

**Polychlorinated Biphenyl (PCB) Residues in
Stream Sediments and Floodplain Soils
Collected June 3-4, 2002
from the Bayou Creek System**

Wesley J. Birge

David J. Price

DRAFT REPORT

July 30, 2003

Submitted to

Jon Maybriar

**Division of Waste Management
Kentucky Department for Environmental Protection**

INTRODUCTION

Sediment samples (18 samples) were taken for PCB analyses from Big and Little Bayou Creeks on June 3-4, 2002. A total of 11 sites were sampled from Big Bayou Creek (stations BB1A through BB9) and 5 sites from Little Bayou Creek (stations LB1 through LB4). In addition, Massac Creek (MC) was sampled (*i.e.* West Fork) and served as a reference station independent of the Bayou Creek system. Sediments were also collected at the combined effluents 010 and 011 in Little Bayou Creek. In addition to stream sediments, floodplain soils were collected at each of the stations. Samples were collected in duplicate and were analyzed for PCBs. Three Aroclors (*i.e.* 1248, 1254, 1260) were determined for all samples.

METHODS

Sediment samples were restricted to the upper 5-10 cm of sediment soil, including depositional areas when found. Floodplain soils were collected within 10 m of the shoreline (5-10 cm deep) in areas where flood debris was present. Any surface vegetation was removed prior to sampling floodplain soils. All sediment and floodplain samples were collected in acetone-rinsed 0.47 L glass jars with Teflon or aluminum foil-lined lids. Stainless steel spoons and scoops used for collections were acetone-rinsed between sampling stations.

PCB Extraction and Analysis

Wet sediment or floodplain soil extractions of PCB and sample cleanup were performed following U.S EPA SW-846 Method 3540C (U.S. EPA, 1997; Erickson, 1997) as described previously by Birge and Price (2002a). Samples were analyzed for Aroclors 1248, 1254, and 1260 according to SW-846 Method 8082 (U.S. EPA, 1997).

Analyses also were performed as described by Birge and Price (2002a).

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

PCB concentrations for individual wet-extracted sediments for Massac Creek and Big Bayou Creek are given in Table 1. Mean values for PCB in sediments are given in Table 3 and Figure 1. No Aroclor 1248 was detected at any of the Big Bayou Creek stations. Aroclor 1248 also was not detected in sediments collected August 13-14, 2001 (Birge and Price, 2002b). Aroclor 1254 was detected at stations BB6 and BB7. Although Aroclor 1260 was observed at stations BB4 through BB9, only stations BB6 and BB8 had quantifiable levels of Aroclor 1260 (5.08 and 5.99 $\mu\text{g}/\text{Kg}$ (ppb) for BB6; 4.53 $\mu\text{g}/\text{Kg}$ for BB8), see Table 1. Maximum total PCB was 9.13 $\mu\text{g}/\text{Kg}$ and occurred at BB6.

PCB concentrations for individual Little Bayou Creek sediments are presented in Table 2. Samples from stations LB2A through LB4 were injected in duplicate (Table 2). Mean sediment PCB values in Little Bayou Creek are presented in Table 3 and Figure 2. Concerning Little Bayou Creek, PCBs were not detected at station LB1 situated upstream of PGDP. However, Aroclors 1254 and 1260 were detected at stations LB2A through LB4 (Tables 2 and 3, Figure 2). The highest concentrations of Aroclor 1254 and

1260 were observed at station LB2A and were 43.14 and 52.07 $\mu\text{g}/\text{Kg}$, respectively. The highest total PCB concentration also was observed at LB2A and was 95.21 $\mu\text{g}/\text{Kg}$. The second highest levels obtained were from sediments at effluents 010+011 (14.44 $\mu\text{g}/\text{Kg}$). The maximum values were 7.26, 7.18, and 14.44 $\mu\text{g}/\text{Kg}$ for 1254, 1260, and total PCBs (Table 2). This was followed by a downstream decrease in PCB concentrations (Figure 2).

Results for PCBs in individual floodplain soils from Massac Creek and Big Bayou Creek are presented in Table 4. Mean PCB results for floodplain soils are presented in Table 6 and Figure 4. Aroclor 1248 was detected only at station BB9 (18.50 $\mu\text{g}/\text{Kg}$). However, Aroclors 1254 and 1260 were detected at stations BB3 through BB9 (Tables 4 and 6, Figure 4). This details a rather broad distribution of these Aroclors. Station BB6 had the highest levels of 30.10 and 40.39 $\mu\text{g}/\text{Kg}$ for 1254 and 1260, respectively. Floodplain soil PCB levels were greater than those from stream sediments. Aroclor 1254 and 1260 concentrations at station BB6 were about 7 to 8 times greater than observed for stream sediments. Aroclor 1260 averaged about 3 times greater than found for sediments at stations BB8 and BB9. The maximum floodplain value for total PCB was 70.04 $\mu\text{g}/\text{Kg}$ at BB6.

Results for individual floodplain soils from Little Bayou Creek are shown in Table 5 and mean PCB values are given in Table 6 and Figure 4. As with the sediments, no PCBs were detected upstream at station LB1. Aroclor 1248 was observed at stations LB2A (37.20 and 41.08 $\mu\text{g}/\text{Kg}$) and LB4 (55.86 and 69.57 $\mu\text{g}/\text{Kg}$). Aroclors 1254 and 1260 were detected at stations LB2A through LB4. The highest concentrations were found at station LB2 for 1254 (127.72 $\mu\text{g}/\text{Kg}$) and 1260 (148.65 $\mu\text{g}/\text{Kg}$). Total PCBs ranged from 139.91 to

275.31 µg/Kg for 8 measurements of floodplain soils taken at stations LB2A through LB4.

DISCUSSION

In a previous report, Aroclor 1248 was detected at concentrations up to 0.1 µg/mL in stream water samples from stations BB6 and BB8 in Big Bayou Creek (Birge and Price, 2003). As noted in this report (Table 1), Aroclor 1248 was not detected in sediments from these stations. Therefore, the stream water PCB contamination observed earlier likely originated from some other source. The absence of Aroclor 1248 in sediments from Big Bayou Creek may indicate that the sediment contamination was not of recent origin. However, the Aroclors with longer environmental half-life were evident at and below station BB6. These included Aroclors 1254 and 1260. The highest concentration of total PCB was 9.1 µg/Kg at station BB6. The distribution of sediment PCB is illustrated in Figure 1.

Greater PCB contamination was observed in Little Bayou Creek, as noted in various earlier studies (Birge and Price, 2002a and 2002b). As in Big Bayou Creek, Aroclor 1248 was not detected in sediments at any of the Little Bayou Creek stations (Table 2; Figure 2). However, Aroclors 1254 and 1260 were found at all Little Bayou Creek stations. Maximum values were recorded for stations LB2A. At this station, Aroclors 1254 and 1260 were observed at concentrations ranging up to 43.1 and 52.1 µg/Kg, respectively. Total PCB was 95.2 µg/Kg at this station. Mean PCB values for sediments from Big and Little Bayou Creeks are given in Table 3.

As noted above, PCB contamination was significantly greater in floodplain soils than in stream sediments. Floodplain samples were taken within 10 m of the stream beds where flood debris was evident. Highest concentrations in Big Bayou Creek were found at station BB4 and below. The maximum value for total PCB was 70.0 µg/Kg at BB6. The distribution

of Aroclors 1254 and 1260 (mean concentrations) in Big Bayou Creek floodplain soils are shown in Figure 3. Aroclor 1248 was found only at station BB9. Highest values for PCBs were observed in Little Bayou Creek at stations LB2A, LB2, and LB3. Total PCB concentrations ranged from 195.7 to 275.3 $\mu\text{g}/\text{Kg}$ at these stations. The PCB contamination pattern for floodplain soils in Little Bayou Creek is illustrated in Figure 4. These findings support the premise that further studies should be conducted on floodplain soils, as well as general yearly surveys of sediments to define multi-year patterns. Greater concern rests with data found for floodplain soils in region BB4 through BB9 in Big Bayou Creek. It is important to note that these data support the conclusion that there has been significant downstream transport of PCBs, as evident for results observed at stations BB8 and BB9.

Greater concern is focused on sediment and floodplain soil contamination found in Little Bayou Creek at section LB2A through LB4. Future measurements should extend downstream of LB4.

Table 1. PCB results for stream sediment samples from Massac Creek and Big Bayou Creek, collected June 3-4, 2002.

Station	Date	Sample ¹	Sample			Aroclor Conc. (µg/Kg)			
			Wet Wt. (g)	Dry Wt. (g)	% Moisture	1248	1254	1260	Total
MC	6/3/02	PSED1A	65.29	51.72	20.8	<3.87	<3.87	<3.87	<3.87
MC	6/3/02	PSED1B	71.98	57.24	20.5	<3.49	<3.49	<3.49	<3.49
BB1A	6/3/02	PSED1A	58.25	46.76	19.7	<4.28	<4.28	<4.28	<4.28
BB1A	6/3/02	PSED1B	68.77	55.23	19.7	<3.62	<3.62	<3.62	<3.62
BB1	6/3/02	PSED1A	68.62	54.66	20.3	<3.66	<3.66	<3.66	<3.66
BB1	6/3/02	PSED1B	56.00	44.18	21.1	<4.53	<4.53	<4.53	<4.53
BB2	6/3/02	PSED1A	72.18	58.78	18.6	<3.40	<3.40	<3.40	<3.40
BB2	6/3/02	PSED1B	77.26	60.54	21.6	<3.30	<3.30	<3.30	<3.30
BB2A	6/3/02	PSED1A	59.99	48.89	18.5	<4.09	<4.09	<4.09	<4.09
BB3	6/3/02	PSED1A	64.89	53.58	17.4	<3.73	<3.73	<3.73	<3.73
BB4	6/3/02	PSED1A	74.73	63.85	14.6	<3.13	<3.13	1.14*	1.14*
BB4	6/3/02	PSED1B	79.99	66.29	17.1	<3.02	<3.02	0.62*	0.62*
BB5	6/3/02	PSED1A	66.24	52.46	20.8	<3.81	<3.81	1.13*	1.13*
BB5	6/3/02	PSED1B	70.00	55.99	20.0	<3.57	<3.57	1.14*	1.14*

¹ PSED1A and PSED1B are duplicate samples from the same jar.

* PCBs were detected, however the values were below the Minimum Quantitation Level (MQL).

Table 1, continued. PCB results for stream sediment samples from Massac Creek and Big Bayou Creek, collected June 3-4, 2002.

Station	Date	Sample ¹	Sample			Aroclor Conc. (µg/Kg)			
			Wet Wt. (g)	Dry Wt. (g)	% Moisture	1248	1254	1260	Total
BB6	6/3/02	PSED1A	58.83	49.21	16.4	<4.06	4.05	5.08	9.13
BB6	6/3/02	PSED1B	58.36	50.05	14.2	<4.00	2.36*	5.99	8.35
BB7	6/3/02	PSED1A	68.81	59.32	13.8	<3.37	<3.37	1.23*	1.23*
BB7	6/3/02	PSED1B	62.29	52.91	15.1	<3.78	6.76	1.03*	7.79
BB8	6/3/02	PSED1A	70.85	59.26	16.4	<3.37	<3.37	4.53	4.53
BB8	6/3/02	PSED1B	61.90	51.89	16.2	<3.85	<3.85	3.59*	3.59*
BB9	6/3/02	PSED1A	46.30	30.18	34.8	<6.63	<6.63	2.56*	2.56*
BB9	6/3/02	PSED1B	52.09	34.10	34.5	<5.87	<5.87	3.73*	3.73*

¹ PSED1A and PSED1B are duplicate samples from the same jar.

* PCBs were detected, however the values were below the Minimum Quantitation Level (MQL).

Table 2. PCB results for stream sediment samples from Little Bayou Creek, collected June 3-4, 2002.

Station	Date	Sample ¹	Sample			Aroclor Conc. (µg/Kg)			
			Wet Wt. (g)	Dry Wt. (g)	% Moisture	1248	1254	1260	Total
LB1	6/3/02	PSED1A	72.64	53.83	25.9	<3.72	<3.72	<3.72	<3.72
LB1	6/3/02	PSED1B	54.93	40.44	26.4	<4.95	<4.95	<4.95	<4.95
LB2A	6/4/02	PSED1A	78.55	63.24	19.5	<3.16	9.32	5.53	14.86
LB2A	6/4/02	PSED1B	63.70	51.07	19.8	<3.92	43.14	52.07	95.21
010+011	6/4/02	PSED1A	57.10	42.53	25.5	<4.70	5.35	4.81	10.16
010+011	6/4/02	PSED1B	57.36	43.68	23.8	<4.58	7.26	7.18	14.44
LB2	6/4/02	PSED1A	49.76	40.26	19.1	<4.97	3.74*	5.19	8.93
LB2	6/4/02	PSED1B	46.14	37.11	19.6	<5.39	2.19*	3.18*	5.38*
LB3	6/4/02	PSED1A	53.48	42.11	21.3	<4.75	<4.75	<4.75	<4.75
LB3	6/4/02	PSED1B	40.51	31.06	23.3	<6.44	4.19*	2.34*	6.53*
LB4	6/3/02	PSED1A	68.75	56.99	17.1	<3.51	3.28*	1.99*	5.28
LB4	6/3/02	PSED1B	75.61	62.33	17.6	<3.21	1.17*	1.39*	2.56*

¹ PSED1A and PSED1B are duplicate samples from the same jar.

* PCBs were detected, however the values were below the Minimum Quantitation Level (MQL).

Table 3. Mean PCB results for stream sediment samples from Massac Creek (MC) and Bayou Creek system collected June 3-4, 2002.

Station	Aroclor Conc. ($\mu\text{g}/\text{Kg}$)			
	1248	1254	1260	Total
MC	<3.49	<3.49	<3.49	<3.49
BB1A	<3.62	<3.62	<3.62	<3.62
BB1	<3.66	<3.66	<3.66	<3.66
BB2	<3.30	<3.30	<3.30	<3.30
BB2A	<4.09	<4.09	<4.09	<4.09
BB3	<3.73	<3.73	<3.73	<3.73
BB4	<3.02	<3.02	0.88*	0.88*
BB5	<3.57	<3.57	1.13*	1.13*
BB6	<4.00	3.20	5.54	8.74
BB7	<3.37	6.76	1.13*	4.51
BB8	<3.37	<3.37	4.06	4.06
BB9	<5.87	<5.87	3.15*	3.15*
LB1	<3.72	<3.72	<3.72	<3.72
LB2A	<3.16	26.23	28.80	55.03
010+011	<4.58	6.31	6.00	12.31
LB2	<4.97	2.96*	4.19*	7.15
LB3	<4.75	4.19*	2.34*	6.53
LB4	<3.21	2.23*	1.69*	3.92

* PCBs were detected, however values were below the Minimum Quantitation Level (MQL).

Table 4. PCB results for floodplain soils from Massac Creek and Big Bayou Creek, collected June 3-4, 2002.

Station	Date	Sample ¹	Sample			Aroclor Conc. (µg/Kg)			
			Wet Wt. (g)	Dry Wt. (g)	% Moisture	1248	1254	1260	Total
MC	6/3/02	PFP1A	75.18	74.37	1.1	<2.69	<2.69	<2.69	<2.69
MC	6/3/02	PFP1B	66.58	65.92	1.0	<3.03	<3.03	<3.03	<3.03
BB1A	6/3/02	PFP1A	38.95	31.33	19.6	<6.38	<6.38	<6.38	<6.38
BB1A	6/3/02	PFP1B	41.74	33.54	19.6	<5.96	<5.96	<5.96	<5.96
BB1	6/3/02	PFP1A	58.94	50.20	14.8	<3.98	<3.98	<3.98	<3.98
BB1	6/3/02	PFP1B	58.94	49.36	16.3	<4.05	<4.05	<4.05	<4.05
BB2	6/3/02	PFP1A	67.04	48.52	27.6	<4.12	<4.12	<4.12	<4.12
BB2	6/3/02	PFP1B	57.31	40.28	29.7	<4.97	<4.97	<4.97	<4.97
BB2A	6/3/02	PFP1A	63.95	61.92	3.2	<3.23	<3.23	<3.23	<3.23
BB3	6/3/02	PFP1B	64.25	57.91	9.9	<3.45	4.70	2.18*	6.88
BB4	6/3/02	PFP1A	51.61	40.54	21.4	<4.93	14.27	10.63	24.90
BB4	6/3/02	PFP1B	49.34	38.72	21.5	<5.17	20.04	11.65	31.70
BB5	6/3/02	PFP1A	62.71	51.44	18.0	<3.89	5.01	4.03	9.04
BB5	6/3/02	PFP1B	58.46	47.48	18.8	<4.21	5.89	2.48*	8.38

¹ PSED1A and PSED1B are duplicate samples from the same jar.

* PCBs were detected, however the values were below the Minimum Quantitation Level (MQL).

Table 4, continued. PCB results for floodplain soils from Massac Creek and Big Bayou Creek, collected June 3-4, 2002.

Station	Date	Sample ¹	Sample			Aroclor Conc. (µg/Kg)			
			Wet Wt. (g)	Dry Wt. (g)	% Moisture	1248	1254	1260	Total
BB6	6/3/02	PFP1A	52.69	46.11	12.5	<4.34	30.10	39.94	70.04
BB6	6/3/02	PFP1B	52.93	46.70	11.8	<4.28	16.46	40.39	56.85
BB7	6/3/02	PFP1A	62.42	60.71	2.7	<3.29	3.87	3.08*	6.95
BB7	6/3/02	PFP1B	70.54	69.31	1.7	<2.89	6.46	1.99*	8.45
BB8	6/3/02	PFP1A	53.83	48.40	10.1	<4.13	12.49	11.25	23.74
BB8	6/3/02	PFP1B	50.89	45.43	10.7	<4.40	12.16	11.72	23.88
BB9	6/3/02	PFP1A	46.07	35.93	22.0	<5.57	18.28	9.16	27.44
BB9	6/3/02	PFP1B	48.98	40.75	16.8	18.50	11.45	9.58	39.52

¹ PSED1A and PSED1B are duplicate samples from the same jar.

* PCBs were detected, however the values were below the Minimum Quantitation Level (MQL).

Table 5. PCB results for floodplain soils from Little Bayou Creek, collected June 3-4, 2002.

Station	Date	Sample ¹	Sample			Aroclor Conc. (µg/Kg)			
			Wet Wt. (g)	Dry Wt. (g)	% Moisture	1248	1254	1260	Total
LB1	6/3/02	PFP1A	45.35	36.86	18.7	<5.43	<5.43	<5.43	<5.43
LB1	6/3/02	PFP1B	41.33	31.70	23.3	<6.31	<6.31	<6.31	<6.31
LB2A	6/4/02	PFP1A	43.55	35.47	18.6	37.20	55.26	138.20	230.66
LB2A	6/4/02	PFP1B	48.17	39.27	18.5	41.08	33.37	121.25	195.70
LB2	6/4/02	PFP1A	50.41	44.30	12.1	<4.51	126.66	148.65	275.31
LB2	6/4/02	PFP1B	62.45	54.50	12.7	<3.67	127.72	105.44	233.16
LB3	6/4/02	PFP1A	48.90	43.93	10.2	<4.55	127.33	112.86	240.19
LB3	6/4/02	PFP1B	53.34	47.76	10.5	<4.19	119.56	103.26	222.83
LB4	6/3/02	PFP1A	44.24	36.99	16.4	55.86	39.81	44.24	139.91
LB4	6/3/02	PFP1B	54.33	46.49	14.4	69.57	42.18	41.82	153.56

¹ PSED1A and PSED1B are duplicate samples from the same jar.

* PCBs were detected, however the values were below the Minimum Quantitation Level (MQL).

Table 6. Mean PCB results for floodplain soils from Massac Creek (MC) and Bayou Creek system collected June 3-4, 2002.

Station	Aroclor Conc. ($\mu\text{g}/\text{Kg}$)			
	1248	1254	1260	Total
MC	<2.69	<2.69	<2.69	<2.69
BB1A	<5.96	<5.96	<5.96	<5.96
BB1	<3.98	<3.98	<3.98	<3.98
BB2	<4.12	<4.12	<4.12	<4.12
BB3	<3.45	4.70	2.18*	6.88
BB4	<4.93	17.16	11.14	28.30
BB5	<3.89	5.45	3.26	8.71
BB6	<4.28	23.28	40.16	63.44
BB7	<2.89	5.17	2.54*	7.70
BB8	<4.13	12.32	11.49	23.81
BB9	18.50	14.86	9.37	33.48
LB1	<5.43	<5.43	<5.43	<5.43
LB2A	39.14	44.31	129.73	213.18
LB2	<3.67	127.19	127.05	254.23
LB3	<4.19	123.45	108.06	231.51
LB4	62.72	40.99	43.03	146.74

* PCBs were detected, however values were below the Minimum Quantitation Level (MQL).

Figure 1. Mean PCB concentrations in sediments from Massac Creek and Big Bayou Creek collected June 3-4, 2002.

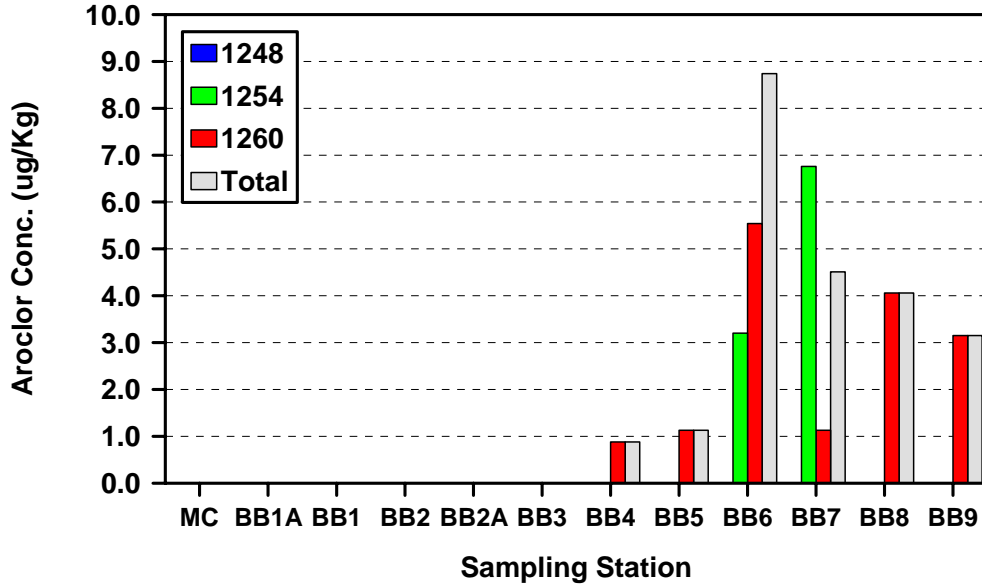


Figure 2. Mean PCB concentrations in sediments from Little Bayou Creek collected June 3-4, 2002.

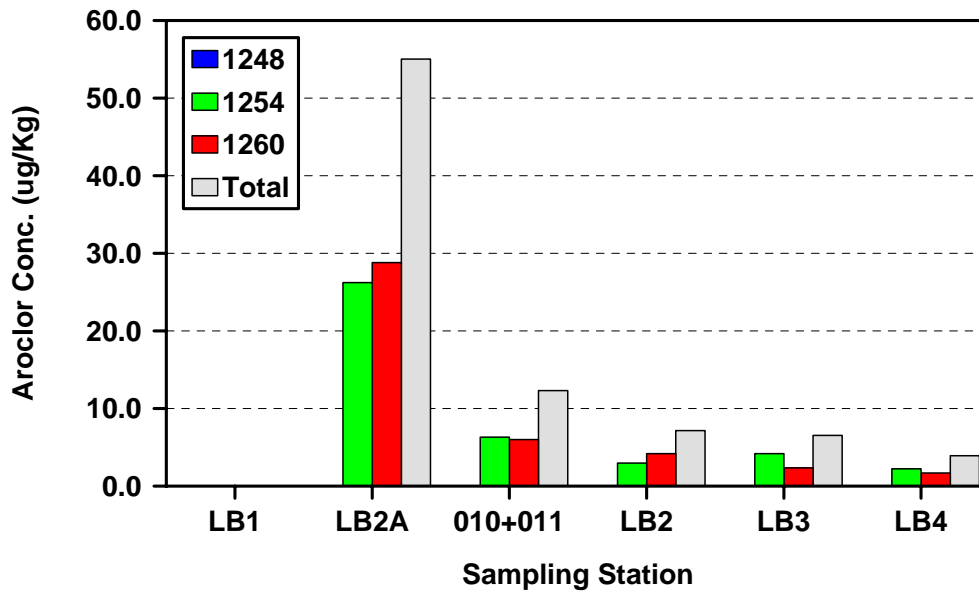


Figure 3. Mean PCB concentrations in floodplain soils from Massac Creek and Big Bayou Creek collected June 3-4, 2002.

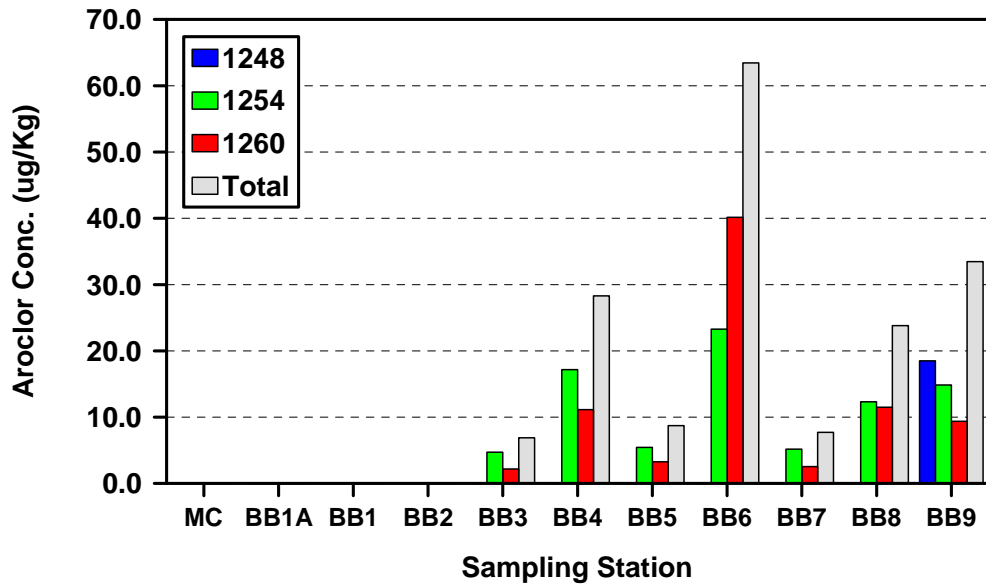
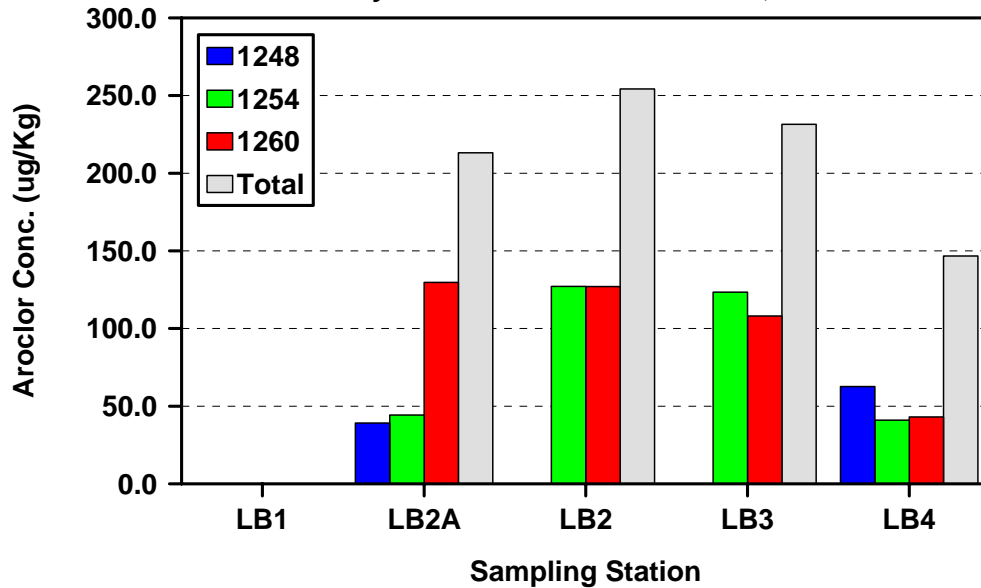


Figure 4. Mean PCB concentrations in floodplain soils from Little Bayou Creek collected June 3-4, 2002.



REFERENCES

ASTM. 1989. Standard Practice for Preparation of Sediment Samples for Chemical Analysis. D 3976-88. Annual Book of ASTM Standards. Vol. 11.02. pp. 598-600. ASTM, Philadelphia, PA.

Birge, W.J. and D.J. Price. 2003. Analysis of Polychlorinated Biphenyl Mixtures (PCB) in Water Samples Collected from the Bayou Creek System on June 3-4, 2002. Report submitted March 18, 2003 to Jon Maybriar, Division of Waste Management.

Birge, W.J. and D.J. Price. 2002a. Analysis of Polychlorinated Biphenyl (PCB) Residues and Metals in Sediment Samples Collected February 19-20, 2001 from the Bayou Creek System. Report submitted February 4, 2002 to Jon Maybriar, Division of Waste Management.

Birge, W.J. and D.J. Price. 2002b. Analysis of Polychlorinated Biphenyl (PCB) Residues and Metals in Sediment Samples Collected August 13-14, 2001 from the Bayou Creek System. Report submitted April 18, 2002 to Jon Maybriar, Division of Waste Management.

Erickson, M.D. 1997. *Analytical Chemistry of PCBs*, 2nd edition. CRC Press, Boca Raton, FL. pp.667.

Federal Register. 1989. Good Laboratory Practice Standards. 40 CFR Part 160. August 17, 1989. Washington, DC.

U.S. EPA. 1997. Test methods for evaluating solid wastes, SW-846, Final Update 3. Office of Solid Waste and Emergency Response, Washington, D.C.