

## Final Report

Passive Air Study at the Ballard Pits State Superfund Site: North Pit

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## **Abstract**

Air analysis was performed at the North Pit at the Ballard Pits-Texas State Superfund site using passive air sampling methods. Persistent Organic Pollutants (POPs) including possible PCBs were collected on polyurethane foam disks (PUFs) and VOCs on Carboxen (Radiello®) tubes, by deploying them at the site for 10 days. Passive air samplers, using the same geometry and sample rate as previously reported, were deployed at 21 locations and positioned 2 m above ground. PCBs and VOCs were analyzed by GC/MS using USEPA SW 846 method 8270 and TO-17, respectively. Airborne PCBs were not detected at our practical detection limit of  $0.303 \text{ ug/m}^3$ . VOCs, however, contained toluene ethylbenzene, xylenes, and trimethylbenzenes in significant amounts, ranging in concentration from 3.9 to  $173 \text{ ug/m}^3$ . Two 8 L Summa canisters were also deployed for 24 hours and showed ultra trace amounts of 3 volatile analytes which are commonly found in laboratory air (chloroethane, chlorobenzene and Freon). This study showed that passive air monitoring at a waste site can be an efficient and cost effective method for determining the concentrations of specific airborne pollutants. Other atmospheric organic and inorganic contaminants could be monitored using passive techniques providing adequate sample rate studies are provided.

## **Introduction**

Air pollution involves and affects most everyone. Because of its importance, there are many different methods, technologies, procedures and constituents involved with air pollution. Air pollution, often considered the most dangerous form, however, is often minimized because of difficulties in field sampling. Regardless, it is important to understand that ambient air is not typically restricted and pollutants can travel far distances and affect large populations (compared to other pollution media such as water and soil). Because of the importance of time when dealing with harmful atmospheric pollutants, active sampling has historically been used to measure pollutant composition and concentrations. However, active sampling is expensive, has limited sample time periods, and other pitfalls resulting from downwind contamination due to the exhausts of pumps or generators required to pass air through a sampler (Thammakhet, C. et al. 2006). Alternatively, passive air sampling which can be used for longer time periods, is less expensive, and does not use equipment that can cause contamination (Cessna, et al.

1995; Jaward et al. 2004; Thammakhet, et al. 2006). Passive sampling is based upon Fick's law of diffusion (Thammakhet, et al. 2006; Bruno, et al. 2005), which states that diffusion occurs from high to low concentration gradients. Passive sampling yields results that can be as accurate as active sampling, yet inexpensive and simple enough to be able to collect multiple samples simultaneously over longer time intervals.

Passive air monitoring of persistent organic pollutants (POPs) has been utilized on large and small scales in several recent studies. For instance, on a global scale Harner et. al (2006) studied POPs from passive air sampling in regions from the high Arctic to Bermuda. Shoeib and Harner (2002) showed that the most effective sampling media for many non-volatile organic compounds such as PCBs is polyurethane foam (PUF). In addition they developed and utilized a housing for PUFs with a specific geometry and sampling rate. On a smaller scale, passive samplers have been used to determine volatile organic compounds (benzene, toluene, xylene naphthalene and others) in indoor air using carbon based adsorbents (Sunesson, et al. 2002). An excellent review article of the use and utility of passive sampling is given by Kot-Wasik et al. (2007).

The objective of this study was to measure 2 classes of airborne POPs; polychlorinated biphenyls (PCBs) and volatile organic compounds (VOCs) at a Texas State Superfund site – Ballard Pits [www.tceq.state.tx.us/remediation/superfund/state/ballard.html](http://www.tceq.state.tx.us/remediation/superfund/state/ballard.html). This report presents the results of airborne PCB and VOC analysis using passive sampling procedures.

## **Methods and Materials**

### *Field procedures*

Pre-cleaned passive air adsorbents consisting of a polyurethane foam disk 14 cm in diameter, with a thickness of 1.35 cm, surface area of 365 cm<sup>2</sup>, mass of 4.40g, volume of 207 cm<sup>3</sup>, and density of 0.0213g/cm<sup>3</sup>, were placed inside a stainless steel sampling chamber consisting of two hinged domes (Photo in Figure 1). This was the same configuration given by Jaward et al. (2004) enabling us to use the same sampling rates determined by Hazradi and Harrad (2007). The field team deployed 21 chambers, along two sides of the long and narrow North Pit, two meters above the ground for 10 days (10-18-2009

to 10-27-2009). The PUF disks and Radiello® tubes were positioned inside the stainless steel housing as shown in Figure 2; schematically and in a photograph. Note the narrow trench between the rows of samplers where some of the waste material was uncovered (Figure 2).

A weather station was also deployed about 100 m south of the North Pit to record environmental conditions during the 10 day sampling period. Klanova et al. (2008) indicated the importance of recording atmospheric and meteorological data during PUF deployment. The results of the wind speed are given in Figure 4 and show the average wind speed was below 5 m/sec for our sample period. This is important since the PUF samplers were calibrated for PCBs at wind speeds less than 5 m/sec. There were 5 rain events during our sampling period. The maximum rainfall occurred on 10-26-09 and registered 0.90 inches from 1242 to 1742 hrs. Air temperature ranged from a high of 85.5 to a low of 49.8 °F. These temperatures are within the range of passive sampling rates for our sampler geometry.

After ten days, passive air samplers (containing PUF and VOC cartridges) were collected and resealed in their original plastic baggies and glass containers and transferred back to the lab for extraction and analysis.

Summa canisters (provided by A and B Laboratories in Houston) were installed at the beginning of the study and positioned at the terminal ends of the passive sampler locations as shown in Figures 2 and 3. The volume of the canisters was 8 L and air was sampled at a constant rate for 24 hours (from vacuum to atmospheric pressure). One of the canisters had a defective valve and no sample was collected on 10-17-09. We returned at the end of the 10 day sampling period and deployed another canister at the east end on 10-27-09 for 24 hours. It is important to note that the Summa canisters sample only 8 L of air compared to the passive air samplers that could collect up to 8000 L of POPs and 450 L (0.450 m<sup>3</sup>) of VOCs for the 10 day period

#### *Laboratory Methods*

Prior to deployment of the passive air samplers, PUF disks were pre-cleaned using multiple cleaning steps, which included: 1) rinsing in 4 L of ultra pure double-deionized water at 90 °C for 30 minutes and dried 2) extraction in a Soxhlet apparatus for 18 hours with high purity acetone and 3) Soxhlet extracted for

an additional 18 hours in reagent grade methylene chloride (dichloromethane) and 4) dried at room temperature under a fume hood. Each pre-cleaned PUF was resealed in a heavy duty plastic bag and kept enclosed until field deployment in the stainless steel sample housing (along with the Radeillo® VOC cartridge). After the 10 day exposure time on 10-27-2009, the PUF and VOC cartridges were picked up and sealed in the same heavy duty bag. In the laboratory, each individual PUF disk was spiked with 1mL of 100 ppm surrogate spiking solution and extracted with methylene chloride for 18 hours in a Soxhlet extractor. The solvent containing all organic compounds was evaporated on a rotary evaporator and 1.0 mL was quantitatively transferred to a 1.5 mL autosampler vial in preparation for GC/MS analysis. The surrogate solution (Restek Corp.) consisted of a mixture of three compounds: nitrobenzene-d5 (d5 indicates that there are 5 deuterated hydrogens on nitrobenzene and likewise for all other "d" labeled surrogates and internal standards), 2-fluorobiphenyl, and p-terphenyl-d14. Prior to injection into the instrument, 10 µL of a 100 ppm internal standard solution (Restek Corp), containing 1,4-dichlorobenzene-d4, naphthalene-d8, acenaphthalene-d10, phenanthrene-d10, chrysene-d12, perylene-d12 was added to each sample before being analyzed by GC/MS. Quantitation of PCB ions, if present, were based on the internal standard method as described in the USEPA SW 846 8270 procedure.

Ten Aroclor standards from mix 1016 and 1260 contained a mixture of over 20 compounds, known as congeners, (purchased from Restek, Sigma Aldrich and AccuStandard) were used as calibration standards. Congeners were selected for quantitation based upon their molecular weight range and retention time separation. A gas chromatograph (Thermo Electron Trace GC) with a Supelco Equity® column (30 m x 0.25 mm id x 0.25 µm film thickness) was used for PCB analysis. The temperature program consisted of the following conditions; initial temperature hold at 60°C for 2 minutes, ramped to 300°C at 10°C per minute, and held at a final temperature of 300°C for 5 minutes. The mass spectrum of each selected ion was determined by a Thermo Electron DSQ quadrupole mass spectrometer operated in full scan mode from 150-450 mass units using electron ionization at 70 eV. Others have reported PCBs using negative chemical ionization with methane as the ionization gas. We selected positive electron ionization at 70 eV since more EPA data has been gathered under these conditions and we could possibly compare our results with others analyzed by EPA methods. This program resolved PCB ions chosen in the 2 Aroclor mixtures (1016/1260) at baseline or near baseline conditions. The X-Caliber

software (Thermo Electron) calibration and post processing method included calculation of surrogates, and selected PCBs from the Aroclor mixtures. The Aroclor 1016/1260 mixture was selected because it contained a wide variety of the PCBs commonly found in the environment. A total of 10 ions from the Aroclor 1016/1260 mixture were selected for identification and quantitation and are listed in Table 1.

A single primary ion and 1 or 2 secondary confirming ions were used to positively identify the presence of PCBs. An initial 5 point calibration curve was generated for 10 specific PCB congeners using the internal standard method as outlined in USEPA method SW 846 8270. A matrix spike (MS) and a matrix spike duplicate (MSD) were prepared and analyzed from a pre-extracted PUF. The matrix spike solution was spiked at 50 ppm and the calibration was used to confirm the presence of PCBs and also to provide quantitative information, if the ions were identified as PCBs, for the 10 selected PCBs, in analytical samples, matrix spikes and surrogates.

Volatile organic compounds (VOCs) were analyzed by A&B Laboratories in Houston using USEPA method TO-17. This method is designed for thermal desorption of Carboxen (or other adsorbent matrices) tubes onto a GC/MS. Details (125 pages) of surrogate and spike recovery data is also available upon request.

## **Results**

No detectable PCBs were found on the PUF media for air samples collected at the North Pit for the time period sampled (October 17 to 27, 2009). The reporting detection limit is 2.5 ug PCB congener/mL at the instrument level yielding a detection limit of 0.303 ug PCB congener/m<sup>3</sup> in air, assuming 8 m<sup>3</sup> air sampled. Recoveries of matrix spikes were satisfactory and indicate that if PCBs were present we would have detected them with the PUF solvent extraction and GC/MS methodology used in our laboratory. Sampling rates for many PCBs were determined using the same sample housing and PUF geometry described by Hazrati and Harrad (2007) who list an "average" PCB sampling rate for the congeners we used in this study of 0.8 m<sup>3</sup> per day. Thus for a 10 day period, the total air sampled was 8 m<sup>3</sup> or a total of 8000 L (for comparison the Summa canister collected 8 L). One can readily see certain

advantages of passive sampling; including a large sample volume and an integrated average over an extended time period.

Spiked samples in the MS-MSD PUFs (Table 2) showed that recoveries were satisfactory ranging from 40 to 70 % recovery for all 10 PCB primary ions. In addition, Table 3 shows surrogates, spiked into every sample, contained a fairly high range (about 30-150% or more). The highest molecular weight surrogate, terphenyl d14, showed especially poor recoveries and it is not sure why this occurred (Table 3). The important issue here is that both surrogates and matrix spikes were recovered in spiked PUF; ensuring that if PCBs were present we would have seen them in the PUF samples.

Volatile compounds were found in all Radiello® Carboxen tubes. The sampling rates for the Radiello sampler body used in this study are given for each specific analyte and is listed in Table 5. We used the following calculation for determining the sample volume for each compound. Below is an example for toluene:

$$30 \text{ mL/min (from Table 5)} \times 60 \text{ min/hr} \times 24 \text{ hr/day} \times 10 \text{ days} \times 1 \text{ L}/10^3 \text{ mL} \times 1 \text{ m}^3/10^3 \text{ L} = \mathbf{0.432 \text{ m}^3}$$

Air volume sampled for each of the volatile analytes found in this project was calculated in a similar manner and the results, which are given in Table 6, show a reasonably consistent set of hydrocarbons.

In Table 7, detected VOCs are listed as averages and standard deviations for all field samples (21), 2 field blanks and one trip blank. These data show that both benzene and styrene are not significant VOCs since they also appear in the field blank at nearly the same concentrations. Only toluene was found in the trip blank at  $1.5 \text{ ug/m}^3$  and with the corresponding field blank was only  $6.5 \text{ ug/m}^3$ . This is insignificant since the mean value for toluene was  $67.2 \pm 22.1 \text{ ug/m}^3$  for all 21 samples. Table 7 also shows that xylenes are the most concentrated VOC, containing over  $120 \text{ ug/m}^3$  (including both m&p and o isomers). It is important to note that no chlorinated VOCs were detected. It appears that the VOC waste material in the North Pit was mostly gasoline derived hydrocarbons.

Summa canister data was reported for EPA method TO-15, specifically for the list of analytes given in Table 4. Only chloromethane, chlorobenzene and dichlorofluoromethane (Freon) were reported.

Each of these organic compounds was reported at the detection limit of the method. It is likely that these compounds are laboratory artifacts and do not reflect the presence of these compounds in the air above the North Pit, since no chlorinated organic compounds were found from desorption of the VOCs in Radiello® tubes. No other analytes were detected in EPA TO-15 list (Table 4).

### **Discussion**

It is clear that no PCBs were detected at this site. However, it is not an unexpected result since PCBs are not volatile and require an unusually high concentration in soil coincident with high wind speeds to become airborne. Other atmospheric organic compounds were present in the PUF extracts and because of their complex nature, they were not characterized. However, VOCs are present and suggest that the soil contamination is likely derived from gasoline or another refined hydrocarbon source.

It has been reported that VOCs such as the xylene isomers (o and m&p) in an urbanized area of the US (Massachusetts), contain about 2.5 ug/m<sup>3</sup> atmospheric burden (Pankow et al. 2003). By comparison, total xylenes in this project contain 121 ug/m<sup>3</sup> which is about 50 times higher than the populated urban setting reported above. In general, the BTEX class of compounds are about 50 times higher here than reported by Pankow et al. (2003) in urbanized settings. Even though we did not detect any odors from the North Pit during our field activities, it is clear that this area of the property contains VOCs in excess of urban air such as found in nearby Corpus Christi. However, there are several chemical refineries along the west section of the Corpus Christi navigation canal that could contribute some VOCs to those reported here. The North Pit is a small area compared to excavated areas in other parts of the Ballard Pits site and it is enclosed by high vegetation (Figure 3) that might prohibit significant air flow into the North Pit from other contaminated sites. It would be useful to have some of the waste material analyzed to determine its chemical makeup.

Passive air monitoring can be a useful alternate to conventional active sampling campaigns when costs and personnel are limited. It is critical that more studies be undertaken to expand the horizons and capabilities of passive sampling methodology and applications.



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Figure 1. Schematic diagram and photograph of the open housing containing the PUF disk. Note that both the PUF disk and the Radiello® cartridge were housed in this enclosure (Harner et al. 2006).

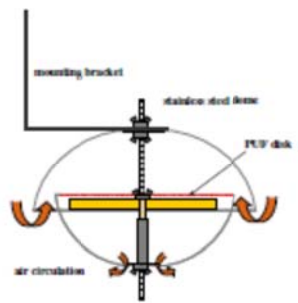


Figure 2. Schematic view of the field deployment of samplers and the location of the Summa canisters.

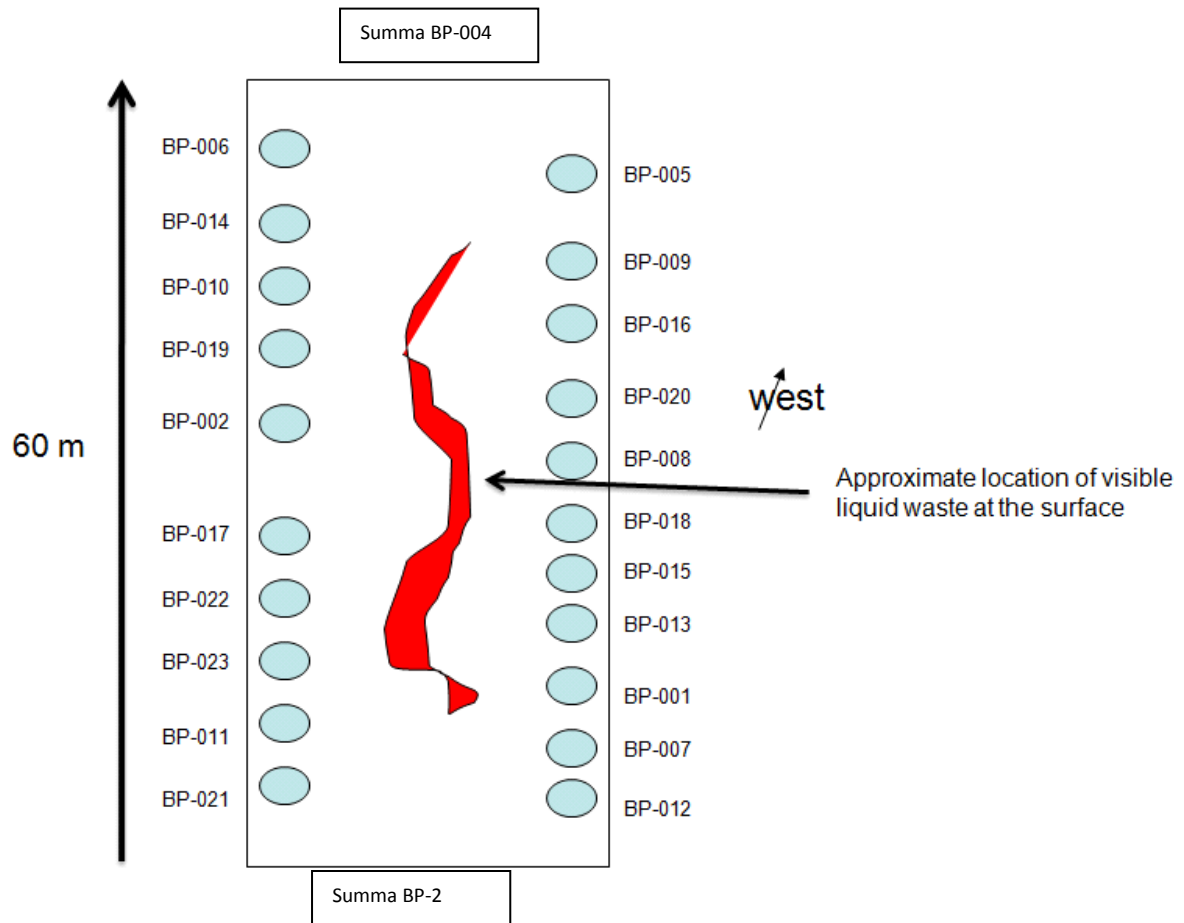


Figure 3. Photograph of the passive samplers positioned at the North Pit. Summa canisters were positioned at each end of the line of sampler housings. They are not visible on this photo.



Figure 4. Average wind speed for the sampling period. Note that no period exceeded 5 m/s which is in the 0.8 m<sup>3</sup> per day sampling rate for our PUF samplers.

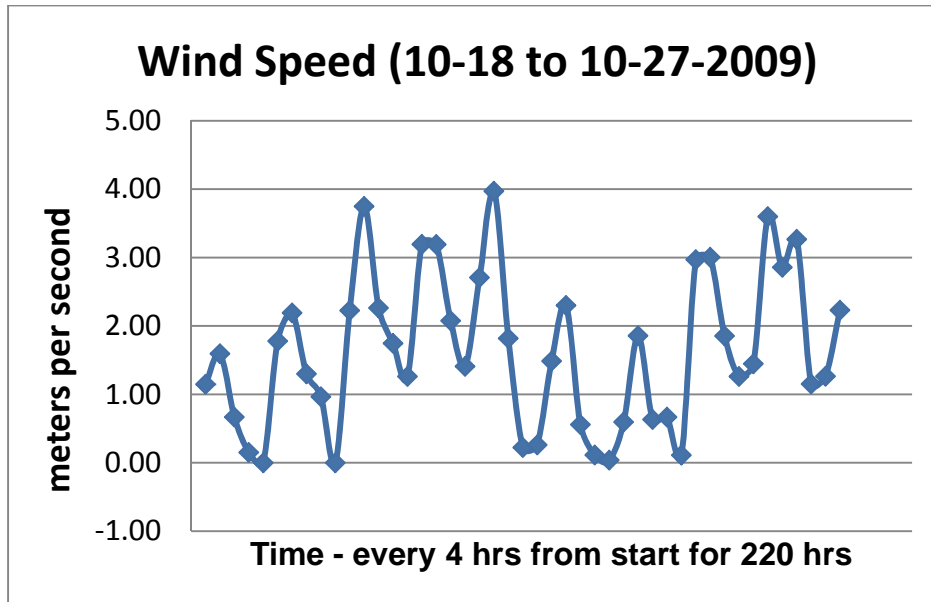


Table 1. List of PCB congeners and their ions used to positively identify and quantify PCBs.

Congeners	Retention Time (minutes)	Primary Ion (m/z)	Secondary Ions (m/z)
A	14.49	222	152, 224
B	15.28	222	224, 152
C	16.85	256	188, 260
D	17.02	260	256
E	17.78	292	222, 220
F	19.43	326	256
H	19.82	360	290, 362
I	20.18	360	362, 290
J	20.62	360	292
L	21.64	394	396, 324

Table 2. PCB results for the 10 primary PCB peaks selected for analysis. Detection limit is 0.303 ug/m<sup>3</sup>.

ID	Peak A	Peak B	Peak C	Peak D	Peak E	Peak F	Peak H	Peak I	Peak J	Peak L
BP-001	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-002	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-005	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-006	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-007	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-008	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-009	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-010	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-011	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-012	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-013	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-014	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-015	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-017	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-018	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-019	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-010	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-021	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-022	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
BP-023	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MS	70.8%	61.4%	40.4%	69.1%	70.3%	62.4%	62.6%	63.0%	60.6%	64.6%
MSD	61.0%	50.0%	53.3%	62.8%	61.9%	49.6%	52.2%	49.9%	49.1%	53.6%



Table 3. Surrogate recoveries (percent) from each PUF and “nd” = not detected.

Sample	Nitrobenzene-d5	2-Fluorobipheynl	p-terphenyl-d14
Solvent Blank	53.2	39.9	83.0
Trip Blank	44.2	56.8	290
Field Blank	162	86.3	nd
BP-001	36.0	135	181
BP-002	174	273	nd
BP-005	65.7	45.4	89.3
BP-006	nd	19.0	nd
BP-007	65.8	32.3	nd
BP-008	72.1	72.7	nd
BP-009	24.3	47.2	284
BP-010	34.2	71.9	337
BP-011	147	71.5	nd
BP-012	162	208	172
BP-013	82.2	167	188
BP-014	46.4	56.3	nd
BP-015	28.1	51.3	nd
BP-016	nd	80.1	nd
BP-017	161	75.3	nd
BP-018	170	78.9	nd
BP-019	173	85.8	nd
BP-020	116	65.8	nd
BP-021	158	84.2	nd
BP-022	8.26	22.9	nd
BP-023	115	68.2	nd

Table 4. Results of Summa canister deployment (USEPA TO-15). Data reported in ug/L with a reporting detection limit given for each volatile analyte required for the TO-15 method.

Volatile Analyte	BP-2	BP-004
1,1,1 trichloroethane	<0.005	<0.005
1,1,2,2 tetrachloroethane	<0.007	<0.007
1,1,2 Trichloro 1,2,2 trifluoroethane	<0.008	<0.008
1,1,2 Trichloroethane	<0.005	<0.005
1,1 Dichloroethane	<0.004	<0.004
1,1 Dichloroethylene	<0.004	<0.004
1,2,4 Trichlorobenzene	<0.007	<0.007
1,2,4 Trimethylbenzene	<0.005	<0.005
1,2 Dibromoethane	<0.008	<0.008
1,2 Dichlorobenzene	<0.006	<0.006
1,2 Dichloroethane	<0.004	<0.004
1,2 Dichloropropane	<0.005	<0.005
1,2 Dichlorotetrafluoroethane	<0.007	<0.007
1,3,5 Trimethylbenzene	<0.005	<0.005
1,3 Dichlorobenzene	<0.006	<0.006
1,4 Dichlorobenzene	<0.006	<0.006
Benzene	<0.003	<0.003
Bromomethane	<0.004	<0.004
Carbon Tetrachloride	<0.006	<0.006
Chlorobenzene	<0.005	<b>0.006</b>
Chloroethane	<0.003	<0.003
Chloroform	<0.005	<0.005
Chloromethane	<b>0.003</b>	<b>0.003</b>
Cis-1,2-Dichloroethylene	<0.004	<0.004
Cis-1,3-Dichloropropane	<0.005	<0.005
Dichlorodifluoromethane	<b>0.005</b>	<b>0.005</b>
Ethylbenzene	<0.004	<0.004
Hexachlorobutadiene	<0.011	<0.011
m&p xylenes	<0.009	<0.009
Methylene chloride	<0.003	<0.003
o-Xylene	<0.004	<0.004
Styrene	<0.004	<0.004
Tetrachloroethylene	<0.007	<0.007
Toluene	<0.004	<0.004
Trans-1,3 Dichloropropene	<0.005	<0.005
Trichloroethylene	<0.005	<0.005
Trichlorofluoromethane	<0.006	<0.005
Vinyl Chloride	<0.003	<0.003

Table 5. Sampling rates for Radiello® passive sampling cartridges.

Sampling rate values Q at 25°C (298 K)

	Q <sub>298</sub> ml·min <sup>-1</sup>	exposure time upper limit (days)	linear up to µg·m <sup>-3</sup> ·min	uncertainty (2σ) %	limit of detection <sup>1</sup> µg·m <sup>-3</sup>
benzene	27.8	7	410,000	8.3	0.05
benzene	26.8	14	410,000 <sup>2</sup>	7.5	0.05
butyl acetate	24.5	14	580,000	12.4	0.05
2-butoxyethanol	19.4	14	550,000	9.7	0.1
cyclohexane	27.6	7	470,000	14.7	0.1
n-decane	22.3	14	450,000	22.4	0.1
1,4-dichlorobenzene	22.0	14	650,000	9.5	0.1
dimethyl disulfide	23.7	7	500,000	9.1	0.04
n-heptane	25.3	14	420,000	7.6	0.05
n-hexane	25.5	7	420,000	10.9	0.05
ethylbenzene	25.7	14	550,000	9.1	0.01
2-ethyl-1-hexanol	14.3	14	550,000	17.4	0.07
2-ethoxyethanol	26.0	14	570,000	7.7	0.05
2-ethoxyethyl acetate	20.9	14	600,000	8.0	0.05
isopropyl acetate	25.8	7	540,000	9.6	0.1
limonene	12.8	14	550,000	24.8	0.2
2-methoxyethanol	4.0	7	1,000,000	--	1.0
2-methoxyethyl acetate	21.0	7	1,000,000	--	0.1
1-methoxy-2-propanol	26.6	7	600,000	11.6	0.2
n-nonane	21.0	14	440,000	11.8	0.07
n-octane	24.1	14	440,000	13.4	0.07
α-pinene	6.4	14	550,000	29.5	0.2
styrene	27.1	14	550,000	24.0	0.01
tetrachloroethylene	25.4	7	1,000,000	8.9	0.02
toluene	30.0	14	550,000	8.3	0.01
1,1,1-trichloroethane	20.0	7	300,000	13.0	0.1
trichloroethylene	27.1	7	800,000	9.5	0.02
1,2,4-trimethylbenzene	21.9	14	550,000	9.6	0.05
n-undecane	12.0	14	520,000	32.7	0.05
m-xylene	26.6	14	550,000	11.3	0.01
o-xylene	24.6	14	550,000	9.1	0.01
p-xylene	26.6	14	550,000	11.3	0.01

<sup>1</sup>after 7 days exposure and with MS detection; analytical conditions as described in the Analysis paragraph

<sup>2</sup>for overall VCCs concentrations not exceeding 500 µg m<sup>-3</sup>





Table 7. Averages and standard deviations for detected and measured VOCs. TB=trip blank, FB=field blank.  
Units are in ug/m<sup>3</sup>

Analytes	Average	Stdev	FB	Stdev	TB
Dichlorodifluoromethane	nd		nd		nd
1,2-Dichlorotetrafluoroethane	nd		nd		nd
1,1-Dichloroethylene	nd		nd		nd
Methylene chloride	nd		nd		nd
1,1-Dichloroethane	nd		nd		nd
cis-1,2-Dichloroethylene	nd		nd		nd
Chloroform	nd		nd		nd
1,2-Dichloroethane	nd		nd		nd
1,1,1-Trichloroethane	nd		nd		nd
Benzene	3.17	1.22	2.24	0	nd
Carbon tetrachloride	nd		nd		nd
1,2-Dichloropropane	nd		nd		nd
Trichloroethylene	nd		nd		nd
cis-1,3-Dichloropropene	nd		nd		nd
trans-1,3-Dichloropropene	nd		nd		nd
1,1,2-Trichloroethane	nd		nd		nd
Toluene	67.2	22.1	6.54	1.06	1.5
1,2-Dibromoethane	nd		nd		nd
Tetrachloroethylene	nd		nd		nd
Chlorobenzene	nd		nd		nd
Ethylbenzene	34	10.3	1.26	0.21	nd
m- & p-Xylenes	72.1	22.9	2.65	0.609	nd
Styrene	1.23	0.65	2.04	0.562	nd
o-Xylene	49.8	16.7	nd		nd
1,1,2,2-Tetrachloroethane	nd		nd		nd
1,3,5-Trimethylbenzene	5.12	1.81	nd		nd
1,2,4-Trimethylbenzene	20.8	5.87	nd		nd
1,3-Dichlorobenzene	nd		nd		nd
1,4-Dichlorobenzene	nd		nd		nd
1,2-Dichlorobenzene	nd		nd		nd
1,2,4-Trichlorobenzene	nd		nd		nd