Impacts of Point and Nonpoint Sources on Vince Bayou and Little Vince Bayou Segment 1007 of the Houston Ship Channel

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ABSTRACT

Vince Bayou, much of which is tidally influenced, flows through the City of Pasadena into the Houston Ship Channel (HSC). Both point source (Wastewater Treatment Plant) and nonpoint source runoff (commercial and residential) occur in Vince Bayou. Vince Bayou was selected for a special study due to the recurrence of fish kills and the appearance of poor water quality.

Historical average values from 1983-1993 indicate elevated levels of fecal coliform, total phosphorus, orthophosphorus, ammonia nitrogen, and nitrate+nitrite nitrogen. Significant sediment toxicity, and elevated levels of metals in water, metals in sediment, and organics in sediment have been detected in Vince Bayou.

Electrofishing was used to assess the fish community. All of the species collected were considered tolerant. Based on this survey, Vince Bayou has water quality typical of other heavily industrialized urban streams within Southeast Texas.

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INTRODUCTION

As of August, 1992, there were 52 domestic outfalls permitted by the TNRCC in segment 1007, one of which is located on Vince Bayou. Segment 1007 has had a history of elevated levels of total inorganic nitrogen, total phosphorus, and ortho-phosphorus (Texas Water Commission [TWC], 1992). In addition, both acute and chronic ambient toxicity and effluent (City of Pasadena) toxicity have been demonstrated. A restricted consumption advisory (Texas Department of Health [TDH], 1991) for blue crab and catfish is in effect due to elevated levels of dioxin in edible tissue. Elevated levels of nickel in the water have also been found (TWC, 1992). TNRCC is presently conducting surface water quality monitoring at eight stations in segment 1007, including one for nekton.

Included in the 52 outfalls is that of the City of Pasadena Wastewater Treatment Plant (WWTP). The City of Pasadena WWTP is the only permitted discharger on Vince Bayou, discharging a daily average of 2-3 MGD into Vince Bayou below South Richey Road (Figure 1). Historically, this plant has experienced problems with the pure oxygen collection system, especially during times of heavy rainfall, and have been under enforcement from the U.S. Environmental Protection Agency (EPA) and the TNRCC for non-compliance (personal communication; Pat Noll, TNRCC water quality investigator).

Sources of nonpoint source pollution surrounding Vince Bayou and Little Vince Bayou consist primarily of runoff from residential lawn care but there is some runoff from parking lots of various commercial businesses.

SITE DESCRIPTION

Vince Bayou is part of segment 1007 of the HSC. The total length of this segment is 14 miles, extending from immediately upstream of Greens Bayou to 100 meters upstream of US HWY 59, including tidal portions of contributing tributaries. Primary uses of this segment include industrial water supply and navigation.

Vince Bayou is an industrialized bayou, with an approximate length of 6 miles, that winds through the City of Pasadena to the HSC. The upper portion of the bayou (about 5 miles) is characteristic of a channelized flood control ditch with low water levels except during heavy rainfall periods. The lower portion (about 1 mile) widens and has some riparian habitat near the confluence with Little Vince Bayou (Figure 1). There is both point source (City of Pasadena WWTP) and nonpoint source (residential and commercial) runoff into the bayou. Water quality in Vince Bayou may also be affected by the tidal influence of the HSC.

MATERIALS AND METHODS

Samples collected to determine the quality of Vince Bayou included: water for routine chemical analysis, toxicity, and dissolved metals; sediment for metals, organic substances, and toxicity; whole fish tissue for metals and organic substances; and electrofishing for fish community analysis.

Water

Water samples for routine chemical analysis were collected in three 1-liter cubitainers per station. Sulfuric acid (used for nutrient preservation) was added to the cubitainer containing water for nutrient analysis. Water for biochemical oxygen demand (BOD) analysis was collected in a 4-liter cubitainer.

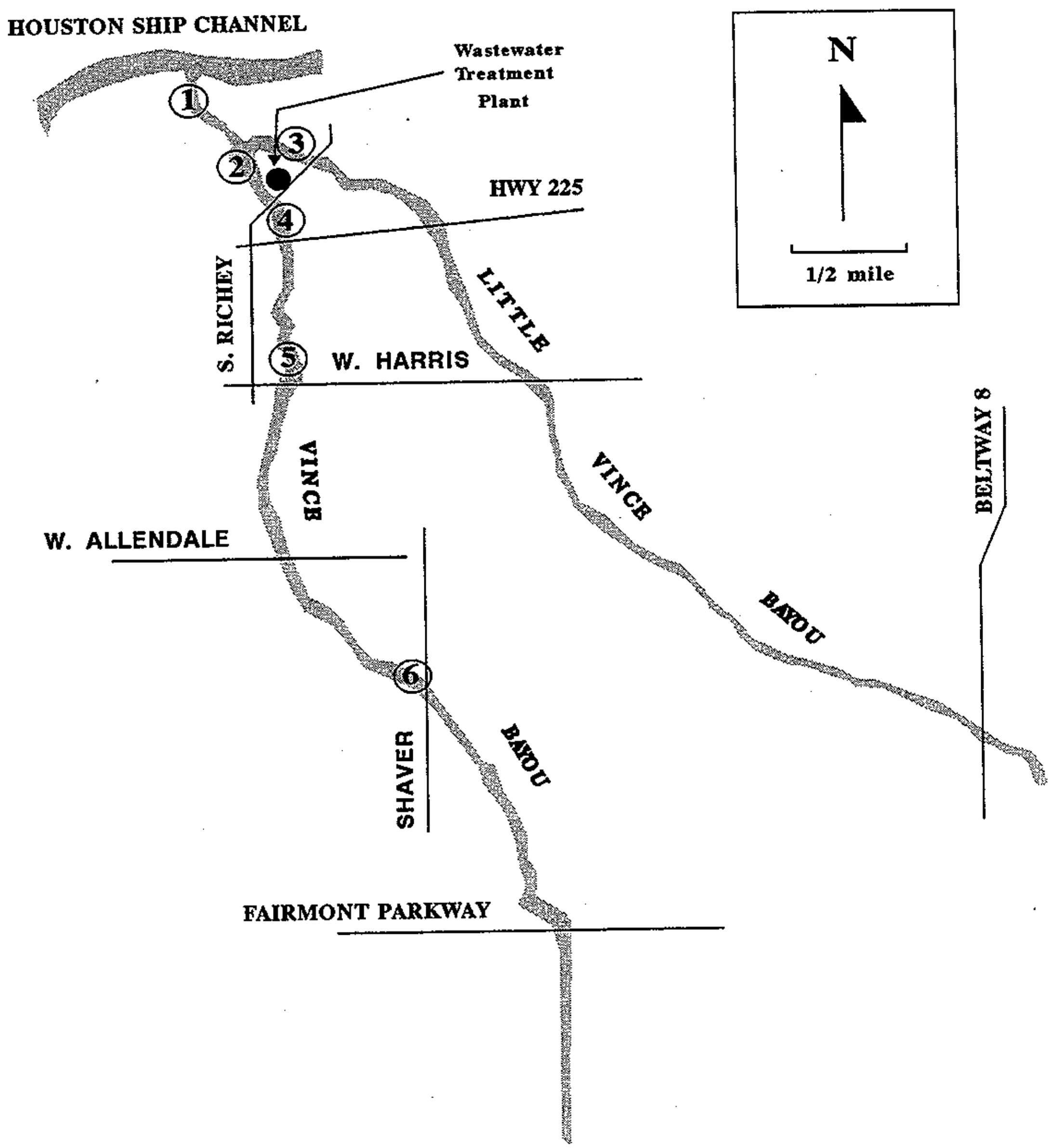

Figure 1. Locations of sampling stations on Vince Bayou and Little Vince Bayou. Station locations: 1) Vince Bayou at pipeline crossing, 2) Vince Bayou downstream of the City of Pasadena WWTP outfall, 3) Little Vince Bayou at S. Richey, 4) Vince Bayou upstream of S. Richey, 5) Vince Bayou at W. Harris, 6) Vince Bayou at Shaver.

Routine chemical and BOD analyses were done by the TNRCC laboratory. Water toxicity samples were collected in 8-liter cubitainers and submitted to the EPA laboratory for analysis. Water for dissolved metals analysis was collected with a peristaltic hand pump using pre-washed (nitric acid) tubing and a 0.45 micron filter cartridge. Filtered water was then dispensed into a 1-liter jar containing 2-ml of concentrated reagent grade nitric acid. Dissolved metals samples were submitted to Southwestern Laboratories (SWL) for analysis and the results were compared to the Texas Surface Water Quality Standards (TWC, 1991).

Sediment

Sediment was collected with an Ekman grab for analysis of organic substances, metals, and toxicity. The most recently deposited sediment (top 2-3 cm) was removed with a teflon scoop and composited into a plastic wash tub. Sediment used for organic substance analysis and metals analysis was taken from the wash tub to fill two 1-liter glass jars. The sample jar reserved for sediment to be used for organic substance analysis was washed with Methylene Chloride whereas the sample jar reserved for sediment to be used for metals analysis was washed with Nitric Acid. Sediment was submitted to SWL for organic substance analysis and to the TNRCC laboratory for metals analysis. Sediment for toxicity testing was composited into a 2-liter plastic jar and submitted to the EPA laboratory for analysis. Sediment samples were taken directly from the stream bottom using a teflon scoop when sediments were not soft enough to allow samples to be obtained by using the Ekman grab. Results from sediment samples were compared to the TNRCC historical data base.

Tissue

Tissue sampling was conducted at one of the six stations using a boat mounted electrofisher. A whole fish was submitted to Inchcape Testing Services for analysis of organic substances and metals contamination. The target species (common carp, Cyprinus carpio) was selected based on its benthic feeding habits. Historical tissue data were included in this report to use as comparison.

Fish Community

The fish community assessment was conducted using a boat mounted electrofisher at the four lower stations but not at the two upstream stations due to the lack of accessibility. Fish were stunned with 170 volts and approximately 55 amps using direct current (DC) generated from the pulsator/generator. Fish were collected for a period of 20 minutes at each station and placed in a holding tank. The fish were then identified to species, the total number of each species recorded, measured to the nearest millimeter, and released. Shannon-Weiner Diversity Index (H') and Pielou's J' Evenness Index (E) were used to describe the fish community at each station. Diversity takes into account the number of species and individuals within each community sampled, and E describes the evenness of that community (Ludwig and Reynolds 1988).

RESULTS

Conductivity values indicate stations 1-4 were affected by saltwater intrusion, whereas stations 5 and 6 were basically freshwater. Based on these values, both saltwater (SW) and freshwater (FW) criteria were utilized for comparison for respective stations when available.

Water

Historical data collected from 1983-1993 indicate average fecal coliform levels to be elevated (91% of the time) above the criteria level of 400 colonies/100 ml set by the TNRCC. Historical averages also indicate the following parameters to be elevated above the screening levels; ammonia (91% of the time), nitrate + nitrite nitrogen (82% of the time), and both total phosphorus and orthophosphorus (100% of the time, Table 1). Results from the present study indicate field measurements at stations 1-4, except for pH at station 2, did not exceed the criteria, while fecal coliform levels exceeded the criteria (both FW and SW) at all six stations. Routine chemical analyses for the present study indicate elevated levels of ammonia nitrogen and nitrate+nitrite nitrogen only at stations 1 and 2, and total phosphorus and orthophosphorus at stations 1-4. Total phosphorus levels were just below the screening level at stations 5 and 6, whereas orthophosphorus at station 5 was right at the screening level and just exceeds the screening level at station 6 (Table 2).

Although these results are indicative of poor water quality, both present and historical toxicity testing results from Vince Bayou has never indicated water toxicity (Table 3). Historical data for station 1007.9200 from 1983 to 1991 shows that ammonia nitrogen levels exceeded the un-ionized ammonia water quality criteria, indicating chronic toxicity in 33 out of 48 samples (69%). Of the six ammonia nitrogen levels monitored in this study, station 1 (which is also 1007.9200), exceeded the un-ionized ammonia water quality criteria indicating chronic toxicity (Table 4).

Results indicate low levels of dissolved metals in Vince Bayou (Table 5). Metals detected include aluminum, arsenic, barium, copper, iron, lead, silver, and zinc. Arsenic was detected at all six stations but at very low levels and did not exceed either the marine acute or marine chronic criteria. Copper was detected at stations 3 and 4, not exceeding the marine acute, but exceeding the marine chronic criterion. Lead levels exceeding the marine chronic criterion were detected at stations 1, 3, 4, and 5.

Sediment

Both past and present sediment sampling has indicated toxicity at station 1, possibly due to the elevated ammonia levels from the WWTP or the HSC (Table 3). No toxicity was indicated at the five remaining stations.

Concentration of metals appeared to be higher in sediment than in water (Table 6). Metals that exceeded the TNRCC Surface Water Quality Monitoring Program's 85th percentile or their respective freshwater or saltwater screening level for one or more stations were arsenic, chromium, copper, lead, mercury, and zinc. Of these, lead and zinc levels were more elevated and occurred at the most number of stations. Organic substances in sediment results indicated some semivolatiles were detected, but at only three stations (Table 7). Screening levels for Bis(2-Ethylhexyl)pthalate indicate this compound to be highly elevated at stations 4 and 5.

Tissue

Results from previous routine tissue sampling in Vince Bayou (1989 and 1990), station 1007.9200 (Vince Bayou at Pipeline Crossing, station 1 of this study), indicate non-elevated levels of metals (ie. copper, mercury, selenium) and both elevated and non-elevated levels of organic substances (ie. DDT, DDE, Dieldrin, Hexachlorobenzene, PCB, Endrin, Chlordane, Dachthal). Non-elevated levels were well below the 85th percentile value. Previous organic substance analyses were less extensive than those of this special study.

Table 1. Annual averages (1983-1993) of field data and various chemical data for Vince Bayou at pipeline crossing, station 1007.9200. Numbers in parentheses indicate the number of values used to determine the mean. Criteria are those used for segment 1007 of the Houston Ship Channel, and the screening levels set forth in *The State of Texas Water Quality Inventory*, 12th Edition, 1994. Shaded areas represent values that exceed their respective criteria or screening level.

Parameters	Screening Levels/Criteria	Years										
		1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983
Temperature (°C)	35.0	22.0 (3)	22.3 (1)	31.3 (1)	25.6 (5)	24.4 (3)	24.1 (10)	23.6 (11)	28.7 (6)	25.5 (3)	21.5 (7)	23.8 (9)
pH (su)	6.5 – 9.0	7.3 (3)	7.2 (2)	6.9 (1)	7.0 (5)	7.2 (3)	7.1 (10)	7.1 (11)	7.2 (6)	7.3 (3)	7.3 (8)	7.3 (9)
Dissolved oxygen (mg/L)	1.00	3.6 (3)	8.0 (1)	1.0 (1)	3.8 (5)	4.2 (3)	3.8 (10)	4.4 (11)	2.1 (6)	3.3 (3)	3.6 (8)	1.9 (9)
Ammonia nitrogen (mg/L)	0.40*	1.61 (4)	0.97 (2)	0.33 (1)	0.89 (4)	3.65 (3)	3.68 (11)	2.72 (12)	3.54 (6)	2.01 (5)	3.60 (8)	4.30 (14)
Nitrate + Nitrite nitrogen (mg/L)	0.40*	0.45 (8)	0.68 (4)	0.99 (2)	0.97 (8)	0.74 (6)	0.66 (20)	0.24 (11)	0.49 (8)	0.43* (5)	0.26 (13)	2.45 (25)
Total phosphorus (mg/L)	0.40*	0.5 (3)	0.9 (1)	0.9 (1)	1.9 (4)	2.0 (3)	2.4 (10)	2.2 (11)	1.4 (6)	2.8 (4)	2.1 (8)	1.7 (7)
Orthophosphorus (mg/L)	0.20*	0.7 (3)	0.9 (2)	0.8 (1)	1.6 (3)	1.6 (3)	2.2 (10)	1.5 (7)	1.2 (6)	1.6 (4)	1.9 (8)	1.5 (8)
Chlorophyll a (µg/L)	30.0*	18 (3)	42 (2)	12 (1)	3.0 (4)	28 (3)	4.0 (10)	8.0 (6)	4.0 (5)	28 (4)	3.0 (6)	0.03 (1)
Fecal coliform (# colonies/100ml)	400	10117 (3)	2350 (2)	600 (1)	1280 (3)	33970 (3)	272 (9)	15259 (11)	14080 (5)	6893 (4)	2280 (8)	184088 (8)

* screening value, not regulatory standard

[a] nitrate only, no nitrite analyzed

Table 2. Water quality and field data for six stations on Vince Bayou and Little Vince Bayou. Data were collected on August 10, 1993. Station locations: 1) Vince Bayou at pipeline crossing, 2) Vince Bayou downstream of the City of Pasadena WWTP, 3) Little Vince Bayou at S. Richey, 4) Vince Bayou upstream of S. Richey, 5) Vince Bayou at W. Harris, 6) Vince Bayou at Shaver. Saltwater (SW) and freshwater (FW) criteria and screening levels are those stated in *The State of Texas Water Quality Inventory*, 12th Edition, 1994. Shaded areas represent values that exceed their respective criteria or screening level.

Parameters	Screening Levels/Criteria		Sampling Stations					
	SW	FW	1	2	3	4	5	6
Temperature (°C)	35.0	N/A	29.9	31.3	33.0	30.4	28.7	32.3
pH (su)	6.5-9.0	N/A	6.6	6.4	7.0	7.1	7.3	7.5
Dissolved oxygen (mg/L)	1.00	N/A	1.9	4.0	1.3	2.0	4.2	5.2
Specific conductance (µmhos/cm)	N/A		7100	4120	4400	3440	444	461
Salinity (ppt)	N/A		3.6	1.8	1.9	1.3	0.0	0.0
Secchi disk (m)	N/A		-	0.63	>0.60	0.60	0.34	0.23
Fecal coliform (# colonies/100ml)	400	400	>60000	60000	25000	5300	29000	38000
TOC (mg/L)	N/A		16	15	14	13	11	10
Ammonia nitrogen (mg/L)	0.40*	1.0*	2.48	1.55	0.55	0.40	0.12	0.12
Nitrate+Nitrite nitrogen (mg/L)	0.40*	1.0*	1.58	2.34	0.32[a]	0.36	0.11	0.10
Total phosphorus (mg/L)	0.40*	0.2*	3.26	4.45	0.47	0.31	0.17	0.15
Orthophosphorus (mg/L)	0.20*	0.1*	2.83	4.01	0.38	0.25	0.10	0.13
Chloride (mg/L)	N/A		1950	1110	1330	932	24	25
Sulfate (mg/L)	N/A		279	188	191	143	22	20
TSS (mg/L)	N/A		7.0	9.0	7.0	8.0	22	31
VSS (mg/L)	N/A		2.0	4.0	2.0	2.0	4.0	4.0
Chlorophyll a (µg/L)	30.0*	30.0*	<1.0	3.05	4.09	<1.0	1.56	<1.0
Pheophytin a (µg/L)	N/A		11.8	7.32	4.23	18.4	3.46	11.0
Hardness (mg/L)	N/A		530	449	428	357	116	116
Total alkalinity (mg/L)	N/A		117	110	94	108	120	132
TKN (mg/L)	N/A		4.10	3.41	1.44	1.25	0.78	0.70
BOD_5 (mg/L)	N/A		6.0	7.0	5.0	4.0	3.0	3.0
COD (mg/L)	N/A		34	32	30	25	17	5.0

* screening value, not regulatory standard

[a] nitrite only, nitrate not analyzed

Table 3. Water and sediment toxicity results for six stations on Vince Bayou and Little Vince Bayou. No significant toxicity is denoted by NS, and S indicates significant toxicity. Tests were done for nine days using Sheepshead minnow (*Cyprinodon variegatus)* as the test organism.

Station/Date	Water	Sediment
Vince Bayou @ Pipeline Crossing		
10-15-92	-	S
01-13-93	NS	-
04-07-93	-	S
07-14-93	NS	-
08-10-93	NS	S
Vince Bayou Below WWTP		
08-10-93	NS	NS
Little Vince Bayou @ S. Richey		
08-10-93	NS	NS
Vince Bayou Upstream of S. Richey		
08-10-93	NS	NS
Vince Bayou @ W. Harris		
08-10-93	NS	NS
Vince Bayou @ Shaver		
08-10-93	NS	NS

Tissue results from the present special study at station 1 indicate non-elevated levels of both metals and organics (Table 8). Chlorinated pesticides and PCB's were detected but not elevated above the 85th percentile values. Chlordane and 4, 4' DDD were elevated when compared to the EPA criteria. Volatile organics were detected but criteria were only available for chloroform and toluene, which were not elevated according to the EPA criteria (U.S. Environmental Protection Agency, 1992).

Fish Community

There were 10 different species collected over the four stations sampled. There were four species found at stations 1 and 3. Five species were found at station 2, and nine species were found at station 4 (Table 9). Percent composition of fish species at each station is shown in Figure 2. Species diversity and evenness indices indicate low diversity and evenness at station 1, but high diversity and moderate evenness for stations 2, 3, and 4. Six of the 10 species collected are considered tolerant species by Linam and Kleinsasser (1993). Although, not listed as tolerant species by Linam and Kleinsasser, the other 4 species are generally considered tolerant.

Table 4. Historical (1983-1991, for station 1007.9200) and present special study data comparing ammonia nitrogen (NH3-N) levels to the EPA acute and chronic criteria for un-ionized ammonia. Shaded areas represent values that exceed the acute or chronic criterion.

Date/Station	Water Temp. (°C)	pH (su)	NH_3-N (mg/L)	Un-ionized NH_3-N (mg/L)	Acute NH_3-N Criterion (mg/L)	Chronic NH_3-N Criterion (mg/L)
02/17/83	16.1	7.4	3.96	0.0293	0.1020	0.0131
02/22/83	14.8	7.6	3.3	0.0349	0.1144	0.0190
03/29/83	18.1	7.2	1.84	0.0100	0.096	0.0095
04/26/83	21.1	7.3	0.062	0.0005	0.1276	0.0136
05/23/83	24.6	7.2	3.55	0.0307	0.1420	0.0108
06/27/83	27.8	7.2	1.44	0.0156	0.1460	0.0108
01/12/84	13.1	7.5	1.69	0.0125	0.0924	0.0134
02/15/84	18.9	7.3	0.256	0.0019	0.1096	0.0126
03/26/84	21.1	6.7	5.32	0.0114	0.0479	0.0034
04/11/84	23.6	7.2	5.5	0.0444	0.1325	0.0108
05/17/84	26.1	7.2	3.55	0.0341	0.1460	0.0108
06/06/84	26.9	7.2	3.46	0.0352	0.1460	0.0108
08/13/85	33.4	7.2	2.71	0.0427	0.2608	0.0273
06/16/86	35.6	6.9	1.2	0.0110	0.1885	0.0159
07/02/86	33.9	7.1	1.48	0.0192	0.2330	0.0225
08/06/86	30.5	7.1	3.79	0.0392	0.1842	0.0178
11/04/86	23.6	7.6	1.65	0.0330	0.2100	0.0272
12/03/86	17.6	7.2	11.00	0.0575	0.0876	0.0092
01/08/87	14.2	7.2	4.08	0.0165	0.0692	0.0073
02/12/87	18.7	7.2	6.3	0.0357	0.0945	0.0099
03/19/87	21.7	7.1	2.5	0.0140	0.1003	0.0086
04/23/87	26.0	7.8	8.7	0.3217	0.2699	0.0367
07/28/87	29.8	6.9	3.47	0.0217	0.0907	0.0054
08/25/87	32.7	6.9	4.29	0.0326	0.1543	0.0131
09/29/87	27.36	6.98	1.68	0.0107	0.1039	0.0065
10/21/87	24.29	7.11	5.45	0.0376	0.1218	0.0088
11/17/87	20.84	7.18	1.01	0.0064	0.1064	0.0103
12/02/87	18.68	6.97	1.07	0.0036	0.0661	0.0058
02/03/88	16.8	7.03	11.1	0.0370	0.0640	0.0059
02/23/88	16.41	7.52	1.64	0.0163	0.1185	0.0177

Table 4. Historical (1983-1991, for station 1007.9200) and present special study data comparing ammonia nitrogen (NH3-N) levels to the EPA acute and chronic criteria for un-ionized ammonia. Shaded areas represent values that exceed the acute or chronic criterion. (Continued)

Date/Station	Water Temp. (°C)	pH (su)	NH_3-N (mg/L)	Un-ionized NH_3-N (mg/L)	Acute NH_3-N Criterion (mg/L)	Chronic NH_3-N Criterion (mg/L)
03/09/88	20.27	7.19	2.76	0.0171	0.1038	0.0106
04/06/88	20.3	7.2	4.02	0.0256	0.1055	0.0108
05/19/88	31.64	7.15	2.21	0.0277	0.2149	0.0216
06/02/88	27.56	7.06	1.51	0.0117	0.1184	0.0078
08/20/88	31.53	7.27	1.17	0.0191	0.2522	0.0282
08/23/88	30.93	7.12	2.68	0.0299	0.1956	0.0192
09/19/88	30.2	6.99	1.22	0.0096	0.1514	0.0135
10/04/88	27.36	6.85	1.07	0.0050	0.0830	0.0048
11/22/88	19.91	6.96	11.1	0.0397	0.0707	0.0062
05/16/89	25.73	7.12	3.32	0.0259	0.1299	0.0090
08/08/89	28.1	7.3	4.91	0.0681	0.1671	0.0136
11/20/89	19.3	7.1	2.73	0.0129	0.0850	0.0082
02/22/90	17.2	7.3	1.1	0.0070	0.0975	0.0112
05/24/90	27.3	7.1	0.67	0.0108	0.2947	0.0284
08/13/90	34.7	7.1	0.16	0.0022	0.2462	0.0237
11/06/90	21.6	6.8	1.63	0.0046	0.0599	0.0043
08/13/91	31.3	6.9	0.33	0.0023	0.1401	0.0118
08/10/93						
Station 1	29.9	6.6	2.48	0.0078	0.0516	0.0027
Station 2	31.3	6.4	1.55	0.0034	0.0798	0.0059
Station 3	33.0	7.0	0.55	0.0054	0.1867	0.0168
Station 4	30.4	7.1	0.40	0.0041	0.1829	0.0176
Station 5	28.7	7.3	0.12	0.0017	0.1671	0.0136
Station 6	32.3	7.5	0.12	0.0035	0.3482	0.0505

Table 5. Dissolved metals in water results (µg/L) for six stations on Vince Bayou and Little Vince Bayou compared to criteria for both acute and chronic freshwater (FW) and saltwater (SW). Data were collected on August 10, 1993. Station locations: 1) Vince Bayou at pipeline crossing, 2) Vince Bayou below City of Pasadena WWTP, 3) Little Vince Bayou at S. Richey, 4) Vince Bayou upstream of S. Richey, 5) Vince bayou at W. Harris, 6) Vince Bayou at Shaver. Shaded areas represent values that exceed the chronic SW criteria.

	Criteria				Stations					
	Acute		Chronic							
Compound	FW	SW	FW	SW	1	2	3	4	5	6
Aluminum	991	-	-	-	22	22	17	36	87	39
Arsenic	360	149	190	78	2.2	2.1	3.1	2.5	2.3	2.6
Barium	-	-	-	-	69	53	80	120	78	110
Cadmium	40	45.62	1.0	10.02	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium	-	-	-	-	<10	<10	<10	<10	<10	<10
Copper	22	16.27	15	4.37	<10	<10	12	11	<10	<10
Iron	-	-	-	-	32	34	122	45	107	46
Lead	-	140	-	5.6	9.0	5.0	9.0	6.0	9.0	4.0
Mercury	2.4	2.1	1.3	1.1	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Nickel	1607	119	179	13.2	<10	<10	<10	<10	<10	10
Selenium	20	564	5.0	136	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Silver	-	7.2	-	0.92	2.2	<0.8	1.4	<0.8	<0.8	<0.8
Zinc	133	98	120	89	12.0	11.0	13.0	14.0	8.9	5.6

Table 6. Metals in sediment results (mg/kg) for six stations on Vince Bayou and Little Vince Bayou. Data were collected on August 10, 1993, and compared to freshwater (FW) and saltwater (SW) screening levels and the TNRCC 85th percentile. Station locations: 1) Vince Bayou at pipeline crossing, 2) Vince Bayou below City of Pasadena WWTP, 3) Little Vince Bayou at S. Richey, 4) Vince Bayou upstream of S. Richey, 5) Vince Bayou at W. Harris, 6) Vince Bayou at Shaver. Shaded areas represent values that exceed the 85th percentile or their respective screening level.

Compound	Screening Level		85th Percentile*	Stations					
	FW	SW		1	2	3	4	5	6
Arsenic	6.7	6.9	8.6	8.93	4.01	3.82	6.97	9.08	6.22
Cadmium	2.0	1.5	5.17	0.92	0.64	0.31	0.82	0.53	0.31
Chromium	26	44	36	32.5	31.4	15.8	30.3	28.0	39.3
Copper	22	40	34	39.8	26.5	12.2	29.7	24.6	23.7
Lead	50	95	58	35.5	107	35.6	17.4	85.9	268
Manganese	481	489	680	160	246	107	188	265	302
Mercury	0.09	0.28	0.42	0.36	0.28	0.15	0.20	0.16	0.08
Nickel	18	19	19	16	15.3	7.6	12.0	11.3	12.9
Selenium	0.95	1.25	1.84	0.772	1.0	<0.10	0.45	0.6	<0.08
Silver	1.6	1.6	4.0	0.79	1.17	<0.20	<0.30	<0.20	0.90
Zinc	93	170	150	263	169	130	217	182	197

* Developed by the TNRCC surface water quality monitoring program.

Table 7. List of semivolatile compounds (μg/kg) detected in Vince Bayou and Little Vince Bayou sediments at six stations. Results are compared to their freshwater (FW) and saltwater (SW) screening levels if available. Not detected is indicated by ND. Shaded areas represent values that exceed their respective screening level.

Compounds	Screening Level		Stations					
	FW	SW	1	2	3	4	5	6
Pyrene	-	-	ND	ND	ND	ND	ND	5490
Benzo(a)pyrene	-	-	ND	ND	ND	ND	ND	2480
Flouranthene	-	-	ND	ND	ND	ND	ND	5340
Benzo(b)flouranthene	-	-	ND	ND	ND	ND	2880	ND
Benzo(k)flouranthene	-	-	ND	ND	ND	ND	ND	4820
Benzo(a)anthracene	-	-	ND	ND	ND	ND	ND	4820
Bis(2-Ethylhexyl)pthalate	894	1197	ND	ND	ND	7100	9050	ND

Table 8. List of detected organic substances and total metals (mg/ kg) in whole fish tissue from Vince Bayou at pipeline crossing for 1989, 1990 and 1993. Data are compared to saltwater (SW) screening levels or criteria if available. Shaded areas represent values that exceed respective criteria or screening level.

Compound	Criteria/Screening Levels			Results		
	Screening Level(SW)	85th Percentile*	EPA Criteria	1989	1990	1993
Chlorinated Pesticides & PCBs						
Chlordane	0.3	0.45	0.0083	1.3	-	0.207
4,4'DDD	6.404	0.12	0.0449	-	-	0.089
4,4'DDE	3.634	0.15	0.0316	0.03	0.083	0.017
4,4'DDT	3.518	0.21	0.0316	0.08	0.087	-
Dachthal	-	-	-	0.03	0.015	-
Dieldrin	0.0389	0.07	0.07	0.07	0.011	0.019
Endrin	-	-	3.23	0.02	-	-
Lindane	3.901	-	0.0081	-	0.003	0.004
PCB	0.0891	1.01	0.0014	-	0.27	-
Volatile Organics						
Carbon disulfide	-	-	-	-	-	0.018
Chloroform	-	-	1.77	-	-	0.007
Trichloroethane	-	-	-	-	-	0.010
Tetrachloroethane	-	-	-	-	-	0.008
Toluene	-	-	2154	-	-	0.008
Xylenes	-	-	-	-	-	0.006
Semivolatile Organics						
Hexachlorobenzene	0.406	0.07	0.00673	-	0.003	-
Total Metals						
Copper	-	5.78	-	-	0.75	-
Lead	5.333	11.24	-	-	-	1.9
Mercury	1.000	0.21	1.0	0.07	-	-
Selenium	-	0.81	-	0.85	0.67	-

* Developed by the TNRCC surface water quality monitoring program.

Table 9. Fish community description of four stations on Vince Bayou and Little Vince Bayou. Station locations: 1) Vince Bayou at pipeline crossing, 2) Vince Bayou below City of Pasadena WWTP, 3) Little Vince Bayou at S. Richey, 4) Vince Bayou upstream of S. Richey. Percent composition is shown in parentheses.

Species		Stations			
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**
Spotted Gar *	*Lepisosteus oculatus*	1 (0.8%)	–	18 (42.9%)	1 (0.5%)
Rio Grande Cichlid	*Cichlasoma cyanoguttatum*	1 (0.8%)	–	22 (52.4%)	38 (17.2%)
Tilapia *	*Oreochromis sp.*	–	–	–	2 (0.9%)
Bluegill *	*Lepomis macrochirus*	–	1 (0.3%)	–	–
Common Carp *	*Cyprinus carpio*	3 (2.5%)	1 (0.3%)	1 (2.4%)	7 (3.2%)
Striped Mullet	*Mugil cephalus*	115 (95.8%)	168 (50.0%)	1 (2.4%)	110 (49.8%)
Gulf Menhaden	*Brevoortia patronus*	–	130 (38.7%)	–	28 (12.7%)
Gizzard Shad *	*Dorosoma cepedianum*	–	36 (10.7%)	–	33 (14.9%)
Gulf Killifish	*Fundulus grandis*	–	–	–	1 (0.5%)
Sailfin Molly *	*Poecilia latipinna*	–	–	–	1 (0.5%)
Total number of fish per station		120	336	42	221
Number of species per station		4	5	4	9
Shannon-Weaver Diversity Index (H') and Evenness (E)		H'=.21 E = .15	H'=.99 E = .61	H'=.88 E = .63	H'=1.42 E =.65

* Listed by Linam and Kleinsasser (1993) as tolerant species.

DISCUSSION

Elevated levels of nutrients at stations 1 and 2 could probably be attributed to the sampling location, downstream of the WWTP outfall, and tidal influence from the HSC. Elevated levels at stations 3 and 4 could be related to the surrounding residential community and/or tidal influence from the HSC. Nutrient levels at stations 5 and 6 are most likely affected by nonpoint sources.

Although none of the detected compounds in water, sediment, or tissue can be pin-pointed to one specific source, the most probable cause of contamination at stations 1-4 is tidal influence from the HSC. Residential and commercial non-point source runoff is the most likely source of water pollution at stations 5 and 6. Air borne contamination from surrounding industry is a possible source of pollution at all stations of Vince Bayou and Little Vince Bayou.

Due to the elevated levels of nutrients in the water, dissolved metals in water, organic substances in sediment, sediment toxicity, the detection of metals and organic substances in whole fish tissue, and the fact that all fish species found in the bayou could be considered tolerant, it appears that Vince Bayou has water quality typical of a heavily industrialized urban stream.

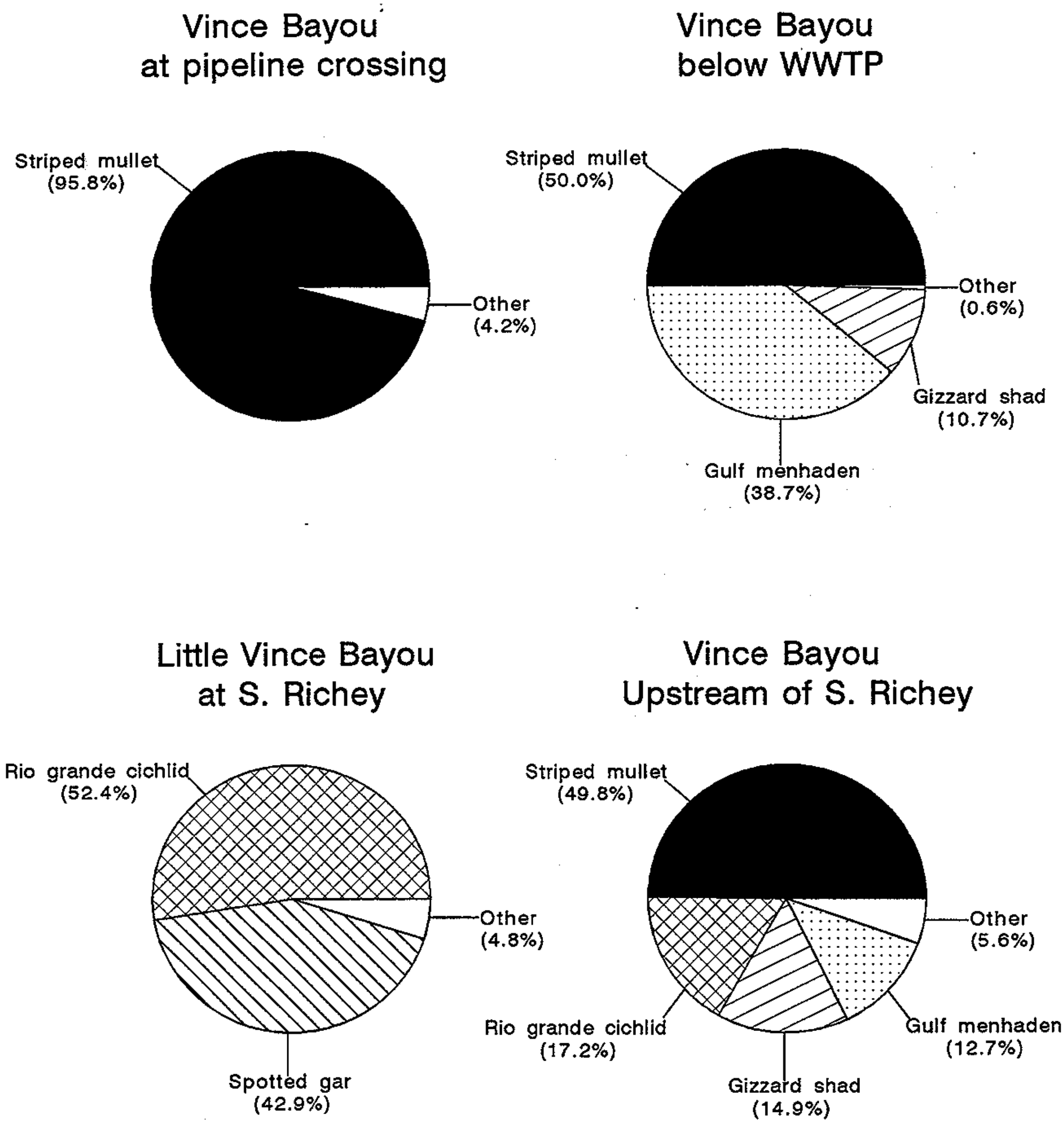

Figure 2. Percent composition of fish species found in Vince Bayou and Little Vince Bayou.

LITERATURE CITED

Knoll, Pat. 1993. Personal communication. Texas Natural Resource Conservation Commission, Water Quality Investigator.

Linam, G.W. and L.J. Kleinsasser. 1993. Classification of Texas Freshwater Fishes into Trophic and Tolerance Groups. Unpublished Report. Texas Parks and Wildlife Department. Austin.

Ludwig, J.A. and J.F. Reynolds. 1988. Statistical Ecology. John Wiley and Sons, New York.

Texas Department of Health. 1991. Fishing Advisories and Closures. TDH Brochure. TDH, Austin.

Texas Water Commission. 1991. Texas Surface Water Quality Standards. Chapter 307, in Title 31 of the Texas Administrative Code. TWC, Austin.

Texas Water Commission. 1992. The State of Texas Water Quality Inventory. 11th Edition. TWC Report LP 92-16. TWC, Austin.

U.S. Environmental Protection Agency. 1992. Clean Water Act 304(a). Criteria and Related Information for Toxic Pollutants. EPA, Atlanta.

Appendix A. Complete list of organic substances and total metals analyzed for in whole fish tissue (Cyprinus carpio) collected from Vince Bayou at Pipeline Crossing. TNRCC station 1007.9200.

PESTICIDES & PCBs
Aldrin
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260
Alpha-BHC
Beta-BHC
Gamma-BHC (Lindane)
Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Kelthane
Heptachlor
Heptachlor epoxide
Methoxychlor
Toxaphene
Mirex

ORGANOPHOSPHORUS PESTICIDES
Demeton-O
Demeton-S
Diazinon
Malathion
Parathion
Azinphos Methyl

CHLORINATED HERBICIDES
2,4-D
2,4,5-T
2,4,5-TP (Silvex)

VOLATILES
Chloromethane
Bromoethane
Vinyl chloride
Trichlorofluoromethane
Methylene chloride
Acetone
1,1-Dichloroethene
1,1-Dichloroethane
Carbon disulfide
Chloroform
1,2-Dichloroethane
cis+trans-1,2-Dichloroethene
1,1,1-Trichloroethane
Carbon tetrachloride
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloropropene
Trichloroethene
Vinyl acetate
1,1,2-Trichloroethane
Benzene
Toluene
Chlorodibromoethane
trans-1,3-Dichloropropene
2-Chloroethylvinyl ether
Bromoform
Tetrachloroethene
1,1,2,2-Tetrachloroethane
Chlorobenzene
Ethylbenzene
Chloroethane
Xylenes
4-Methyl-2-pentanone
2-Hexanone
Styrene

SEMIVOLATILES
Bis(2-ethylhexyl)phthalate
Di-n-octylphthalate
Benzo(b)fluoranthene
Benzo(k)fluoranthene
N-Nitrosodiphenylamine
Hexachlorocyclopentadiene
2-Chloronapthalene
2-Nitroaniline
Dimethylphthalate
Acenaphthylene
2,6-Dinitrotoluene
2,4-Dinitrotoluene
3-Nitroaniline
Acenapthene
Dibenzofuran
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(g,h,i)perylene
N-Nitrosodimethyl amine
Benzidine
2-Chlorophenol
Hexachloroethane
Diethylphthalate
Benzyl alcohol
Bis(2-Chloroisopropyl)ether
Pyrene
2,4-Dinitrophenol
4-Nitrophenol
4-Chlorophenylphenyl ether
Hexachlorobutadiene
4-Bromophenyl ether
Hexachlorobenzene
Phenanthrene
Benzo(a)anthracene
2-Nitrophenol
2,4-Dimethylphenol
Benzoic Acid
2,4-Dichlorophenol
4-Chloro-3-methylphenol
Hexachlorophene
N-Nitrosodi-n-butyl amine
1,2-Dichlorobenzene
N-Nitroso-di-n-propyl amine

SEMIVOLATILES – Continued
Nitrobenzene
Isophorone
Bis(2-chloroethoxy)methane
1,2,4-Trichlorobenzene
Napthalene
2-Methylnapthalene
Anthracene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
4-Chloroaniline
4-Nitroaniline
Fluorene
Benzo(a)pyrene
Butyl benzyl phthalate
3,3'-Dichlorobenzidine
2-Methylphenol
4-Methylphenol
Bis(2-Chloroethyl)ether
Fluoranthene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Diphenylhydrazine
4,6-Dinitro-2-methylphenol
Pentachlorophenol
Di-n-butylphthalate

TOTAL METALS
Arsenic
Cadmium
Chromium
Copper
Mercury
Lead
Selenium

MISCELANEOUS ANALYSIS
% Lipid

Appendix B. Complete list of compounds analyzed for in organic substances in sediment samples.

PESTICIDES & PCBs
Aldrin
Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1248
Aroclor-1254
Aroclor-1260
Alpha-BHC
Beta-BHC
Delta-BHC
Gamma-BHC (Lindane)
Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Endrin ketone
Heptachlor
Heptachlor epoxide
Methoxychlor
Toxaphene
Mirex

ORGANOPHOSPHORUS PESTICIDES
Demeton
Guthion
Diazinon
Malathion
Parathion

CHLORINATED HERBICIDES
2,4-D
2,4,5-TP (Silvex)

VOLATILES
Chloromethane
Bromoethane
Vinyl chloride
Chloroethane
Methylene chloride
Acetone
1,1-Dichloroethene
1,1-Dichloroethane
1,2-Dichloroethene
Chloroform

VOLATILES – Continued
1,2-Dichloroethane
Methylethyl ketone
1,1,1-Trichloroethane
Carbon tetrachloride
Ethylene Dibromide
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloropropene
Dibromochloromethane
1,1,2-Trichloroethane
Benzene
trans-1,3-Dichloropropene
2-Chloroethylvinyl ether
Bromoform
Tetrachloroethene
1,1,2,2-Tetrachloroethane
Toluene
Chlorobenzene
Ethylbenzene
Xylene (total)
Acrolein
Acrylonitrile
Trichloroethene

SEMIVOLATILES
Bis(2-ethylhexyl)phthalate
Di-n-octylphthalate
Benzo(b)fluoranthene
Benzo(a)pyrene
Benzo(k)fluoranthene
Hexachlorocyclopentadiene
2-Chloronapthalene
2-Nitroaniline
Dimethylphthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenapthene
Dibenzofuran
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(g,h,i)perylene
N-Nitrosodimethyl amine
Benzidine
2-Chlorophenol
4-Bromophenylphenyl ether
2-Methylphenol
4-Methylphenol
Pyridine
Bis(2-Chloroethyl)ether
1,3-Dichlorobenzene

SEMIVOLATILES – Continued
Hexachloroethane
Diethylphthalate
4-Chlorophenylphenyl ether
Fluorene
4-Nitroaniline
Napthalene
4-Chloroaniline
Hexachlorobutadiene
2-Methylnapthalene
N-Nitroso-di-n-propylamine
1,2-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
Benzo(a)anthracene
Chrysene
2-Nitrophenol
2,4-Dimethylphenol
Benzoic Acid
2,4-Dichlorophenol
4-Chloro-3-methylphenol
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
Di-n-butylphthalate
4-Bromophenylphenyl ether
Hexachlorobenzene
Phenanthrene
Anthracene
Phenol
1,2,4-Trichlorobenzene
2,4-Dinitrotoluene
Butyl benzyl phthalate
N-Nitrosodiphenylamine
Benzyl alcohol
Bis(2-Chloroisopropyl)ether
Pyrene
2,4-Dinitrophenol
4-Nitrophenol
Azobenzene
4,6-Dinitro-2-methylphenol
Pentachlorophenol
Hexachlorophene
N-Nitrosodiethylamine
N-Nitroso-di-n-butylamine
1,2,4,5-Tetrachlorobenzene
Pentachlorobenzene
Carbaryl
Fluoranthene
Fluoranthene
Isophorone
Bis(2-Chloroethoxy)methane