

A SUMMARY OF PRIORITY POLLUTANT DATA  
FOR POINT SOURCES AND SEDIMENT IN INNER COMMENCEMENT BAY:  
A PRELIMINARY ASSESSMENT OF DATA AND CONSIDERATIONS FOR FUTURE WORK

PART 2. CITY WATERWAY

by

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## INTRODUCTION

This document is part of a larger compilation and review of data on priority pollutant concentrations in point source discharges and surface sediments in Commencement Bay and adjacent waterways collected between 1979 and 1982 and reported by WDOE, EPA, and NOAA. Also presented here are hitherto unpublished data from WDOE point source sampling and a series of sediment collections made by EPA and WDOE. Water column data were also reviewed for this report, but only to a limited extent and not tabulated. Pollutant concentrations in biota and biological responses to water and sediment samples were not, in general, reviewed.

This information was gathered with the aim of providing direction for the next phase of work in the Commencement Bay near-shore marine environment. In the interest of putting together a useful package in a timely fashion, an outline format is used.

The report is arranged by waterway in the six parts listed below; each to be issued in separate installments as the data are compiled and reviewed. The second installment, City Waterway, is included with these introductory remarks.

	<u>Subject</u>	<u>Anticipated Completion Date (1983)</u>
Part 1.	Hylebos Waterway	Completed
Part 2.	City Waterway	Completed
Part 3.	Blair Waterway	May 27
Part 4.	Sitcum Waterway	June 10
Part 5.	Milwaukee, Puyallup, St. Paul, Middle Waterway and S.W. Shore Commencement Bay	June 24
Part 6.	Summary	end of July

## SAMPLING AND ANALYTICAL METHODS

The results presented here are from studies conducted by a number of investigators and should be compared with caution because of the variable collection, extraction, and analytical methods employed. Even a casual review of the data will reveal that detection limits vary between laboratories and that certain compounds are regularly reported in some studies and rarely reported in others. The importance of consistent sampling techniques and analytical methods in future Commencement Bay investigations cannot be over-emphasized.

The methods employed in obtaining most of the data compiled here are described in the reports cited at the end of each data package. The WDOE point source data on discharges other than ASARCO, St. Regis, Tacoma Central STP, U.S. Oil, Reichhold, Pennwalt, Sound Refining, and Hooker (which are documented in WDOE "Class II" reports) and the data on sediment samples collected by EPA and WDOE on 5/13/81, 7/31/81, and 8/03-04/81 are being reported for the first time. The procedures used in obtaining these new data are briefly described below.

The point source samples were collected in one-gallon glass jars (base/neutral extractables, acid extractables, pesticides, and PCBs), 40 ml screw-top glass vials with teflon septums (volatiles), and 2-1/2 or 5-gallon polyethylene cubitainers (trace metals and conventional water quality parameters\*). Sample bottles were cleaned according to EPA priority pollutant protocol. Laboratory and field blanks were included in conjunction with the point source samples as a check against sample contamination. All samples were composites, typically collected over a 2 - 6 hour period. Rising tides precluded long compositing periods at a number of discharges. Flows were measured with a magnetic flowmeter or bucket and stopwatch.

The analytical plan included sample analysis at several different laboratories. Organics analysis was done by EPA contract laboratories. Trace metals were analyzed at the WDOE Tunwater laboratory. Joe Blazeovich, EPA Region X laboratory at Manchester, reviewed the organic priority pollutant data reported by the contract laboratories prior to inclusion in this report.

The intertidal sediment samples taken by WDOE on 7/30-31/81 were collected by hand using a stainless steel "cookie cutter" measuring 9 cm in diameter and 2.5 cm deep. Several samples were taken along a transect of the lower beach, usually below or near a point source discharge, and pooled. After mixing with a glass rod, subsamples were placed in glass (organics analysis) or plastic (trace metal analysis) containers and analyzed as described above. A third portion of the sample was sent to the EPA Newport laboratory for bioassay using amphipods as the test organism. (The results of bioassay tests were reported by R.C. Swartz in the Marine Pollution Bulletin Vol. 13, No. 10, pp. 359-364, 1982.)

The subtidal sediments collected by EPA and WDOE on 5/13/81 and 8/03-04/81 were taken with a Van Veen grab modified with rubber flaps to reduce loss of surface fines during retrieval. Subsamples of the top 2 cm were taken by core and analyzed as described above, except that a few samples were analyzed by the EPA Newport laboratory for a limited number of priority pollutants only.

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\*These data are available on request.

PART 2. CITY WATERWAY

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## CITY WATERWAY

Refer to  
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### General Observations

1. Relatively few samples have been collected in City Waterway. There is a lack of data on concentrations of priority pollutants in subsurface sediments and limited water column data.
2. Preliminary review of the data available on Commencement Bay sediments suggests City Waterway has relatively high concentrations of Pb, Cd, PAH, PAE (phthalate acid esters), DDT, and PCB.
3. A recent toxicity survey (reference 1) of sediments from Elliot Bay, Duwamish River, Commencement Bay, Sinclair Inlet, Port Madison, and Birch Bay using several tests measuring sub-lethal effects on marine organisms ranked City Waterway as the second most toxic site tested.

### General Considerations for Future Work

1. At present, there is insufficient data to compare rates of accumulation of toxic metals and organics in the sediment with source loadings. Major missing pieces of information are the sedimentation rate and the flux of chemicals between City Waterway and Commencement Bay. As these data become available, an effort should be made to calculate a mass balance for contaminants of concern in the waterway.
2. There is a need for criteria which establish the amounts of contaminants in sediment that represent a hazard to marine life and public health.

### Metals - Observations

1. The 15th Street drain had the highest metals concentrations of the four point sources sampled. Only one sample has been collected from this discharge. Table 11
2. The largest metal loads measured were 32 pounds/day Pb, 16 pounds/day Zn, and 5.3 pounds/day Cu from the west drain at the head of City Waterway. Table 12
3. Water column samples collected by Dames and Moore (reference 2) in October and December of 1980 indicated City Waterway had higher Cu and Zn concentrations than other waterways. Surface waters had higher concentrations than mid-depth or bottom waters. The highest Cu concentration measured, 9  $\mu\text{g/L}$ , was intermediate between EPA's 24-hour average criterion of 4  $\mu\text{g/L}$  and not-to-exceed criterion of 23  $\mu\text{g/L}$ .
4. Sediment metal concentrations were highest in the inner portion of the waterway and declined near the waterway's entrance. High concentrations of Pb and Cd were observed. Figure 10  
Table 16

Metals - Considerations for Future Work

1. More point source, water column, and bottom sediment data need to be collected. Field observations indicate the quantity and quality of water in drains to the waterway are highly variable. This should be taken into account during sampling. Sediment samples should include cores to determine vertical stratification of metals.
2. It should be determined if metals are reaching the waterway due to on-going or past practices at American Plating Company, Fick Foundry, and Martinac Shipbuilding Corporation.

Organics - Observations

1. The few organic priority pollutants detected in discharges to City Waterway were largely restricted to the west drain at the head of the waterway (1 of 2 samples only) and the 15th Street drain. Chloroform, naphthalene, and cyanide were present in both discharges. The west drain also contained butylbenzyl phthalate, toluene, and traces of trichloroethylene and tetrachloroethylene. Phenol was found in the 15th Street drain. All concentrations were less than 10 µg/L. Table 14
2. Organic priority pollutant loads to the waterway calculated from these data are low. Table 15
3. No data quantifying organic pollutant concentrations in water column samples from the waterway are available.
4. Volatiles were not detected in the three sediment samples analyzed for these constituents. Table 16
5. Relatively high concentrations of PAH, PAE, and PCB have been measured in some waterway sediments. PAH and PCB are highest at the NOAA station north of the 11th Street bridge. Table 16  
Figure 11
6. The WDOE Southwest Regional Office has determined that groundwater beneath tank farms on the east shore of the waterway are grossly contaminated with petroleum. Petroleum can be seen seeping into the water along the shoreline below. A sample of groundwater from the monitoring well at "D" Street collected May 18, 1982, contained the following concentrations of benzene, toluene, and PAH:

	<u>"Water fraction"</u> (EPA #23543)	<u>"Oil fraction"</u> (EPA #23544)
benzene (µg/L)	3,400	no sample
ethylbenzene (µg/L)	7,000	" "
toluene (µg/L)	46,000	" "
naphthalene (µg/L)	46,000	142,000
anthracene/phenanthrene (µg/L)	130	400
fluorene (µg/L)	n.d.	100

n.d. = none detected

(Large numbers of substituted benzene and naphthalene compounds detected in both fractions but not quantified.)

7. A high concentration of HCBd, .236 mg/Kg (dry), has been reported by the EPA Newport laboratory from a sediment sample at the mouth of the waterway. Table 16

Organics - Considerations for Future Work

1. As noted for metals, more point source and sediment data are needed. The water column has not been sampled for organic priority pollutants.
2. The extent to which petroleum in the groundwater has contaminated the waterway should be determined. If possible, the load of PAH and related compounds to the waterway in seepage from this source should be estimated.



## REFERENCES

1. Chapman, P.M., et al., 1982. Survey of Biological Effects of Toxicants upon Puget Sound Biota. I. Broad-scale Toxicity Survey. NOAA Technical Memorandum OMPA-25.
2. Dames and Moore, 1981. Commencement Bay Studies, Volume V, Water Quality. For U.S. Army Corps of Engineers, Seattle District.
3. Malins, D.C., et al., 1980. Chemical Contaminants and Biological Abnormalities in Central and Southern Puget Sound. NOAA Technical Memorandum. OMPA-2.
4. Malins, D.C., et al., 1982. Chemical Contaminants and Abnormalities in Fish and Invertebrates from Puget Sound. NOAA Technical Memorandum OMPA-19.
5. NOAA, 1981. Unpubl. data. Concentrations of Aromatic Hydrocarbons and Metals found in Sediments from Central Puget Sound.
6. USEPA, 1982. Unpubl. sediment data. Letter from D.W. Schults, USEPA Marine Science Center, Newport, Oregon, to Art Johnson, WDOE.

East 11th Street

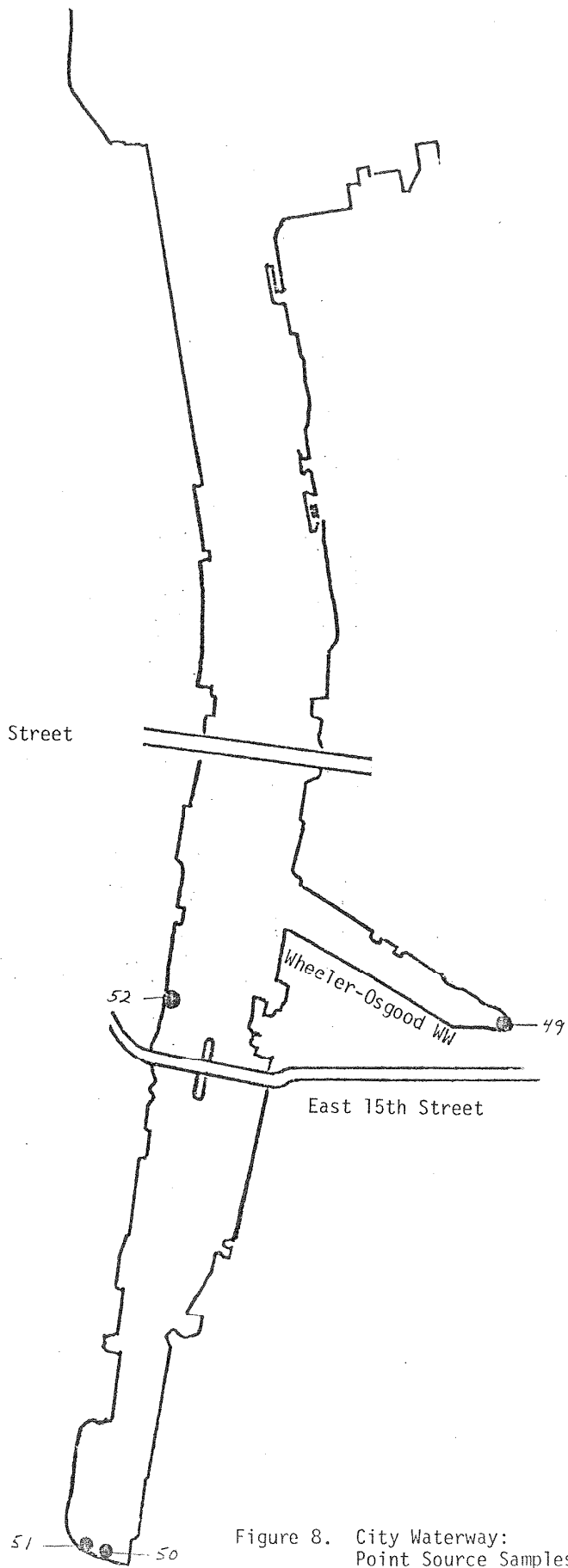


Figure 8. City Waterway:  
Point Source Samples.

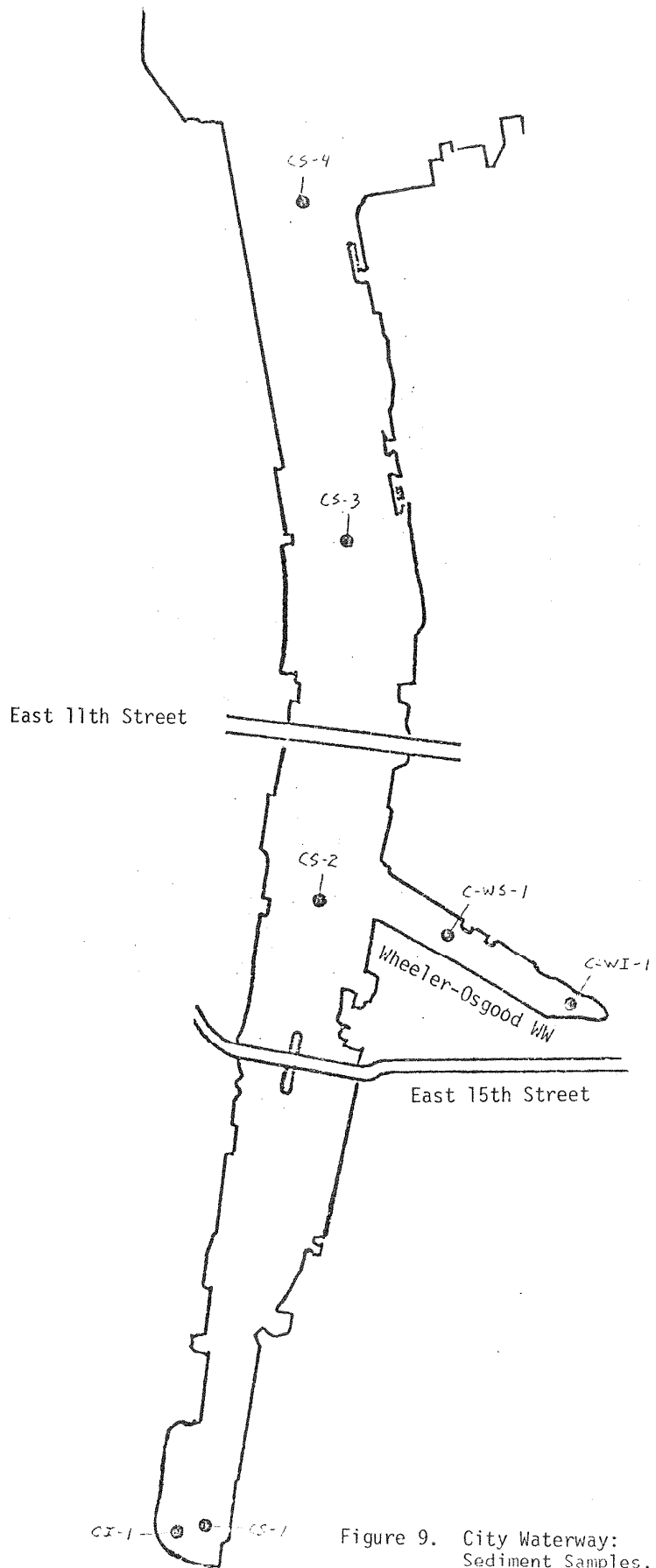


Figure 9. City Waterway: Sediment Samples.

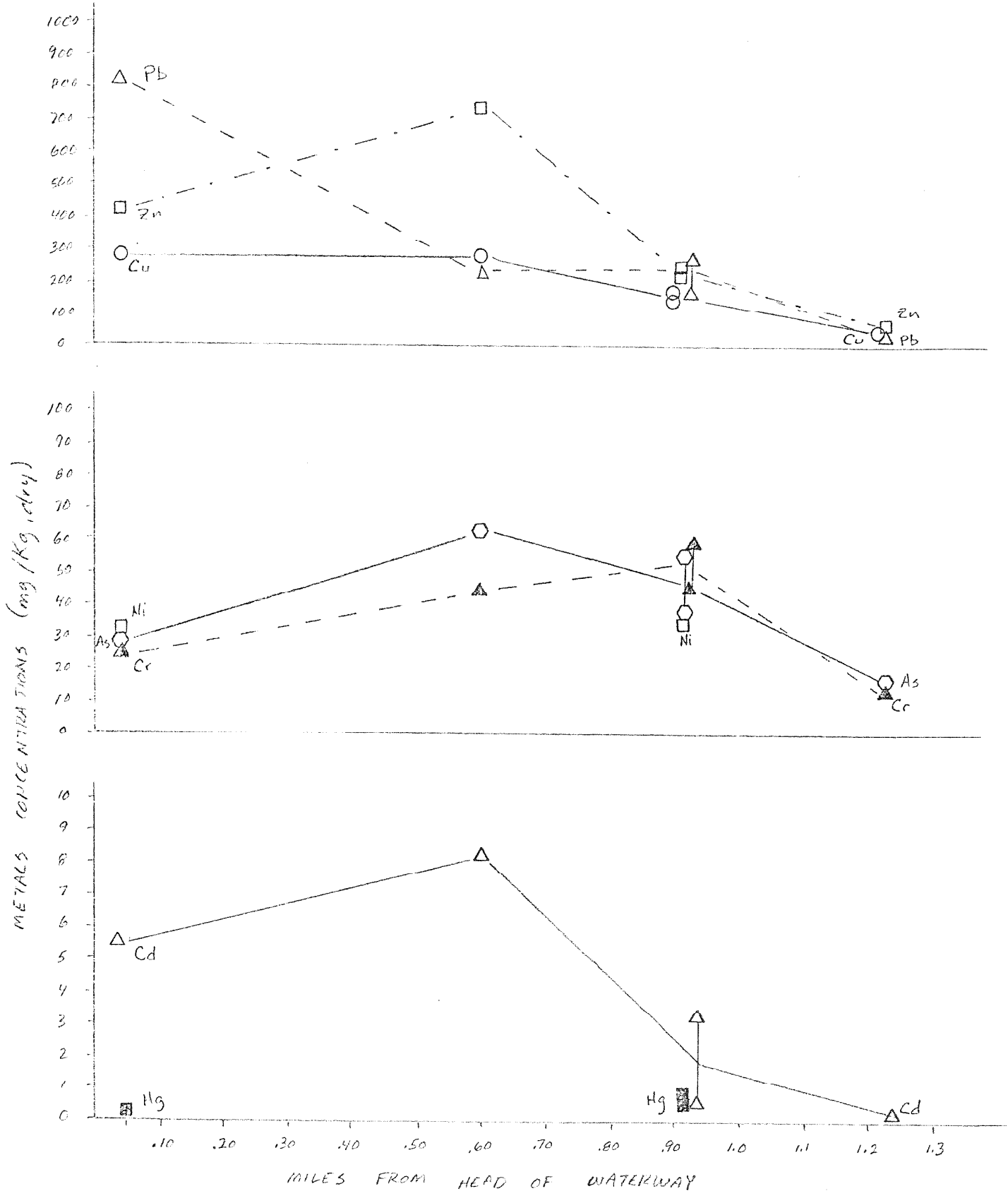


Figure 10. City Waterway: Concentrations of metals in subtidal sediments.

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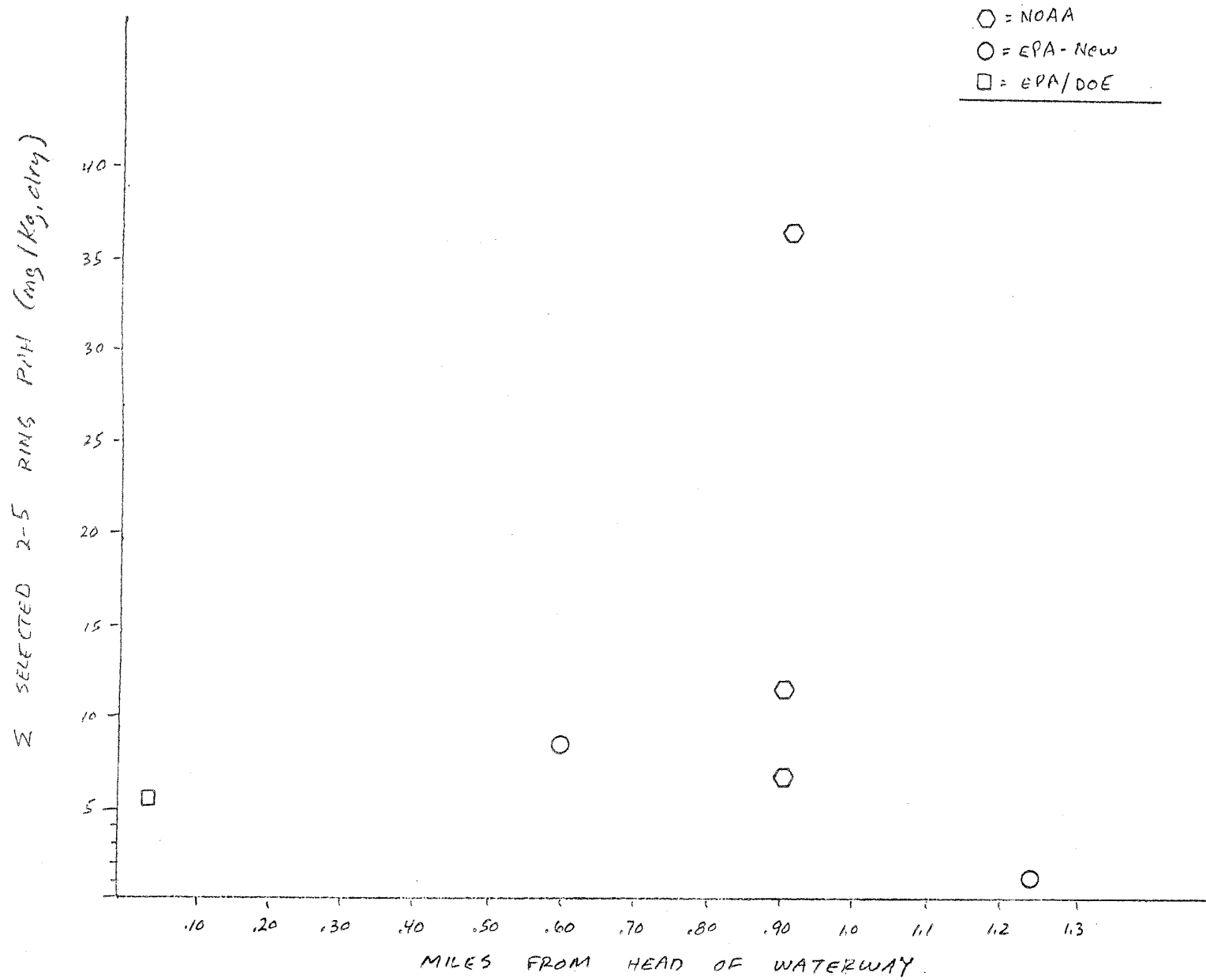


Figure 11. Sum of selected\* PAH compounds in subtidal sediments.

\*naphthalene, phenanthrene, anthracene, fluorene, pyrene, chrysene, benzo(a)anthracene, fluoranthene

Table 11. City Waterway: Trace Metals Concentrations in Point Source Discharges ( $\mu\text{g/L}$ , total metal).

Discharge	Date Sampled	Time Sampled	Investigator	Sample Number	Station No.	Flow (MGD)	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Drain at Head of Wheeler-Osgood	7/28/81	0830-1200	WDOE	30113	49	.13	20	.6	4	40	.24	24	75	140
" " " " " "	3/29/82	1300-1530	WDOE	82-1388	49	.63	18	<2	<10	10	<.20	<20	80	80
East Drain at Head of Waterway	7/28/81	0850-1115	WDOE	3043	50	2.58	<1	<10	<2	<1	<.20	<1	<100	12
" " " " " "	2/16/82	1420-1800	WDOE	82-624	50	10.98	26	<5	<20	50	<.20	<5	59	80
West Drain at Head of Waterway	7/28/81	0850-1115	WDOE	3045	51	1.47	<1	10	<2	6	<.20	<1	<100	34
" " " " " "	2/16/82	1435-1800	WDOE	82-627	51	10.66	16	<5	<20	60	<.20	9	360	180
15th Street Drain	4/28/82	1300-1445	WDOE	82-2104	52	.14	150	6	20	420	.39	<20	650	370

Table 12. City Waterway: Trace Metal Loads (pounds/day).

Discharge	Date Sampled	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Drain at Head of Wheeler-Osgood	7/28/81	.020	.0007	.0043	.043	.0003	.0026	.081	.15
" " " " " "	3/29/82	.0014	--	--	.053	--	--	.42	.42
East Drain at Head of Waterway	7/28/81	--	--	--	--	--	--	--	.26
" " " " " "	2/16/82	2.4	--	--	4.6	--	--	5.4	7.3
West Drain at Head of Waterway	7/28/81	--	.12	--	.074	--	--	--	.42
" " " " " "	2/16/82	1.4	--	--	5.3	--	.80	32	16
15th Street Drain	4/28/82	.18	.007	.023	.49	.0005	--	.76	.43

Table 13. City Waterway: Organic Priority Pollutant Concentrations in Point Source Discharges ( $\mu\text{g/L}$ ).

Discharge	Drain at Head of Wheeler-Osgood		East Drain Head of Waterway		West Drain Head of Waterway		15th Street Drain
	7/28/81	3/29/82	7/28/81	2/16/82	7/28/81	2/16/82	4/28/82
Date Sampled	0830-1200	1300-1530	0850-1115	1420-1800	0850-1115	1435-1800	1300-1445
Time Sampled	WDOE	WDCE	WDOE	WDOE	WDOE	WDOE	WDOE
Investigator	30113	J1343	30115	J0441	30117	J0442	J0478
Sample Number	49		50		51		52
Station Number							
Flow (MGD)	.13	.63	2.58	10.98	1.47	10.66	.14
<u>Volatiles</u>							
chloroform	--	a	--	--	4.5	--	<10
trichloroethylene	--	a	T	--	T	--	a
tetrachloroethylene	--	a	--	--	T	--	a
toluene	--	a	--	--	1	--	a
<u>Base/Neutrals</u>							
naphthalene	--	a	--	--	.4	--	<10
anthracene/phenanthrene	--	15	--	--	--	--	a
butylbenzyl phthalate	--	a	--	--	6.1	--	a
<u>Acid Extractables</u>							
phenol	--	a	--	--	--	--	<10
<u>Pesticides</u>							
	--	--	--	--	--	--	--
<u>Miscellaneous</u>							
cyanide	5		<5		5		5

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-- = Not detected

a = Not detected, but detection limit high relative to other analyses

T = Trace; value is greater than the limit of detection but less than the limit of quantification (1  $\mu\text{g/L}$  in most cases)



Table 14. City Waterway: Organic Priority Pollutant Loads (pounds/day).

Discharge Date Sampled	Drain at Head of Wheeler-Osgood		East Drain Head of Waterway		West Drain Head of Waterway		15th Street Drain
	7/28/81	3/29/82	7/28/81	2/16/82	7/28/81	2/16/82	4/28/82
<u>Volatiles</u>							
chloroform	--	--	--	--	.055	--	.0058*
trichloroethylene	--	--	.011*	--	.0061*	--	--
tetrachloroethylene	--	--	--	--	.0061*	--	--
toluene	--	--	--	--	.010	--	--
<u>Base/Neutrals</u>							
naphthalene	--	--	--	--	.0049*	--	.0058*
anthracene/phenanthrene	--	.079	--	--	--	--	--
butylbenzyl phthalate	--	--	--	--	.075	--	--
<u>Acid Extractables</u>							
phenol	--	--	--	--	--	--	.0058*
<u>Pesticides</u>							
	--	--	--	--	--	--	--
<u>Miscellaneous</u>							
cyanide		.026		.23*		.44	.0058

-- = Not detected

\* = Calculated using 1/2 quantification limit

Table 15. City Waterway: Sediment Sites.

Station Code	Original Agency Code	Collector	Analysis By	Location Name	Latitude 47°	Longitude 122°	Date Collected
*CI-1	I-4	DOE	EPA/DOE <sup>a</sup>	Head of City Waterway	14' 32"	25' 52"	7/30/81
*C-WI-1	I-5	"	" "	Head of Wheeler-Osgood	15' 04"	25' 30"	7/30/81
+CS-1	2	EPA	" "	Head of City Waterway	14' 32"	25' 51"	8/03/81
CS-2	CII	"	EPA-New <sup>b</sup>	City Waterway off Wheeler-Osgood Entrance	15' 06"	25' 54"	5/13/81
+C-WS-1	CI	EPA	EPA-New	Wheeler-Osgood	15' 06"	25' 44"	5/13/81
CS-3	5-09031	NOAA	NOAA <sup>c</sup>	City Waterway North of 11th Street	15' 25"	26' 00"	1979
"	"	"	"	" " " " " "	15' 25"	26' 00"	1980
"	"	"	"	" " " " " "	15' 25"	26' 00"	1981
CS-4	A-I	EPA	EPA-New	City Waterway Entrance	15' 41"	26' 10"	5/13/81

<sup>a</sup>USEPA - contract laboratory (organics)  
WDOE - Tumwater laboratory (metals)

<sup>b</sup>USEPA - Newport laboratory

<sup>c</sup>NOAA (Malins, et al.) OMPA-2, etc.

\*CI-1, C-WI-1 = intertidal samples  
+CS-1, C-WS-1, etc. = subtidal samples

Table 16. City Waterway: Sediment<sup>†</sup> Priority Pollutant Concentrations (mg/Kg dry weight).

Station Code	Intertidal		Subtidal						
	CI-1	C-WI-1	CS-1	CS-2	C-WS-1	CS-3	CS-3	CS-3	CS-4
Agency Responsible for Analysis	EPA/DOE	EPA/DOE	EPA/DOE	EPA-New	EPA-New	NOAA	NOAA	NOAA	EPA-New
Original Agency Code	1-4	1-5	2	C-11	C-1	5-09031	5-09031	5-09031	A-1
Miles from Head of WW	.03	.02	.04	.60	.12	.92	.92	.92	1.23
Year Collected	1981	1981	1981	1981	1981	1979	1980	1981	1981
Percent Solids	53	41	37	42.3	28.0	41	42.1	44	68.6
<u>Metals</u>									
As	46	36	28	63	39		55	38	18
Cd	2.0	3.8	5.5	8.2	10.7	(9.09)	.50	3.2	.28
Cr	34	33	26	45.1	34.7	46.5	45.7	59	13.2
Cu	220	320	280	276	196	178	174	190	38
Hg	.35	.21	.34			1.03	.62	.97	
Ni	36	36	32			33.3			
Pb	600	290	820	225	149	269	174	270	25
Sb	6.2	14	5.0			44.0			
Zn	270	620	410	742	637	224	267	240	60
<u>Volatiles</u>									
<u>Base/Neutrals</u>									
hexachlorobenzene	--	--	--	--	--	.003	.0082	.0032	.057
hexachlorobutadiene	--	--	--	--	--	.002	.0058	.0032	.236
naphthalene	T	--	--	.372	.65	4.0	.58	.98	.143
acenaphthene	T	--	.2			.71	.10	.15	
acenaphthalene	T	--	--			.31	.10		
anthracene/phenanthrene	1.5	.26	1.7	1.278	4.881	7.0	.47	2.09	.192
fluorene	T	--	.24	.133	.375	.81	.18	.29	T
pyrene	2.1	T	1.3	6.02*	15.45*	10.0	1.8	3.9	.57*
chrysene/benzo(a)anthracene	1.3	--	.96	.985	7.431	8.5	2.67	2.29	.347
fluoranthene	2.2	.25	1.4			6.1	1.2	2.2	
benzo(a)pyrene	1.3	--	1.1			2.6	.65	.83	
benzo(k)fluoranthene/ 3,4-benzofluoranthene	1.1	--	1.1			6.6**	1.3**		
benzo(g,h,i)perylene	T	--	--						
ideno(1,2,3-cd)pyrene	T	--	--			1.3	.35		
dimethyl phthalate	--	--	--	.063	--				T
diethyl phthalate	--	--	--	--	--				.085
di-n-butyl phthalate	--	--	T	.154	.357				.15
di-n-octyl phthalate	--	--	.58	1.1	.357				1.7
bis(2-ethylhexyl) phthalate	2.6	1.4	9.6	7.7	9.08				.372
butylbenzyl phthalate	--	--	.86	.78	.857				.155
<u>Acid Extractables</u>									
phenol	--	T	--						
<u>Pesticides and PCBs</u>									
4,4'-DDD	--	--	--	--	--	.030	.030	.016	--
4,4'-DDE	--	--	--	--	T	.005	.0077	--	--
4,4'-DDT	--	--	--	T	T	.020	.003	.0094	--
total DDT forms	--	--	--	T	T	.077	.046	.025	--
PCB-1254	--	--	--	T	T				--
PCB-1260	--	.06	--	--	--				--
total PCBs	--	.06	.08	T	T	.381	.647	.292	--

+ = All data represent samples obtained from the top 2-5 cm of sediment  
 -- = None detected  
 \* = Pyrene + fluoranthene  
 \*\* = Benzofluoranthenes  
 T = Trace amounts  
 ( ) = Value questionable - included, but not used for any calculations

Table 17. Summary of City Waterway Sediment Priority Pollutant Data (mg/Kg, dry weight).

Constituent	Intertidal Sediments		Subtidal Sediments		
	Minimum	Maximum	Minimum	Maximum	Median
<u>Metals*</u>					
As	36	46	18	63	37
Cd	2.0	3.8	.28	10.7	4.4
Cr	33	34	13.2	59	35
Cu	220	320	38	280	190
Hg	.21	.35	.34	1.03	.80
Ni	36	36	32	33.3	33
Pb	290	600	25	820	225
Zn	270	620	60	742	267
<u>Base/Neutrals</u>					
hexachlorobenzene	--	--	--	.057	(.003)
hexachlorobutadiene	--	--	--	.236	(.0045)
naphthalene	--	T	--	4.0	.58
acenaphthene	--	T	.1	.71	.17
acenaphthalene	--	T	--	.31	(.2)
anthracene/phenanthrene	.26	1.5	.192	7.0	1.7
fluorene	--	T	T	.81	.24
pyrene	T	2.1	<.57	10	(2.8)
chrysene/benzo(a)anthracene	--	1.3	.347	8.5	2.3
fluoranthene	.25	2.2	1.2	6.1	1.8
benzo(a)pyrene	--	1.3	.65	2.6	1.0
benzo(k)fluoranthene/ 3,4-benzofluoranthene	--	1.1	1.1	6.6	1.3
benzo(g,h,i)perylene	--	T	--	--	I
ideno(1,2,3-cd)pyrene	--	T	--	1.3	(.35)
dimethyl phthalate	--	--	--	.063	--
diethyl phthalate	--	--	--	.085	--
di-n-butyl phthalate	--	--	T	.357	.15
di-n-octyl phthalate	--	--	.357	1.7	.8
bis(2-ethylhexyl) phthalate	1.4	2.6	.372	9.6	7
butylbenzyl phthalate	--	--	.155	.86	.7
<u>Acid Extractables</u>					
phenol	--	T	--	--	I
<u>Pesticides and PCBs</u>					
4,4'-DDD	--	--	--	.030	(.025)
4,4'-DDE	--	--	--	.0077	(.005)
4,4'-DDT	--	--	--	.020	(.01)
total DDT forms	--	--	--	.077	(.046)
PCB-1254	--	--	--	T	--
PCB-1260	--	.06	--	--	--
total PCBs	--	.06	T	.647	(.3)

T = Trace amount

I = Insufficient data

-- = None detected

( ) = Estimated median

\* = Strong acid digestion data only