Publication No. 85-e22

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

7272 Cleanwater Lane, LU-11 • Olympia, Washington 98504-6811 • (206) 753-2353

MEMORANDUM

February 13, 1985

To: Lynn Singleton

From: Joe Joy

Subject: Dilution Requirements for Some EPA Priority Pollutants in Secondarily Treated Effluent to Meet EPA Saltwater Criteria

At your request I have constructed the two attached tables, the first contains the following elements:

- EPA priority pollutants and their EPA criteria for the protection of saltwater aquatic life
- Concentrations of these pollutants detected in secondary or tertiary municipal wastewater
- The dilution required for maximum and most common concentrations of these effluent pollutants to meet applicable EPA criteria.

The second table lists some background concentrations of selected priority pollutants in Puget Sound. A brief explanation of these two tables and their sources follows.

Criteria, Effluent Data, and Dilution: Table 1.

EPA priority pollutant saltwater criteria were taken from the Federal Registers of: Nov. 28, 1980; Aug. 13, 1981; and February 7, 1984 (FR 1980; FR 1981; FR 1984).

The concentrations of priority pollutants in municipal wastewater are listed from a variety of sources:

- EPA maximum value: This was the maximum value detected in treated effluent from fifty publicly owned treatment works (POTWs). The POTWs included both secondary and tertiary plants. Each was sampled 60 to 303 times for priority pollutants (Burns and Roe Industrial Services Corp., 1982).
- EPA median values: These values represent the median influent concentration multiplied by the median removal efficiency reported for activated sludge (A.S.) and trickling filter (T.F.) plants (Burns and Roe Industrial Services Corp., 1982).

- Los Angeles POTWs: These were mean secondary municipal effluent concentration from Los Angeles County Joint Water Pollution Control Plants (JWPCP) (Mils, Dean and Porcella, et al., 1982).

- WDOE records: These are geometric means or the range of metal concentrations in secondary treatment plant effluents summarized from 14 to 19 samples (Heffner, 1982).

- Orange County: These are geometric mean concentrations from a trickling filter (T.F.) and an activated sludge (A.S.) POTW in Orange County (McCarty and Reinhard, 1980).

- EPATOX: Values represent the range of concentrations in nine samples from five municipal effluents in EPA Region 10. Samples were taken in 1978 and 1980 (EPATOX, 1981).

- Other: Concentrations of individual pollutants from various journal articles.

- Most Common: These concentrations were picked as the most representative of secondary municipal effluents based on those concentrations, or ranges of concentrations, listed in the table.

It is important to note that metals and cyanide effluent concentrations listed in Table 1 are for total fraction. As a generalization, criteria were applied to these data even if the criteria specified a particular fraction or ionic state; e.g., arsenic +3, active copper, and free cyanide, etc.

The simple dilution requirements have been calculated for both the maximum and the most common effluent concentrations to meet EPA marine acute and chronic toxicity criteria. For our purposes, a generalization has been made concerning the aquatic criteria:

- acute = anytime

- chronic = 24-hour = 30-day

Although this is not strictly correct, the generalization provides a reasonable method to evaluate all the various criteria. For more information on the difference between these terms, please see the November 28, 1980, Federal Registers (1980 and 1984). The dilution factor does not consider individual pollutant's chemical interactions, fate, transport mechanisms; e.g., bioaccumulation potentials, synergistic effects, speciation in marine water, volitilization, etc. It also does not consider the background concentrations of pollutants in the receiving water.

Background Pollutants: Table 2.

The second table lists background concentrations of some metals, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PNA) in Puget Sound. The data are taken from several references, and include only concentrations of these pollutants in Budd Inlet or outside the industrialized urban embayments of Puget Sound; e.g., Commencement Bay, Elliott Bay, etc.

JJ:cp

Attachments

cc: Dick Cunningham

References

Buhler, D.R., M.E. Rasmusson, and H.S. Nakaue, 1973. "Occurrence of hexachlorophene and pentachlorophenol in sewage and water." Envir. Sci. and Tech. 7(10):929-934

Burns and Roe Industrial Services Corp., 1982. Fate of Priority Toxic Pollutants in Publicly Owned Treatment works: Vol. I. EPA 440/1-82/303 September 1982, Effluent Guidelines Div., U.S. Environmental Protection Agency, Washington, D.C. 88 pgs + appendices

Carpenter, R., M.L. Peterson, and R.A. Jahnke, 1978. "Sources, sinks and cycling of arsenic in the Puget Sound region." pg. 459-80 In: Estuarine Interactions, M. Wiley, ed., Academic Press, New York, NY.

Curl, H., (ed.), 1982. Estuarine and Coastal Pollutant Transport and Transformation: The Role of Particulates, FY 80-82 Final Report. Pacific Marine Environmental Laboratory, U.S. Dept. of Commerce NOAA/ERL, Seattle, WA.

Dexter, R.N., D.E. Anderson, E.A. Quinlan, et al., 1981. A Summary of Knowledge of Puget Sound Related to Chemical Contaminants. NOAA Tech. Memo. OMPA-13, Dec. 1981, Boulder, CO. 435 pp.

EPATOX, 1981. Unpublished data from 10 EPATOX file on the PDPSTORET system. Surveillance and Analysis Division, U.S. EPA, Region 10, Seattle, WA. 131 pp.

Federal Register, 1980. "Water quality criteria documents; availability." Vol. 45, FR 79318, Nov. 28, 1980.

Federal Register, 1981. Vol. 46, FR 40919, August 13, 1981.

Federal Register, 1984. Vol. 49, FR 4551, February 15, 1984.

Heffner, M., 1982. "Metals concentrations found during WDOE inspections of municipal wastewater treatment plants." Memo to Bill Yake, Water Quality Investigations Section, Washington Dept. of Ecology, April 1, 1982.

McCarty, P.L. and M. Reinhard, 1980. "Trace organics removed by advance wastewater treatment." Journ. Wat. Poll. Cont. Fed. 52(7):1907-22.

Mills, W.B., J.D. Dean, D.B. Porcella, et al, 1982. Water Quality Assessment, EPA-600/6-82-004a, September 1982, Environmental Research Laboratory, U.S. Environmental Protection Agency, Athens, GA. 570 pp.

Pavlou, S.P. and R.N. Dexter, 1979. "Distribution of polychlorinated biphenyls (PCB) in estuarine ecosystems. Testing the concept of equilibrium partitioning in the marine environment." Envir. Sci. and Tech. 13(1):65-71.

Riley, R.G., E.A. Crecelius, D.C. Mann, et al., 1980. Quantitation of Pollutants in Suspended Matter and Water from Puget Sound. NOAA Tech. Memo. ERL MESA-49. U.S. Dept. of Commerce NOAA/MESA, Boulder, Co. 99 pp.

Schell, W.R., A. Nevissi, D. Piper, et al., 1977. Heavy Metals near the West Point Outfall and the Central Basin of Puget Sound. Municipality of Metropolitan Seattle final report. August 1977. 174 pp.

Table 1. EPA priority pollutants, their: saltwater aquatic life criteria, concentrations in secondary and tertiary municipal effluents, and dilution required to meet aquatic life criteria at maximum and most common concentrations. All concentrations are in ug/L.

POLLUTANT	SALTWATER CRITERIA				MUNICIPAL EFFLUENTS									DILUTION REQUIREMENTS			
	CHRONIC	ACUTE	24HR.	ANYTIME	EPA 1/ maximum value	EPA 2/ median values AS	EPA 2/ median values TF	Los Angeles 3/ POTWs	MODE 4/ records	Orange County 5/ TF	Orange County 5/ AS	EPATOX 5/	OTHER	MOST COMMON	ACUTE Most Common	ACUTE Maximum	CHRONIC Most Common	CHRONIC Maximum
Acenaphthene	970	710	-	-	25							<0.1		<0.1	0	0	0	0
Acrolein	55	-	-	-								<0.01						
Acrylonitrile	-	-	-	-								<0.01						
Dieldrin	-	-	0.0019	0.71	0.1							<0.001-0.004		0.001	0	0	0	52
Aldrin	-	-	-	1.3	0.0							<0.001-0.2		0.001	0	4		
Antimony	-	-	-	-	69			3.0				<0.1-1.2		0.1				
Arsenic			7/															
__Arsenic (+3)	500	-	(63)	(120)	122			4.0				<0.1-4.3		5	0	0 (0)	(0)	(1)
__Arsenic(+5)	2319	-	-	-														
__Monosodium methanearsenate	-	-	-	-														
Asbestos	-	-	-	-														
Benzene	5100	700	-	-	72	0.5	0.4	22				<0.01-0.1		10	0	6	0	0
Benzidine	-	-	-	-								<0.01						
Beryllium	-	-	-	-	12			0.2				<0.01-1.3						
Cadmium	-	-	4.3(12)	59(38)	199	0.5	3.0	0.0	<1-20			<0.01-1.2		10	0 (0)	2 (4)	1 (0)	43 (16)
Carbon Tetrachloride	50,000	-	-	-	67			16			<0.1	<0.01		5	0	0		
Chlordane	-	-	0.004	0.09	0.2							<0.001		0.001	0	1	0	49
Chlorinated Benzenes	160	129	-	-	330*									5*	0*	1*	0*	2*
__Hexachlorobenzene	-	-	-	-	10							<0.01						
__1,2,4,5-tetrachlorobenzene	-	-	-	-														
__Pentachlorobenzene	-	-	-	-														
__Trichlorobenzene	-	-	-	-	310					0.46	0.10	<0.01		0.2				
__Monochlorobenzene	-	-	-	-	9			3		2.5	0.11	<0.01		2				
Chlorinated Ethanes	-	-	-	-														
__Monochloroethane	-	-	-	-	960							<0.01						
__1,1-dichloroethane	-	-	-	-	6							<0.01						
__1,2-dichloroethane	13,000	-	-	-	13,000			11				<0.01		1	0	0		
__1,1,1-trichloroethane	31,200	-	-	-	3500	4	2	100		4.7	2.9	<0.01-0.5		25	0	0		
__1,1,2-trichloroethane	-	-	-	-	6							<0.01						
__1,1,1,2-tetrachloroethane	-	-	-	-														
__1,1,2,2-tetrachloroethane	9020	-	-	-	5							<0.01-1		0.01	0	0		
__Pentachloroethane	390	281	-	-											0	0	0	0
__Hexachloroethane	940	-	-	-								<0.01		<0.01	0	0		
Chlorinated Naphthalenes	7.5	-	-	-								<0.01		<0.01	0	0		

All footnotes on last page.

Table 1 - continued. EPA priority pollutants, their: saltwater aquatic life criteria, concentrations in secondary and tertiary municipal effluents, and dilutio required to meet aquatic life criteria at maximum and most common concentrations. All concentrations are in ug/L.

POLLUTANT	SALTWATER CRITERIA				MUNICIPAL EFFLUENTS									DILUTION REQUIREMENTS			
	CHRONIC	ACUTE	24HR.	ANYTIME	EPA 1/ maximum value	EPA 2/ median values AS	EPA 2/ median values TF	Los 3/ Angeles POTWs	WQOE 4/ records	Orange 5/ County TF	Orange 5/ County AS	EPATOX 6/	OTHER MOST COMMON	ACUTE Most Common	ACUTE Maximum	CHRONIC Most Common	CHRONIC Maximum
Chlorinated Phenols	-	-	-	-													
__4-chloro-3-methylphenol	-	-	-	-	4												
__2,4,6-trichlorophenol	-	-	-	-	3							<0.01-0.4	0.1				
__2,3,5,6-tetrachlorophenol	440	-	-	-										0	0		
__4-chlorophenol	29,700	-	-	-										0	0		
__3-chlorophenol	-	-	-	-													
__2,3-dichlorophenol	-	-	-	-													
__2,5-dichlorophenol	-	-	-	-													
__2,6-dichlorophenol	-	-	-	-													
__3,4-dichlorophenol	-	-	-	-													
__2,3,4,6-tetrachlorophenol	-	-	-	-													
__2,4,5-trichlorophenol	-	-	-	-								<0.01					
__2-methyl-4-chlorophenol	-	-	-	-													
__3-methyl-6-chlorophenol	-	-	-	-													
Chloroalkyl Ethers	-	-	-	-								<0.01					
__bis(chloromethyl)ether	-	-	-	-								<0.01					
__bis(2-chloroethyl)ether	-	-	-	-								<0.01					
__bis(2-chloroisopropyl)ether	-	-	-	-								<0.01					
Chloroform	-	-	-	-	106	3	2	30		1.6	2.9	0.5-3	5				
2-chlorophenol	-	-	-	-	5							<0.01					
Chromium																	
__Chromium(+6)	-	-	18(54)	1260(1200)										0	0	0	0
__Chromium(+3)	10,300	-	-	-	890	17	55	90	<2-30			1-8	50	0	0		
Copper	-	-	4(2)	23(3.2)	255	21	67	50	20			7-83	30	0 (0)	10 (79)	7 (14)	63 (127)
Cyanide(free-HCN+,CN-)	30	2	(0.57)	(1)	2140	95	107					<0.001-0.04	0.01	0 (0)	70(2139)	0 (0)	1069 (3754)
DDT & metabolites	-	-	0.001	0.13	0.5							<0.001-0.04	0.005	0	3	4	499
__DDD(TDE)	3.6	-	-	-	0.3							<0.001-0.12	0.005	0	6		
__DDE	14	-	-	-								<0.001-0.009	0.005	0	0		
Dichlorobenzenes	1970	-	-	-	40*					2.4	0.67	<0.01-0.1	1.0*	0*	0*		
Dichlorobenzidines	-	-	-	-	5							<0.01					
Dichloroethylenes	224,000	-	-	-	17	0.4	0.1					<0.01-3.0	0.1	0	0		
__1,1-dichloroethylene	224,000	-	-	-	11							<0.01	<0.01	0	0		
2,4-dichlorophenol	-	-	-	-	470							<0.01-1					
Dichloropropanes	10,300	3040	-	-	0							<0.01-0.3	0.01	0	0	0	0
Dichloropropenes	790	-	-	-								<0.01	<0.01	0	0		

All footnotes on last page.

Table 1 - continued. EPA priority pollutants, their: saltwater aquatic life criteria, concentrations in secondary and tertiary municipal effluents, and dilution required to meet aquatic life criteria at maximum and most common concentrations. All concentrations are in ug/L.

POLLUTANT	SALTWATER CRITERIA				MUNICIPAL EFFLUENTS										DILUTION REQUIREMENTS			
	CHRONIC	ACUTE	24HR.	ANYTIME	EPA 1/ maximum value	EPA 2/ median values AS	EPA 2/ median values TF	Los Angeles 3/ POTWs	WQDE 4/ records	Orange County 5/ TF	Orange County 5/ AS	EPATOX 6/	OTHER	MOST COMMON	ACUTE Most Common	ACUTE Maximum	CHRONIC Most Common	CHRONIC Maximum
2,4-dimethylphenol	-	-	-	-	18							<0.01						
2,4-dinitrotoluene	590	-	-	-	2							<0.01	<0.01		0	0		
1,2-diphenylhydrazine	-	-	-	-	2							<0.01						
Endosulfan	-	-	0.0087	0.034	2*							<0.001	0.001		0*	58*	0*	229*
Endrin	-	-	0.0023	0.037								<0.001	0.001		0		0	
Ethylbenzene	430	-	-	-	120	0.8	0.8	18		1.4	3.04	<0.01	1		0	0		
Fluoroanthene	40	16	-	-	33							<0.01	<0.01		0	0	0	1
Haloethers	-	-	-	-	6							<0.01						
__2-chloroethyl vinyl ether	-	-	-	-														
__4-bromophenyl phenyl ether	-	-	-	-														
__4-chlorophenyl phenyl ether	-	-	-	-														
__bis(2-chloroethoxy)methane	-	-	-	-														
Halomethanes	12,000	6400	-	-	62,000*	2*	9*	18*				<0.01-9*	10*		0*	4*	0*	9*
__bromomethane	-	-	-	-														
__chloromethane	-	-	-	-														
__chlorodibromomethane	-	-	-	-														
__dichloromethane	-	-	-	-														
__dichlorobromomethane	-	-	-	-														
__dichlorodifluoromethane	-	-	-	-														
__trichlorofluoromethane	-	-	-	-														
Heptachlor	-	-	0.0036	0.053	2*							<0.001	0.001		0*	37*	0*	555*
Hexachlorobutadiene	32	-	-	-								<0.001						
Hexachlorocyclohexanes	-	-	-	-														
__lindane (gamma BHC)	0.16	-	-	-	1.4					0.19	0.15	<0.001-0.09	0.005		0	0		
__BHC isomer mixtures	0.34	-	-	-	3.8*							<0.001-0.2*	0.01*		0*	10*		
____alpha BHC	-	-	-	-	0.7							<0.001-0.23	0.001					
____beta BHC	-	-	-	-	1.7							<0.001	<0.001					
____delta BHC	-	-	-	-								<0.001-0.004						
Hexachlorocyclopentadiene	7	-	-	-								<0.001	<0.001		0	0		
Isophorone	12,900	-	-	-	12							<0.61-0.3	0.1		0	5		
Lead	600	25	(0.6)	(220)	400	10	42.	3	<3-200			2-14	30		0 (0)	0 (1)	0 (2)	15 (46)
Mercury	-	-	0.1(0.1)	3.7(1.9)	2	0.1	0.2	0.1				<0.61-0.2	0.2		0 (0)	0 (0)	1 (1)	19 (19)
Naphthalene	2350	-	-	-	24	0.2				0.57	0.06	<0.01-0.2	0.2		0	0		
Nickel	-	-	7.1	140	679	37	27	220	<3-50			5-50	30		0	4	3	95
Nitrobenzene	6600	-	-	-	4							<0.01			0	0		

All footnotes on last page.

Table 1 - continued. EPA priority pollutants, their: saltwater aquatic life criteria, concentrations in secondary and tertiary municipal effluents, and dilution required to meet aquatic life criteria at maximum and most common concentrations. All concentrations are in ug/L.

POLLUTANT	SALTWATER CRITERIA				MUNICIPAL EFFLUENTS									DILUTION REQUIREMENTS			
	CHRONIC	ACUTE	24HR.	ANYTIME	EPA 1/ maximum value	EPA 2/ median values AS	EPA 2/ median values TF	Los Angeles 3/ POTWs	NODE 4/ records	Orange County 5/ TF	Orange County 5/ AS	EPATOX 6/	OTHER	MOST COMMON	ACUTE Most Common	ACUTE Maximum	CHRONIC Most Common	CHRONIC Maximum
Nitrophenols	4850	-	-	-	240*										8*	8*		
__2,4-dinitro-o-cresol	-	-	-	-								<0.01						
__Dinitrophenols	-	-	-	-								<0.01						
__Mononitrophenols	-	-	-	-	235*							<0.01						
__Trinitrophenols	-	-	-	-	4							<0.01						
Nitrosamines	33	-	-	-								<0.01						
__Dimethylnitrosamine	-	-	-	-								<0.01			8	8		
__Diphenylnitrosamine	-	-	-	-														
__Di-n-propylnitrosamine	-	-	-	-														
Pentachlorophenol	53	34	-	-	440													
Phenol	5800	-	-	-	89	8.8		14				<0.01-2	2 †	2	8	7	8	12
Phthalate Esters	2944	-	-	-	2750*							<0.01-24		10	8	8		
__bis(2-ethylhexyl)phthalate	-	-	-	-	410	10	21	4		28	9.3	<0.01-26		10	8*	8*		
__Diethyl phthalate	-	-	-	-	32	8.3	-	<10				<0.01-3						
__Dimethyl phthalate	-	-	-	-	5			<10		16	5.4	<0.01-2						
__Di-n-butyl phthalate	-	-	-	-	138	1	2	90		2.9	4.4	<0.01-6						
__Di-n-octyl phthalate	-	-	-	-	12							0.1-1.1						
__n-butylbenzyl phthalate	-	-	-	-	2200	0.2	0.9					<0.01						
Polychlorinated Biphenyls	10	-	0.03	-	3.1*					1.3	0.47	<0.005	0.06 ††	0.05	0*	0*	1*	182*
Polynuclear Aromatic Hydrocarbons	300	-	-	-	160*									0.1*	0*	0*		
__Acenaphthylene	-	-	-	-	5							<0.01						
__Anthracene	-	-	-	-	32							<0.01						
__Benzo(a)anthracene	-	-	-	-	11							<0.01						
__Benzo(b)fluoranthene	-	-	-	-								<0.01						
__Benzo(k)fluoranthene	-	-	-	-								<0.01						
__Benzo(g,h,i)perylene	-	-	-	-	4							<0.01						
__Benzo(a)pyrene	-	-	-	-								<0.01						
__Chrysene	-	-	-	-	11							<0.01						
__Dibenzo(a,h)anthracene	-	-	-	-	5							<0.01						
__Fluorene	-	-	-	-	5							<0.01						
__Indeno(1,2,3-c,d)pyrene	-	-	-	-	42							<0.01						
__Phenanthrene	-	-	-	-	32							<0.01						
__Pyrene	-	-	-	-	11							<0.01-0.3						

All footnotes on last page.

Table 1 - continued. EPA priority pollutants, their: saltwater aquatic life criteria, concentrations in secondary and tertiary municipal effluents, and dilution required to meet aquatic life criteria at maximum and most common concentrations. All concentrations are in ug/L.

POLLUTANT	SALTWATER CRITERIA				MUNICIPAL EFFLUENTS										DILUTION REQUIREMENTS			
	CHRONIC	ACUTE	24HR.	ANYTIME	EPA 1/ maximum value	EPA 2/ median values AS	EPA 2/ median values TF	Los 3/ Angeles POTWs	NDCE 4/ records	Orange County 5/ TF	Orange County 5/ AS	EPATOX 6/	OTHER MOST COMMON	ACUTE Most Common	ACUTE Maximum	CHRONIC Most Common	CHRONIC Maximum
Selenium	-	-	-	-	1045			7				<0.01-0.8					
__Selenite	-	-	54	410													
__Selenate	-	-	-	-													
Silver	-	-	-	2.3	44	1	4	2	<1-3			<0.01-7	5	1	18		
Tetrachloroethylene	10,200	450	-	-	1200	4	4	160		0.6	1.5	<0.01-7	10	0	0	0	2
Thallium	2130	-	-	-	2			1				<0.01-5	1	0	0		
Toluene	6300	5000	-	-	1100	2	3	24				<0.01-240	10	0	0	0	0
Toxaphene	-	-	-	0.07								<0.02	<0.02	0	0		
Trichloroethylene	2000	-	-	-	630	3	1	12		0.9	-	<0.01-8	3	0	0		
Vinyl Chloride (Chloroethylene)	-	-	-	-	5000							<0.01					
Zinc	-	-	58	170	3000	52	156	260	72			40-310	100	0	21	1	65

1/EPA maximum value from Burns and Roe Industrial Services Corp., 1982, Tables 4 and 7.

2/EPA median influent concentrations times percent removal for activated sludge (AS) and trickling filter (TF) plants. Data from Burns and Roe Industrial Services Corp., 1982, Tables 9 and 11.

3/Secondary effluent values for Los Angeles County publicly owned treatment works (POTWs). Data are as presented in Table III-55 of Mills, Dean and Porcella, et al., 1982.

4/Geometric mean or range of concentration(s) from secondary treatment plants as presented in Heffner, 1982.

5/Orange County Sanitation District trickling filter (TF) and activated sludge (AS) effluent values in Table IX(QI) of McCarty and Reinhard, 1980.

6/EPATOX STORET file treatment plant effluent values from EPA, 1981.

7/( ) = Proposed criterion promulgated by EPA:FR, 1984.

†Data from Buhler, Rasmusson and Nakaue, 1973.

††Data from Table IX-5 of Dexter, Anderson, Quinlan, et al., 1981.

*Summation of concentrations of chemicals in group.

TF = trickling filter

AS = activated sludge

< = less than

Table 2. Concentrations of selected priority pollutants in Puget Sound waters. All concentrations in ug/L unless otherwise noted.

	Central Puget Sound[a]		Budd Inlet[b]	Point No Point[c]	
	Total	Dissolved	Converted Particulate	Soluble	Total
Metals					
Arsenic	1.5-2.0	1.4-1.8	<0.19	--	--
Cadmium	0.3	0.3	--	0.3	0.3
Chromium	--	--	0.21	--	--
Copper	0.5	0.3-0.4	0.40	0.15	0.17
Lead	2.8	--	0.22	4.2	4.4
Nickel	1.3	0.3-0.4	0.10	0.30	0.40
Selenium	--	--	0.01		
Zinc	1.9	--	1.55	1.1-2.0	1.3-2.3

	Water	Suspended Particulates (ug/g)	Surface Film
PCB[d]	0.004	0.100	0.012

	Budd Inlet	
Polynuclear Aromatic Hydrocarbons[b]	Converted Particulate	Dissolved
Naphthalene	0.0002	0.021
Fluorene	0.0004	<0.001
Phenanthrene	0.0010	0.005
Anthracene	0.0008	<0.001
Fluoranthene	0.0007	0.025
Pyrene	0.0018	0.003
Benzo(a)anthracene	<0.0001	<0.001
Chrysene	<0.0001	<0.001
Benzo(a)pyrene	<0.0001	<0.001

[a]Arsenic values from Carpenter, Peterson, and Jahnke, 1978-(Figure 1). Dissolved cadmium, copper, and nickel values from Curl, 1982-(Table 5.6). Total cadmium, copper, lead, nickel, and zinc from Schell, et al., 1977-(Table 6.1).

[b]Metal values converted from Table 2 of Riley, et al., 1980 using Olympia suspended matter concentrations (ppm, dry weight) and applying 8.6 mg/L dry weight suspended load (Table 1) value for Olympia. Dissolved polynuclear aromatic hydrocarbon (PNA) from Table 11, and suspended matter PNA values from Table 15.

[c]Values taken from Schell, et al., 1977-(Table 4.1).

[d]Values from Pavlou and Dexter, 1979-(Table 1, Main Basin).