corresponding laboratory for analysis.

The shipment modalities shall be agreed upon in close cooperation between the country and the regional/international laboratory responsible for the analysis.

4. DOCUMENTATION

An MS Excel file is provided to document each sampling event. The MS Excel file - named "GCMP" - contains the worksheet and information: "Georeferences".

This worksheet provides a summary of all information related to the location and conditions of the sampling sites:

Country name:	Full name and ISO_3 code
Site/Location:	Short name assigned
Address:	Physical address
Water type:	Surface seawater-ocean, surface water–lake, surface water–river
GPS coordinates:	Degrees (latitude and longitude) and decimal values (latitude and longitude)
Narrative:	Brief narrative description of the location and its surroundings, and any other important observation about the site or sampling devices.
Institution responsible:	Name of the institution undertaking the sampling.
Photo:	Please insert a photograph of the sampling site.

5. REFERENCES

Baabish, A., Sobhanei, S., Fiedler, H. (2021). Priority perfluoroalkyl substances in surface waters - A snapshot survey from 22 developing countries. *Chemosphere* 273. https://doi.org/10.1016/j.chemosphere.2021.129612.

Dunn, M., Becanova, J., Snook, J., Ruyle, B., Lohmann, R. (2023). Calibration of Perfluorinated Alkyl Acid Uptake Rates by a Tube Passive Sampler in Water. *ACS ES&T Water.* https://pubs.acs.org/doi/10.1021/acsestwater.2c00384?ref=PDF.

Gardiner, C., Robuck, A., Becanova, J., Cantwell, M., Kaserzon, S., Katz, D. et al. (2022). Field Validation of a Novel Passive Sampler for Dissolved PFAS in Surface Waters. *Environmental Toxicology and Chemistry* 41(10), 2375–2385. https://doi.org/10.1002/etc.543.

Kaserzon, S., Vijayasarathy, S., Bräuning, J., Mueller, L., Hawker, D., Thomas, K. et al. (2019). Calibration and validation of a novel passive sampling device for the time integrative monitoring of per- and polyfluoroalkyl substances (PFASs) and precursors in contaminated groundwater. *Journal of Hazardous Materials* 366, 423-431. https://doi.org/10.1016/j.jhazmat.2018.12.010.

United National Environment Programme [UNEP] and Secretariat of the Stockholm Convention (2025). *Guidance on the Global Monitoring Plan for Persistent Organic Pollutants*. https://chm.pops.int/Portals/0/download.aspx?d=UNEP-POPS-Guidance-GMP-POPs-Jan2025.En.docx.

Weiss, J., de Boer, J., Berger, U., Muir, D., Ruan, T., Torre, A., et al. (2015). *PFAS analysis in water for the Global Monitoring Plan of the Stockholm Convention Set-up and guidelines for monitoring. United Nations Environment Programme.* https://wedocs.unep.org/handle/20.500.11822/29682.

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