

**Analysis of Polychlorinated Biphenyl Mixtures (PCB) and Metals  
in Water Samples Collected from the Bayou Creek System  
on August 13-14, 2001**

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## INTRODUCTION

Water samples (45 samples) were taken from Big and Little Bayou Creeks on August 13-14, 2001 for PCB and metal analyses. A total of 10 sites were sampled from Big Bayou Creek (stations BB1A through BB9) and 4 sites were included for Little Bayou Creek (stations LB1 through LB4). A new reference station, upstream of BB1 and designated BB1A, was included in this stream survey. In addition, the Massac Creek (MC) station, on the West Fork of Massac Creek, was sampled and served as a possible reference station independent of the Bayou Creek system. Water samples were taken at each station for general water quality analyses which included pH, conductivity, alkalinity, and hardness. Two water samples per station were collected for PCB assays, and a separate water sample per station was collected for metal analysis. Three Aroclors (*i.e.* 1248, 1254, and 1260) and 9 metals (*i.e.* Ag, Be, Cd, Cr, Cu, Fe, Ni, Pb and Zn) were analyzed for each sample.

## METHODS

### Water Collection

**General Water Quality:** Samples for water quality measurements were collected in 1-L "Cubitainer" receptacles and were placed on ice until delivery to the laboratory.

**PCBs:** Water samples for PCB analyses were collected in chemically cleaned, 1-L amber glass jars with teflon-lined caps. New jars were obtained from

I-Chem®. Samples for PCB determinations were placed on ice until delivery to the laboratory and maintained under refrigeration (4°C) until extraction.

**Metals:** Water samples for metal assays were collected in acid-cleaned 250-mL polyethylene bottles. Samples were preserved with concentrated HNO<sub>3</sub> upon collection and analyzed for total recoverable (TR) metals.

### **General Water Quality**

Water quality parameters included pH, conductivity, alkalinity and hardness that were measured according to procedures described by APHA (1995). The measurements were performed with a pH meter (Orion Research EA920), a conductivity meter (Amber Science Model 604), the bromocresol green-methyl red titrimetric procedure, and the EDTA titrimetric procedure, respectively.

### **PCB Water Extractions**

Extraction and cleanup of water samples followed procedures described by Birge and Price (2002), and were completed within 7 days of collection.

### **PCB Determinations**

Samples were analyzed for Aroclors 1248, 1254, and 1260 according to SW-846 Method 8082 (U.S. EPA, 1997). Analyses were performed as described by Birge and Price (2002).

## **Water Metal Determinations**

Nine metals were analyzed, including silver (Ag), beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), iron, (Fe), lead (Pb), nickel (Ni), and zinc (Zn). Metal analyses were performed by graphite furnace-atomic absorption spectrophotometry (GF-AAS) as described by Birge and Price (2002).

## **Quality Assurance**

Permanent bench records were kept of all assays and annotated as required under Good Laboratory Practices (*Federal Register*, 40 CFR, Part 160, August 17, 1989). All printouts and graphic recordings were filed and are open for inspection. These bench records will be archived within two years after the close of the project but retrievable upon request. Chain of Custody was maintained for all samples collected.

# **RESULTS**

## **Water Quality**

The results for general water quality parameters are given in Table 1. Overall, pH values were within the preferred range of 6.5-8.5. Station BB5 had the highest pH value of 8.3. Conductivity ranged from 107 to 362  $\mu\text{MHOs/cm}$  and was highest at BB8. Alkalinity varied from 16 to 40 mg  $\text{CaCO}_3/\text{L}$  in Big Bayou Creek and 20 to 28 mg  $\text{CaCO}_3/\text{L}$  in Little Bayou Creek. Hardness ranged from 44 to 88 mg  $\text{CaCO}_3/\text{L}$  and 64 to 88 mg  $\text{CaCO}_3/\text{L}$  for Big and Little Bayou Creeks,

respectively. Hardness levels were highest for stations BB6, BB7, BB8 and BB9. The mean values were  $56.7 \pm 9.3$  for stations upstream of effluent 001 and  $85.0 \pm 3.8$  for stations below this outfall. Hardness ( $\text{mg CaCO}_3/\text{L}$ ) for Little Bayou Creek averaged  $76.0 \pm 11.8$ .

### **PCB Contamination**

Results for PCB analyses of water samples are given in Tables 2 and 3 for Big and Little Bayou Creeks, respectively. No PCBs were quantifiable in any of the water samples collected, observing detection limits of 0.08 to 0.11  $\mu\text{g PCB/L}$ .

### **Metal Contamination**

Results for metal assays of water samples are given in Tables 4 and 5 for Big and Little Bayou Creeks, respectively. Silver was not detected at any of the stations at the 0.25  $\mu\text{g/L}$  (ppb) detection limit. Metal concentrations for Beryllium (Be) and Lead (Pb) were below the minimum quantitation limit and are shown only for qualitative purposes. Be concentrations increased at stations BB6 and BB7, which are situated just downstream of effluent 001. Pb was highest at stations BB5 and BB6, where the concentrations were 0.599 and 0.460  $\mu\text{g/L}$ . Cadmium (Cd) was only detected at station BB4 (0.724  $\mu\text{g/L}$ ). Chromium (Cr) was observed at stations BB5 through BB8, with BB7 having the highest concentration. Cr values were 1.49, 1.37, 2.37, and 1.96  $\mu\text{g/L}$  for stations BB5, BB6, BB7, and BB8, respectively. Copper (Cu) was highest for stations BB5 and

BB6 (4.20 and 2.50 µg/L). Iron was highest at stations BB5 (1955.9 µg/L) and BB2 (1310.3 µg/L). Zinc (Zn) was highest at stations BB2 and BB4 (9.74 and 7.06 µg/L). Be, Fe and Zn were highest at stations LB1 and LB4 in Little Bayou Creek (Table 5). It should be noted that Fe concentrations exceeded 1 mg/L at these stations. Metal contamination was less than recorded in previous studies (Birge and Price, 2001). This may indicate improvement within the Bayou Creek system but further monitoring will be required to confirm these results. Seasonal and annual fluctuations are known to occur in Big and Little Bayou Creeks.

Table 1. Water quality results for stream water samples from the Bayou Creek system collected August 13-14, 2001.

Station	pH	Conductivity ( $\mu$ MHOs/cm)	Alkalinity (mg CaCO <sub>3</sub> /L)	Hardness (mg CaCO <sub>3</sub> /L)
MC <sup>1</sup>	6.7	107	16	36
BB1A	7.2	235	28	60
BB1	7.3	229	40	64
BB2	6.9	143	20	44
BB3	7.2	222	24	68
BB4	7.3	224	16	56
BB5	8.3	216	16	48
BB6	7.8	346	16	84
BB7	7.5	355	20	80
BB8	7.3	362	16	88
BB9	7.1	252	16	88
LB1	7.1	140	28	68
LB2	7.6	295	20	88
LB3	7.6	284	20	84
LB4	7.1	141	24	64

<sup>1</sup> Massac Creek was sampled at the UK site (Western Fork).

Table 2. PCB results for water samples from Big Bayou Creek collected August 14, 2001.

Station	Date	Sample	Aroclor Concentration ( $\mu\text{g/L}$ )		
			1248	1254	1260
MC	08/14/01	PWS1	<0.080	<0.080	<0.080
MC	08/14/01	PWS2	<0.102	<0.102	<0.102
BB1A	08/14/01	PWS1	<0.082	<0.082	<0.082
BB1A	08/14/01	PWS2	<0.102	<0.102	<0.102
BB1	08/14/01	PWS1	<0.081	<0.081	<0.081
BB1	08/14/01	PWS2	<0.103	<0.103	<0.103
BB2	08/14/01	PWS1	<0.081	<0.081	<0.081
BB2	08/14/01	PWS2	<0.100	<0.100	<0.100
BB3	08/14/01	PWS1	<0.081	<0.081	<0.081
BB3	08/14/01	PWS2	<0.101	<0.101	<0.101
BB4	08/14/01	PWS1	<0.081	<0.081	<0.081
BB4	08/14/01	PWS2	<0.102	<0.102	<0.102
BB5	08/14/01	PWS1	<0.084	<0.084	<0.084
BB5	08/14/01	PWS2	<0.112	<0.112	<0.112
BB6	08/14/01	PWS1	0.099	<0.084	<0.084
BB6	08/14/01	PWS2	<0.101	<0.101	<0.101
BB7	08/14/01	PWS1	<0.082	<0.082	<0.082
BB7	08/14/01	PWS2	<0.101	<0.101	<0.101
BB8	08/14/01	PWS1	0.040*	<0.081	<0.081
BB8	08/14/01	PWS2	<0.104	<0.104	<0.104
BB9	08/14/01	PWS1	<0.082	<0.082	<0.082
BB9	08/14/01	PWS2	<0.107	<0.107	<0.107

\* PCBs detected, however the value was below Minimum Quantitation Limit (MQL).



Table 3. PCB results for water samples from Little Bayou Creek collected August 13, 2001.

Station	Date	Sample	Aroclor Concentration ( $\mu\text{g/L}$ )		
			1248	1254	1260
LB1	08/13/01	PWS1	<0.084	<0.084	<0.084
LB1	08/13/01	PWS2	<0.103	<0.103	<0.103
LB2	08/13/01	PWS1	<0.084	<0.084	<0.084
LB2	08/13/01	PWS2	<0.104	<0.104	<0.104
LB3	08/13/01	PWS1	<0.082	<0.082	<0.082
LB3	08/13/01	PWS2	<0.101	<0.101	<0.101
LB4	08/13/01	PWS1	<0.082	<0.082	<0.082
LB4	08/13/01	PWS2	<0.101	<0.101	<0.101

Table 4. Metal concentrations in water samples from Massac Creek and Big Bayou Creek collected August 14, 2001.

Station	Date	Sample	Water Metal Conc. (µg/L) <sup>1</sup>								
			Ag	Be	Cd	Cr	Cu	Fe	Pb	Ni	Zn
MC	8/14/01	MWS1	<0.250	0.023*	<0.250	<1.000	1.011	286.1	0.134*	<3.00	0.96*
BB1A	8/14/01	MWS1	<0.250	0.045*	<0.250	<1.000	<1.000	736.0	0.176*	<3.00	<1.00
BB1	8/14/01	MWS1	<0.250	0.034*	0.357	<1.000	<1.000	510.1	0.238*	<3.00	6.12
BB2	8/14/01	MWS1	<0.250	0.044*	<0.250	<1.000	1.968	1310.3	0.396*	5.07	9.74
BB3	8/14/01	MWS1	<0.250	0.033*	<0.250	<1.000	1.653	533.8	0.203*	2.99	1.28
BB4	8/14/01	MWS1	<0.250	0.056*	0.724	<1.000	1.811	241.1	0.118*	3.09	7.06
BB5	8/14/01	MWS1	<0.250	0.067*	<0.250	1.487	4.200	1955.9	0.599*	3.97	4.48
BB6	8/14/01	MWS1	<0.250	0.100*	<0.250	1.370	2.495	566.4	0.460*	4.17	2.16
BB7	8/14/01	MWS1	<0.250	0.102*	<0.250	2.366	1.855	453.9	0.403*	4.12	1.13
BB8	8/14/01	MWS1	<0.250	0.080*	<0.250	1.964	1.262	341.9	0.393*	3.82	<1.00
BB9	8/14/01	MWS1	<0.250	0.057*	<0.250	<1.000	2.226	849.8	0.310*	5.43	1.16

<sup>1</sup> Asterisk represent samples where metal concentrations were detected but were below minimum quantitation limit (MQL).

Table 5. Metal concentrations in water samples from Little Bayou Creek collected August 13, 2001.

Station	Date	Sample	Water Metal Conc. ( $\mu\text{g/L}$ ) <sup>1</sup>								
			Ag	Be	Cd	Cr	Cu	Fe	Pb	Ni	Zn
LB1	8/13/01	MWS1	<0.250	0.133*	<0.250	<1.000	3.360	1553.7	0.406*	5.27	13.66
LB2	8/13/01	MWS1	<0.250	0.044*	<0.250	0.938*	3.782	357.8	0.291*	3.26	5.53
LB3	8/13/01	MWS1	<0.250	0.044*	0.283	<1.000	3.284	416.3	0.280*	5.66	3.74
LB4	8/13/01	MWS1	<0.250	0.067*	<0.250	1.030	2.766	1614.9	0.321*	5.18	12.07

<sup>1</sup> Asterisk represent samples where metal concentrations were detected but were below minimum quantitation limit (MQL).

## REFERENCES

APHA-American Public Health Association, American Water Works Association and Water Pollution Control Federation. 1995. Standard Methods for the Examination of Water and Wastewater, 19th edition. American Public Health Association, Washington, DC.

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