SERDP

TECHNICAL GUIDANCE

Technology Guidance for Sentinel™ Passive PFAS Samplers

Osorb® Media Use in PFAS Passive Samplers

Craig Divine
Arcadis

Paul Edmiston
College of Wooster

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SERDP Project ER20-1127

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Arcadis

Paul Edmiston
College of Wooster

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14. ABSTRACT
This Technology Guidance and procedures memo describes the collection of surface water and groundwater samples using a new passive sampling device being developed for per- and polyfluoroalkyl substances (PFAS) in environmental waters.

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TECHNICAL GUIDANCE

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ACRONYMS AND ABBREVIATIONS

COC	Chain-of-custody
DER	Department of Environment Regulation
DI	Distilled or deionized
DO	Dissolved oxygen
FID	Flame ionization detector
HDPE	high-density polyethylene
IDW	Investigation-derived waste
NAPL	Non-aqueous phase liquid
ng/L	nanograms per liter
NHDES	New Hampshire Department of Environmental Services
PFAS	Per- and Polyfluoroalkyl Substances
PFBA	Perfluorobutanoic acid
PFC	Perfluorinated Compound
PFD	Personal flotation device
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PFPeA	Perfluoropentanoic acid
PID	Photoionization detector
PPE	Personal protective equipment
PVC	Polyvinyl chloride
ORP	Oxidation-reduction potential
QC	Quality control
SERDP	Strategic Environmental Research and Development Program
SSHP	Site Safety and Health Plan
TGI	Technical Guidance Instructions

Osorb Passive Sampler Sampling Instructions

1.0 INTRODUCTION

This Technology Guidance and procedures memo describes the collection of surface water and groundwater samples using a new passive sampling device being developed for per- and polyfluoroalkyl substances (PFAS) in environmental waters.

2.0 TECHNOLOGY DESCRIPTION

Arcadis and the College of Wooster have developed a passive sampling device (named the Sentinel™) for PFAS under the Department of Defense Strategic Environmental Research and Development Program (SERDP) project ER20-1127. The sampler design is simple and robust, using an organosilica resin modified with cross-linked amine polymer in a high-density polyethylene (HDPE) housing with polypropylene mesh. Addition of amine groups as a weak ion-exchange resin in combination with Cu^{2+} was designed to promote binding of short-chain PFAS compounds. Passive sampler uptake rates were relatively constant in laboratory tests even under condition of extreme ionic strength and natural organic matter concentrations, indicating potential applicability to a wide range of environmental water types. Integrative performance for most analytes showed a linear response to concentration with time (except for perfluorobutanoic acid [PFBA] and perfluoropentanoic acid [PFPeA]), which simplifies calculation of aqueous concentrations. Sampling times as short as 3 days were necessary to reach limits-of-detection <70 nanograms per liter (ng/L) for perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS).

3.0 PASSIVE SAMPLER CONSTRUCTION

The passive sampler body is constructed of 2 mm HDPE with a 1 cm through-hole (**Figure 1**). Adsorbent (60 mg) is placed between the 98 x 98 polypropylene mesh screens which were heat welded onto the opposite faces of HDPE using a thin ring of HDPE plastic. The adsorbent is pre-wetted with glycerol allowing the samplers to be placed in the environmental water without any pre-treatment steps. The 250 µm particle size of Cu(II)-PEI-SOMS allows the resin to be retained within open mesh screens thus providing direct contact of the resin with water. Samplers have two 1/4”-threaded attachment points. The sampler is sized and tapered at one end to fit into a standard 50 mL centrifuge tube, allowing minimal handling during sample collection, transport, and analysis. If removal of the adsorbent resin is needed, the mesh windows snap off by forcefully bending the sampler by hand.

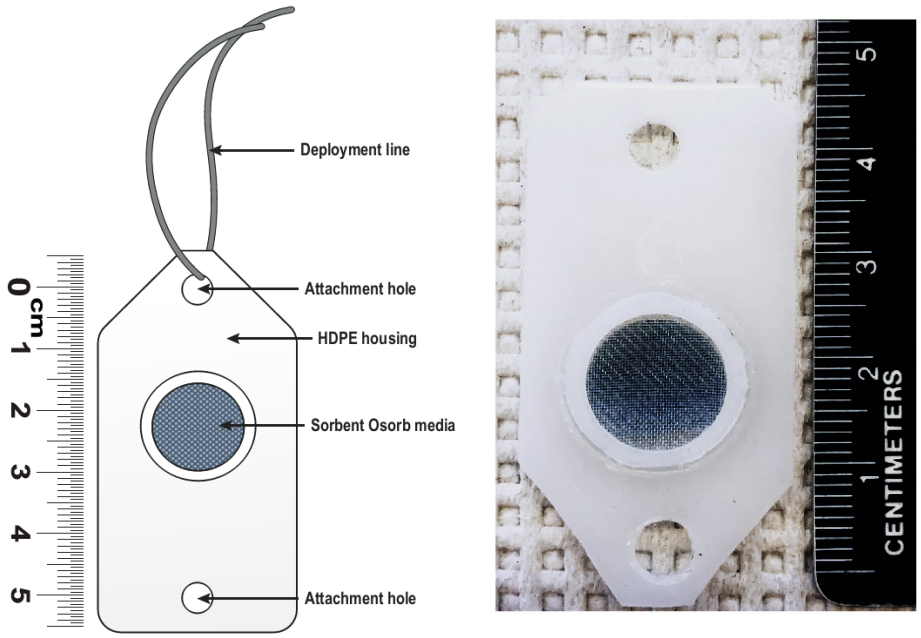

Figure 1. Schematic (Left) and Photograph (Right) of the PFAS Passive Sampler

4.0 SCOPE AND APPLICATION

The general procedures to follow in obtaining surface water and groundwater samples are outlined below. The intent of this Technology Guidance and procedures memo is to provide instructions for use of the passive sampler. The procedure must be revised based upon input obtained during field use and compiled with additional guidance instructions for collection of samples from other types of environmental waters. The procedures cover specific considerations for PFAS due to their unique chemical and physical properties, low detection limits, and regulatory standards. This procedure may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to the procedure must be approved in advance by the project team leaders.

5.0 PERSONNEL QUALIFICATIONS

All field personnel must have appropriate training as described in the project Site Safety and Health Plan (SSHP). Field sampling personnel must be trained in proper sampling procedures, under the guidance of an experienced field geologist, engineer, or technician. Field sampling personnel must also be versed in the relevant technical guidance instructions (TGI) and standard operating procedures necessary to successfully complete the desired field work.

6.0 EQUIPMENT LIST

The following materials must be available, during sampling. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

6.1 GENERAL SAMPLING DOCUMENTATION

- Approved site-specific work plan (e.g., Programmatic Quality Assurance Project Plan, field implementation plan, field sampling plan, or field work order)
- SSHP; personal protective equipment (PPE), as required by the site SSHP and task-specific Job Safety Analysis
- Site plan with proposed sampling locations
- Planned sample table
- Field notebook that is not waterproof and/or smart device (phone or tablet)
- Passive sampler-specific field forms (see **Attachments 1** and **2**)

6.2 GROUNDWATER SAMPLING EQUIPMENT AND DOCUMENTATION

- Planned sample table for groundwater identifying:
  - Deployment locations/depths
  - Well construction details (including well screen intervals)
- Well keys and other tools to remove service covers (manual torque wrench with 9/16" socket and flat head screwdriver typical)
- Photoionization detector (PID) or Flame ionization detector (FID) (as appropriate, depending on site-specific constituents of concern)
- PFAS-free electronic water-level indicator or oil/water interface probe with 0.01-foot accuracy (oil/water as appropriate; note that sampling will not be performed when sheen or light non-aqueous phase liquid is present)
- Down-hole multiparameter sonde (e.g., YSI 6-Series Multi-Parameter Instrument water quality meter for monitoring pH, temperature, conductivity, oxidation-reduction potential [ORP], dissolved oxygen [DO])
  - Appropriate length cable for downhole YSI, to reach desired screen interval
  - Optional: supplemental turbidity meter (if purge-based samples are also being collected)
- HDPE plastic sheeting to protect all down-hole sampling equipment from contact with potential sources of contamination
- 150-foot measuring tape (or sufficient length for the maximum site depth requirement)
- Nitrile gloves

6.3 MATERIALS FOR SECURING PASSIVE SAMPLER IN MONITORING WELL

- Well cap with loop (e.g., J-plug style) to attach sampler suspension line

- 1/8-inch diameter or narrower nylon twine (for suspending sampler). Polypropylene twine may be used if preferred by project; however, polypropylene is more buoyant than nylon and may require additional sample weights.
- Weights (stainless steel screws, sampling weights, or other inert material) to anchor the passive sampler
- Optional: Stainless steel, HDPE, or nylon cable ties to secure passive sampler/ suspension line assembly. Note: passive sampler is very light and well-tied knots are acceptable to secure it.
- 150-foot measuring tape (or sufficient length for the maximum site depth requirement)
- Safety cutting tool (e.g., self-retracting safety knife)
- Nitrile gloves

6.4 PASSIVE SAMPLER EQUIPMENT FOR DEPLOYMENT IN SURFACE WATER

- Passive samplers (supplied by the laboratory in conical centrifuge tubes; label tube upon deployment and return to laboratory in the same centrifuge tube)
- YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO
- Supplemental turbidity meter
- Stainless-steel probe rod—for evaluating bottom softness when wading to sampling locations
- Tape measure
- Stainless steel, polyvinyl chloride (PVC) or HDPE yard stick for measuring water depth
- Rubber boots or rubber waders (only non-coated rubber, other more high-tech waterproof material is not permitted)
- Life jacket or other personal flotation device (PFD) as necessary based on water depth (note, these will likely have PFAS-containing materials so be careful to avoid cross-contamination when using)
- Weight (e.g., concrete block, HPDE container with sand)
- Wooden or metal stakes
- Wire to wrap around concrete block or stake (attachment point for sampler)
- HDPE or metal zip ties (nylon zip ties will be allowed depending on site-specific requirements) to attach sampler
- PFAS-free twine/rope
  - Nylon (depending on site-specific requirements) or polypropylene twine/rope
- PFAS-free flotation materials (e.g., HDPE fishing bobber, cork, etc.)
- Cutting device (e.g., scissors)
- Nitrile gloves

6.5 PASSIVE SAMPLER EQUIPMENT FOR COLLECTION IN SURFACE WATER

- YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO
- Supplemental turbidity meter
- Stainless-steel probe rod—for evaluating bottom softness when wading to sampling locations
- Tape measure
- Stainless steel PVC or HDPE yard stick for measuring water depth
- Rubber boots or rubber waders (only non-coated rubber, other more high-tech waterproof material is not permitted)
- Life jacket or other PFD as necessary based on water depth (note, these will likely have PFAS-containing materials so need to be careful to avoid cross-contamination when using) Cutting device (e.g., scissors)
- Ziploc® brand bags to hold ice and samples
- Bottles containing "PFAS-free" water used for field blanks
- Appropriate blanks (bottles for rinse blanks)
- Packing and shipping materials
- Chain-of-Custody (COC) Forms
- Appropriate transport containers (coolers) with ice and appropriate labeling, no blue ice
- Nitrile gloves

6.6 DECONTAMINATION/WATER MANAGEMENT

- PFAS-free decontamination fluids and equipment
- Distilled or deionized (DI) water for initial decontamination rinsing
- Laboratory-provided PFAS-free water for final decontamination rinsing
- HDPE or PVC brushes and squirt bottles
- Stainless steel bowl
- HPDE buckets to hold decontamination fluids
- Alconox® or Liquinox® (other detergents are prohibited)
- Portable field hand washing setup
- Non-hazardous drum labels as required for investigation-derived waste handling
- Nitrile gloves

6.7 FIELD NOTES

- Pens, pencils, and/or fine/ultra-fine Sharpies® for writing
- Appropriate field forms
- Clipboards, field binders, field notebook, and field note pages that are NOT waterproof
- Digital camera

6.8 OTHER

- Garbage bags
- Paper towels
- Packing tape
- Dedicated HDPE plastic sheeting to prevent sample contact with the ground
- Field clothing made of cotton or other natural fibers that is well laundered (i.e., washed at least 5 times)
- PFAS-free sunscreen and insect repellant

7.0 CAUTIONS

This section provides a summary of methods and procedures applicable to the collection of environmental samples for field screening or laboratory analysis during PFAS site characterization activities. In general, sampling techniques used for PFAS site characterization are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. For example, Teflon™ and other fluoropolymer containing materials are found in pumps, tubing, and sample storage containers and therefore should be avoided if possible (Department of Environment Regulation [DER], Western Australia 2016; New Hampshire Department of Environmental Services [NHDES] 2016). Certain field documentation materials such as waterproof paper or field books, adhesive paper products, and some writing utensils (grouped as non-Sharpie® markers) are also prohibited items during PFAS sampling (DER 2016; NHDES 2016).

New nitrile gloves should be donned before any of the following activities:

- Decontamination of re-usable sampling equipment
- Contact with sample containers or PFAS-free water bottles
- Handling quality control (QC) samples including field blanks and equipment blanks

Additionally, new nitrile gloves should also be donned after handling of any non-dedicated sampling equipment; contact with contaminated surfaces; and whenever judged necessary by field personnel. When in doubt change your gloves. Waterproof field books must not be used for field notes. Instead, field notes should be on loose paper on Masonite, plastic, or aluminum clip boards. Other requirements for field notes include:

- Keep field notes, writing implements, and electronic data collection tablets away from samples and sampling materials
- Do not write on sampling bottles unless they are closed

The potential presence of PFAS in equipment that may come in contact with the target water sample must be evaluated as part of the sample planning process to maintain sample integrity.

While permissible during fog or intermittent showers, surface water samples should not be collected during steady, prolonged rainfall. If accessing the sample location from water, approach slowly from downstream to avoid disturbing the bottom.

When deploying samplers using weights (e.g., concrete blocks) at surface water bottom, take care to minimize sediment disturbance during placement. Avoid entraining sediment in sample container upon retrieval of sampler. Gently shake gross sediment from sampler housing, and/or rinse with PFAS-free DI water prior to placing into centrifuge tubes for shipment.

8.0 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with surface water sampling will be performed in accordance with a site-specific SSHP, a copy of which will be present on site during such activities.

8.1 GROUNDWATER SAMPLING

Access to wells may expose field personnel to hazardous materials such as contaminated groundwater or non-aqueous phase liquid (NAPL) (e.g., oil). Other potential hazards include pressurized wells, stinging insects that may inhabit well heads, other biologic hazards (e.g., ticks in long grass/weeds around well head), and potentially the use of sharp cutting tools (scissors, knife)—open well caps slowly and keep face and body away to allow to vent any built-up pressure; only use non-toxic peppermint oil spray for stinging insect nests; review client-specific health and safety requirements, which may preclude the use of fixed/folding-blade knives, and use appropriate hand protection.

Deploying and retrieving passive samplers and field meters requires staff to lower and raise materials into and out of the monitoring well. Be sure to use proper bending and lifting techniques to avoid muscle strain and other potential injuries.

8.2 SURFACE WATER SAMPLING

It is assumed a boat will not be used to access surface sampling points.

- Walk established paths whenever possible to avoid slip/trip hazards. Take your time and watch your footing.
- A PFD may be required to complete surface water sampling.
- Always have three points of contact when entering and exiting a stream channel, if necessary.
- Do not touch sediments with bare hands or detect odors by placing sediments close to your nose.
- STOP WORK when conditions change or become unsafe and discuss if/how to proceed safely before resuming work.

8.3 MOBILIZATION AND PREPARATION FOR GROUNDWATER

- Don appropriate PPE.
- All equipment must be either new or decontaminated prior to use.
- Calibrate field meters (e.g., water-level meter, down-hole sonde [pH, temperature, conductivity, ORP, and DO], and turbidimeter) according to the instrument manufacturer's specifications.

  - Daily calibration results must be recorded on the appropriate form(s) as specified by the field work plan.
  - Instruments that cannot be calibrated according to the manufacturer's specifications must be removed from service and tagged.
- Visually inspect the well to ensure that it is undamaged, properly labeled, and secured.
  - Damage or other conditions that may affect the integrity of the well must be recorded in the Field Activity Daily Log and brought to the attention of the designated Field Manager and/or Project Manager.
  - Note well construction and conditions on the passive sampler field form (**Attachment 1**).
- Lay out plastic sheeting to create a clean work area and set up monitoring and sampling equipment.
- Observe if any air is flowing into or out of the casing (e.g., bubbles, hissing sounds); if so, note accordingly on the passive sampler field form (**Attachment 1**).
- Safely (slowly) remove the well cap.
- If specified in the site-specific workplan, measure volatile organic compounds at the rim of the well with a PID and FID instrument record the reading in the field logbook. Also, measure the breathing space adjacent to the well and check any measurements against the SSHP guidelines to be sure conditions are safe to work.
- If the well casing does not have a reference point to measure from, usually a V-cut or indelible mark in the well casing, create one and perform/record all measurements from this mark.
- If specified in the site-specific workplan, determine if NAPL is present in the well using an oil/water interface probe in accordance with appropriate TGI.
  - If NAPL is present, record the depth to NAPL and static water level on the passive sampler field form (**Attachment 1**).
  - Passive samplers will not be deployed, and samples must not be collected from wells where NAPL is present.
- Measure and record the depth to water and the total depth of the groundwater monitoring well (to 0.01 ft) on the passive sampler field form—care must be taken to minimize disturbance of the water column and to any particulates attached to the sides or at the bottom of the well.
  - Compare the measurement of the total depth of the well with the previous measurement and check against the well screen details provided in the field workplan and/or planned sample table to determine the percent of screen occluded by sediment (if any).
  - If more than 20 percent of a well screen is occluded by sediment, consult with the project manager/field manager before proceeding with sampling.
- Determine the midpoint of the saturated screened interval and record on the passive sampler field form. This is the target deployment depth for the passive sampler.
- Collect and record field parameters using a multiparameter down-hole sonde (e.g., YSI).

8.4 PASSIVE SAMPLER PROCEDURE FOR DEPLOYMENT IN GROUNDWATER

- Don appropriate PPE, including nitrile gloves, while assembling and deploying sampler.
- Remove passive sampler from centrifuge tube (shipping container). Immediately replace cap. (Do not place the cap on any surface; do not touch the inside of the cap.)
- Avoid touching the mesh portion of the sampler behind which the sorbent is contained.
- Attach deployment line to one of the threaded holes in the passive sampler housing either directly (using knots) or a combination of knots and zip-tie.
- Attach a weight (e.g., stainless steel screw) to the second threaded hole in the passive sampler housing.
- If collecting multiple passive samplers from the same location (duplicates, or samplers deployed for varying time periods), the passive samplers may be connected together using zip-ties, with a weight attached to the lowest sampler in the series.
- Record sample ID, deployment date/time, and deployment depth on field form. Note that deployment date and time are important to record, as the deployment duration is needed to calculate the concentrations in water, based on the mass sorbed to the sampler.
- Take a photograph of the sampler deployment.
- Attach the deployment line to well cap loop (using knots and zip-ties as preferred) and secure well vault.
- Collect 1 equipment blank from each piece of sampler attachment equipment (e.g., sampler, twine/wire, etc.) in between deployments and indicate the type of equipment on the field form.

8.5 PASSIVE SAMPLER PROCEDURE FOR RETRIEVAL IN GROUNDWATER

- Collect samples in order from least impacted to most impacted, if known.
- Perform preliminary tasks detailed above; however, measure depth to groundwater prior to retrieval of the passive sampler while total well depth must be collected after the passive sampler has been retrieved from the well.
- Don fresh set of nitrile gloves immediately prior to collecting passive samplers.
- Label the centrifuge tube with sample ID, with the cap closed.
- Gently pull deployment line upwards and retrieve passive sampler; snip off knot and/or cable tie attaching sampler, using appropriate cutting tool (e.g., scissors).
- Photograph passive sampler at retrieval.
- If passive sampler housing contains gross sediment, shake manually, and gently rinse with PFAS-free DI water from wash bottle. Contain rinse water in pail with lid and dispose with decontamination fluids. Note on field form if significant sediment was observed on passive sampler housing during retrieval.
- Open pre-labeled centrifuge tube, emplace passive sampler with tapered end at bottom of tube, and close lid. Do not touch inside of lid.
- If passive samplers deployed in series are being returned to well, remember to reattach weight to the last (deepest) sampler in the series.

- Remove deployment line from well cap and dispose with investigation-derived waste (IDW) (unless dedicated reuse in the same well is desired; line should be decontaminated prior to return to well). Stainless steel weights may be decontaminated and reused.
- Collect one field blank per sampling week.

Figure 2. Depicts the passive sampler deployed in groundwater well.

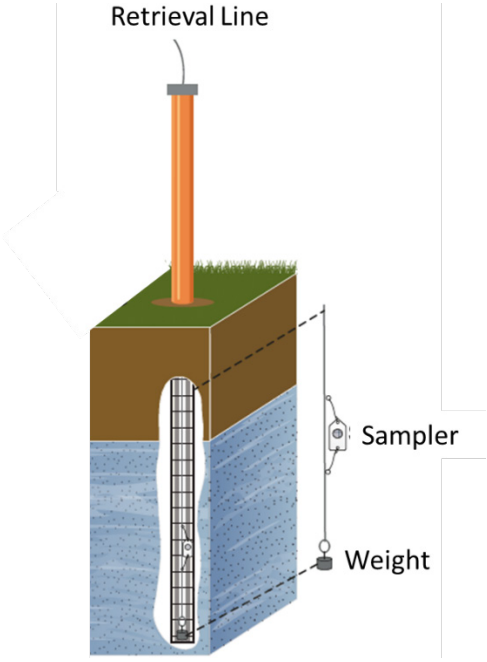

Figure 2. Depiction of Passive Sampler Deployed in a Groundwater Well.

8.6 MOBILIZATION AND PREPARATION FOR SURFACE WATER

- Don appropriate PPE.
- Verify all dedicated sample gear has been properly decontaminated.
- Mobilize to sampling location. If accessing by wading, approach slowly from a downstream direction to limit disturbance of the bottom and resulting suspension of sediment into the surface water at sampling location.
- Identify the proposed sample location in the field notebook along with other appropriate information (e.g., location, date, time, personnel, weather).
- Measure and record water depth at the sampling location.
- Assess whether proposed deployment method is feasible at the location (see below).
- Measure and record water quality parameters in the field log.
- Do not sample surface water when it is raining. Fog or intermittent showers are okay, but not steady rainfall.

8.7 PASSIVE SAMPLER PROCEDURE FOR DEPLOYMENT IN SURFACE WATER

- Place plastic sheeting in work area.
- Don nitrile gloves while assembling and emplacing sampler in stream. Use nitrile glove with long cuff that covers the forearm, as this will help avoid submerging clothing or skin during sampling.
- Wrap metal wire or polypropylene twine around and through concrete block (weight). Wire is recommended for turbulent water with suspended bed load and/or coarse debris.
- Remove passive sampler from centrifuge tube. Immediately replace cap (do not place the cap on any surface; do not touch the inside of the cap).
- Avoid touching the mesh portion of the sampler behind which the sorbent is contained.
- Place an HDPE zip-tie through one of the holes at end of passive sampler housing. Attach the zip-tie securely through the cord/wire wrapped around the block.
- Facing the upstream direction, place the concrete block such that the passive sampler attachment point is submerged below the water surface and in a zone of flowing water (if surface water is flowing). A second zip-tie can be used if needed to secure the sampler.
- An alternate attachment option is to drive a stake into the streambed and attach sampler with wire or zip-tie, such that the passive sampler attachment point is submerged below the water surface and in a zone of flowing water.
- Do not submerge hands below top of gloves during sampling such that clothing or bare skin of sampling personnel comes into contact with the surface water.
- If collecting multiple passive samplers from the same location (duplicates, or samplers deployed for varying time periods), a second sampler may be attached to the same concrete block or stake as long as the samplers do not touch each other.
- Record sample ID, deployment time, and deployment depth on field form.
- Take a photograph of each sampler deployment.
- Store the centrifuge tube labeled with sample ID in clean Ziploc bag until sampler retrieval.
- Collect 1 equipment blank from each piece of sampler attachment equipment (e.g., sampler, twine/wire, etc.) in between deployments and indicate the type of equipment on the field form.
  - Note, if using waders to access sampling locations, collect equipment blank from the waders.

8.8 PASSIVE SAMPLER PROCEDURE FOR RETRIEVAL IN SURFACE WATER

- Collect samples in order from downstream to upstream.
- Don fresh set of nitrile gloves. Use nitrile glove with long cuff that covers the forearm, as this will help avoid submerging clothing or skin during sampling.
- Measure and record water depth on field form.
- Photograph sampler deployed in stream at each location.
- Measure and record water quality parameters on sampling forms.

  - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.
  - Use supplemental turbidity meter to measure turbidity.
- Don fresh set of nitrile gloves immediately prior to collecting passive samplers.
- Label the centrifuge tube with sample ID, with the cap closed.
- Facing the upstream direction (if the surface water body is flowing), access the sample location, and snip off cable tie attaching sampler, using appropriate cutting tool (e.g., scissors).
- Do not submerge hands below top of gloves during sampling such that clothing or bare skin of sampling personnel comes into contact with the surface water.
- If passive sampler housing contains gross sediment, shake manually, and gently rinse with PFAS-free DI water from wash bottle. Contain rinse water in pail with lid and dispose with decontamination fluids.
- Open pre-labeled centrifuge tube, emplace passive sampler with tapered end at bottom of tube, and close lid. Do not touch inside of lid.
- Collect one field blank (PFAS-free water poured into sample bottle) during the sampling week.

Figure 3. Depicts the passive sampler deployed in an example surface water location.

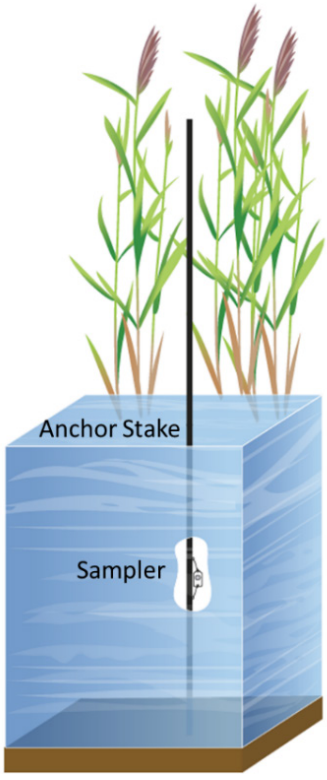

Figure 3. Depiction of Passive Sampler Deployed in an Example Surface Water Location.

9.0 LABORATORY SAMPLE MANAGEMENT, POST-SAMPLING

- Once the passive sampler has been placed in the tube, and the cap has been completely tightened, complete the label ID with sample ID, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle.
- Recommended QC samples consist of the following:
  - 1 field duplicate for every 10 passive samples.
  - 1 equipment blank from each piece of sampler attachment equipment (e.g., sampler, twine/ wire, etc.).
    - Note, if using waders to access sampling locations, collect equipment blank from the waders.
  - 1 field blank per week, consisting of PFAS-free DI water poured into clean bottle.
  - 1 trip blank, which will be a passive sampler that accompanies the other samples (passive sampler that comes to site, held in air a few minutes, returned to tube and shipped back to the lab).
- Record the label information and time of sampling in the field notes and sampling forms.
- Fill out the laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
- Place sample tubes in a sealed Ziploc® bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.

10.0 WASTE MANAGEMENT

Handling of IDW should follow client and/or state guidelines.

11.0 DATA RECORDING AND MANAGEMENT

The supervising field lead will be responsible for documenting sampling events to record all relevant information in a clear and concise format. The record of sampling events should include:

- Sample dates and times
- Project name and location
- Project number, client, and site location
- Sampling details (e.g., field measured water quality parameters, standing water column depth)
- Type of tools used
- Weather conditions

Field staff should ensure COC Forms are properly completed.

12.0 DECONTAMINATION

To avoid cross-contamination during sampling, all reusable sampling equipment will be cleaned between sampling locations as follows. Repeat these steps twice at all locations suspected of containing a Class B firefighting foam source.

- Don new pair of nitrile gloves prior to decontamination.
- Rinse sampling equipment with Alconox or Liquinox® cleaning solution; scrub equipment with a plastic brush if needed.
- Rinse two times with distilled water or DI water.
- Rinse one time with "PFAS-free" water or once with methanol/isopropanol/acetone, if it is available, and once with "PFAS-free" water; organic solvents are especially useful for decontaminating soil sampling equipment. If organic cleaning solvents cannot be brought to site, scrub equipment a second time after a single distilled or DI water rinse, then rinse two times with distilled or DI water and once with "PFAS-free" water (i.e., two scrubbings and four water rinsings total).
- Collect all rinsate in a sealed pail for disposal. Do not reuse decontamination solutions between sampling locations.
- Allow time to air dry prior to re-use.

13.0 WOOSTER - ARCADIS SENTINEL™ PASSIVE SAMPLER EXTRACTION PROCEDURE

Passive samplers can be stored at 4°C until analysis until analysis. Samplers are typically processed within 2 weeks of delivery. Please see procedure below and reference the associated notes and diagram of the extraction process **(Figure 2)**.

13.1 PROCEDURE

1. (***Rinse***) The sampler is rinsed with PFAS-free DI water to remove debris from sampling. Rinsing can be done in a tube with rapid shaking or under a constant flow of water.[1-3]
2. (***Surrogate Adsorption***) The sampler is placed in a 50 mL conical centrifuge tube (i.e., Falcon™ tube[4]) along with 15 mL of DI water containing isotopically labeled surrogates (50 ng each). The tube is placed at an angle on its side (approximately 20 degrees) on a platform shaker ensuring the adsorbent is submerged. The tube with sampler is shaken for 7-8 hours.
3. (***Dry***) The sampler is removed from surrogate solution. Residual surrogate solution is removed by centrifugation of the sampler at 1,500 rpm (20 seconds) in a new 50 mL centrifuge tube.
4. (***Extraction***) The sampler is placed in 50 mL centrifuge tube containing 20 mL of methanol with 2% NH4OH. The tube is placed at an angle on its side on a platform shaker and mixed for 4 hours to extract bound PFAS and surrogates at room temperature.[5]
5. The sampler is removed from the methanol solution and placed in a new 50 mL centrifuge tube and centrifuged for 20 seconds at 1,500 rpm to spin down residual methanol. The methanol recovered by centrifugation is combined with the extraction solution.

6. (***Evaporation and Reconstitution***) The methanol/ NH4OH is evaporated to dryness under nitrogen. Residue is reconstituted in 1.00 mL of methanol containing internal standards.
7. [Optional] The reconstituted solution is centrifuged in 1.5 mL centrifuge tube at 14,000 rpm to remove particulates prior to HPLC-MS/MS.

Notes:

(1) Adsorbent in new samplers is shipped with 50% glycerol wetting the resin. If a sampler has not been used (ex. Field Blank), the sampler should be stored in 50 mL of DI water for 24 hours to remove glycerol. The DI water can be replaced at intervals to help fully remove glycerol. Removal of glycerol improves the binding of surrogates.

(2) [Optional]. To access the resin inside the passive sampler, the sampler can be bent snapping open one of the heat-welded mesh windows. Resin removal may be useful for alternative processing methods. Note: In the Wooster lab, all processing steps are done with resin maintained in the passive sampler.

(3) In extreme cases, the plastic housing of some passive samplers returned from the field is stained or coated with residues that are difficult to remove by water rinse. In such cases a KimWipe is generally successful in removing residues.

(4) Samplers are tapered on one end to fit into the bottom of a standard 50 mL centrifuge tube.

(5) The procedure can be paused at the methanol extraction step.

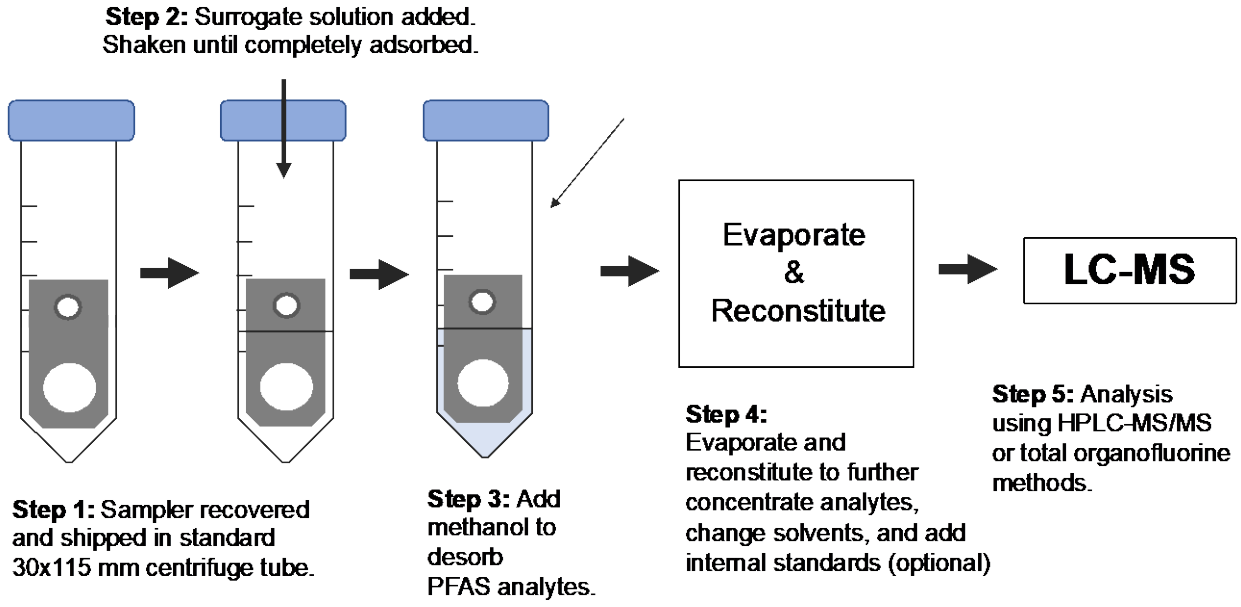

Figure 4. Diagram of the Extraction Process.

14.0 PASSIVE SAMPLER – CONVERTING MASS ADSORBED TO THE PFAS CONCENTRATION IN WATER

The accumulated mass (ng) recovered from the passive sampler is converted to the aqueous phase concentration, *C*w (ng/L), using the following equation.

$$C_w = \frac{accumulated\ mass}{R_s \times t}$$

where *R*s is the sampling rate (L/day) and *t* is the sampling time in days. Sampling rates were experimentally determined in bench-scale measurements and vary according to flow rate and temperature (see table below).

If the temperature of the water is cold (4-10°C) first multiply the *R*s value by the multiplier.

PFAS	*R*s (L/day) Temp = 10-25°C		*R*s Multiplier Temp = 4-10°C
	Monitoring Well	Flowing Stream	
4:2 FTS	0.012	0.060	0.45
6:2 FTS	0.012	0.060	0.45
8:2 FTS	0.012	0.060	0.45
HFPO-DA	0.012	0.060	0.45
PFOSA	0.012	0.060	0.45
PFBA	0.0033	0.012	1.0
PFPeA	0.0063	0.017	0.86
PFHxA	0.0093	0.051	0.67
PFHpA	0.0112	0.061	0.50
PFOA	0.0124	0.065	0.45
PFNA	0.0131	0.068	0.50
PFDA	0.0131	0.068	0.50
PFUdA	0.0124	0.065	0.45
PFDoA	0.0124	0.060	0.45
PFTrDA	0.012	0.060	0.45
PFTeDA	0.0012	0.060	0.45
PFBS	0.0121	0.055	0.45
PFHxS	0.0150	0.070	0.45
PFOS	0.0125	0.065	0.45

Notes:

1. Well = flow rate 0-2 cm/min

2. Stream = flow rate >2 cm/min

15.0 REFERENCES

Department of Environment Regulation (DER). Government of Western Australia. 2016. Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Contaminated Sites Guidelines. February.

New Hampshire Department of Environmental Services (NHDES). 2016. Perfluorinated Compound (PFC) Sample Collection Guidance. November.

16.0 ENCLOSURES:

Attachment 1 – Field Form for Groundwater Sampling with PFAS Passive Sampler

Attachment 2 – Field Form for Surface Water Sampling with PFAS Passive Sampler

PFAS Passive Sampler Groundwater Sampling Form

Site: _____ **Field Technician: Name(s)/Company**

Location: _____ _____

Well ID: _____ _____

Well Type: ☐Monitoring ☐Other: _____

Well Finish: ☐Stick Up ☐Flush Mount

Measuring Pt (MP): ☐Top of Casing ☐Other (specify):_____

Total Depth (ft bgs): _____ **Screened Interval (ft bgs):** _____

Well Casing: Diameter: _____ Material: _____

Well Screen: Diameter: _____

Deployment

Date and Time of deployment: Date: _____ Time: _____

Weather conditions: _____

Depth to groundwater at time of deployment (below MP): _____

Sounded depth to bottom (below MP): _____

Calculated saturated screen interval thickness (ft): _____ **Calculated midpoint of saturated screen (ft below MP):** _____

Type of weight attached to sampler: _____

Retrieval

Date and Time of retrieval: Date: _____ Time: _____

Total # of days deployed: _____

Weather conditions: _____

Depth to groundwater at time of retrieval: _____

Downhole field parameters upon retrieval:

Temp:_____**(^{o}C)** **Sp. Cond.:**_____**(uS/cm)** **ORP:**_____ **(mV)** **Water quality meter:**_____

pH:_____ **Turbidity:**_____**(NTU)** **DO:**_____ **(mg/L)** **Serial #:**_____

Notes/Observations:

PFAS Passive Sampler Field Record - Surface Water

Sample ID _____ Project: _____

DESCRIPTION OF SAMPLE LOCATION: Project No.: _____

Location ID _____ Name of Water Body _____

Depth of Water: _____ Location Description _____

GPS coordinates: _____ Flow Conditions _____

_____ Substrate description _____

Photo ID: _____ Vegetation description _____

_____

Comments: _____

Sampler Deployment: _____

Date _____ Sampling Personnel _____

Time _____ _____

Weather _____ Depth of Water _____

Sampler Depth _____ Flow Conditions _____

Description of Attachment Method _____

_____

_____

Field Parameters: _____

pH _____ DO _____

Temp _____ ORP _____

Sp Cond _____ Turbidity _____

SAMPLER RETRIEVAL: _____

Date _____ Sampling Personnel _____

Time _____ _____

Weather _____ Depth of Water _____

Sampler Depth _____ Flow Conditions _____

Field Parameters: _____

pH _____ DO _____

Temp _____ ORP _____

Sp Cond _____ Turbidity _____

Comments _____

_____

_____

_____

_____

SAMPLES: Lab _____

Number	**Sample ID**	**Analysis**

TOTAL: ☐