

## Procedure for use of Dual Membrane Passive Diffusion Samplers (DMPDBs) in Groundwater Monitoring Wells

### Compounds of Concern, Sample Volume, Sampler Placement

1. Verify that the compounds of concern (COC) to be sampled are compatible with the DMPDB sampling method.
  - a. Most standard COCs may be sampled, including; VOCs, Semi-VOCs, Metals, Ions, Inorganics, 1,4 dioxane and PFAS.
2. Determine the lab minimum volume requirements for analysis of the COC and verify that the sampler selected provides at least the required volume.
  - a. Lab sample volume requirements vary by lab and method<sub>1</sub>
3. Verify that the wells to be sampled are completed with 2-inch schedule 40 or larger casing and screen or at least 2-inches in borehole diameter if completed in fractured bedrock.
4. For wells completed in unconsolidated materials with well screen, verify:
  - a. The water level before placing or removing samplers.
    - i. If the well contains DMPDBs or other passive samplers that are secured to the well cap only remove the cap far enough to allow entry of the water level probe and so the DMPDB's do not come out of the water as that will change the water level.
  - b. The intended sample zone is within the saturated portion of the well screen and,
  - c. There is an adequate saturated screen interval to accommodate a weight below the DMPDB and a minimum of 3 to 6-inches of saturated screen above the top of the DMPDB when installed at the sampling interval and,
  - d. That the sampler will remain completely submerged during groundwater fluctuation that may occur.
  - e. No portion of the DMPDB is exposed to the air or is in the casing when installed at the sample interval.
5. For wells completed in open boreholes and fractured rock, verify;
  - a. The water level before placing or removing samplers.
    - i. If the well contains DMPDBs or other passive samplers that are secured to the well cap only remove the cap far enough to allow entry of the water level probe and so the DMPDB's do not come out of the water as that will change the water level.
  - b. The intended sample zone is within the saturated portion of the well and preferably, adjacent to known cracks or fissures that may contribute water to the well,
  - c. There is water in the open borehole to accommodate a weight below the DMPDB and a minimum of 3 to 6-inches of well water above the top of the DMPDB when installed at the sampling interval and,
  - d. That the sampler will remain completely submerged during groundwater fluctuation that may occur.
  - e. No portion of the DMPDB is exposed to the air or is in the casing when installed at the sample interval.

### Sampler Locations, Number of Samplers, Profiling, Duplicates

6. For a first-time installation of passive samplers of any type, in wells with saturated sampling intervals of 10-feet or longer, AND in which there is no historical or interval related sample chemistry data, consideration should be given to installing at least two samplers to determine whether there is vertical stratification of compounds and/or concentration across the saturated screen. The information from one round of sampling using multiple samplers to profile the well can be used to select optimum sampler placement for one sampler for future events, or whether multiple intervals should be monitored in keeping with project Data Quality Objectives (DQOs).

- a. When larger well fields, with similar well construction and aquifer details are monitored, it may be sufficient to select several representative wells for profiling and use the results for selecting sampler placements across the field, rather than profile each well.
  - b. When profiling, at a minimum place one DMPDB in the upper 5-feet of the saturated screen sample interval and one in the bottom 5-feet of the saturated sample interval. Additional samplers may be installed mid-interval for more detailed profiling. It is generally accepted that *without previously obtained information about well conditions and potential contaminant stratification*, one passive sampler should not be called on to represent more than a 5-foot interval. Alternatively, known information about the well may suggest that a single sampler will accurately represent sample intervals of 20 feet or more.
7. Multiple DMPDBs may be used in a well to continuously profile the well and monitor discrete intervals.
- a. In wells where multiple DMPDBs are to be installed in series along the length of saturated screen to profile the well, verify that the criteria in #2 or #3 above are met for each DMPDB installed.
8. For wells having diameters of 2-inches or larger, duplicate samples may be obtained by placing two or more DMPDBs in series, one above the other, in the sample interval and the placement criteria in #2 or #3 above are met for all samplers. For wells having diameters of 4-inches or larger, duplicate samples may be obtained by placing two or more DMPDBs side by side at the same sample interval.

### **Suspension Tethers**

9. DMPDB samplers should be installed on a weighted suspension tether that has been configured to match the well depth, sample interval and method of attaching to the well cap at the top of the well. Tethers should be constructed of polypropylene, stainless steel or other chemically resistant material and are considered re-usable if properly constructed. Nylon is to be avoided because it absorbs water and elongates, and is often dusted with whiteners for appearance.
- a. EON provides inexpensive custom Suspension Tether manufacturing that includes weights, sampler attachment points on the tether at the selected sample interval, Well ID tags, Well Caps to which the tether is attached and a spool for winding the tether when retrieving.
  - b. For most installations, the tether is configured so that the weight is attached to the bottom of the tether and rests on the bottom of the well.
    - i. The weight should be selected to overcome the slight buoyance of samplers and the effects of friction as the DMPDBs are lowered into position.
    - ii. In most cases a minimum of 20 ounces of weight is recommended.
    - iii. Weights should be made of stainless steel.
  - c. Attachment points are typically made of small diameter stainless steel rings attached to the tether so as to be secure, on at a location for the top of the sampler and one for the bottom of the sampler, so that when the sampler is attached to both rings and the weight is resting on the well bottom, the sampler is in the designated sample interval.
  - d. DMPDB samplers are attached to the connection points using zip-ties. (see # 13 below)
  - e. Temporary or field installed attachment loops may be constructed using a short (4 to 8-inches) zip-tie, through the braid of the tether, formed into a loop about 0.50-inch diameter.
  - f. An optional Well ID tag should be attached to the tether at the location of the reference (or 0.00-ft) measuring point.

- g. The Well Cap should be fitted with a ring or “eye” screw fitted into the bottom of the cap and strong enough to hold the DMPDB samplers when installed. The top of the tether is connected to the ring on the well cap at a position that allows the bottom weight to rest on the bottom of the well with minimum slack in the line.

### **DMPDB Sampler Preparation, Filling, Installing**

10. The DMPDB sampler should be prepared for use by carefully removing it from the protective wrapper, being careful not to cut or puncture the membranes that run along the length of the sampler.
  - a. Remove the Red Cap and locate the fill kit (funnel with extension tube).
  - b. Find the small package of “juice-box” straws packaged in bulk with the DMPDB and place them in a location where they will be available when the samplers are removed from the well for sampling.
  - c. Find the small package of Zip-Ties packaged in bulk that will be used to attach the DMPDBs to the tether line during installation.
11. Rinse the funnel with deionized water and insert the extension tube into the white nozzle at the top of the sampler. The bottom of the extension tube should be at or lower than the bottom of the upper membrane which is at the location of the securing band around the sampler about 6-inches from the top of the sampler. Hold the DMPDB in the vertical orientation with the white nozzle up.
  - a. DMPDB samplers may optionally be rinsed with deionized water if protocols require, however, because the DMPDB is in residence long enough to equilibrate with the surrounding water, it is unlikely that any “incidental” contact with the environment will affect the sample representation.
  - b. For the standard DMPDB with the mesh-type upper membrane, fill the sampler with deionized water (typically ASTM Type-1) to the top of the securing band or until water starts to seep out the sampler. The upper membrane is not to be filled. (Other membrane combinations of the DMPDB may be filled to the top)
  - c. Make sure the bottom “tail” of the sampler has water in it by alternately squeezing the air out of the tail and “bouncing” the sampler slightly.
12. Holding the DMPDB around the white nozzle, place the Red Cap in the Nozzle and press it fully into the Nozzle with the palm or thumb of the hand. If that proves too difficult, use a small rubber mallet, and gently tap the cap firmly into place.
  - a. Filled samplers can be temporarily stored in an upright position using clean 5 -gallon pails or other, suitable container or hang from a tripod by the vertical strap.
13. Before installing the DMPDBs, secure the top of the tether to the well cap connection point to prevent the tether from accidentally slipping into the well. The tether can also be tied-off to a tripod or other stationary device. It is recommended that the well cap be attached to the top of the tether as a protection against losing the tether down the well.
14. Place the weighted end of the tether inside the well casing and lower until the first attachment ring is above the top of the casing.
15. If multiple DMPDB samplers are to be installed on the same tether, start by installing the bottom DMPDB first. Pick up a filled DMPDB, keeping it in the vertical position and attach the DMPDB alongside suspension tether using two zip-ties as follows;
  - a. At the bottom of the DMPDB is a stainless-steel ring. One zip-tie is attached through the ring on the DMPDB and through the bottom connection ring on the tether.

- b. One zip-tie is placed around the black vertical strap above the top of the DMPDB and through the second ring on the tether and zipped tightly so as not to slip upward past the stop-block on the black strap. Photographic instructions are provided by EON.
- c. If multiple PDBS are installed in one well, lower the tether as each sampler is attached to the tether, attach the next DMPDB and repeat until all are attached.
- d. Continue lowering the tether until the well cap can be secured to the top of the casing. Place any extra rope (often there is extra tether above the well cap to facilitate field adjustments) into the casing below the well cap. The well cap should be secured so that surface water runoff does not enter the well during sampling. Tether line should not be placed between the cap and casing as this presents a water pathway.

### **Residence Time, Sample Recovery**

16. The samplers should be left in place, undisturbed for a residence time that allows for diffusion of COCs to reach equilibrium between the groundwater flowing through the well and the contents inside the DMPDB. Because diffusion is driven by concentration gradients, the sampler will maintain equilibrium with the groundwater if well concentrations change. Each COC has its own rate of diffusion so there will be a lag time of a few hours to a few days to regain equilibrium if well concentrations changes occur rapidly. After the initial equilibration period, the DMPDB will always represent the concentration of each COC during the past 1 to 7 days. Generally recommended minimum residence times, taking into account the disturbance occurring to flow in the well when samplers are installed and equilibration time through the membranes;
  - a. VOCs Minimum: two weeks
  - b. Semi-VOCs, Inorganics, Metals, Ions, Minimum: three weeks
  - c. 1,4-Dioxane, PFAS, Minimum: three weeks (may be less for fast recharge wells)
  - d. As a cost saving measure, it is recommended that samplers be installed during one event and left in place until the next event. At the next event, the sampler is recovered, sampled and a new sampler installed. This reduces field mobilizations.
17. Immediately prior to sampler recovery and before removing samplers from the well, the water level in the well should be measured.
18. Remove the DMPDB samplers by first un-securing the well cap and pulling the tether upward from the well until the first DMPDB appears.
  - a. Take care to secure the tether as it is being pulled up to prevent it, and the sampler(s) from slipping down the well.
  - b. Take care to keep the tether clean and away from contamination.
  - c. The use of spool is recommended to hold tether as it is being removed from the well.
19. Follow guidelines and protocols for sample handling
  - a. Decant the DMPDB (see below) immediately upon remove from the well. Do not leave samplers in the air, buckets coolers, etc prior to sampling.
  - b. As with all sampling methods, do not discharge DMPDB samplers near sources of contamination, including airborne compounds, auto exhaust, etc.
  - c. Handle all lab containers and samples according to protocols.
20. Grab the DMPDB near the top of the sampler and around the white nozzle, keeping it vertical while lifting it out of the well. Follow cleanliness and sample handling protocols established for the site.

- a. When multiple DMPDBs are on the same tether, if possible, leave the lower samplers in the well while decanting from each upper sampler.
- b. Using a set of snips, carefully cut the zip-ties that secure the sampler to the tether rings or loops. If using zip-tie loops through the tether do not cut those, only cut the ties that connect between the sampler and the loop or tether connection ring.
- c. Alternately, secure the tether with the DMPDB from one of the arms of a tripod so the sampler is securely hanging in the air.
- d. Place a bucket under the DMPDB to capture small amounts of sample water that may release during sampling.
- e. Open the lab provided sampling containers to be filled by this sampler and place them closely nearby.
- f. Locate the small diameter “juice-box” straws that were packaged with the samplers.
- g. Hold the DMPDB vertical and select a location about 1/3<sup>rd</sup> to ½ way down the filled length.
- h. Taking one straw, point the straw away from any person and pierce through the membrane and the perforated tube at the selected location. It may require a small amount of force and finesse to pierce the membrane and push through the perforated tube.
- i. Immediately place the sample container under the straw and fill the container. The straw and sampler may be manipulated up and down or tilting to control the flow. Squeezing the water from the “tail” Control will improve with practice.
- j. When the DMPDB has drained to the level of the straw and flow ceases, remove the straw, and pierce the membrane again lower on the sampler body to obtain more sample.
- k. When sampling is complete, dispose of sampler according to local and project requirements.

### **Install New DMDPB Samplers**

21. Reinstall new samplers while the tether is removed from the well, following installation procedures beginning at #10 above.

### **Passive Sampling References:**

These references explain the principles that apply to passive groundwater sampling in general and contain information about specific passive sampling methods and devices that may or may not be commercially available.

- User’s Guide for Polyethylene-Based Passive diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells. Don A. Vroblesky, U.S. Geological Survey, 2001
- Technical and Regulatory Guidance for Using Polyethylene Diffusion Bag Samplers to Monitor Volatile organic Compounds in Groundwater. ITRC, February 2004
- Results Report for the Demonstration of No-Purge Groundwater Sampling Devices at Former McClellan Air Force Base, California. Parsons, October 2005
- Technology Overview of Passive Sampler Technologies, ITRC March 2006
- Protocol for Use of Five Passive Samplers to Sample for a Variety of Contaminants in Groundwater, ITRC, February 2007



- Passive Sampling of Groundwater Wells for Determination of Water Chemistry, Imbrigiotta, T.E., and Harte, P.T., 2020 U.S. Geological Survey, 2020
- ITRC Fact Sheet: Sampling and Analysis 1,4 Dioxane, ITRC, March 2020
- Laboratory Bench Test and Side by Side Field Comparison of Results for the DMPDB. Various references, EON Products, Inc. <https://www.eonpro.com/documents-resources/>

**Footnotes:**

1. Minimum Lab Sample Volume Requirements Table, Protocol for Use of Five Passive Samplers to Sample for a Variety of Contaminants in Groundwater, Appendix A, ITRC, February 2007