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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 6. SUMMARY

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PART 6. SUMMARY

INTRODUCTION

This summary completes a review of source and sediment data on priority pollutants in Commencement Bay waterways and the southwest shoreline of the bay. Each waterway was discussed in one of the five parts listed below; individual parts being circulated to interested parties as they were completed. Refer to the individual report sections for detailed information on the data summarized here in Part 6.

	Subject	Date Issued
Part 1.	Hylebos Waterway	April, 1983
Part 2.	City Waterway	May, 1983
Part 3.	Blair Waterway	July, 1983
Part 4.	Sitcum Waterway	July, 1983
Part 5.	Milwaukee, Puyallup, St. Paul, Middle Waterway and S.W. Shore Commencement Bay	October, 1983
Part 6.	Summary	December, 1983

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SUMMARY

1. Point Source Data

EPA and WDOE data on 60 individual discharges to Commencement Bay have been reviewed. The data base consists of over 100 samples collected between September 1979 and April 1982.

Some of the important limitations inherent in these data may not have been sufficiently emphasized in preceding parts of this report. Although concentration and flow data for municipal and industrial discharges are considered to be reasonably accurate, the data on storm drains and natural drainages are subject to the vagaries of precipitation, upstream uses, and tidal effects. In many cases only one or two samples have been collected from a given discharge. For many discharges, only dry-weather data are available. In addition, analytical methods for some compounds, PAH for example, have not always been sufficiently sensitive to detect or quantify them in water. In light of these and other considerations, EPA and WDOE are continuing to monitor those discharges where large numbers and/or high concentrations of contaminants have been found. Perhaps the most important caution in interpreting these data is the fact that the relative importance of other sources of contaminants such as aerial fallout, release from sediments, spills, advection, etc., has not been determined. Keeping these limitations in mind, the following observations were made.

Metals concentrations in most discharges were not large. In general, higher concentrations appeared to be associated with wet weather than dry weather. Especially high metals concentrations were found in seeps to Hylebos Waterway, Pennwalt seeps and drains, log sort yard runoff, the Lincoln Avenue south drain to Blair Waterway, the 15th Street storm drain to City Waterway, and ASARCO's south and middle outfalls.

Metals loads representative of dry weather have been calculated from the WDOE data and summarized in Table 40*. The largest total loads were for As, Cu, and Zn -- 390, 313, and 220 pounds/day, respectively. ASARCO discharges contributed most of the loads for these metals (64 percent to 95 percent depending on the metal in question) as well as 80 percent of the total Cd load of 12 pounds/day. The St. Regis paper mill effluent was only 10 percent of the overall Cu load, but constituted the largest load of Cu to an individual waterway (St. Paul) by a substantial margin. The largest Cr and Ni loads, 16 and 31 pounds/day, respectively, were to Hylebos Waterway and accounted for 66 percent and 76 percent of the total. Hooker (Occidental) was the major source of Cr and Ni loads. The Tacoma Central STP was the major Hg source based on its load of .087 pounds/day. It also contributed 36 percent and 21 percent of the total Pb and Zn loads. The remaining waterways (Blair, Sitcum, St. Paul, Middle, Milwaukee, and City) as well as the Old Tacoma storm drain and Ruston STP had small metals loads.

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*Because of its very large flow and low metals concentrations, loads for the Puyallup River were not included in Table 40. These data have been calculated and are in Part 5.

Relatively few organic priority pollutants were detected in most discharges, as shown in Table 41. Overall detection frequencies for the major compound groups, in descending order of frequency, were volatiles > acid extractables > base/neutrals > pesticides > PCBs. Cyanide, an inorganic compound, was routinely detected (i.e., 64 percent of samples). The individual compounds most frequently detected were chloroform (54 percent), trichloroethylene (37 percent), tetrachloroethylene (31 percent), phenol (26 percent), naphthalene (24 percent), chlorodibromomethane (20 percent), bis(2-ethylhexyl) phthalate (20 percent), pentachlorophenol (19 percent), and anthracene/phenanthrene (18 percent). Interlaboratory differences in detection limits make it difficult to determine if organics concentrations tended to be higher in wet weather, as was noted for metals.

Most of the sampling effort has been concentrated on Hylebos Waterway discharges. The greatest variety of compounds was detected here. Chemicals such as trichlorofluoromethane, bromoform, carbon tetrachloride, chloroethane, 1,1-dichloroethylene, several PAH, hexachlorobutadiene, 2-chloronaphthalene, nitrobenzene, and 4-bromophenylether were detected only in Hylebos discharges. Detection of pesticides was largely restricted to Pennwalt and Hooker discharges to the Hylebos.

Only a few additional compounds were detected outside Hylebos Waterway or at greater frequencies. For example, the highest detection frequency and widest array of phenolic compounds were found in the Tacoma Central STP effluent. Chlorobenzene and 1,2-dichloroethane were detected only in Blair Waterway. PCBs were not detected in any of the EPA or WDOE Commencement Bay point source samples.

Table 42 summarizes the WDOE data on organic priority pollutants loads. Loads greater than one pound/day were calculated for chloroform (492 pounds), bromoform (19.8 pounds), phenol (4.9 pounds), trichloroethylene (3.8 pounds), bis(2-ethylhexyl) phthalate (3.4 pounds), naphthalene (2.1 pounds), dichlorobromomethane (1.9 pounds), butylbenzyl phthalate (1.9 pounds), tetrachloroethylene (1.7 pounds), di-n-octyl phthalate (1.4 pounds), toluene (1.1 pounds), and 2-chlorophenol (1.1 pounds). A cyanide load of 3.1 pounds/day was also calculated.

The total calculated load for many compounds was contributed entirely by discharges to Hylebos Waterway. The total chloroform, dichlorobromomethane, and toluene loads were overwhelmingly due to the St. Regis effluent (St. Paul Waterway). Effluents from the Tacoma Central and Ruston STPs contributed most of the dichlorobenzenes and phthalates loads, with the former contributing 96 to 100 percent of the loads for five of the six phenols detected. Pentachlorophenol loads came primarily from the north Lincoln Drain into Blair Waterway. For some compounds of concern in Commencement Bay such as PAH and hexachlorobutadiene, extremely low loads were measured. As mentioned above, PCBs were not detected in point sources.

2. Water Column Data

The limited available data from EPA, Battelle, Dames and Moore, and WDOE surveys suggest that, outside the immediate vicinity of discharges, the waters of Commencement Bay and adjacent waterways do not have especially high metals concentrations. Most metals measurements have been at levels not considered harmful to aquatic life. However, the receiving waters near ASARCO, Pennwalt, Tacoma Central STP, and log sort yards on Blair and Hylebos waterways have a potential for adverse effects on marine life because of elevated metals, especially arsenic, copper, zinc, lead, mercury, and cadmium. There are data indicating copper may be at levels harmful to marine life in Hylebos Waterway.

Most of the water column data on organic priority pollutants are from Blair and Hylebos waterways. Concentrations of PCBs, chlorinated butadienes, chlorinated ethylenes, and haloforms are higher here than reported for most other marine waters. PCBs exceed certain of the EPA criteria for protection of marine life. No PCB sources have been identified. Low concentrations of hexachlorobutadiene have been measured in Hooker and Pennwalt discharges. Hooker is the major known source of chloroform and chlorinated ethylenes to Hylebos Waterway. Pennwalt is the major known bromoform source. Blair water column data suggest an as yet unidentified source of volatiles may exist somewhere along the middle of the north shoreline.

Organic priority pollutant concentrations in the water column are also of potential concern in St. Paul Waterway off St. Regis (chloroform) and in the Puyallup River at the Central STP outfall (a variety of compounds).

3. Sediment Data

Priority pollutant data from 115 samples of surface sediment collected by NOAA, Battelle, EPA, and WDOE in Commencement Bay waterways and the Ruston shoreline were reviewed. Most samples were from Hylebos, Blair, and Sitcum waterways -- 46, 26, and 14 samples, respectively.

The subtidal sediment data have been summarized in Table 43 by showing maximum and median pollutant concentrations.

As is now well known, Sitcum Waterway sediments have the highest concentrations of As, Cu, Pb, and Zn; the latter three metals possibly derived from spilled ore. Sediment(s) in City and Hylebos waterways have the second and third highest levels of metals in sediment. Horizontal gradients in metal concentrations are evident in Hylebos, Blair, Sitcum, and City waterways. There are no core data for metals.

Volatiles generally were not detected in subtidal sediment except for trace amounts in a few Hylebos and St. Paul waterways samples. Sediment-associated volatiles have been detected most frequently in the Hylebos intertidal zone -- 6 of 13 samples had one or more compound(s) detected. Each of these 6 samples was either a Pennwalt- or Hooker-related sediment.

Acid extractables, like volatiles, were rarely detected in most waterway sediments. Three sediment samples adjacent to St. Regis had phenol concentrations of 1.2, 1.6, and 91 mg/Kg. Chlorinated phenols have been detected in two samples -- one near the St. Regis outfall and one in Sitcum Waterway. 2.3 mg/Kg of 4-nitrophenol was also detected in the Sitcum sample.

DDT and metabolites are the only pesticides routinely detected in most waterways. Especially high concentrations -- up to 3.6 mg/Kg ΣDDT -- occur in Pennwalt intertidal sediments. Pennwalt seeps and drains constitute the major known discharge of DDT compounds to Commencement Bay. Aldrin has been found in sediment samples collected near Pennwalt and Hooker. Although concentrations are an order of magnitude higher near Hooker, the only instance of aldrin detection in discharges to the Hylebos was in a Pennwalt seep.

The predominant organic priority pollutants in Commencement Bay waterways sediment are the base/neutrals hexachlorobenzene (HCB), hexachlorobutadiene (HCBD), PAH, and phthalates, and PCBs. Up to 1.3 mg/Kg HCB, 3.3 mg/Kg HCBD, and 1.7 mg/Kg PCBs have been measured in Hylebos surface sediments. The median concentrations of HCB and HCBD in Hylebos subtidal sediment are an order of magnitude above the medians for other waterways. PAH and phthalates appear to be highest in City Waterway.

A gradient of decreasing PAH in surface subtidal sediments moving from the head of Hylebos Waterway toward its mouth was observed and may be partly associated with Kaiser sludge beds on upper Kaiser ditch. In contrast, PAH in Blair Waterway sediments are lowest in the innermost waterway; both high and low concentrations are reported from samples seaward of Lincoln Avenue. A source material for PAH has not been found in Blair. There are not sufficient data on City Waterway sediments to determine if a PAH concentration gradient exists.

No gradients in HCB, HCBD, or PCB concentrations were apparent in the subtidal surface sediment data on the Hylebos or other waterways (but see section 5, following). Variations in the detection limits achieved by different laboratories makes identification of gradients difficult. The highest HCB and HCBD concentrations are near Hooker. Seven Hylebos sediment samples have had high PCB concentrations, around 1 mg/Kg, but these were collected at stations scattered throughout the waterway.

Core data on Hylebos sediment show up to 77 mg/Kg chlorinated butadienes, 7 mg/Kg PCBs, and 105 mg/Kg aromatic hydrocarbons in subsurface layers. The lower chlorinated butadienes (tri, tetra, penta) have been found at higher concentrations than hexachlorobutadiene in both surface and subsurface sediment samples. EPA does not include the lower butadienes among the priority pollutants.

4. Restatement of Major Considerations for Future Work

For each of the Commencement Bay waterways previously discussed in Parts 1 - 5 of this report, an attempt was made to point out data gaps and survey needs. The following considerations are among the most important of these:

a. Develop sediment criteria for protection of marine life;

b. Mass balance contaminants of concern in Hylebos, Blair, and City waterways;

c. Collect more water column data in Sitcum, St. Paul, and City waterways;

d. Collect more sediment data, including cores, in Sitcum, Milwaukee, St. Paul, Middle, and City waterways;

e. Conduct receiving environment surveys at Hooker, ASARCO, and St. Regis -- include objectives outlined in Parts 1 and 5;

f. Identify source(s) of volatiles to Blair Waterway;

g. Measure metals concentrations and loads to waterways from log sort yards where ASARCO slag was used for ballast;

h. Evaluate the Kaiser ditch system as a source of PAH to Hylebos Waterway;

i. Determine the significance to pelagic marine life of observed levels of haloforms, chlorinated aliphatics, chlorinated butadienes, and polychlorinated biphenyls in the Blair and Hylebos water columns; and

j. Analyze sediment, water, and biota for potentially toxic chemicals not included among EPA's priority pollutants.

5. Additions and Corrections to Part 1. Hylebos Waterway

-- The EPA Manchester laboratory, using lower detection limits for PAH than employed in the point source data summarized in this report, analyzed three water samples collected June 13, 1983 from Kaiser ditch. The following concentrations of priority pollutant PAH were measured in the sample nearest the ditch mouth:

benzo(a)anthracene	.28 μg/L
benzo(a)pyrene	.26 "
benzo(b)fluoranthene and/or benzo(k)fluoranthene	.43 "
chrysene	1.1 "
fluorene	.02 "
phenanthrene	.4 "
pyrene	.6 "

-- The sediment core used by Riley to calculate contaminant loads to Hylebos sediments was collected in Commencement Bay off the peninsula of land between Hylebos and Blair waterways. It should have been noted that the sedimentation rate there may be different from that inside Hylebos Waterway.

-- Observation #3 for metals should read "Bottom waters have higher Pb, Cd, Cu, Se, Cr, and Ni concentrations than surface waters".

-- There are insufficient data on contaminants in runoff from General Metals and nearby waterway sediments.

-- Ed Long (NOAA, Seattle) has noted that, looking at Riley's core data only, there appears to be a clear trend in high PCB and chlorinated butadienes (both tri- and hexachlorobutadiene) in surface and subsurface sediment layers near Hooker (Occidental) relative to other Hylebos and Blair stations.

-- Les Williams (Tetra Tech, Bellevue) has pointed out that aldrin levels in Hylebos sediments may represent a hazard to marine life. QA/QC for these data have not been re-examined.

Table 40. Summary of WDOE data collected September 1979 to April 1982 on metals loads to Commencement Bay and adjacent waterways (pounds/day).

Metal	Hylebos Waterway		Blair Waterway		Sitcum Waterway		Tacoma Central STP		St. Paul Waterway		Middle Waterway		City Waterway		Old Tacoma Storm Drain		Ruston STP		ASARCO		Sum of Loads
	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	
As	5.2	1.3	4.0	1.0	.7	.18	1.7	.44	4.4	1.1	.0021	<.1	.20	<.1	.011	<.1	1.3	.33	370	95	390
Cd	1.1	9.3	.1	.83	--		1.4	12	.0019	<.1	.0002	<.1	.13	1.1	--		--		9.6	80	12
Cr	16	76	.74	3.5	--		1.1	5.2	5.4	26	--		.030	.14	.027	.13	.40	1.9	.1	.48	21
Cu	1.6	.51	.88	.28	.18	<.1	7.3	2.3	30	9.6	.0025	<.1	.61	.19	--		2.6	.83	270	86	313
Hg	.007	5.4	.011	8.5	--		.087	67	.012	9.2	--		.0008	.62	.0023	1.8	.014	11			.13
Ni	31	66	1.5	3.2	--		8.1	17	.021	<.1	--		.0026	<.1	--		--		6.1	14	47
Pb	.17	1.1	1.0	6.3	.43	2.7	5.4	34	.014	<.1	--		.84	5.3	--		.24	1.5	7.5	47	16
Zn	.98	.45	2.9	1.3	1.1	.50	47	21	.14	6.4	.080	<.1	1.3	.59	.11	<.1	15	6.8	140	64	220

Note: Dry-weather data only used where possible. See Parts 1 - 5 of this report for details on loading calculations. There are no major discharges to Milwaukee Waterway.

-- = not detected

Table 41. Detection frequency (DF) of organic priority pollutants in WDOE and EPA samples from point source discharges to Commencement Bay and adjacent waterways, September 1979 - April 1982.

	Hylebos Waterway DF*	%	Blair Waterway DF	%	Sitcum Waterway DF	%	Tacoma Central STP DF	%	Puyallup River Mouth DF	%	St. Paul Waterway DF	%	Middle Waterway DF	%	City Waterway DF	%	Old Tacoma Storm Drain DF	%	Ruston STP DF	%	ASARCO South Outfall DF	%	Overall DF	%
Volatiles																								
chloroform	24/37	65	5/15	33	2/4	50	3/3	100	1/3	33	1/3	33	1/1	100	2/6	33	1/2	50	1/2	50			41/76	54
dichlorobromomethane	11/36	31	0/14	0	0/3	0	1/3	33	0/3	0	1/3	33	a		0/5	0	0/1	0	1/2	50			14/70	20
chlorodibromomethane	10/36	28	1/14	7	0/3	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	1/2	50			12/70	17
trichlorofluoromethane	1/36	3	0/14	0	0/3	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			1/69	1
bromoform	7/36	19	0/14	0	0/3	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			7/69	10
carbon tetrachloride	5/36	14	0/14	0	0/3	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			5/69	7
chloroethane	5/36	14	0/4	0	0/3	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			5/69	7
1,1-dichloroethane	3/36	8	2/14	14	0/3	0	1/3	33	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			6/69	9
1,2-trans-dichloroethylene	5/36	14	6/16	38	0/3	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			11/71	15
1,1-dichloroethylene	3/36	8	0/14	0	0/3	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			3/69	4
1,1,1-trichloroethane	8/36	22	5/15	33	2/4	50	2/3	67	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			17/71	24
trichloroethylene	18/36	50	4/15	27	1/3	33	1/3	33	0/3	0	0/3	0	a		2/5	40	0/1	0	0/1	0			26/70	37
tetrachloroethylene	12/36	33	2/14	14	2/4	50	3/3	100	0/3	0	0/3	0	a		1/5	20	0/1	0	2/2	100			22/71	31
1,1,2,2-tetrachloroethane	2/36	6	1/14	7	1/3	33	0/3	0	0/3	0	1/3	33	a		0/5	0	0/1	0	0/1	0			5/69	7
toluene	4/36	11	2/14	14	0/3	0	2/3	67	0/3	0	1/3	33	a		1/5	20	0/1	0	1/2	50			11/70	16
benzene	4/36	11	2/14	14	0/3	0	2/3	67	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			8/69	12
1,2-dichloroethane	0/36	0	2/14	14	0/3	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			2/69	3
ethylbenzene	0/36	0	0/14	0	0/3	0	1/3	33	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0			1/69	1
Base/Neutrals																								
naphthalene	9/36	25	2/14	14	0/4	0	3/3	100	0/3	0	2/3	67	a		2/6	33	0/1	0	1/1	100	0/1	0	17/72	24
acenaphthene	2/36	6	0/14	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	2/71	3
acenaphthylene	2/36	6	0/14	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	2/71	3
anthracene/phenanthrene	11/36	31	0/14	0	0/4	0	1/3	33	0/3	0	0/3	0	a		1/6	17	0/1	0	0/1	0	0/1	0	13/72	18
fluorene	5/36	14	1/15	7	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	6/72	8
pyrene	5/36	14	0/14	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	5/71	7
chrysene/benzo(a) anthracene	7/36	19	0/14	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	7/71	10
fluoranthene	9/36	25	0/14	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	9/71	13
benzo(a)pyrene	1/36	3	0/14	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	1/71	1
benzo(b)fluoranthene	1/36	3	0/14	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	1/71	1
hexachloroethane	6/36	17	1/14	7	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	7/71	10
hexachlorobutadiene	6/36	17	0/14	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	6/71	8
1,2-dichlorobenzene	2/36	6	4/15	27	0/4	0	1/3	33	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	7/72	10
1,3-dichlorobenzene	2/36	6	0/14	0	0/4	0	1/3	33	0/3	0	0/3	0	a		0/5	0	0/1	0	1/1	100	0/1	0	4/71	6
1,4-dichlorobenzene	2/36	6	1/14	7	0/4	0	1/3	33	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	4/71	6
hexachlorobenzene	5/36	14	1/14	7	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	6/71	8
2-chloronapthalene	1/36	3	0/14	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	1/71	1
dimethyl phthalate	1/16	6	0/4	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	1/41	2
diethyl phthalate	2/16	13	1/4	25	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	3/41	7
di-n-butyl phthalate	1/16	6	0/4	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	1/41	2
di-n-octyl phthalate	0/16	0	0/4	0	0/4	0	1/3	33	0/3	0	0/3	0	a		0/5	0	0/1	0	1/1	100	0/1	0	2/41	5
butylbenzyl phthalate	0/16	0	0/4	0	0/4	0	1/3	33	0/3	0	1/3	33	a		1/5	20	0/1	0	1/1	100	0/1	0	4/41	10
bis(2-ethylhexyl) phthalate	4/16	25	1/4	25	0/4	0	2/3	67	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	1/1	100	8/41	20
nitrobenzene	1/16	6	0/4	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	1/41	2
4-bromophenyl ether	1/16	6	0/4	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	1/41	2
chlorobenzene	0/36	0	1/14	7	0/4	0	0/3	0	0/3	0	0/3	0	a		0/5	0	0/1	0	0/1	0	0/1	0	1/71	1

*Detection frequency = number of samples in which a compound is detected ÷ total number of samples analyzed for that compound.

[a]Detection limits high in single sample collected.

NOTE: Analyses employing poor detection limits not used in this tabulation.

Table 41 - continued.

	Hylebos Waterway DF*	%	Blair Waterway DF	%	Sitcum Waterway DF	%	Tacoma Central STP DF	%	Puyallup River Mouth DF	%	St. Paul Waterway DF	%	Middle Waterway DF	%	City Waterway DF	%	Old Tacoma Storm Drain DF	%	Ruston STP DF	%	ASARCO South Outfall DF	%	Overall DF	%
Acid Extractables																								
phenol	5/16	31	0/5	0	1/4	25	3/3	100	0/3	0	0/3	0	a		1/6	17	0/1	0	1/2	50			11/43	26
2,4-dimethyl phenol	0/16	0	0/5	0	0/4	0	2/3	67	0/3	0	0/3	0	a		0/6	0	0/1	0	0/1	0			2/42	5
2-chlorophenol	1/16	6	0/5	0	0/4	0	2/3	67	0/3	0	0/3	0	a		0/6	0	0/1	0	0/1	0			3/42	7
2,4-dichlorophenol	0/16	0	0/5	0	0/4	0	2/3	67	0/3	0	0/3	0	a		0/6	0	0/1	0	0/1	0			2/42	5
2,4,6-trichlorophenol	3/16	19	0/5	0	0/4	0	2/3	67	0/3	0	0/3	0	a		0/6	0	0/1	0	0/1	0			5/42	12
pentachlorophenol	2/16	13	3/5	60	1/4	25	2/3	67	0/3	0	0/3	0	a		0/6	0	0/1	0	0/1	0			8/42	19
Pesticides and PCBs																								
aldrin	1/22	5	1/7	14	0/4	0	0/3	0	0/3	0	0/3	0	a		0/7	0	0/2	0	0/2	0			2/53	4
α-BHC	3/22	14	1/7	14	0/4	0	0/3	0	0/3	0	0/3	0	a		0/7	0	0/2	0	0/2	0			4/53	6
β-BHC	1/22	5	0/7	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/7	0	0/2	0	0/2	0			1/53	2
δ-BHC	1/22	5	0/7	0	0/4	0	1/3	33	0/3	0	0/3	0	a		0/7	0	0/2	0	0/2	0			2/53	4
γ-BHC	3/22	14	0/7	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/7	0	0/2	0	1/2	50			4/53	6
4,4'-DDT	6/22	27	0/7	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/7	0	0/2	0	0/2	0			6/53	11
4,4'-DDE	4/22	18	0/7	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/7	0	0/2	0	0/2	0			4/53	6
4,4'-DDD	3/22	14	0/7	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/7	0	0/2	0	0/2	0			3/53	6
PCBs	0/22	0	0/7	0	0/4	0	0/3	0	0/3	0	0/3	0	a		0/7	0	0/2	0	0/2	0			0/53	0
Miscellaneous																								
cyanide	8/18	44	4/6	67	2/2	100	2/3	67	2/3	67					4/4	100	1/2	50	2/2	100			25/40	63

*Detection frequency = number of samples in which a compound is detected ÷ total number of samples analyzed for that compound.

[a]Detection limits high in single sample collected.

NOTE: Analyses employing poor detection limits not used in this tabulation.

Table 42. Summary of WDOE data collected September 1979 to April 1982 on organic priority pollutants loads to Commencement Bay and adjacent waterways (pounds/day).

	Hylebos Waterway		Blair Waterway		Sitcum Waterway		Tacoma Central STP		St. Paul Waterway		Middle Waterway		City Waterway		Old Tacoma Storm Drain		Ruston STP		
	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Load	% of Total CMB Load	Sum of Loads
Volatiles																			
chloroform	9.3	1.9	.094	<.1	.0048	<.1	2.2	.4	480	98	.004	<.1	.061	<.1	--		--		492
dichlorobromomethane	.0018	<.1	--		--		--		1.9	100	--		--		--		--		1.9
chlorodibromomethane	.75	100	--		--		--		--		--		--		--		--		.75
trichlorofluoromethane	.12	100	--		--		--		--		--		--		--		--		.12
bromoform	19.8	100	--		--		--		--		--		--		--		--		19.8
carbon tetrachloride	.0002	100	--		--		--		--		--		--		--		--		.002
chloroethane	.0002	100	--		--		--		--		--		--		--		--		.002
1,1-dichloroethane	.0002	.1	.0083	5.2	--		.15	95	--		--		--		--		--		.16
1,2-trans-dichloroethylene	.38	86	.064	14	--		--		--		--		--		--		--		.44
1,1-dichloroethylene	.0004	100	--		--		--		--		--		--		--		--		.0004
1,1,1-trichloroethane	.013	5.2	.040	16	.043	18	.15	61	--		--		--		--		--		.25
trichloroethylene	2.4	63	--		.014	.4	1.4	37	--		--		.017	.4	--		--		3.8
tetrachloroethylene	1.0	58	--		.011	.6	.32	19	--		--		.0061	.4	--		.39	23	1.7
1,1,2,2-tetrachloroethane	.12	94	--		.0028	2.2	--		.0039	3.1	--		--		--		--		.13
toluene	.23	21	.022	2.1	--		--		.81	75	--		.010	.9	--		--		1.1
Base/Neutrals																			
naphthalene	.032	1.6	.0013	<.1	--		.62	30.0	1.2	58	--		.011	.5	--		.20	9.7	2.1
acenaphthene	.0022	100	--		--		--		--		--		--		--		--		.0022
acenaphthylene	.0076	100	--		--		--		--		--		--		--		--		.0076
anthracene/phenanthrene	.010	11.1	--		--		--		--		--		--		--		--		.010
fluorene	.0065	100	--		--		--		--		--		--		--		--		.0065
pyrene	.054	100	--		--		--		--		--		--		--		--		.054
chrysene/benzo(a)anthracene	.075	100	--		--		--		--		--		--		--		--		.075
fluoranthene	.047	100	--		--		--		--		--		--		--		--		.047
hexachloroethane	.0043	100	--		--		--		--		--		--		--		--		.0043
hexachlorobutadiene	.026	100	--		--		--		--		--		--		--		--		.026
1,2-dichlorobenzene	.022	4.3	.041	8.0	--		.45	88	--		--		--		--		--		.51
1,3-dichlorobenzene	.021	20	--		--		--		--		--		--		--		.080	80.0	.10
1,4-dichlorobenzene	.022	2.7	.012	1.5	--		.77	96	--		--		--		--		--		.80
hexachlorobenzene	.044	100	--		--		--		--		--		--		--		--		.044
2-chloronaphalene	.0054	100	--		--		--		--		--		--		--		--		.0054
dimethyl phthalate	.0022	100	--		--		--		--		--		--		--		--		.0022
diethyl phthalate	.098	100	--		--		--		--		--		--		--		--		.098
di-n-octyl phthalate	--		--		--		.29	21	--		--		--		--		1.1	80	1.4
butylbenzyl phthalate	--		--		--		--		.0039	.2	--		.075	4.0	--		1.8	96	1.9
bis(2-ethylhexyl) phthalate	.0003	<.1	--		--		3.4	100	--		--		--		--		--		3.4
nitrobenzene	.0086	100	--		--		--		--		--		--		--		--		.0086
4-bromophenyl ether	.011	100	--		--		--		--		--		--		--		--		.011
Acid Extractables																			
phenol	.20	4.1	--		--		4.7	96	--		--		.0058	.1	--		--		4.9
2,4-dimethylphenol	--		--		--		.54	100	--		--		--		--		--		.54
2-chlorophenol	.012	1.1	--		--		1.1	99	--		--		--		--		--		1.1
2,4-dichlorophenol	--		--		--		.62	100	--		--		--		--		--		.62
2,4,6-trichlorophenol	.00003	<.1	--		--		.73	100	--		--		--		--		--		.73
pentachlorophenol	.074	20	.30	80	--		--		--		--		--		--		--		.37
Pesticides																			
aldrin	.00006	<.1	.0038	100	--		--		--		--		--		--		--		.038
α-BHC	.00003	<.1	.038	100	--		--		--		--		--		--		--		.038
β-BHC	.0001	100	--		--		--		--		--		--		--		--		.0001
4,4'-DDT	.0010	100	--		--		--		--		--		--		--		--		.0010
4,4'-DDE	.0002	100	--		--		--		--		--		--		--		--		.0002
4,4'-DDD	.00007	100	--		--		--		--		--		--		--		--		.00007
Miscellaneous																			
cyanide	.032	1.0	.13	4.1	--		2.5	79	--		.0004	<.1	.0058	.2	--		.48	15	3.1

Note: Dry-weather data only used where possible. See Parts 1 - 5 of this report for details on loading calculations. There are no major discharges to Milwaukee Waterway. No simultaneous flow and organic priority pollutant data are available for ASARCO effluents.

-- = Not detected

Table 43. Summary of maximum and median concentrations of selected priority pollutants in subtidal surface sediments from Commencement Bay waterways (mg/Kg, dry weight).

Constituent	Hylebos Waterway Maximum	Hylebos Waterway Median	Blair Waterway Maximum	Blair Waterway Median	Sitcum Waterway Maximum	Sitcum Waterway Median	Milwaukee Waterway Maximum	Milwaukee Waterway Median	Puyallup River Maximum	Puyallup River Median	St. Paul Waterway Maximum	St. Paul Waterway Median	Middle Waterway Maximum	Middle Waterway Median	City Waterway Maximum	City Waterway Median	Southwest Shoreline Commencement Bay Maximum	Southwest Shoreline Commencement Bay Median
Metals																		
As	203	48	77	45.3	472	170		29.2*	16	(9)	40	21	70	(54)	63	37		I
Cd	3.2	0.99	.66	.34	7.0	3.8		2.7*	.14	(<.1)	3	2.8	3.6	(2.1)	10.7	4.4		I
Cr	59	29	29.5	18	58.7	22		23.6*	12	(10)	28	25	27.2	(22)	59	35		I
Cu	259	130	106	70	2100	581		120*	16	(16)	170	160	486	(290)	280	190		I
Hg	1.2	0.28	.26	.14	.79	.34		.10*		.02*	.41	.15	I	2.2*	1.03	.80		I
Ni	35	18	22.4	15	36.1	16					22	23			33.3	33		I
Pb	197	110	74	49	793	430		109*	4	(2)	100	70	230	(140)	820	225		I
Zn	404	170	132	87	1720	700		214*	23	(13)	200	114	353	(220)	742	257		I
Volatiles																		
chloroform	T	--	--	--	--	--		I		I	I	--	I	I	--	--		I
trichloroethylene	T	--	--	--	--	--		I		I	--	--	I	I	--	--		I
toluene	T	--	--	--	--	--		I		I	T	--	I	I	--	--		I
Base/Neutrals																		
hexachlorobenzene	1.3	(.06)	.003	(.0025)	.0083	(.003)		.0059*		.00014*	.019	(.019)	.0048	(.0048)	.057	(.003)		I
hexachlorobutadiene	3.3	(.05)	.228	(.003)	.004	(.002)		.0036*		--*	.0062	(.006)	.0029	(.0029)	.236	(.0045)		I
naphthalene	.55	.10	2.434	(.055)	.48	(.2)		.42*	.94	(.5)	3.0	1.4	.536	.51	4.0	.58		I
acenapthene	.069	(.05)	.090	(.02)	3.0	(.1)		.099*		.0005*	.19	(.19)	.140	(.14)	.71	.7		I
acenapthalene	.090	(.05)	.030	(.004)	.074	(.02)		.075*		I	.21	(.21)	.083	(.083)	.31	(.2)		I
anthracene/phenanthrene	2.69	.62	.874	.20	19	.49		.380*	.053	(.4)	.94	.82	.530	(.25)	7.0	1.7		I
fluorene	.48	(.08)	.111	.05	6	.071		.120*		.004*	.27	(.27)	.16	(.16)	.81	.24		I
pyrene	6.1	1.3	.870	.23	38	1.0		.99*	.01	(.01)	.97	.95	1.6	(1.2)	10	(2.8)		I
chrysene/benzo(a)anthracene	6.0	2.0	1.6	.47	77	.39		1.25*		.018*	.77	(.77)	1.2	(.7)	8.5	2.3		I
fluoranthene	4.7	1.0	1.15	.24	27	.56		1.2*		.012*	1.2	1.15	1.3	(1.3)	6.1	1.8		I
benzo(a)pyrene	5.5	.68	.525	.13	230	.30		.24*		.0046*	.021	(.021)	.26	(.26)	2.6	1.0		I
benzo(k)fluoranthene/ 3,4-benzofluoranthene	2.9	1.3	.72	.45	94	.35		.61*		I	.081	(.081)	.54	(.54)	6.6	1.3		I
benzo(g,h,i)perylene	.34	(.1)	--	--	15	--		I		I	--	--	--	I	I	I		I
ideno(1,2,3-cd)pyrene	.43	.24	.18	.07	11	(.08)		.16*		I	.0091	(.0091)	.14	(.14)	1.3	(.35)		I
total PAH forms		7.5		1.9		4.1		5.4*		0.95*		(5.9)		(5.3)		12.4		I
diethyl phthalate	.094	.05	.092	--	.093	--		I		I	--	--	--	--	.085	--		I
bis(2-ethylhexyl) phthalate	1.76	.30	1.725	.48	1.07	.27		I		I	--	--	.429	(.4)	9.6	8.4		I
butylbenzyl phthalate	.36	(.1)	.18	--	.080	--		I		I	--	--	--	--	.86	.82		I
Acid Extractables																		
phenol	T	--	--	--	.38	--		I		I	91	(46)		I	I	I		I
2-chlorophenol	--	--	--	--	.33	--		I		I	--	--		I	I	I		I
2,4,6-trichlorophenol	--	--	--	--	--	--		I		I	T	--		I	I	I		I
p-chloro-m-cresol	--	--	--	--	.4	--		I		I	--	--		I	I	I		I
4-nitrophenol	--	--	--	--	2.3	--		I		I	--	--		I	I	I		I
pentachlorophenol	--	--	--	--	T	--		I		I	.84	(.4)		I	I	I		I
Pesticides and PCBs																		
aldrin	.82	(.02)	--	--	.002	--		I		I	--	--		I	--	I		I
α-BHC	.063	(.01)	--	--	--	--		I		I	--	--		I	I	I		I
γ-BHC	.04	--	--	--	.00038	--		I		I	--	--			I	I		
total DDT forms	.87	(.015)	.0134	.0075	.023	(.01)		.037*		.00004*	.017	(.017)	.0013	(.0013)	.077	(.046)		I
total PCBs	1.7	.2	.128	(.02)	.21	.06		.223*		.00074*	.25	(.25)	.229	(.23)	.647	(.3)		I

-- = None detected
* = One sample only
( ) = Estimated median (low number of detected concentrations)
I = Insufficient data
T = Trace amount