Puget Sound Estuary Program

HEALTH RISK ASSESSMENT OF CHEMICAL CONTAMINATION IN PUGET SOUND SEAFOOD

TC-3338-28
FINAL REPORT

September 1988

Prepared by
Tetra Tech, Inc.

Prepared for
U.S. Environmental Protection Agency
Region X - Office of Puget Sound
Seattle, Washington

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Tetra Tech, Inc.
11820 Northup Way, Suite 100
Bellevue, Washington 98005

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ACKNOWLEDGMENTS

This document was prepared by Tetra Tech, Inc., for the U.S. Environmental Protection Agency (EPA) in partial fulfillment of Contract No. 68-02-4331. Ms. Sally Hanft of U.S. EPA was the Project Officer and Ms. Catherine Krueger of U.S. EPA was the Project Monitor. Dr. Donald Wilson of Tetra Tech was the Program Manager.

The primary author of this report was Dr. Leslie Williams. Dr. Gary Pascoe, Dr. Jean Jacoby, Ms. Nancy Musgrove, and Ms. Lynne Kilpatrick-Howard of Tetra Tech, Inc., provided technical assistance. Valuable comments on the preliminary stages of risk analysis and on the draft report from which this report was developed were provided by Ms. Catherine Krueger and Dr. John Armstrong of U.S. EPA. Additional valuable comments and discussion were provided by work group participants from local, state, and federal agencies, universities, and consulting organizations. Ms. Marcy Brooks-McAuliffe and Ms. M. Sue Trevathan assisted in technical editing and report production.

EXECUTIVE SUMMARY

Potentially toxic chemicals such as PCBs, pesticides, and metals may accumulate in the edible tissues of fish, shellfish, and macroalgae harvested from Puget Sound. Concern over the potential health risks associated with consumption of locally harvested seafood prompted several recent studies of catch and consumption patterns, and of chemical contaminants in the catch of recreational harvesters. Other studies have focused on contaminant concentrations and potential health risks associated with consumption of Puget Sound biota harvested in the vicinity of hazardous waste sites or urbanized areas. During 1986-1987, a broad-scale survey of the extent of chemical contamination in Puget Sound seafood was sponsored by the U.S. Environmental Protection Agency (EPA) Region X. Support for this effort was provided by the Washington Department of Fisheries (WDF), the Washington Department of Ecology (Ecology), and the Washington Department of Social and Health Services (DSHS). These survey data and other data collected for National Oceanic and Atmospheric Administration, Ecology, or the U.S. EPA Puget Sound Estuary Program were used in this report to characterize potential human health risks associated with chemical contaminants in Puget Sound seafood.

The primary objective of this report is threefold: to provide resource management and health agencies with a general indication of the magnitude of potential risks, to indicate whether immediate regulatory action was warranted to protect public health, and to guide future data collection efforts. A secondary objective of this report is to provide health agencies and the public with a tool that could be used to easily estimate potential health risks associated with chemicals in Puget Sound seafood as additional data become available in the future.

This report focuses entirely on recreational harvesters of Puget Sound seafood, who comprise a subset of the general population. For the purpose of

this analysis, recreational harvesters are defined as individuals who frequently collect fish, shellfish, or edible seaweed for use in personal consumption. Although not specifically addressed in this report, potential risks associated with consumption of commercially harvested Puget Sound seafood should be similar to those associated with consumption of recreationally harvested Puget Sound seafood, assuming similar seafood consumption patterns and seafood contamination levels.

The report is intended to provide the public and regulatory agencies with a framework characterizing the relative hazards associated with chemical contaminants in various seafood categories and locations in the Puget Sound basin. Because of limitations in the available data, the results of this effort should not be viewed as an indication of absolute health risks. In general, highly conservative assumptions concerning chemical toxicity and exposure are used to estimate potential health risks. Because of the conservative nature of U.S. EPA's risk assessment model, actual health risks to consumers of Puget Sound seafood associated with the limited number of chemicals evaluated in this study are likely to be less than the estimates of potential health risks provided in this report. It is not known, however, to what extent nonmeasured chemicals contribute to the overall health risks associated with seafood consumption.

OVERVIEW AND SUMMARY OF THE RISK ASSESSMENT PROCESS

Risk assessment is a scientific procedure to determine the probability of adverse health effects from a specific exposure to a toxic agent. The general format for risk assessment and all definitions of terms used in this report are consistent with those provided by National Research Council (1983) and U.S. EPA (1986a,b,c,d). The following sections provide an overview of the risk assessment process and a summary of how that process was applied to chemical contaminants in Puget Sound seafood.

Overview of Risk Assessment

As indicated in Figure ES-1, risk assessment is a multistep process comprising the following tasks:

- Hazard Assessment -- Selection of chemicals of concern and qualitative evaluation of their potential to cause adverse health effects (e.g., birth defects, cancer) in animals or in humans

- Dose-Response Assessment -- Quantitative estimation of the relationship between the dose of a substance and the probability of an adverse health effect

- Exposure Assessment -- Characterization of the populations exposed to the toxic chemicals of concern; the environmental transport and fate pathways; and the magnitude, frequency, and duration of exposure

- Risk Assessment -- Estimation of risk for the health effect of concern, based on information from the dose-response and exposure assessments

- Uncertainty Analysis -- Qualitative and, where possible, quantitative description of the assumptions and limitations inherent in each step of the risk assessment.

Although these steps are presented sequentially, the risk assessment process is highly iterative. Further elaboration on the uses of risk assessment and risk management in evaluation of chemically contaminated fish and shellfish is available in several U.S. EPA guidance manuals (Tetra Tech 1986; PTI 1987).

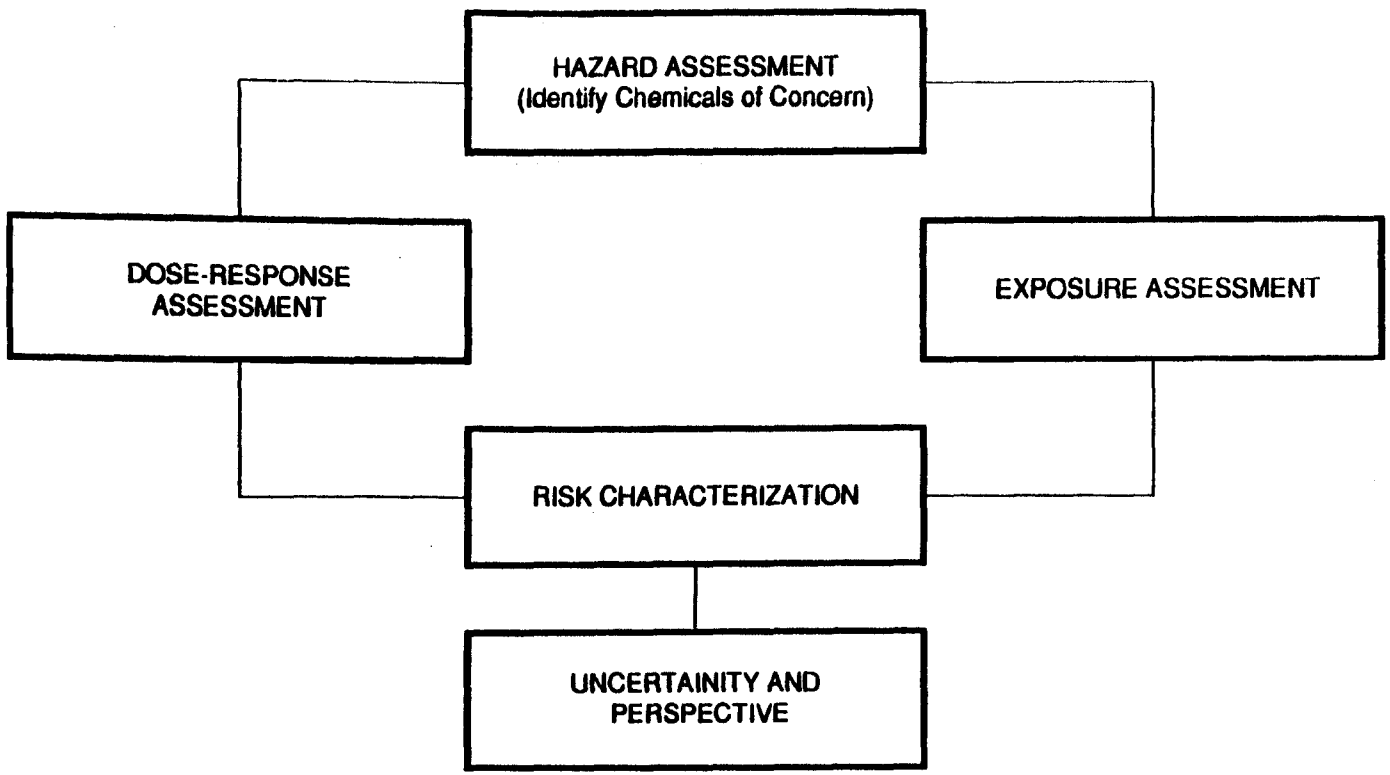


Figure ES-1. Overview of the risk assessment process.

Summary of the Risk Assessment Process for Puget Sound Seafood

The risk analysis of chemical contaminants in Puget Sound seafood was organized into the following major sections:

- Compilation and review of Puget Sound data on chemicals in seafood
- Assessment of human health risks due to consumption of Puget Sound seafood
- Comparisons of seafood contaminant concentrations and associated health risks in Puget Sound with those in other U.S. coastal locations
- Development of a graphical tool for estimating health risks for a wide range of exposure conditions.

The compilation and review of Puget Sound data involved synthesizing numerous data sources into a composite data set, and identifying 37 candidate chemicals for risk analysis. These chemical data were then evaluated in a health risk assessment that followed the multistep procedure outlined above. In the hazard assessment, the 37 candidate chemicals were evaluated in a preliminary risk assessment, and 8 chemicals or compound groups of concern were selected for detailed evaluation of risks. The dose-response assessment compiled dose-response variables for the 37 candidate chemicals and presented toxicity profiles for the subset of eight chemicals of concern identified in the hazard assessment. The exposure assessment consisted of an evaluation of the concentrations in biota of the eight chemicals of concern by seafood category and sampling location within Puget Sound. This task also included a summary of seafood consumption rates that was based in part on recent surveys of recreational harvesters in Puget Sound. In the risk characterization, the dose-response information and consumption rate information were combined to quantitatively estimate the range of health risks associated with consumption of seafood contaminated with the eight

chemicals of concern. Uncertainties, limitations, and assumptions are discussed qualitatively at each stage of the risk assessment process.

To supplement the risk characterization, contaminant concentrations in Puget Sound biota were compared with those in biota from other U.S. coastal areas. A method for graphical characterization of risks for the eight chemicals of concern was also developed. The purpose of this activity was to provide regulatory agencies and the public with a generic graphical tool that could be used to easily estimate potential health risks associated with a wide range of chemical concentrations and consumption rates for Puget Sound seafood.

COMPILATION AND REVIEW OF PUGET SOUND DATA

Ten data sets were evaluated for this risk assessment. The studies that generated these data ranged considerably in their objectives, survey designs, and sampling and analysis methods. However, each survey characterized chemical contamination in industrialized or urbanized areas of Puget Sound, and included one or more areas located well away from urban centers or sources of industrial contaminants. Hence, the Puget Sound seafood risk assessment was likely based on data that are representative of the various degrees of chemical contamination observed throughout the sound.

The selection of chemicals for evaluation in the risk assessment was based on the results of quality assurance (QA) reviews for each of the studies as well as on other criteria. Identification of candidate chemicals for the risk assessment was conducted in several steps. An initial decision to accept or reject available data was based on whether the seafood species sampled and the locations at which they were collected were clearly identified. Further evaluation of samples that passed this initial selection was based on the frequency of detection and data quality for individual chemicals. This process resulted in the identification of 37 candidate chemicals or compound groups for further evaluation of health risks associated with consumption of chemically contaminated seafood.

RISK ASSESSMENT

The 37 candidate chemicals or compound groups were evaluated according to the general risk assessment guidelines established by the U.S. EPA (1986a,b, c,d), as well as guidance developed for the Puget Sound Estuary Program for risk assessment of chemically contaminated seafood (Tetra Tech 1986).

Following data compilation, data were available for chemical contaminants in fish, shellfish, and macroalgae from 22 locations in Puget Sound (Figure ES-2). The taxa sampled at one or more of these locations are listed in Table ES-1. The number of taxa and kinds of algae and animals sampled varied considerably among areas. For the purposes of the risk assessment, the various species were pooled into categories that are more representative of differences in potential ingestion rates and therefore human contaminant exposure (see Exposure Assessment below). The various categories were fish, shellfish, kelp and green algae, and red algae of the genus *Porphyra* (commonly known as nori).

Hazard Assessment and Selection of Chemicals of Concern

After the initial screening and identification of the 37 chemicals of potential concern, these chemicals were further characterized and prioritized by considering the following factors:

- Preliminary worst-case risk evaluation
- The frequency of detection and maximum concentrations in different categories of biota sampled throughout Puget Sound
- The toxicological characteristics of the various contaminants.

Using a range of reasonable upper-bound assumptions, the objective of the preliminary risk evaluation was to identify those substances from the

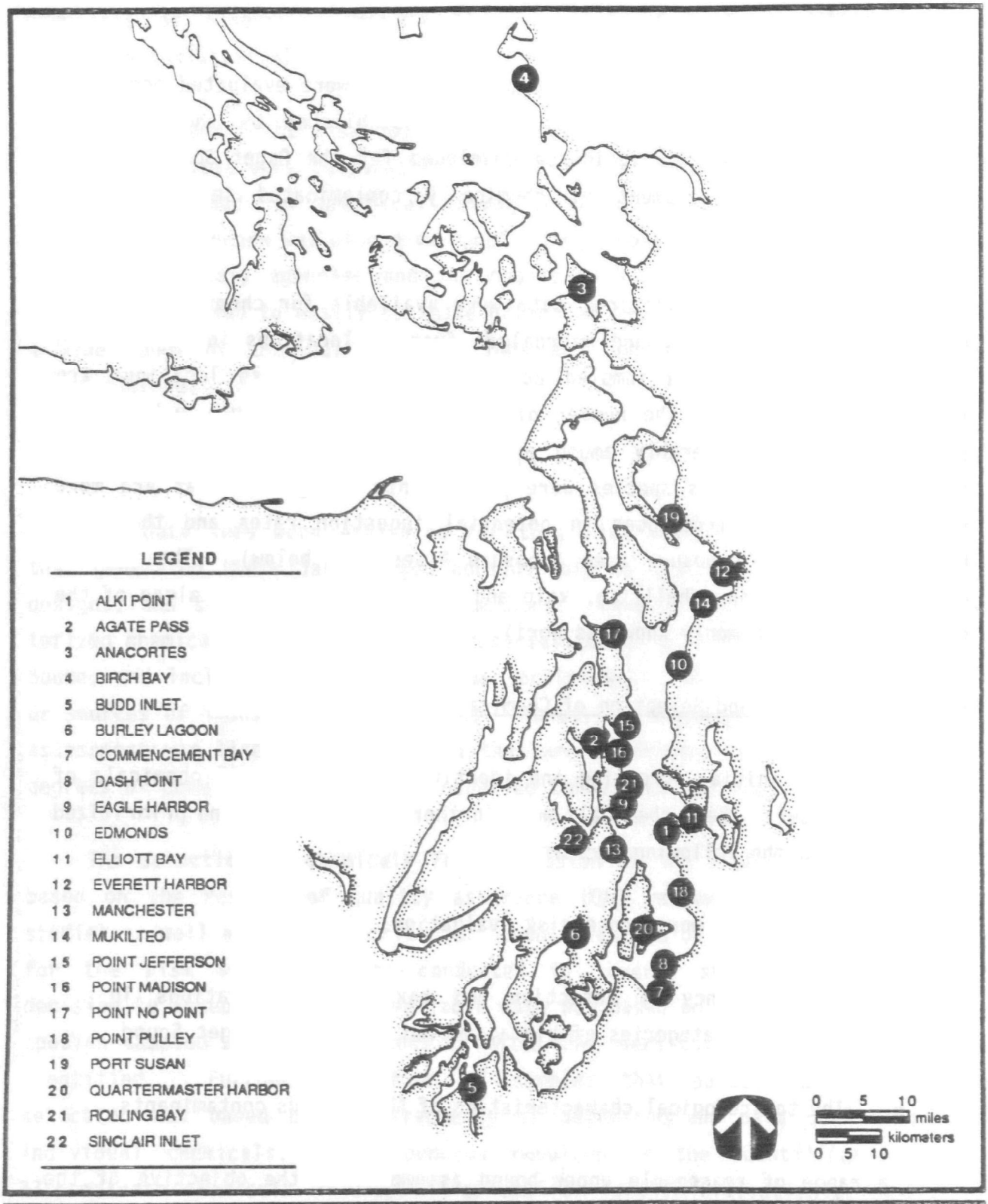


Figure ES-2. Sampling areas for risk assessment of chemically contaminated seafood.

TABLE ES-1. SCIENTIFIC AND COMMON NAMES OF FISH, SHELLFISH, AND MACROALGAE EVALUATED IN RISK ASSESSMENT OF CHEMICALLY CONTAMINATED SEAFOOD

Category	Type	Scientific Name	Common Name
Fish	Pelagic	*Oncorhynchus kisutch*	Coho salmon
		Oncorhynchus tshawytscha	Chinook salmon
		Merluccius productus	Pacific hake
		Embiotoca lateralis	Striped perch
		Sebastes spp.	Rockfish
		Anoplopoma fimbria	Sablefish
	Bottom feeding	*Gadus macrocephalus*	Pacific cod
		Theragra chalcogramma	Walleye pollock
		Microgadus proximus	Tomcod
	Bottom fish	*Parophrys vetulus*	English sole
		Platichthys stellatus	Starry flounder
		Citharichthys sordidus	Pacific sanddab
		Lepidopsetta bilineata	Rock sole
		Hippogloissoides elassodon	Flathead sole
		Enophrys bison	Buffalo sculpin
Shellfish	Crab	*Cancer magister*	Dungeness crab
		Cancer productus	Rock crab
	Bivalve	*Clinocardium nuttalli*	Heart cockle
		Macoma inquinata	--
		Macoma nasuta	Bent nose clam
		Macoma secta	Sand clam
		Macoma spp.	--
		Mya arenaria	Softshell clam
		Protothaca staminea	Littleneck clam
		Saxidomus giganteus	Butter clam
		Tapes japonica	Manila clam
		Tresus capax	Horseneck clam
	Squid	*Loligo opalescens*	Market squid
Macroalgae	Brown algae (kelp)	*Laminaria* spp.	--
		Nereocystis spp.	--
	Green algae	*Ulva* spp.	Sea lettuce
	Red algae	*Porphyra* spp.	Nori

initial list of 37 chemicals that are truly of concern in Puget Sound seafood.

Based on the results of the preliminary risk estimates, the various chemicals were categorized into high-priority, medium-priority, and low-priority groups (Table ES-2). The chemicals of concern selected for further risk analysis included all of the high-priority chemicals or compound groups and one medium-priority chemical (mercury). The carcinogenic chemicals or compound groups of concern are arsenic, carcinogenic PAH [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene], PCB, alpha-HCH, and Σ DDT (i.e., DDD, DDE, and DDT). The noncarcinogenic chemicals of concern are cadmium, lead, and mercury.

Dose-Response Assessment

In developing risk assessment methods, U.S. EPA recognized that fundamental differences exist between carcinogenic dose-response variables and noncarcinogenic dose-response variables that could be used to estimate risks. Because of these differences, human health risk characterization is conducted separately for carcinogens and noncarcinogens.

Key dose-response variables used in quantitative risk assessment are potency factors for carcinogens and reference dose (RfD) values for noncarcinogens. The carcinogenic potency factor [expressed in units of $(mg/kg/day)^{-1}$] is typically determined by the upper 95 percent confidence limit of slope of the linearized multistage model that expresses excess cancer risk as function of dose. The RfD (expressed in units of mg/kg/day) is an estimated single daily chemical intake rate that appears to be without risk if ingested over a lifetime (Vettorazzi 1976, 1980; U.S. EPA 1980, 1987a; Dourson and Stara 1983).

Available dose-response information for quantitative risk assessment is summarized in Table ES-3 for the 37 candidate chemicals. These variables were used for the preliminary risk determination and selection of the eight chemicals of concern described in the Hazard Assessment. Potency factors

TABLE ES-2. CATEGORIES OF CANDIDATE CHEMICALS[a] OR COMPOUND GROUPS BASED ON PRELIMINARY RISK ESTIMATES

Priority	Toxic Class	Chemical or Compound Group
High[b]	Carcinogens	Arsenic Carcinogenic PAH[c] PCBs (total PCB, PCB-1254, PCB-1260) alpha-HCH DDT and related compounds (DDD and DDE)
	Noncarcinogens	Cadmium Lead
Medium[d]	Carcinogens	Hexachlorobenzene Heptachlor
	Noncarcinogens	Mercury Copper
Low[e]	Carcinogens	Hexachlorobutadiene
	Noncarcinogens	Antimony Chromium Nickel Selenium Silver Zinc Bis(2-ethylhexyl)phthalate Alpha-endosulfan 2-Butanone Acetone

[a] Some chemicals were not categorized because dose-response information needed to estimate risks was not available (see Dose-Response Assessment). These substances were anthracene, phenanthrene, benzo(k)fluoranthene, fluoranthene, pyrene, di-n-octyl phthalate, 2-hexanone, and vinyl acetate.

[b] Based on worst-case carcinogenic risks $>10^{-5}$, and on worst-case noncarcinogenic risk index >1.

[c] Includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene.

[d] Based on worst-case carcinogenic risks that range from 10^{-6} to 10^{-5}, and on worst-case noncarcinogenic risk index that ranges from 0.25 to 1.

[e] Based on worst-case carcinogenic risk $<10^{-6}$, and on worst-case noncarcinogenic risks <0.25.

TABLE ES-3. DOSE-RESPONSE INFORMATION FOR CHEMICALS DETECTED IN FISH, SHELLFISH, AND MACROALGAE

Chemical Class	Chemical	Carcinogens: Potency Factor $(mg/kg/day)^{-1}$	Carcinogens: Weight of Evidence[a]	Noncarcinogens: RfD (mg/kg/day)	Noncarcinogens: Confidence[b]
Metals	Antimony			0.0004	1
	Arsenic	1.500[c]	A		
	Cadmium			0.0003	
	Chromium (VI)			0.0050	1
	Copper			0.0370	
	Lead			0.0014	
	Mercury (methyl)			0.0003	2
	Nickel			0.0200	2
	Selenium			0.0030	
	Silver			0.0030	
	Zinc			0.2100	
LPAH	Anthracene				
	Phenanthrene		D		
HPAH	Benzo(a)anthracene	11.500	B2		
	Benzo(a)pyrene	11.500	B2		
	Benzo(b)fluoranthene	11.500	B2		
	Benzo(k)fluoranthene		D		
	Chrysene	11.500	B2		
	Fluoranthene				
	Pyrene				
Chlorinated aliphatic compounds	Hexachlorobutadiene	0.078	C	0.0020	1
Chlorinated aromatic compounds	Hexachlorobenzene	1.670	B2		
Phthalates	Bis(2-ethylhexyl)phthalate			0.0200	2
	Di-n-octyl phthalate				
PCBs	PCBs-total	7.700	B2		
	PCB-1254	7.700	B2		
	PCB-1260	7.700	B2		
Pesticides	alpha-HCH	11.120	B2		
	DDD, 4,4'	0.340	B2		
	DDE, 4,4'	0.340	B2		
	DDT, 4,4'	0.340	B2	0.0005	2
	Endosulfan-alpha			0.0001	2
	Heptachlor	4.500	B2		1
Ketones	2-Butanone			0.0500	2
	2-Hexanone				
	Acetone			0.1000	2
Unsaturated alcohols	Vinyl acetate				

[a] Weight of evidence ratings are (A) human carcinogen, (B1) probable human carcinogen based on limited epidemiological evidence, (B2) probable human carcinogen based on evidence from animal studies, (C) possible human carcinogen, (D) not classifiable as to human carcinogenicity, (E) evidence of noncarcinogenicity in humans.
[b] Confidence ratings are low (1), medium (2), and high (3).
[c] Potency factor based on interim recommendation of the U.S. EPA Risk Assessment Forum.

and weight-of-evidence ratings for carcinogens and reference dose (RfD) values, and confidence ratings for noncarcinogens were collated from a variety of sources including the Integrated Risk Information System database, the Public Health Risk Evaluation Database, health advisory documents, the Superfund Public Health Evaluation Manual, and the drinking water criteria for PCBs.

Exposure Assessment

The exposure assessment for consumption of chemically contaminated seafood from Puget Sound was performed in three parts. First, the concentrations of the eight chemicals of concern in Puget Sound biota were summarized by seafood category and sampling location, and were compared with available U.S. Food and Drug Administration (FDA) tolerances or action levels. Second, seafood consumption rates based in part on recent surveys of recreational harvesters in Puget Sound were summarized. Finally, chemical concentration data and consumption rates were combined to estimate the average daily dose associated with each chemical of concern.

Concentrations of Chemicals of Concern--

Concentration data for the chemicals of concern in various categories of seafood from all Puget Sound locations [i.e., fish, shellfish (bivalves and squid only), kelp and *Ulva*, and nori] are summarized in Table ES-4. The data summary provided in Table ES-4 is based on only those data that met all data quality objectives, and on the use of one-half the quantification limits for those substances that were not detected.

FDA tolerances or action levels exist for three of the eight chemicals that are of concern in this risk assessment: mercury, PCBs, and Σ DDT. Overall, average concentrations of these substances in the various species and categories of seafood were less than the FDA tolerances or action levels for all locations in Puget Sound. The only notable exception was the concentration of PCBs [2.06 mg/kg (2,060 ug/kg) wet weight] in a single sample of English sole from Elliott Bay. The FDA tolerance for PCBs in fish

TABLE ES-4. SUMMARY DATA[a] FOR CHEMICALS OF CONCERN IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Chemical	Seafood Category	No. Samples	Percent Detected	Concentration (ug/kg wet wt)[b] Mean	SE	Minimum	Maximum	95 Percent Confidence Limits[c] Lower	Upper
Arsenic	Fish	147	100	3,441	354	190	20,700	2,740	4,141
	Shellfish	110	100	3,252	254	1,200	22,100	2,749	3,756
	Kelp/Ulva	33	100	2,559	380	340	9,200	1,785	3,333
	Nori	7	100	2,279	499	470	3,880	1,057	3,500
Cadmium	Fish	142	76	5.4	0.6	0.5	66.0	4.1	6.6
	Shellfish	118	100	219.1	16.2	2.0	1,280.0	187.0	251.2
	Kelp/Ulva	33	100	173.2	19.4	46.0	437.0	133.7	212.6
	Nori	7	100	213.1	48.6	62.0	394.0	94.3	332.0
Lead	Fish	141	50	16.3	3.0	0.5	200.0	10.4	22.1
	Shellfish	96	81	199.3	33.1	1.0	1,980.0	133.5	265.1
	Kelp/Ulva	33	85	338.0	135.7	2.5	4,460.0	61.6	614.3
	Nori	7	57	76.8	36.8	2.5	240.0	0.0	166.9
Mercury	Fish	82	87	26.6	4.2	0.5	260.0	18.3	34.9
	Shellfish	93	100	22.5	1.6	1.0	103.0	19.3	25.6
	Kelp/Ulva	33	48	1.7	0.5	0.5	15.0	0.8	2.6
	Nori	7	43	1.0	0.3	0.5	3.0	0.2	1.8
DDT, DDE, DDD	Fish	205	40	11.15	2.24	0.85	415.00	6.72	15.57
	Shellfish	26	69	1.60	0.49	0.15	11.33	0.60	2.61
	Kelp/Ulva	33	100	4.03	0.11	3.00	7.00	3.80	4.26
	Nori	7	100	3.86	0.14	3.00	4.00	3.51	4.21
alpha-HCH	Fish	143	3	0.60	0.09	0.05	6.00	0.42	0.78
	Shellfish	19	-	0.05	0.00	0.05	0.10	0.05	0.06
	Kelp/Ulva	33	-	0.53	0.03	0.50	1.50	0.47	0.59
	Nori	7	-	0.50	0.00	0.50	0.50	0.50	0.50
Carcinogenic PAH	Fish	-	-	-	-	-	-	-	-
	Shellfish	32	47	61.9	25.2	2.5	748.0	10.6	113.2
	Kelp/Ulva	5	-	261.7	62.6	120.0	480.0	87.9	435.5
	Nori	-	-	-	-	-	-	-	-
PCB	Fish	185	99	138.2	17.6	1.8	2,060.0	103.5	172.9
	Shellfish	41	83	44.7	10.2	1.0	230.0	24.0	65.5
	Kelp/Ulva	33	-	10.6	0.6	10.0	30.0	9.4	11.8
	Nori	7	-	10.0	0.0	10.0	10.0	10.0	10.0

[a] Only those values that met data quality objectives were used in the data summary, and in the subsequent risk characterization. Consequently, the number of samples and summary statistics indicated herein may differ substantially from those based on both qualified and unqualified data, which are summarized in Appendix B.

[b] One-half the quantitation limits was assumed for values that were not detected.

[c] The 95 percent confidence interval was determined as follows:

$$\text{Lower confidence limit (LCL)} = \text{mean} - t_{0.05\ (n-1)} \times SE$$
$$\text{Upper confidence limit (UCL)} = \text{mean} + t_{0.05\ (n-1)} \times SE$$

where:

$t_{0.05\ (n-1)}$ = Student's two-tailed t value for alpha = 0.05 and n-1 degrees of freedom.

SE = The standard error of the mean.

and shellfish is 2 mg/kg (2,000 μg/kg). FDA action levels or tolerances have not been established for other chemicals of concern in Puget Sound seafood.

Seafood Consumption Rates--

Concern over the potential health risks associated with consumption of seafood prompted several recent studies that focused on catch and consumption patterns for recreational anglers in Puget Sound (Pierce et al. 1981; McCallum 1985; Landolt et al. 1985, 1987). The results of each of these studies were summarized and analyzed statistically to derive a number of independent estimates of seafood consumption rates for the 5th, 50th (i.e., median), and 95th percentiles of the angling population. Based on this analysis, a consumption rate of 12.3 g/day was used to estimate average exposure, and a consumption rate of 95.1 g/day was used to estimate high exposure to chemically contaminated fish from Puget Sound.

Consumption rates specific to Puget Sound were not available for shellfish or for macroalgae. Nash (1971) compiled regional information indicating that the median shellfish consumption rate for the general population is 1.1 g/day, which was the value used to estimate average exposure in Puget Sound. A consumption rate of 21.5 g/day (assuming 151 g/serving x 52 servings/yr) was used to estimate high exposure to chemically contaminated shellfish from Puget Sound.

Average and high exposure estimates for consumption of macroalgae were based on marketing information developed by a local mariculture facility specializing in the production of algae of the genus *Porphyra*, which is commonly known as nori. Estimates of average U.S. consumption rates were used to determine average exposure, and estimates of average consumption rates in Japan were used to determine high exposure, which may be representative of ethnic minorities who harvest macroalgae from Puget Sound. For kelp, the average consumption rate in the U.S. is 0.023 g/day, and that in Japan is 16.2 g/day. For nori, the average consumption rate in the U.S. is 0.006 g/day, and that in Japan is 4.1 g/day.

Dose-Estimation--

All risk estimates are dependent on determination of chemical doses. Because the consumption rate information described above is based on averages for all species within a category, dose estimates were only derived for major categories of seafood (i.e., fish, shellfish, kelp and *Ulva*, and nori). The following expression was used for dose estimation:

$$D_{ij} = (C_{ij} \times I_j \times A_i)/B$$

where:

D_{ij} = Dose of chemical i in seafood category j (mg/kg body weight/day)
C_{ij} = Concentration of chemical i in seafood category j (mg/kg seafood)
I_j = Ingestion rate for seafood category j (kg seafood/day)
A_i = Absorption coefficient for chemical i (unitless)
B = Standard assumption for average lifetime body weight (70 kg).

The following major assumptions were used in dose-estimation:

- Exposure occurs daily over a 70-yr lifetime
- A representative body weight for a lifetime of exposure is 70 kg
- The absorption coefficient is 1 percent for ingested arsenic and 100 percent for the other chemicals.

Approximately 1 percent of the total arsenic in seafood is in the inorganic form. Because the carcinogenic potency factor for arsenic is based on ingestion of inorganic arsenic, 1 percent of the total arsenic concentration was used to estimate risks associated with seafood consumption.

Mean chemical concentrations and the average consumption rates described previously for various categories of seafood were used to estimate average lifetime doses for the various chemicals of concern. The upper 95 percent confidence limit of mean concentrations in various seafood categories, and the high-case consumption rates for each category of seafood were used to estimate high lifetime doses for each chemical of concern. Thus, dose-estimation was based on a range of values representative of average exposure conditions and high exposure conditions.

Risk Characterization

Dose-response variables summarized in the Dose-Response Assessment were used with the dose estimates summarized in the Exposure Assessment to characterize potential health risks associated with chemically contaminated seafood from Puget Sound.

Risk Estimation Methods--

Potential risks associated with each carcinogen of concern in various categories of seafood were estimated as the probability of excess cancer using the following equation:

$$R_{ij} = 1 - \exp(-P_i \times D_{ij})$$

where:

R_{ij} = Risk associated with chemical i in seafood category j
P_i = Carcinogenic potency factor for chemical i $(mg/kg/day)^{-1}$
D_{ij} = Dose of chemical i in seafood category j (mg/kg/day).

Attributes of carcinogenic potency factors and methods of dose estimation are as described above (see Dose Response Assessment and Exposure Assessment).

Nonprobabilistic hazards associated with ingestion of noncarcinogens in various seafood categories were expressed as a ratio:

$$RI_{ij} = D_{ij}/RfD_i$$

where:

RI_{ij} = Risk index for chemical i in seafood category j
D_{ij} = Dose of chemical i in seafood category j (mg/kg/day)
RfD_i = Reference dose for chemical i (mg/kg/day).

Characteristics of the RfD and methods of dose estimation are as described above.

Finally, potential cumulative health risks associated with exposure to multiple carcinogenic chemicals or multiple noncarcinogenic chemicals in various categories of seafood were determined by summing the risks for individual contaminants within a seafood category and then summing the risks across all seafood categories.

Risk Interpretation--

The cumulative risk estimate for carcinogens provides an indication of the lifetime probability of excess cancer that may occur through exposure to one or more substances, each of which may act independently on various target organs. In general, U.S. EPA decisions concerning individual lifetime risk estimates in the range of 10^{-7} to 10^{-3} are made on a case-by-case basis and are strongly influenced by considerations of the population risk (Travis et al. 1987; Travis and Haltemer-Frey 1988). Individual risk levels greater than 10^{-3} are usually subject to regulatory action, and those less than 10^{-7} are rarely subject to regulatory action. Under Superfund, U.S. EPA (1986d) has established a target range of 10^{-7} to 10^{-4} for remedial action alternatives that are designed to mitigate exposure to hazardous substances.

The cumulative risk index for noncarcinogens assumes simple additivity of effects and provides a numerical indication of the nearness to acceptable limits of exposure or the degree to which acceptable exposure limits are exceeded (U.S. EPA 1986c). A cumulative risk index greater than 1.0 suggests that exposure to an individual substance or all substances collectively exceeds a generalized level of concern for a common toxicological endpoint or target organ.

Results--

Under the procedure outlined above, chemical doses and dose-response variables were used to estimate potential health risks for the three noncarcinogenic and five carcinogenic chemicals of concern.

Risk index values for cumulative exposure to the three noncarcinogenic chemicals (i.e., cadmium, lead and mercury) via consumption of all categories of seafood ranged from 0.04 for average exposure conditions to 0.9 for high exposure conditions. Risk index values for individual noncarcinogens were typically low and ranged from less than 0.001 for all three substances in kelp and nori to 0.3 for cadmium in shellfish.

Carcinogenic risks for cumulative exposure to arsenic and the four organic chemicals of concern ranged from $2x10^{-4}$ for average exposure conditions to $4x10^{-3}$ for high exposure conditions. These relatively high cumulative carcinogen risk levels were driven primarily by potential exposure to PCBs in fish from specific locations in Puget Sound (Commencement Bay, Elliott Bay, Manchester, and Sinclair Inlet). PCBs in fish from these areas accounted for most of the risk, although arsenic in fish and PCBs in squid from Commencement Bay were contributing factors. Potential health risks, exclusive of the contribution of PCBs, were within the generally acceptable range of 10^{-6} to 10^{-5}.

COMPARISONS WITH LOCATIONS OUTSIDE OF PUGET SOUND

To place the foregoing health risk assessment into a national perspective, contaminant concentrations and associated health risks in Puget Sound biota were compared with those in biota from outside of Puget Sound. The health risk assessment indicates that risks associated with the noncarcinogenic chemicals of concern are within acceptable levels (i.e., <1). Consequently, comparisons with contaminant concentrations in biota located outside of Puget Sound were limited to the carcinogenic chemicals of concern (i.e., arsenic, carcinogenic PAH, PCB, alpha-HCH, and Σ DDT).

In developing monitoring guidance for contaminant bioaccumulation, the U.S. EPA sponsored an extensive review of available bioaccumulation data for a wide number of marine fishes and shellfish from U.S. coastal and territorial waters (Tetra Tech 1987). Although only a selected number of target species were considered in the bioaccumulation review, it was based on high quality information that is generally comparable to that used for the risk assessment of chemically contaminated seafood in Puget Sound (see Compilation and Review of Puget Sound Data).

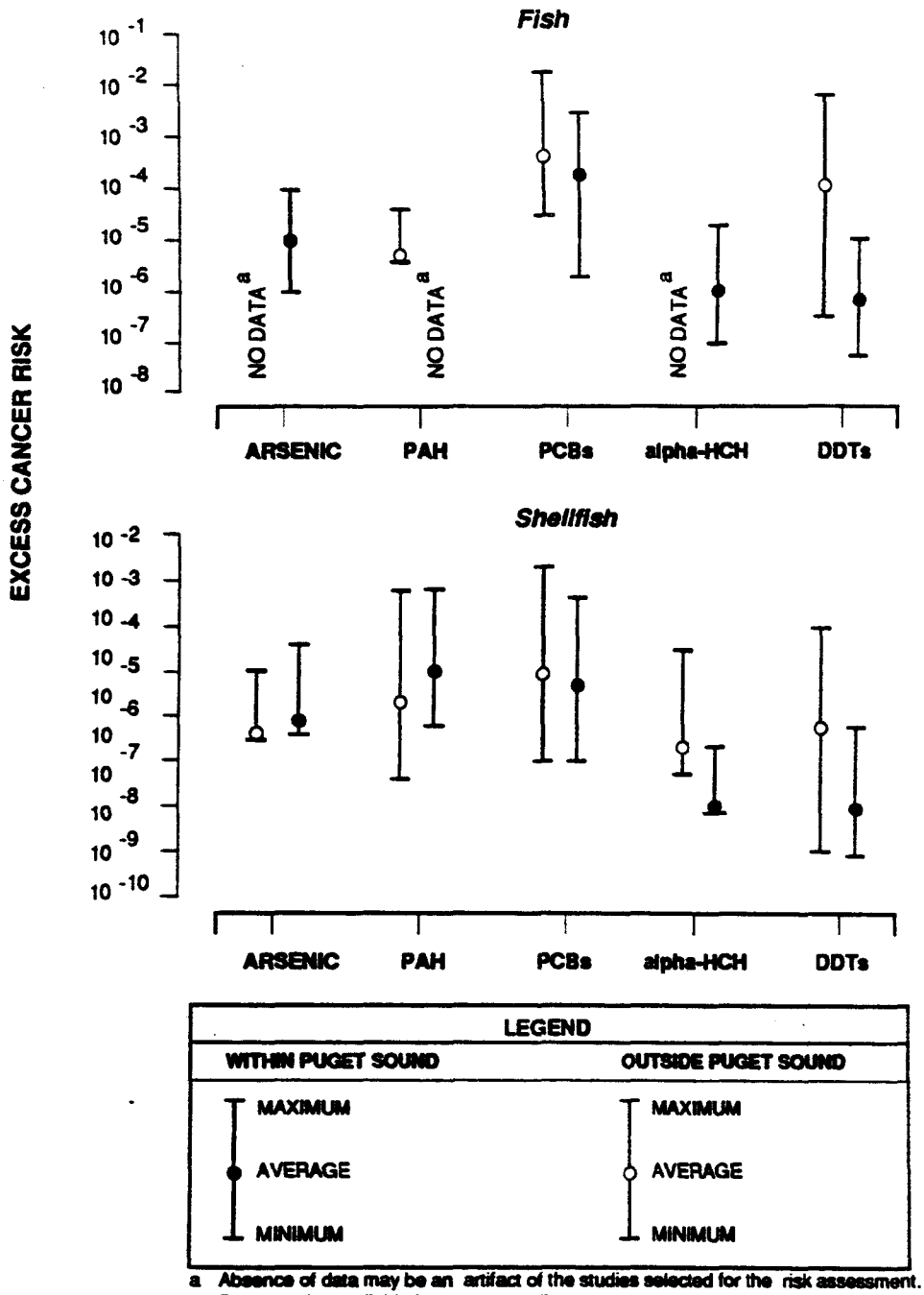
Chemical concentration data for carcinogens of concern were available for fishes and shellfish from coastal and offshore areas ranging from Nova Scotia to Virginia on the Atlantic coast, and from Washington to Oregon on the Pacific coast. These data are representative of a range of chemical concentrations in biota from relatively clean sites (e.g., Bodega Head, CA), and from areas of known contamination (e.g., Raritan Bay, NY). Data for carcinogens of concern in macroalgae outside of Puget Sound were not available for comparison.

To estimate a range of potential health risks associated with carcinogens of concern in other regions, the contaminant concentration data for locations outside of Puget Sound were combined with exposure assumptions for Puget Sound (see Exposure Assessment) and risk estimates were calculated as for risks associated with Puget Sound seafood. These risk estimates for regions outside of Puget Sound were derived for comparative purposes only.

Risk estimates for other regions may vary from those calculated here because of regional differences in exposure conditions (e.g., Belton et al. 1986).

Comparisons based on these estimated risk levels are summarized in Figure ES-3. For shellfish, average-case risk levels were less than or equal to 10^{-5} for all substances both within and outside of Puget Sound. However, high-case risk levels for individual locations exceeded U.S. EPA's regulatory target range of 10^{-7} to 10^{-4} for PAH and PCBs both within and outside of Puget Sound. In general, both average-case and high-case risk estimates for PCBs, alpha-HCH, and Σ DDT in shellfish from Puget Sound were either comparable to or substantially (i.e., 1 order of magnitude) less than those in shellfish from outside of Puget Sound. Although risk levels associated with arsenic were within U.S. EPA's regulatory target range, average-case and high-case values for shellfish in Puget Sound were greater than those for shellfish from locations from outside of Puget Sound. For PAH in shellfish, average-case risks within Puget Sound were substantially higher than those outside Puget Sound.

For PCBs in fish, average-case and high-case risk levels exceeded U.S. EPA's regulatory target range of 10^{-7} to 10^{-4} both inside and outside of Puget Sound. Average-case risks for PCBs in fish were approximately the same ($2x10^{-4}$ vs. $4x10^{-4}$) within and outside Puget Sound. However, the high-case risk level for individual locations within Puget Sound was substantially less than that for locations outside of Puget Sound. Both average-case and high-case risk levels associated with Σ DDT in fish from Puget Sound were less than those for fish from locations outside of Puget Sound. In Puget Sound, risk levels associated with Σ DDT in fish were approximately 10^{-6} for average exposure conditions, and approximately 10^{-5} for high exposure conditions. In contrast, risks associated with Σ DDT exposure to fish from locations outside of Puget Sound ranged from 10^{-4} for average exposure conditions to approximately 10^{-2} for high exposure conditions.



a Absence of data may be an artifact of the studies selected for the risk assessment. Data may be available from other studies.

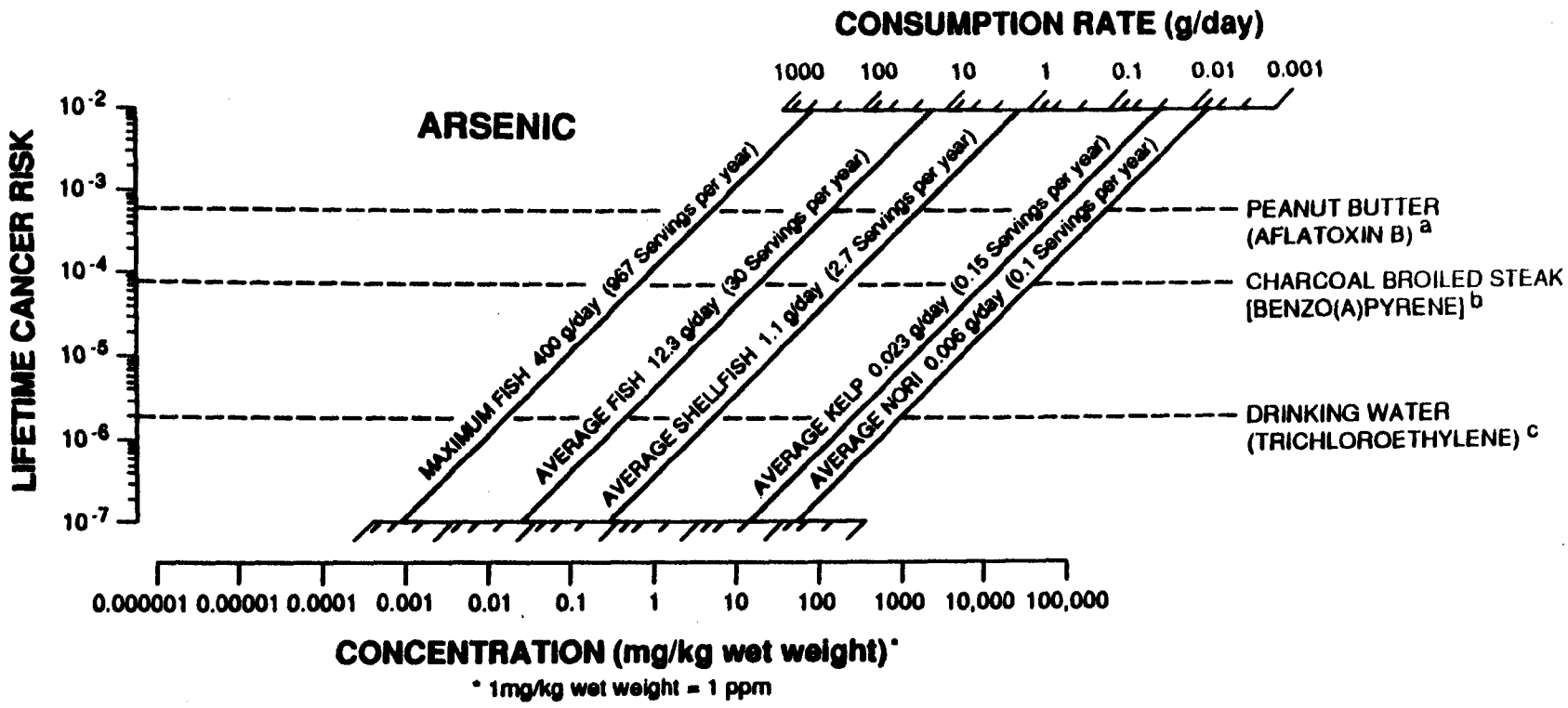
Figure ES-3. Comparison of the ranges of risk estimates for carcinogenic chemicals of concern in Puget Sound fish and shellfish with those in fish and shellfish from locations outside of Puget Sound.

GRAPHICAL RISK CHARACTERIZATION

To characterize the range of variation in potential health risks associated with chemical contaminants in Puget Sound seafood, graphs of potential health risks were plotted as a function of a wide range of possible contaminant concentrations and consumption rates for each chemical of concern (Figures ES-4 to ES-11). These graphs allow estimation of potential health risks associated with chemicals of concern in Puget Sound seafood for a range of seafood types, possible consumption rates, and locations. To assist in carcinogenic risk interpretation, risk levels associated with naturally occurring contaminants in food (i.e., aflatoxin B in peanut butter and PAH in charcoal broiled steaks), or anthropogenic contaminants in drinking water (i.e., trichloroethylene) are indicated by horizontal dashed lines. By using the methods and assumptions outlined above (see Exposure Assessment), potential health risks were plotted for five consumption rates in each graph. The lines plotted for these consumption rates are only intended as examples. A scale is provided on each graph so that health risks can be estimated for any consumption rate in the range of 0.001 to 1,000 g/day.

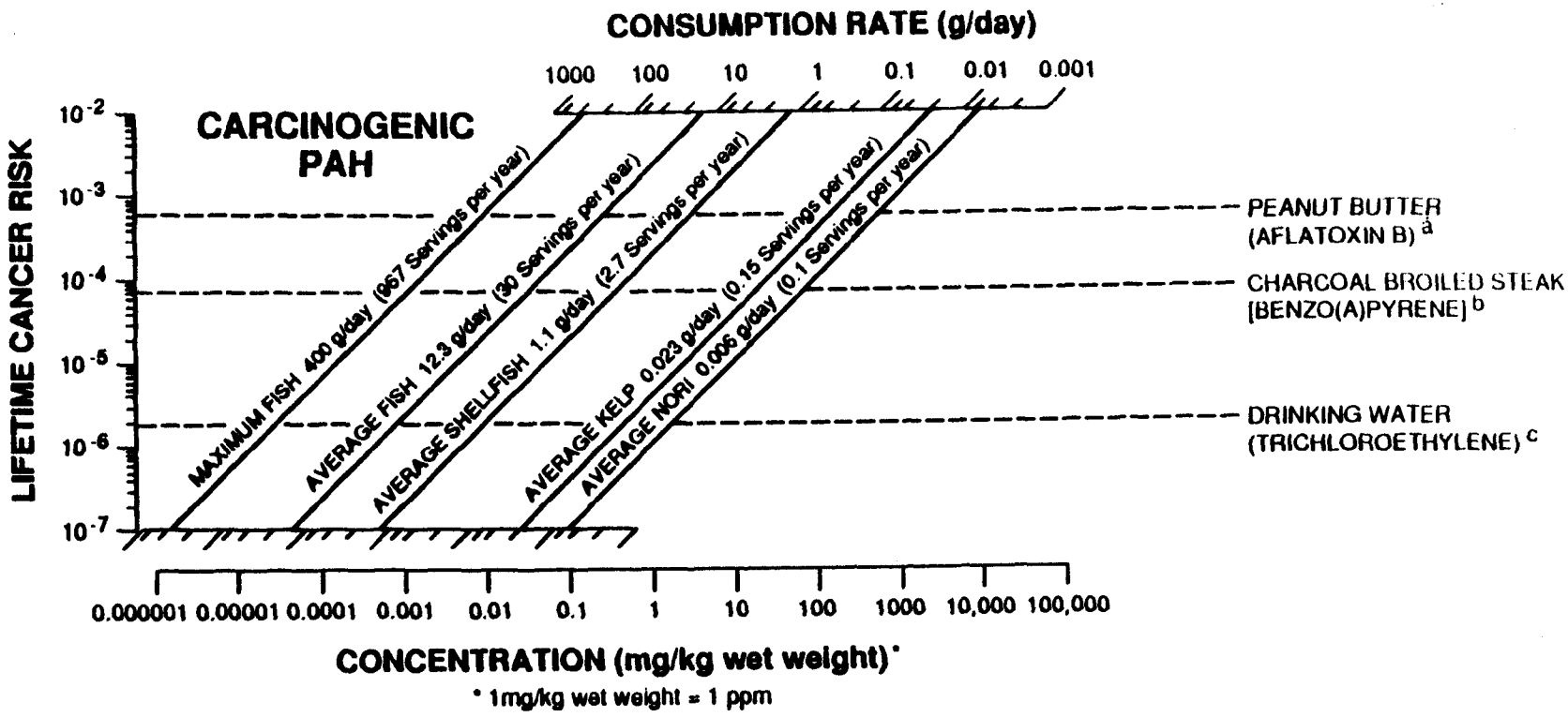
CONCLUSIONS

In summary, potential health risks associated with consumption of chemically contaminated seafood from Puget Sound are primarily attributable to PCB concentrations in fishes and the additive contributions of other substances in other categories of seafood. For consumption of seafood from Puget Sound, potential health risks, exclusive of the contribution of PCB, are within the generally acceptable range of 10^{-6} to 10^{-5}. However, with the inclusion of PCB-contaminated fish, the potential cumulative health risks associated with the consumption of chemically contaminated seafood may exceed 10^{-4} for certain locations in Puget Sound. These elevated risk levels do not imply the existence of unique or pervasive chemical contamination in Puget Sound biota, but serve to indicate that portions of Puget Sound, like other U.S. coastal areas, are subject to the legacy of past uses and management of potentially toxic chemicals. In general, PCB



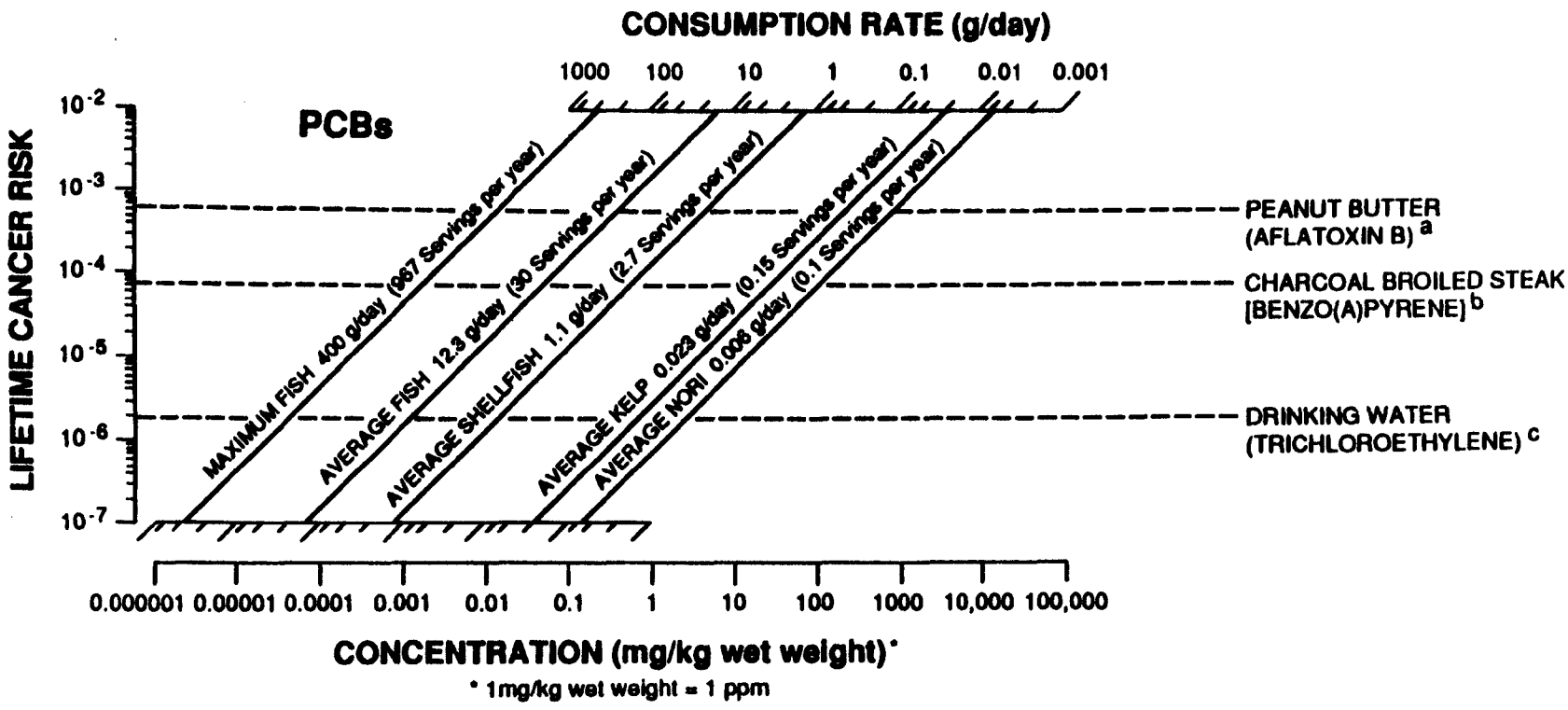
a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure ES-4. Graphical risk characterization for arsenic in seafood.



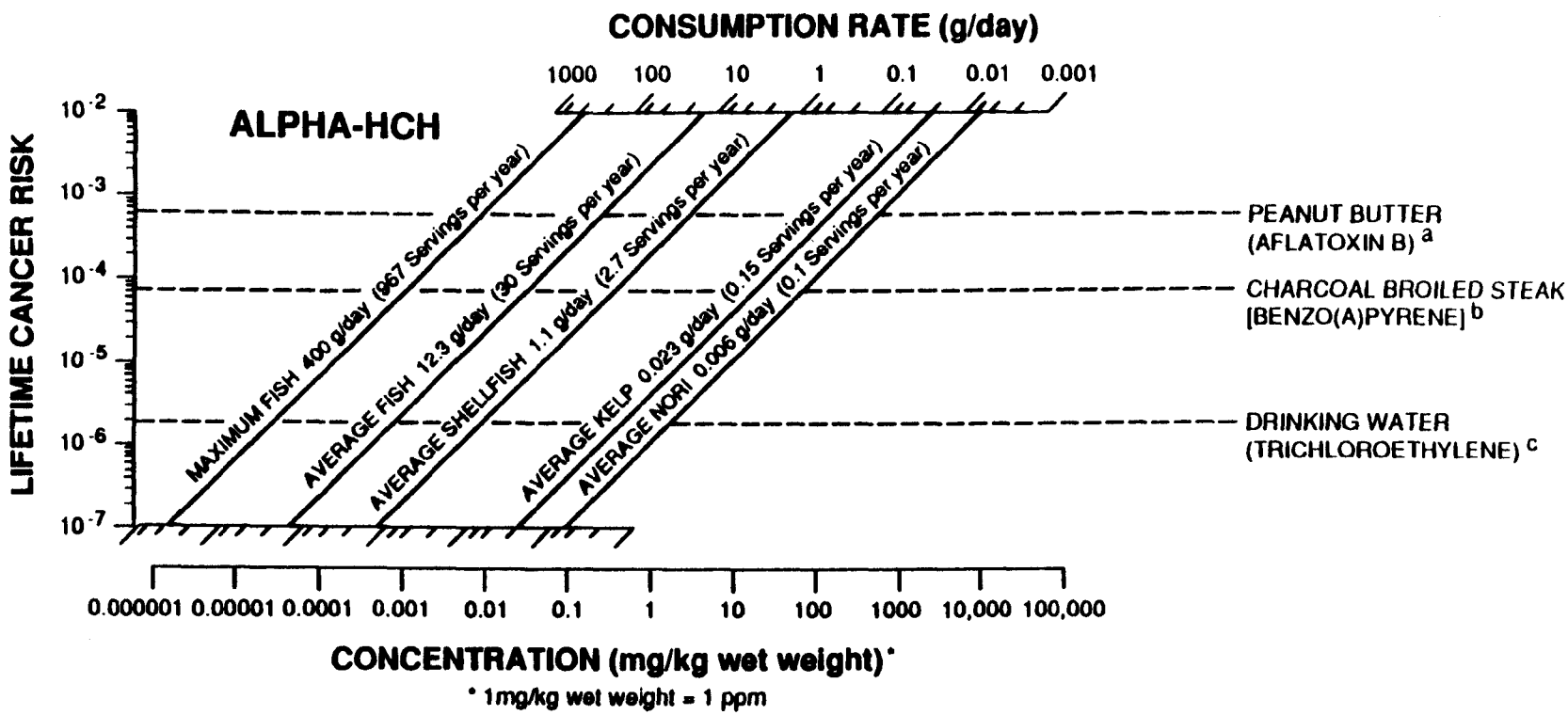
a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure ES-5. Graphical risk characterization for carcinogenic PAH in seafood.



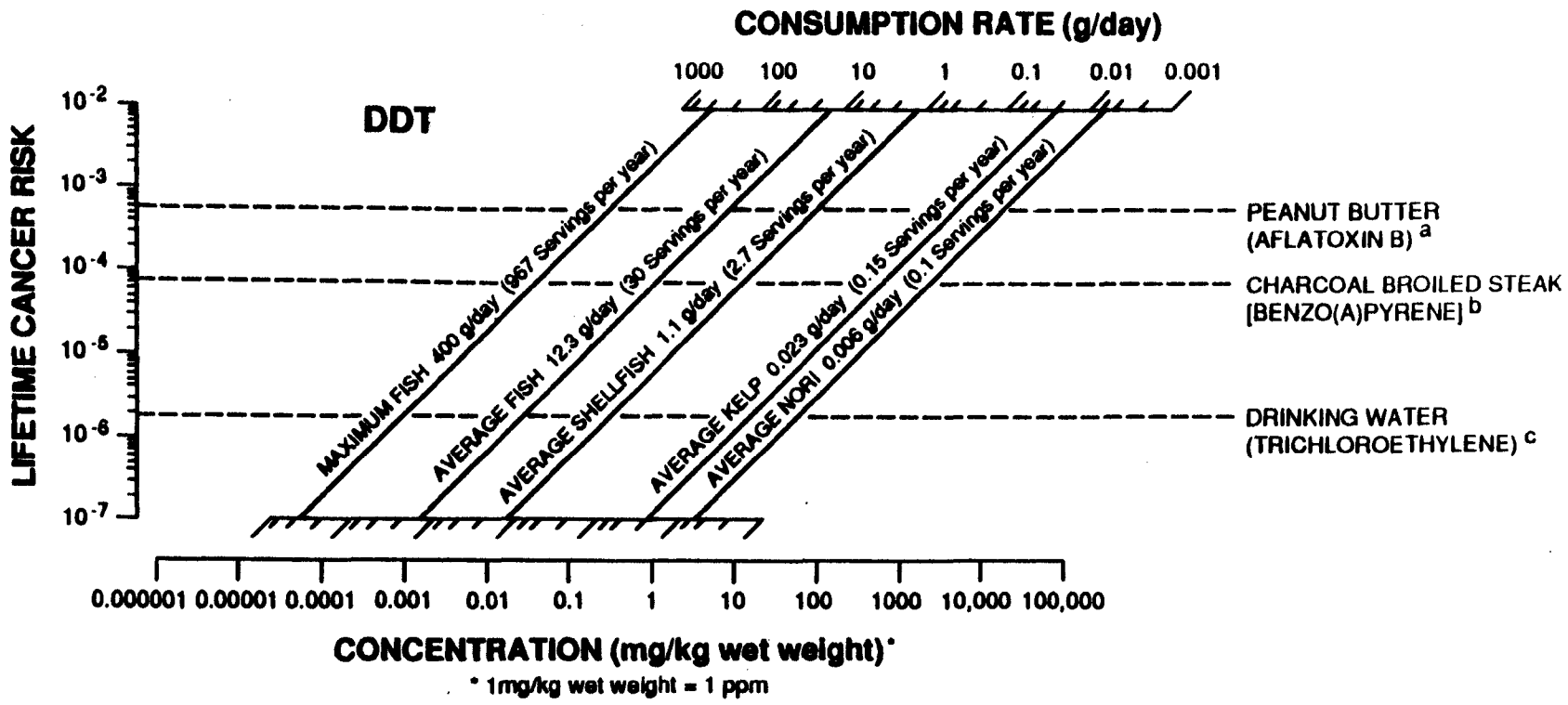
a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure ES-6. Graphical risk characterization for PCBs in seafood.



a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure ES-7. Graphical risk characterization for alpha-HCH in seafood.



a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure ES-8. Graphical risk characterization for DDT, DDD, and DDE in seafood.

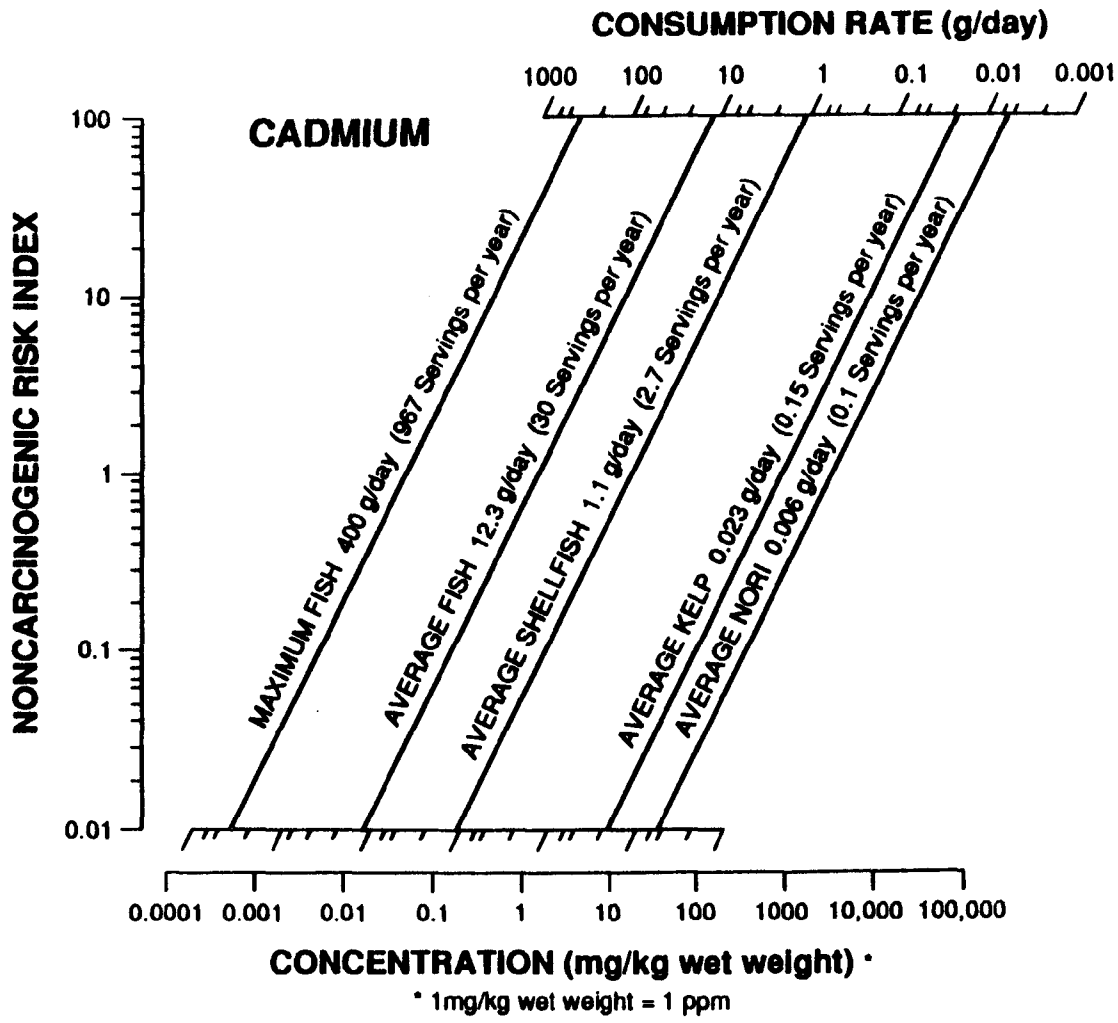


Figure ES-9. Graphical risk characterization for cadmium in seafood.

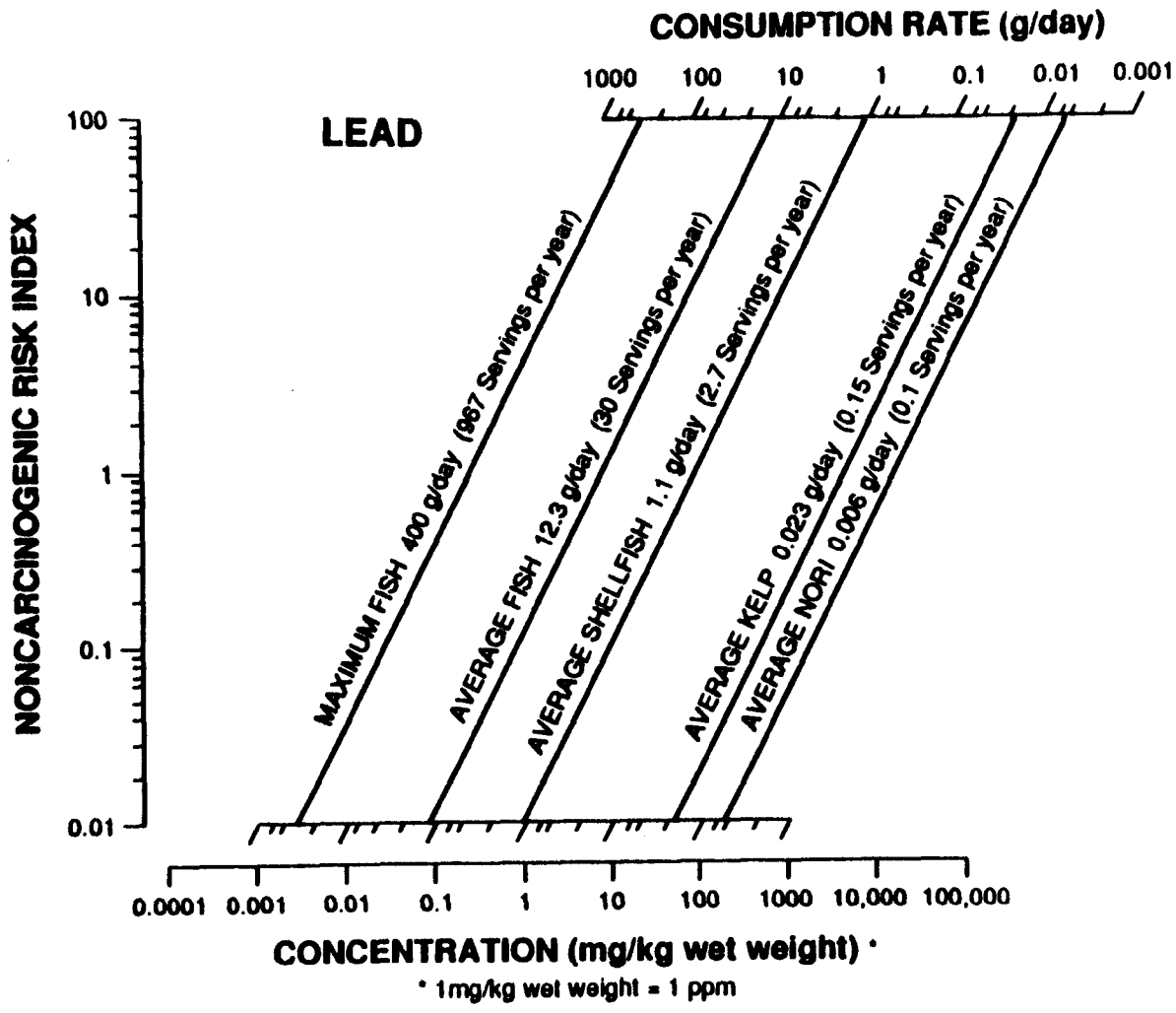


Figure ES-10. Graphical risk characterization for lead in seafood.

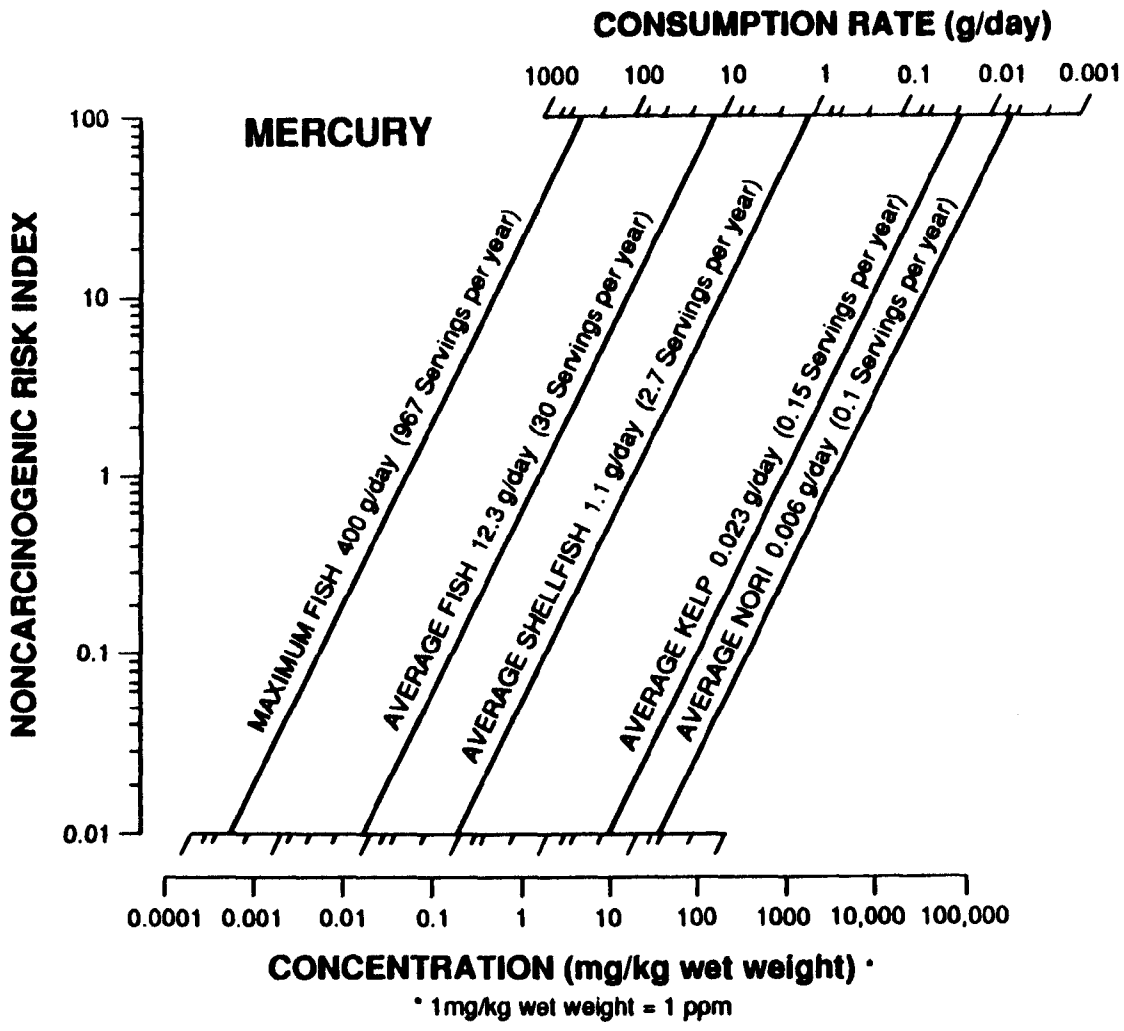


Figure ES-11. Graphical risk characterization for mercury in seafood.

contamination in fish is a long-recognized, ubiquitous, and persistent problem in various regions of the U.S. and in other industrialized nations (Landrigan 1980; Belton et al. 1986; Swain 1988; Friberg 1988).

Finally, it should be recognized that the method of risk estimation used herein provides generally conservative estimates of health risk, and focuses exclusively on recreational harvesters of Puget Sound seafood, who comprise a subset of the general population in the Puget Sound basin. Because of the conservative nature of U.S. EPA's risk assessment procedure, and because of limitations in the available data, the results of this effort should not be viewed as a definitive indication of potential health risks associated with consumption of Puget Sound seafoods. The intent of the report is to provide a framework for characterization of the relative hazard associated with chemical contaminants in various seafood categories in Puget Sound.

INTRODUCTION

Potentially toxic chemicals such as PCBs, pesticides, and metals may accumulate in the edible tissues of fish, shellfish, and macroalgae harvested from Puget Sound. Concern over the potential health risks associated with consumption of locally harvested seafood prompted several recent studies of catch and consumption patterns (Pierce et al. 1981; McCallum 1985; Landolt et al. 1985, 1987) and chemical contaminants in the catch (Landolt et al. 1985, 1987) of recreational harvesters. Other studies have focused on contaminant concentrations and potential health risks associated with consumption of Puget Sound biota harvested in the vicinity of hazardous waste sites or urbanized areas (PTI and Tetra Tech 1988a,b; Tetra Tech 1988; Yake et al. 1984; Norton, D., 5 February 1986, personal communication). During 1986-1987, a broad-scale survey of the extent of chemical contamination in Puget Sound seafood was undertaken by several agencies. The U.S. Environmental Protection Agency Region (EPA) X, the Washington Department of Fisheries (WDF), the Washington Department of Ecology (Ecology) and the Washington Department of Social and Health Services (DSHS) sponsored sampling and analysis programs to determine concentrations of pesticides, PCB, metals, and other chemicals in edible tissues of selected fish, shellfish, and macroalgal (i.e., seaweed) species at a range of locations throughout Puget Sound.

This report focuses entirely on recreational harvesters of Puget Sound seafood who comprise a subset of the general population. For the purpose of this analysis, recreational harvesters are defined as those individuals who are frequent collectors of fish, shellfish, or edible seaweed for use in personal consumption. Although not specifically addressed in this report, potential risks associated with consumption of commercially harvested Puget Sound seafood should be similar to those associated with consumption of recreationally harvested Puget Sound seafood, assuming similar seafood consumption patterns and seafood contamination levels.

In order to conduct this risk evaluation it was necessary to make assumptions and generalizations about patterns of seafood consumption. The assumptions presented here may or may not reflect the full range of consumption patterns actually existing within this population group, or the range of seafood contaminant conditions existing in Puget Sound.

Because of uncertainties inherent in the risk assessment process, and limitations in the available data, the objective of this report was not to develop a definitive indication of potential health risks associated with consumption of Puget Sound seafoods. The primary objectives of this report were to provide resource management and health agencies with a general indication of the magnitude of potential risks, provide an indication as to whether immediate regulatory action was warranted to protect public health, and to guide future data collection efforts. A secondary objective of this report was to provide health agencies and the public with a tool that could be used to easily estimate potential health risks associated with chemicals in Puget Sound seafood as additional data becomes available in the future. To meet these objectives, the report is organized into five major sections:

- Section 1. An overview and summary of the risk assessment process

- Section 2. Compilation and review of Puget Sound data on chemicals in seafood

- Section 3. Assessment of human health risks due to consumption of Puget Sound seafood

- Section 4. Comparisons of seafood contaminant concentrations and associated health risks in Puget Sound with those in other U.S. coastal locations

- Section 5. A graphical tool for estimating health risks for a wide range of exposure conditions.

In summary, the intent of the report is to provide the public and regulatory agencies with a framework for characterization of the relative hazard associated with chemical contaminants in various seafood categories and locations in the Puget Sound basin. Because of limitations in the available data, the results of this effort should not be viewed as an indication of absolute health risks. In general, highly conservative assumptions concerning chemical toxicity and exposure are used to estimate potential health risks. Because of the conservative nature of U.S. EPA's risk assessment model, actual health risks to consumers of Puget Sound seafood associated with the limited number of chemicals evaluated in this study are likely to be less than the estimates of potential health risks provided in this report. It is not known, however, to what extent nonmeasured chemicals contribute to the overall health risks associated with seafood consumption.

OVERVIEW AND SUMMARY OF THE RISK ASSESSMENT PROCESS

OVERVIEW OF RISK ASSESSMENT

Risk assessment is a scientific procedure to determine the probability of adverse health effects from a specific exposure to a toxic agent. Risk assessment differs from risk management, although both are components of regulatory decision-making (National Research Council 1983). Risk assessment provides the scientific basis for public policy and action. In risk management, risks are interpreted in light of legislative, socioeconomic, technical, and political factors, and appropriate controls are determined.

Direct measurement of human health risks is possible in certain limited circumstances. Such circumstances generally involve a single high exposure or repeated moderate exposures to a specific chemical, and a clear cause-effect relationship. For example, direct measurement of cancer risks might be possible in a population of workers exposed to an industrial chemical spill. In contrast, it is virtually impossible to directly measure the health risks of eating seafood harvested from Puget Sound during recreational activities. Models that predict health risks are therefore needed. Risk assessment procedures used in this report focus on predicting health risks from long-term exposure to relatively low levels of contamination.

The following sections provide an overview of the steps in risk assessment. The general format for risk assessment and all definitions of terms used in this report are consistent with those provided by National Research Council (1983) and U.S. EPA (1986a,b,c,d). As indicated in Figure 1, risk assessment is a multistep process comprised of the following tasks:

- Hazard Assessment -- Selection of chemicals of concern and qualitative evaluation of their potential to cause adverse

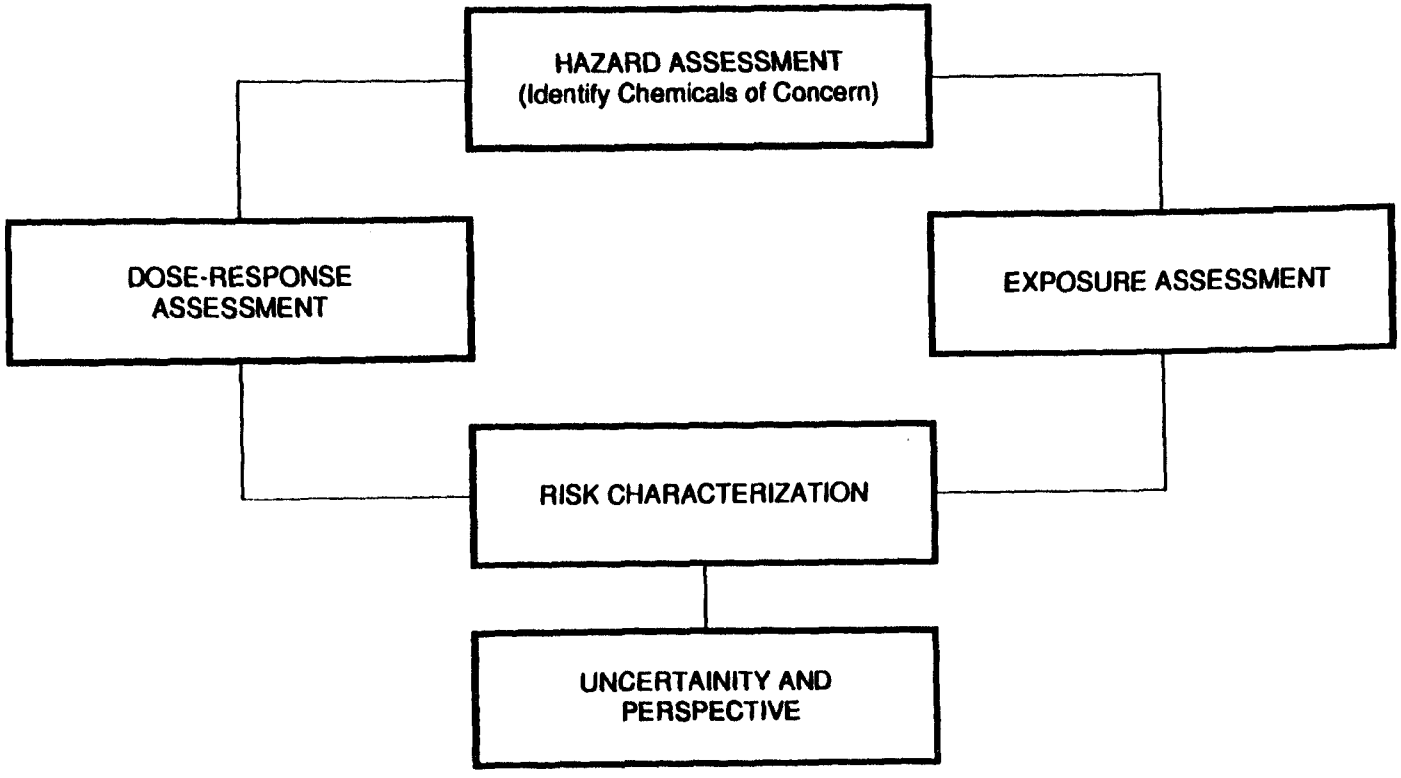


Figure 1. Overview of the risk assessment process.

health effects (e.g., birth defects, cancer) in animals or in humans

- Dose-Response Assessment -- Quantitative estimation of the relationship between the dose of a substance and the probability of an adverse health effect

- Exposure Assessment -- Characterization of the populations exposed to the toxic chemicals of concern; the environmental transport and fate pathways; and the magnitude, frequency, and duration of exposure

- Risk Assessment -- Estimation of risk for the health effect of concern, based on information from the dose-response and exposure assessments

- Uncertainty Analysis -- Qualitative and where possible, quantitative description of the assumptions and limitations inherent in each step of the risk assessment.

A summary of the role that each of these steps plays in the risk assessment process is provided below. Although these steps are discussed sequentially, the risk assessment process is highly iterative. Information developed in each step of the risk assessment is useful in subsequent steps and provides feedback to preceding steps. For example, dose-response information may be used in the hazard assessment step to select and characterize chemicals of concern. Toxicity profiles developed in the hazard assessment may affect selection of dose-response variables, and may provide meaningful qualitative information for use in the risk characterization or uncertainty analysis.

The following summary is, for the most part, abstracted from several recent U.S. EPA guidance manuals (Tetra Tech 1986; PTI 1987) on risk assessment of chemically contaminated seafood. Further elaboration on the

uses of risk assessment and risk management in evaluation of chemically contaminated seafood is available in the U.S. EPA guidance manuals.

Hazard Identification

The first step in the risk assessment process is to define toxicological hazards posed by the individual chemical contaminants in the seafood samples. These hazards are defined by identifying chemicals of concern, and by constructing a toxicity profile for each contaminant of concern.

The contaminants of concern for a particular seafood risk assessment should be selected based on the following criteria:

- High persistence in the aquatic environment
- High bioaccumulation potential
- High toxicity to humans (or suspected high toxicity to humans based on mammalian bioassays)
- Known sources of contamination in areas of interest
- High concentrations in previous samples of seafood from areas of interest.

Further screening of chemicals is possible based on preliminary risk analysis. For example, some chemicals have relatively low toxicity. Only extremely high concentrations (e.g., >100 ppm) in seafood would cause concern, assuming a high seafood consumption rate for 70 yr (for discussion of consumption rates, see Exposure Assessment section).

Toxicity profiles consist of a summarization of qualitative and quantitative aspects of chemicals of concern that provide an indication of the types of health injury or disease that may occur under specific exposure

conditions. The kinds of information that may be useful in developing toxicity profiles include:

- Physical-chemical properties (e.g., chemical speciation, vapor pressure, octanol water partition coefficients)

- Metabolic and pharmacokinetic properties (e.g., metabolic degradation products, depuration kinetics)

- Toxic effects for specific routes of exposure (e.g., target organs, cytotoxicity, carcinogenicity, mutagenicity).

Physical-chemical properties are important in determining the environmental behavior of chemicals of concern and in evaluating the relative importance of potential exposure pathways leading to human receptors. Metabolic and pharmacokinetic properties are important in the characterization of the behavior of a chemical within the body, including its assimilation, transport, transformation, accumulation, and elimination. For a given chemical of concern, toxic effects may be expressed in variety of ways depending on the magnitude, duration, route of exposure, and sensitivity of exposed individuals. Available toxicity information may be limited to studies of experimental animals or may include a range studies on both experimental animals and humans.

The range of information developed for the toxicity profiles is then used to determine whether toxicity observed in experimental animals or humans in one exposure setting could also occur in humans under the specific exposure conditions of concern in the risk assessment. Toxicity profiles may also influence the nature and extent of subsequent steps in risk analysis. For example, the endpoint of concern in the dose-response assessment may be selected based on the most severe adverse effect identified in the toxicity profile. In the absence of quantitative data for other steps in the risk assessment process, the toxicity profile constitutes the best evaluation of risk. Toxicity profiles are available for approximately

195 chemicals from the U.S. EPA, Office of Waste Programs Enforcement and Office of Environmental Criteria and Assessment.

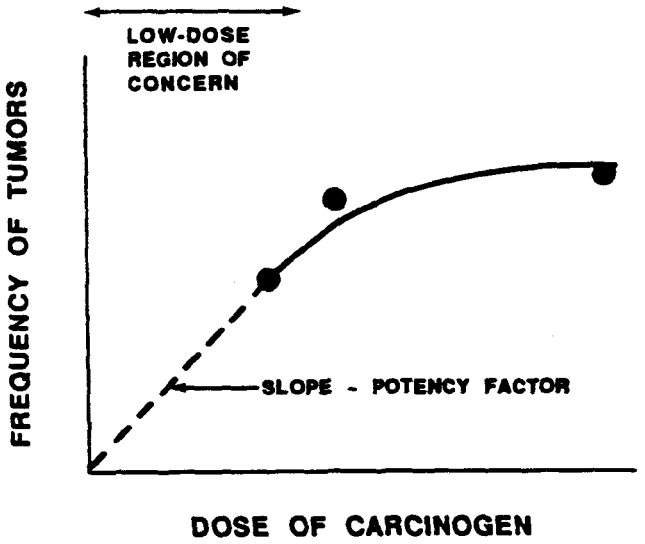
Dose-Response Assessment

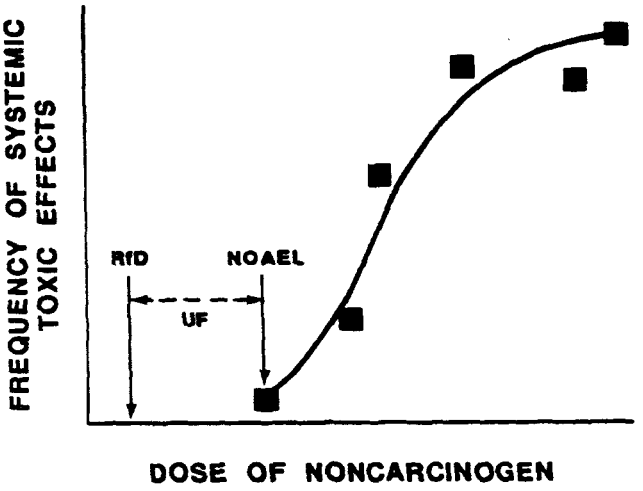
After the potential hazard associated with each contaminant of concern is characterized, the relationship between dose of a substance and its biological effect is determined. Dose-response data are used to determine the toxicological potency of a substance, a quantitative measure of its potential to cause a specified biological effect. There may be many dose-response relationships for a substance if it produces different toxic effects under different conditions of exposure. However, risks associated with a substance cannot be ascertained with any degree of confidence unless dose-response relationships are quantified, even if the substance is known to be "toxic".

In developing risk assessment methods, U.S. EPA recognized that fundamental differences exist between carcinogenic dose-response variables and noncarcinogenic dose-response variables that could be used to estimate risks. Because of these differences, human health risk characterization is conducted separately for carcinogens and noncarcinogens.

Key dose-response variables used in quantitative risk assessment are potency factors for carcinogens and reference dose (RfD) values for noncarcinogens. A generalized illustration of the role of these variables in dose-response relationships for carcinogens and noncarcinogens is shown in Figure 2. The carcinogenic potency factor [expressed in units of $(mg/kg/day)^{-1}$] is typically determined by the upper 95 percent confidence limit of slope of the linearized multistage model that expresses excess cancer risk as function of dose. The model is based on high to low dose extrapolation, and also assumes that there is no threshold for the initiation of toxic effects.

The RfD (expressed in units of mg/kg/day) is an estimated single daily chemical intake rate that appears to be without risk if ingested over a





LEGEND

OBSERVED DATA POINTS

- ● Chemical A
- ■ Chemical B

MODELS

- Low Dose Extrapolation
- Models Fit Within Observed Data Range

RfD	Reference Dose
UF	Uncertainty Factor
NOAEL	No Observed Adverse Effects Level

Figure 2. Hypothetical dose-response relationships for a carcinogen, and a noncarcinogen.

lifetime (Vettorazzi 1976, 1980; U.S. EPA 1980, 1987a; Dourson and Stara 1983). It is usually based on the relationship between the dose of a noncarcinogen and the frequency of systemic toxic effects in experimental animals or humans, and assumes that a threshold exists for the initiation of toxic effects (Dourson and Stara 1983). The threshold of observed effects is divided by an uncertainty factor to derive an RfD that is protective of the most sensitive members of the population.

Exposure Assessment

Exposure assessment is the overall process that links sources and distribution mechanisms of chemical contaminants in the environment to human receptors. For risk assessment of chemically contaminated seafood, the exposure assessment is typically conducted in a number of stages:

- Characterization of the environmental transport and fate pathways of chemicals of concern

- Estimation of average concentrations of chemical of concern in seafood species

- Characterization of potentially exposed populations, including fisheries harvest activities and patterns of seafood consumption

- Estimation of the magnitude and duration of the dose of each chemical of concern incurred by the human receptor population.

Mathematical models of key physical and chemical processes, which may be supplemented with experimental studies, are often relied upon to predict transport and fate pathways. Uncertainties associated with such predictions in the complex natural environment may be enormous, and may be avoided altogether by direct measurement of contaminant concentrations in potential exposure media. Thus, appropriately designed and conducted sampling and

analyses programs provide the best means for determining concentrations of chemicals of concern in edible portions of seafood species.

For risk assessment of chemically contaminated seafood, the characterization of exposed populations may include an identification of fisheries harvest zones, analyses of fisheries activities within those zones, an evaluation of the distribution of the catch, and characterization of consumption patterns that can be used in dose estimation. Only selected steps may be performed in a given exposure assessment, depending on data availability, study objectives, and funding limitations. Where comprehensive catch and consumption statistics are not available, estimates of seafood consumption rates may be based on standard values for the U.S. population or other assumed values.

Dose is the amount of a chemical received by an organism over a specified time interval, and is usually expressed in units of mg chemical/kg body wt/day. Because the oral route of exposure is the only route considered for consumption of chemically contaminated seafood, dose estimation may be based on the amount of a chemical that is ingested (i.e., an "ingested dose") or on the amount of material that is ingested and assimilated by absorption across the gastrointestinal lining (i.e., an "absorbed dose"). An ingested dose is obtained by multiplying the concentration of a chemical in seafood (expressed in units of mg/kg wet wt) by in ingestion rate (expressed in units of kg seafood/day), and dividing this product by an estimated human body weight (expressed in kg). The absorbed dose is obtained by multiplying the ingested dose by an assimilation coefficient. The assimilation coefficient is actually a composite variable that indicates:

- Differences in actual assimilation efficiency between experimental animals that were used to derive dose-response variables and in humans

- Age-specific differences in absorption efficiency within the human population

- Differences in the bioavailability of a chemical between the exposure medium used in determination of a dose-response relationship (e.g., water) and the exposure medium of concern in the risk assessment (e.g., seafood)

- Differences in chemical speciation between the exposure medium used in determination of a dose-response relationship (e.g., inorganic arsenic in drinking water) and the exposure medium of concern in the risk assessment [e.g., total (i.e., inorganic plus organic) arsenic in seafood].

In summary, the dose, its duration and timing, and the characteristics of the population receiving it are the critical measures of exposure for the risk characterization.

Risk Characterization

In the risk characterization stage, the results of the dose-response assessment and the exposure assessment are combined to estimate the probability and extent of adverse effects associated with consumption of chemically contaminated seafood. Because of fundamental differences between dose-response variables for carcinogens and those for noncarcinogens, risk characterization is conducted separately for carcinogens and noncarcinogens (see Dose-Response section above).

In its simplest expression, carcinogenic risks are estimated as the probability of excess lifetime cancer by multiplying the estimated human dose by the carcinogenic potency factor. For noncarcinogens, risks are expressed as a non-probabilistic risk index by dividing the estimated dose by the reference dose. The risk index is compared to a value of 1 (i.e., where the estimated dose equals the reference dose) to evaluate the chemical hazard (Stara et al. 1983; U.S. EPA 1985). Risk index values greater than 1 indicate that the estimated exposure is potentially of concern. Because data on chemical interactions are limited, estimated risks for individual chemicals are usually summed to obtain an approximate estimate of total risk

for a chemical mixture. Because technological limitations preclude analyzing seafood samples for all potentially toxic chemicals, risk estimates should not be interpreted as estimates of total risk associated with seafood ingestion.

The risk characterization step can be much more complicated than indicated here (Tetra Tech 1986; PTI 1987). Independent risk estimates can be calculated for each chemical in each exposure medium (e.g., different species of seafood) at various locations defined in the exposure assessment. Depending on the available data, risks can also be partitioned among subsets of the exposed population. The objectives of such an approach are to determine who is at risk and which combination of chemicals and media account for that risk.

The results of the risk assessment may be presented in both a tabular and graphic format. In the supporting text of a risk assessment, all final estimates of risk should be rounded to one significant digit, or an order of magnitude if appropriate.

Interpretation of noncarcinogenic risk index values is based on direct comparisons with reference dose values and supporting information developed in the toxicity profiles. Risk index values greater than one provide only a general indication of concern for potential toxic effects. The severity of such effects must be interpreted in light of information concerning the dose response relationship for the specific chemical and toxic endpoint in question.

Interpretation of carcinogenic risk estimates may be based on comparison of health risks for the study area with:

- Health risks for consumption of seafood from a reference area
- Health risks for consumption of alternative foods (e.g., charcoal broiled steak)

- The range of allowable health risks determined in regulatory decisions.

In general, U.S. EPA decisions concerning individual lifetime risk estimates in the range of 10^{-7} to 10^{-3} are made on a case-by-case basis and are strongly influenced by considerations of the population risk (Travis et al. 1987; Travis and Haltemer-Frey 1988). Population risk is an estimate of the number of cancers produced within a population of specified size per generation. High individual risk estimates may translate into low population risk (i.e., less than 1) where the size of the exposed population is small. Individual risk levels greater than 10^{-3} are usually subject to regulatory action, and those less than 10^{-7} are rarely subject to regulatory action.

Uncertainty Analysis

There are numerous factors associated with each step of the risk assessment process that contribute to uncertainty in the risk characterization. Quantitative approaches to the characterization of uncertainty are described in the U.S. EPA guidance manuals on risk assessment of chemical contaminants in aquatic organisms (Tetra Tech 1986; PTI 1987), but are beyond the level of discussion intended for this summary. Major factors associated with uncertainty in risk estimates are listed as follows:

1. Uncertainties in the determination of the weight-of-evidence classification for potential carcinogens.

2. Uncertainties in estimating Carcinogenic Potency Factors or RfDs, resulting from:

    - Uncertainties in extrapolating toxicologic data obtained from laboratory animals to humans

    - Limitations in quality of animal study

- Uncertainties in high- to low-dose extrapolation of bioassay test results, which arise from practical limitations of laboratory experiments and variations in extrapolation models.

3. Variance of site-specific consumption rates and contaminant concentrations.

4. Uncertainties in the selection of assumed values for consumption rates (e.g., 6.5 g/day, 20 g/day, and 165 g/day) when site-specific data are not available.

5. Uncertainties in the efficiency of assimilation (or absorption) of contaminants by the human gastrointestinal system.

6. Variation of exposure factors among individuals, such as:

   - Variation in fishery species composition of the diet among individuals

   - Variation in food preparation methods and associated changes in chemical composition and concentrations due to cooking.

7. Uncertainties associated with risks from chemical contaminants that were not included in the analysis of seafood tissues, but, nonetheless, may be present.

8. Adequacy of the study design to provide the numbers of samples needed to describe accurately contaminant concentrations in each species at various locations and times (e.g., seasons) throughout the study area.

9. Uncertainties in interpretive aspects of the risk characterization, which arise from such factors as:

- Lack of data for contaminant concentrations in seafood from relatively clean reference areas, which are needed to describe accurately "background" levels of risk associated with seafood consumption

- Lack of reference diet information needed to assess accurately "background" concentrations of chemicals of concern in non-seafood components of the diet, which may be particularly important for comparisons of high exposure populations, whose diet may include a disproportionate amount of seafood, with the general population, whose diet may consist of an average amount of seafood plus a variety of other foods

- Lack of additional risk-benefit information concerning the influence of diet on other health endpoints (e.g., heart disease), which, again, may be important for comparisons of high exposure populations, whose diet may include a disproportionate amount of seafood, with the general population, whose diet may consist of an average amount of seafood plus a variety of other foods.

In conclusion, uncertainty ranges (e.g., 95 percent confidence intervals) around estimates of mean risk may typically span 3-5 orders of magnitude. The approach taken by U.S. EPA (1980, 1985, 1986a; Tetra Tech 1986; PTI 1987) is to estimate a plausible-upper limit to risk. In this way, it is unlikely that risk will be underestimated substantially. Moreover, the plausible-upper-limit estimate serves as a consistent basis for relative risk comparisons.

SUMMARY OF THE RISK ASSESSMENT PROCESS FOR PUGET SOUND SEAFOOD

The risk assessment of chemical contaminants in Puget Sound seafood was conducted in two phases. Phase 1 consisted of data compilation, identification of candidate chemicals for further evaluation, and a hazard assessment. The objective of Phase 1 was to identify chemicals of potential concern for further risk analysis, and to determine if immediate regulatory action was required. Phase 2 consisted of a detailed risk analysis for chemicals of potential concern identified in the hazard assessment. The Phase 2 analysis was based on a summary of average contaminant concentrations and a variety of plausible exposure assumptions.

The compilation and review of Puget Sound data consisted of synthesizing numerous data sources into a composite data set, and identification of 37 candidate chemicals for risk analysis. In the hazard assessment, data concerning the frequency of detection, maximum concentration, toxic potency, and metabolic and pharmacokinetic properties of the 37 candidate chemicals were used to develop preliminary worst-case risk estimates. From these preliminary estimates, eight chemicals or compound groups of concern were selected for detailed evaluation of risks.

The dose-response assessment compiled dose-response variables for the 37 candidate chemicals and presented toxicity profiles for the subset of eight chemicals of concern identified in the hazard assessment. The exposure assessment consisted of an evaluation of the concentrations in biota of the eight chemicals of concern by seafood category and sampling location within Puget Sound. This task also included a summary of seafood consumption rates that was based in part on recent surveys of recreational harvesters in Puget Sound.

In the risk characterization, the dose-response information developed in the toxicity assessment and consumption-rate information developed in the exposure assessment were combined to quantitatively estimate the range of health risks associated with consumption of seafood contaminated with the eight chemicals of concern.

Uncertainties, limitations, and assumptions are discussed qualitatively at each stage of the risk assessment process. In general, uncertainty was characterized by using a range of values and assumptions to estimate risks associated with average exposure conditions and with plausible high exposure conditions. Upper-bound exposure conditions consisted of using the upper 95 percent confidence limits of mean concentrations and reasonable high estimates of seafood consumptions rates to determine dose levels associated with ingestion of chemically contaminated seafood. Finally, additional perspective was incorporated into the risk assessment by comparing contaminant concentrations in Puget Sound biota with those in biota from other U.S. coastal areas.

To supplement the risk characterization, a separate section on graphical characterization of risks for the eight chemicals of concern was developed. The purpose of this section was to provide regulatory agencies and the public with a generically formatted graphical tool that could be used to easily estimate potential health risks associated with a wide range of chemical concentrations and human consumption rates. The graphics will provide a useful tool for rapidly evaluating potential health risks as additional data become available for various locations throughout Puget Sound.

COMPILATION AND REVIEW OF PUGET SOUND DATA

Chemical contamination in the marine environment has been the subject of numerous investigations in the past decade. In Puget Sound, these investigations have ranged from general surveys of contaminant distribution and bioaccumulation (e.g., Konasewich et al. 1982) to investigations of site-specific problems associated with hazardous waste sites (Tetra Tech 1985). Some of these studies included information on contaminant bioaccumulation in marine biota that was used to assess site-specific health risks associated with ingestion of chemically contaminated seafood (e.g., Schwab et al. 1987; Tetra Tech 1985, 1988). In general, these past investigations indicate considerable variability in the severity and spatial extent of contaminant bioaccumulation in Puget Sound biota, but do not provide a comprehensive regional picture of potential health risks associated with consumption of Puget Sound seafood. Consequently, this report was intended to provide a regional overview of the magnitude of the health risk problem. To accomplish this objective, contaminant bioaccumulation data were compiled from a number of broad-scale surveys and site-specific investigations that were conducted within the past 5 years using the most recent available analytical methods. Data from previous studies that had assessed health risks are not included here (e.g., Versar 1985; Tetra Tech 1985). However, contaminant concentrations and health risks described in these studies can be compared with those determined here by using the graphical risk characterization model presented below (see Graphical Risk Characterization).

SOURCES OF DATA

The following data sets were evaluated for the risk assessment of chemically contaminated seafood in Puget Sound:

- U.S. EPA and WDF 1987 survey of chemical contaminants in salmon (data provided in Appendix A)

- U.S. EPA 1986 survey of chemical contaminants in shellfish (data provided in Appendix A)

- U.S. EPA and Ecology 1986 survey of chemical contaminants in macroalgae (data provided in Appendix A)

- DSHS study of chemical contaminants in shellfish (Faigenblum 1988)

- Urban Bay Action Program data of toxic substances in fish from Elliott Bay (PTI and Tetra Tech 1988a)

- Urban Bay Action Program data of toxic substances in fish and crabs from Everett Harbor (PTI and Tetra Tech 1988b)

- National Oceanic and Atmospheric Administration (NOAA) study of potential toxicant exposure among consumers of recreational fish caught in Puget Sound (Landolt et al. 1985, 1987)

- Ecology surveys of shellfish from contaminated areas in Eagle Harbor and Budd Inlet (Yake et al. 1984; Norton, D., 5 February 1986, personal communication).

These studies ranged considerably in their objectives, survey design, and sampling and analysis methods. However, the focus of each survey was to characterize chemical contamination in industrialized or urbanized areas of Puget Sound. Each survey also included one or more areas located well away from urban centers or sources of industrial contaminants. Hence, the Puget Sound seafood risk assessment is likely based on data that are representative of the varying degrees of chemical contamination observed throughout the sound.

DATA QUALITY

In general, risk assessment methods depend on a wide number of assumptions concerning toxicity and exposure which are then used to extrapolate from measured contaminant concentrations in various media (e.g., fish) to potential health impacts in humans (see Risk Assessment section below). Consequently, understanding the quality of the underlying data is a critical step in defining limitations and uncertainties associated with risk estimates.

There are a wide range of sampling, chain-of-custody, analytical, data reporting, and interpretive problems associated with obtaining high quality chemical data. These problems are typically identified for tissue chemistry data sets during the data validation process. Uncertainties in data quality are indicated in two ways:

- Quality assurance (QA) reviews that are submitted as independent technical memoranda or included with the data report

- Attachment of qualifiers (i.e., footnotes) to specific reported values.

The Puget Sound data sets described in the preceding section were complete in that each had undergone QA review by the agency sponsoring each survey, and, in most cases, the sample values that were of uncertain validity were identified with qualifier footnotes. Although existing QA reports were reviewed as part of this risk assessment, U.S. EPA did not conduct independent QA evaluations of data generated by other agencies. In general, data qualifiers indicate that a sample value should either be rejected or considered as an estimate for a number of reasons, including:

- Exceedance of control limits for precision and accuracy

- Exceedance of allowable holding times

- Detection of the compound in an associated blank
- Low recovery of the internal standard used for calibration
- No verification of tentatively identified compounds.

Quality assurance reviews and qualified sample values for the 1986-1987 multi-agency (i.e., U.S. EPA, WDF, DSHS, and Ecology) study of contaminant concentrations in salmon, shellfish and macroalgae are presented in Appendix A. Quality assurance reviews and data qualifiers for the remaining studies are presented in published reports and technical memoranda by Landolt et al. (1985, 1987), Faigenblum (1988), PTI and Tetra Tech (1988a,b), Yake et al. (1984), and Norton (5 February 1986, personal communication).

The QA reviews and data qualifiers were used in this report in two ways. In Phase 1, data qualifiers were used, among other criteria, to identify "screening" quality data for a range of candidate chemicals. These screening quality data were then used in a preliminary worst-case risk evaluation to select chemicals of concern for further evaluation. Using screening data in Phase 1 provided an expedient means for determining the need for further risk evaluation (see Hazard Assessment Section below). In Phase 2 of this study, a detailed characterization of potential health risks associated with chemicals of concern was performed using only those data that met all data quality objectives. By focusing Phase 2 of this study on only high quality data, limitations inherent in chemical data that are of uncertain validity, for whatever reason, were eliminated from the risk assessment process.

SELECTION OF CANDIDATE CHEMICALS OF CONCERN

The selection of chemicals for evaluation in this risk assessment was based on the results of the QA reviews for each of the studies as well as on other criteria. Identification of candidate chemicals for the risk assessment was conducted in several steps. An initial selection of the available data was based on consideration of adequate sample identification.

Further evaluation of samples that passed this initial selection was based on the frequency of detection and data quality for individual chemicals.

Samples and their associated chemical analytes were selected for use in this risk evaluation using the following criteria:

- Identification of sample locations. Only those samples that could be clearly associated with specific locations in Puget Sound were accepted for risk evaluation, thus permitting spatial characterization of contaminant concentrations and risks.

- Species identification. Only chemical analyses that were performed on organisms from individual species, or from organisms identified to genus level where species identification was not possible, were accepted for risk evaluation. Composite samples of two or more species within a seafood category (e.g., bivalves) were only accepted for the risk evaluation for certain locations where species-specific data were not available.

Application of these general criteria resulted in eliminating a few samples from the NOAA data sets (Landolt et al. 1987). However, elimination of these samples did not affect the overall selection of chemicals of concern.

Among the samples that passed the initial data selection, chemical analytical data were available for over 150 substances in biota collected from various locations throughout Puget Sound. Candidate chemicals of potential concern were selected from these samples using the following criteria:

- Frequency of detection. A chemical must have occurred above detection limits in at least one sample.

- Data quality objectives. For each chemical that was detected at least once, all data quality objectives for the respective reports must have been met for at least one sample in which the chemical was detected (i.e., substances were eliminated from consideration if all of the detected values were "qualified" with respect to data quality objectives).

The former criterion precluded risk assessment of chemicals that were never detected in any of the biological samples. The latter criterion precluded risk assessment of chemicals that may have been detected, but which were of uncertain validity because the data values consistently failed to meet data quality objectives. Application of these two contaminant selection criteria resulted in the identification of 37 candidate chemicals or compound groups (Table 1) for further evaluation of health risks associated with consumption of chemically contaminated seafood.

Note that all of the available data for these 37 chemicals were carried forward to the hazard assessment stage of Phase 1 of the risk assessment. Because acceptance of all the data for each candidate chemical of concern was only contingent upon the existence of one "unqualified" value, the data for some of these 37 chemicals may include a high proportion of "qualified" values. Consequently, the data at this stage of the risk assessment was only considered suitable for screening purposes.

TABLE 1. CHEMICALS OF POTENTIAL CONCERN IN PUGET SOUND SEAFOOD

Trace metals	Antimony Arsenic Cadmium Chromium Copper Lead Mercury Nickel Selenium Silver Zinc
LPAH	Anthracene Phenanthrene
HPAH	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Fluoranthene Pyrene
Chlorinated aliphatic hydrocarbons	Hexachlorobutadiene
Chlorinated aromatic hydrocarbons	Hexachlorobenzene
Phthalates	Bis(ethylhexyl)phthalate Di-n-octyl phthalate
PCBs	PCB-1254 PCB-1260 PCB-total
Pesticides	alpha-HCH (=alpha-BHC) p,p'-DDD p,p'-DDE p,p'-DDT alpha-Endosulfan Heptachlor
Ketones	2-Butanone 2-Hexanone Acetone
Unsaturated alcohols	Vinyl acetate

RISK ASSESSMENT

Further evaluation of the 37 chemicals or compound groups in Table 1 followed the general risk assessment guidelines established by the U.S. EPA (1986a,b,c,d), as well as guidance developed for the Puget Sound Estuary Program for risk assessment of chemically contaminated seafood (Tetra Tech 1986). Following data compilation and screening, data were available for chemical contaminants in fish, shellfish, and macroalgae from 22 locations in Puget Sound (Figure 3). The taxa sampled at one or more of these locations are listed in Table 2. The number of taxa and kinds of algae and animals sampled varied considerably among areas. Consequently, for the purposes of the risk assessment, the various species were pooled into categories that are more representative of differences in potential ingestion rates and therefore human contaminant exposure (see Exposure Assessment below). The various categories were fish, shellfish, kelp and green algae, and red algae of the genus *Porphyra* (commonly known as nori).

HAZARD ASSESSMENT AND SELECTION OF CHEMICALS OF CONCERN

In the hazard assessment, the 37 chemicals of potential concern, these chemicals were further characterized and prioritized by considering the following factors:

- Preliminary worst-case risk evaluation
- The frequency of detection and maximum concentrations in different categories of biota sampled throughout Puget Sound
- The toxicological characteristics of the various contaminants.

The objective of the preliminary risk evaluation was to use a range of reasonable upper-bound assumptions to identify those substances from the

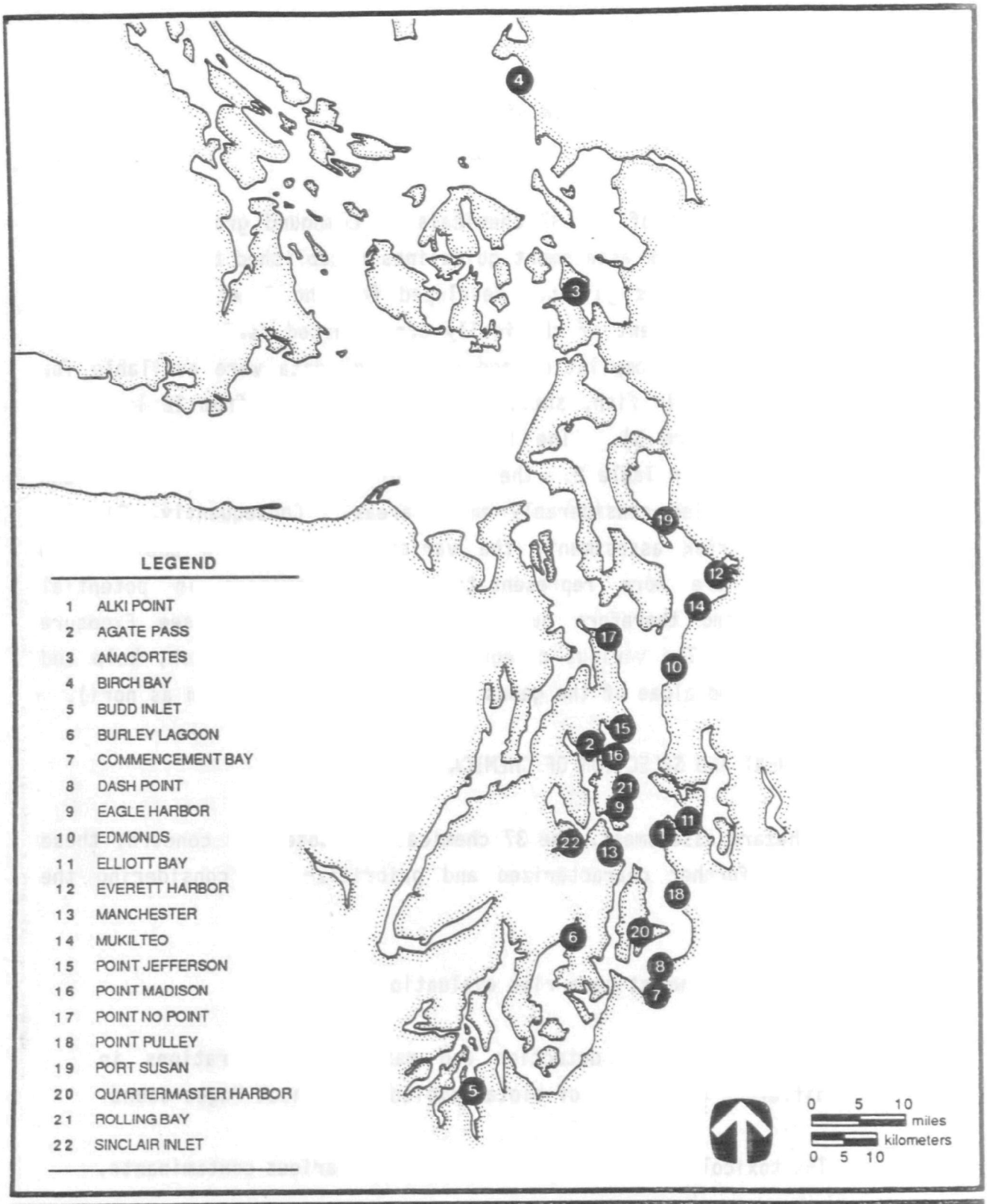


Figure 3. Sampling areas for risk assessment of chemically contaminated seafood.

TABLE 2. SCIENTIFIC AND COMMON NAMES OF FISH, SHELLFISH, AND MACROALGAE EVALUATED IN RISK ASSESSMENT OF CHEMICALLY CONTAMINATED SEAFOOD

Category	Type	Scientific Name	Common Name
Fish	Pelagic	*Oncorhynchus kisutch*	Coho salmon
		Oncorhynchus tshawytscha	Chinook salmon
		Merluccius productus	Pacific hake
		Embiotoca lateralis	Striped perch
		Sebastes spp.	Rockfish
		Anoplopoma fimbria	Sablefish
	Bottom feeding	*Gadus macrocephalus*	Pacific cod
		Theragra chalcogramma	Walleye pollock
		Microgadus proximus	Tomcod
	Bottom fish	*Parophrys vetulus*	English sole
		Platichthys stellatus	Starry flounder
		Citharichthys sordidus	Pacific sanddab
		Lepidopsetta bilineata	Rock sole
		Hippogloissoides elassodon	Flathead sole
		Enophrys bison	Buffalo sculpin
Shellfish	Crab	*Cancer magister*	Dungeness crab
		Cancer productus	Rock crab
	Bivalve	*Clinocardium nuttalli*	Heart cockle
		Macoma inquinata	--
		Macoma nasuta	Bent nose clam
		Macoma secta	Sand clam
		Macoma spp.	--
		Mya arenaria	Softshell clam
		Protothaca staminea	Littleneck clam
		Saxidomus giganteus	Butter clam
		Tapes japonica	Manila clam
		Tresus capax	Horseneck clam
	Squid	*Loligo opalescens*	Market squid
Macroalgae	Brown algae (kelp)	*Laminaria* spp.	--
		Nereocystis spp.	--
	Green algae	*Ulva* spp.	Sea lettuce
	Red algae	*Porphyra* spp.	Nori

initial list of 37 chemicals that are truly of concern in Puget Sound seafood. In this step, higher than average consumption rates and maximum concentration values were used only to estimate the highest individual chemical risks that could realistically occur, and to provide the sponsoring agencies with guidance concerning the need for immediate regulatory action. Hence, the preliminary risk evaluation constitutes a reasonable worst-case analysis, and is not intended to indicate actual health risks for seafood harvesters under more probable exposure conditions. For this reason, results of the preliminary risk evaluation are only presented in a summary tabular form and are not presented in detail in this report.

The preliminary risk estimates (Table 3) were based on the maximum concentrations observed for the various categories of seafood and on dose-response variables for carcinogenic substances (i.e., carcinogenic potency factors) and noncarcinogenic substances [i.e., reference dose values (RfDs)]. Details concerning sources of information for the dose-response variables, and how dose-response variables are used in risk estimation are provided below in the Toxicity Assessment and Exposure Assessment sections. The following major assumptions were used in these preliminary worst-case risk estimates:

- Average daily consumption rate of seafood is 26.1 g/day
- Exposure occurs daily over a 70-yr lifetime
- A representative body weight for a lifetime of exposure is 70 kg
- Absorption efficiency is 1 percent for ingested arsenic and 100 percent for the other chemicals.

As discussed below in the Exposure Assessment, estimates of the average daily consumption rate for fish range from 1.9 to 26.1 g/day. Consequently, a value of 26.1 g/day is a maximum estimate for average daily consumption of fish and was used in preliminary risk estimates.

TABLE 3. PRELIMINARY RISK ESTIMATES FOR CHEMICALS OF CONCERN IN FISH, SHELLFISH, AND MACROALGAE

Chemical Class	Chemical	N	Percent Detected	Maximum (ug/kg)	Potency Factor $(mg/kg/d)^{-1}$	RfD (mg/kg/d)	Dose[a,b] (mg/kg/d)	Carcinogenic Risk[c]	Noncarcinogenic Risk Index[d]
Metals	Antimony	26	34.6	80		0.0004	3.0E-05		0.075
	Arsenic	299	100.0	22,100	1.500		8.2E-05[e]	1E-04	
	Cadmium	301	88.7	1,280		0.0003	4.8E-04		1.646
	Chromium	72	86.7	2,330		0.0050	8.7E-04		0.174
	Copper	218	100.0	30,180		0.0370	1.1E-02		0.304
	Lead	278	63.3	4,460		0.0014	1.7E-03		1.188
	Mercury	347	90.7	260		0.0003	9.7E-05		0.323
	Nickel	35	74.3	1,900		0.0200	7.1E-04		0.035
	Selenium	59	81.4	300		0.0030	1.1E-04		0.037
	Silver	90	34.4	91		0.0030	3.4E-05		0.011
	Zinc	234	100.0	49,300		0.2100	1.8E-02		0.088
LPAH	Anthracene	46	54.3	130			4.8E-05		
	Phenanthrene	46	65.2	740			2.8E-04		
HPAH	Benzo(a)anthracene	46	32.6	210	11.500		7.8E-05	9E-04	
	Benzo(a)pyrene	46	34.8	58	11.500		2.2E-05	2E-04	
	Benzo(b)fluoranthene	46	41.3	120	11.500		4.5E-05	5E-04	
	Benzo(k)fluoranthene	28	28.6	3			1.1E-06		
	Chrysene	46	37.0	360	11.500		1.3E-04	2E-03	
	Fluoranthene	46	69.6	970			3.6E-04		
	Pyrene	46	45.7	920			3.4E-04		
Chlorinated aliphatics	Hexachlorobutadiene	124	6.0	1.79	0.078	0.0020	6.7E-07	5E-08	
Chlorinated aromatics	Hexachlorobenzene	125	30.8	7.68	1.670		2.9E-06	5E-06	
Phthalates	Bis(2-ethylhexyl)phthalate	9	44.4	1,000		0.0200	3.7E-04		0.019
	Di-n-octyl phthalate	9	66.7	1,700			6.3E-04		
PCBs	PCB-1254	102	52.9	210	7.700		7.8E-05	6E-04	
	PCB-1260	85	17.6	13	7.700		4.8E-06	4E-05	
	PCBs-total	241	98.8	2,060	7.700		7.7E-04	6E-03	
Pesticides	Alpha-HCH	217	2.8	6	11.120		2.2E-06	2E-05	
	DDD, 4,4'	283	18.0	31	0.340		1.2E-05	4E-06	
	DDE, 4,4'	291	49.5	410	0.340		1.5E-04	5E-05	
	DDT, 4,4'	292	13.4	28	0.340	0.0005	1.0E-05	4E-06	
	Endosulfan-alpha	84	1.2	3		0.0001	1.1E-06		0.022
	Heptachlor	217	0.9	2	4.500		7.5E-07	3E-06	
Ketones	2-Butanone	8	62.5	85		0.0500	3.2E-05		0.0006
	2-Hexanone	8	25.0	34			1.3E-05		
	Acetone	8	87.5	13,000		0.1000	4.8E-03		0.048
Unsaturated alcohols	Vinyl acetate	8	50.0	43			1.6E-05		

[a] Estimated dose = [concentration (mg/kg food) x ingestion rate (kg food/day)]/[body weight (70 kg)].
[b] Assumes an ingestion rate of 26.1 g/d over a 70-yr lifetime.
[c] Carcinogenic risk = 1- exp(-potency factor x estimated dose).
[d] Noncarcinogenic risk index = estimated dose/RfD.
[e] Assumes that 1 percent of the maximum value exists as inorganic arsenic.

The preliminary risk estimates and the frequency of detection information (Table 3) were used to select chemicals or compound groups of potential concern for further evaluation. Based on the results of the preliminary risk estimates, the various chemicals were categorized into high-priority, medium-priority, and low-priority groups (Table 4). The criteria used to categorize the chemicals and an explanation of the derivation of these criteria are as follows:

- High priority -- risk estimates greater than 10^{-5} for carcinogens, and risk indices greater than 1 for noncarcinogens

- Medium priority -- risk estimates ranging from 10^{-6} to 10^{-5} for carcinogens, and risk indices ranging from 0.25 to 1 for noncarcinogens

- Low priority -- risk estimates less than 10^{-6} for carcinogens, and risk indices less than 0.25 for noncarcinogens.

Dose-response variables and methods of risk estimation for carcinogens differ substantially from those for noncarcinogens (see Toxicity Assessment and Risk Characterization sections). Consequently, the risk-based criteria for prioritization of the carcinogens differ from those for noncarcinogens. In general, carcinogenic risk estimates indicate the probability of excess cancer over a lifetime of exposure. For noncarcinogens, a risk index is based on a comparison with a reference dose, which is an estimated single daily chemical intake rate that appears to be without risk if ingested over a lifetime. Thus, a noncarcinogenic risk index that is greater than 1 indicates that lifetime exposure exceeds the level at which toxic effects may be observed.

Based on the results of the preliminary risk evaluation, the chemicals of concern selected for further risk analysis included all of the high-priority chemicals or compound groups and one medium-priority chemical (mercury). The carcinogenic chemicals or compound groups of concern are

TABLE 4. CATEGORIES OF CANDIDATE CHEMICALS[a] OR COMPOUND GROUPS BASED ON PRELIMINARY RISK ESTIMATES

Priority	Toxic Class	Chemical or Compound Group
High[b]	Carcinogens	Arsenic Carcinogenic PAH[c] PCBs (total PCB, PCB-1254, PCB-1260) alpha-HCH DDT and related compounds (DDD and DDE)
	Noncarcinogens	Cadmium Lead
Medium[d]	Carcinogens	Hexachlorobenzene Heptachlor
	Noncarcinogens	Mercury Copper
Low[e]	Carcinogens	Hexachlorobutadiene
	Noncarcinogens	Antimony Chromium Nickel Selenium Silver Zinc Bis(2-ethylhexyl)phthalate Alpha-endosulfan 2-Butanone Acetone

[a] Some chemicals were not categorized because dose-response information needed to estimate risks was not available (see Dose-Response Assessment). These substances were anthracene, phenanthrene, benzo(k)fluoranthene, fluoranthene, pyrene, di-n-octyl phthalate, 2-hexanone, and vinyl acetate.

[b] Based on worst-case carcinogenic risks $>10^{-5}$, and on worst-case noncarcinogenic risk index >1.

[c] Includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene.

[d] Based on worst-case carcinogenic risks that range from 10^{-6} to 10^{-5}, and on worst-case noncarcinogenic risk index that ranges from 0.25 to 1.

[e] Based on worst-case carcinogenic risk $<10^{-6}$, and on worst-case noncarcinogenic risks <0.25.

arsenic, carcinogenic PAH [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene], PCB, alpha-HCH, and Σ DDT (i.e., DDD, DDE, DDT). Note that the carcinogenic PAH, PCB, and Σ DDT are compound groups, each of which is comprised of a number of individual substances. However, from the risk assessment perspective, the individual substances within each of these groups are similar toxicologically and, based on present information, are assigned identical dose-response variables. Hence, the maximum risk estimate for an individual substance within a compound group was used to categorize the group as a whole.

The noncarcinogenic chemicals of concern are cadmium, lead, and mercury. Of these, cadmium and lead exceeded a risk index of 1. However, the inclusion of mercury was considered important because it is highly bioaccumulative in aquatic organisms, is of special concern to segments of the public that consume more than 37.3 g of fish per day (i.e., 15 lb/yr), and may contribute to cumulative toxic effects in organs affected by cadmium and lead exposure (Table 5) (U.S. EPA 1984e).

Medium-priority chemicals that were not selected as chemicals of concern were hexachlorobenzene, heptachlor, and copper. The preliminary risk estimates for these chemicals were within an "acceptable" range as determined by past regulatory decisions. Hexachlorobenzene and heptachlor were omitted because their frequency of detection (0.9-24 percent) was much lower than that for mercury (91 percent). Copper was omitted for several reasons: it is an essential trace element; its risk index (0.30) was lower than that for mercury (0.32); its maximum concentration was within the range of legal tolerances established by various countries (see Tetra Tech 1986); and, with the exception of individuals suffering from Wilson's disease (i.e., a metabolic disorder resulting in excessive accumulation of copper), it is well-regulated physiologically in humans (Carson et al. 1986).

Dose-response information was not available for 8 of the 37 candidate chemicals of potential concern: anthracene, phenanthrene, benzo(k)fluoranthene, fluoranthene, pyrene, di-n-octyl phthalate, 2-hexanone, and vinyl acetate. Hence, these chemicals could not be evaluated for potential toxic

TABLE 5. TOXICITY PROFILES OF CHEMICALS OF CONCERN

Carcinogens	
Arsenic	The carcinogenic potency factor is based on the probability of excess skin cancer resulting from the ingestion of inorganic arsenic (U.S. EPA 1984a). Development of lung tumors is the primary carcinogenic endpoint of inhalation. Other toxic endpoints of concern are neurological disorders, especially in children exposed to acutely toxic concentrations (U.S. EPA 1984a).
PCBs	The liver and cutaneous tissues are primary target organs for both oral and inhalation routes of exposure. PCB exposure in experimental animals is associated with hepatocellular carcinoma, hepatotoxicity, fetotoxicity, and development of skin lesions (IARC 1978). In humans, PCB exposure is associated with skin lesions (chloracne), liver dysfunctions, and sensory neuropathy (Kuratsune 1976), and may be fetotoxic (Fein et al. 1984; Rogan et al. 1986).
PAHs	Potency estimation of the carcinogenicity of PAHs as a class of compounds is based on the data from a single PAH compound, benzo(a)pyrene (BaP). This approach assumes that all carcinogenic PAHs are equal in potency to BaP. BaP causes tumors systemically and at the site of exposure in experimental animals. For example, oral ingestion may produce stomach tumors and inhalation may result in lung tumors in addition to systemic neoplasms. Data on carcinogenic effects to humans consist of epidemiological studies with PAH-containing mixtures (soots, tars, oils, etc.) (IARC 1973, 1983; U.S. EPA 1981).
DDT	Several studies have demonstrated that oral exposure of experimental animals to DDT is associated with benign liver tumors (U.S. EPA 1984b). Pertinent data on the carcinogenicity of inhaled DDT are not available. No human data on DDT carcinogenicity are available.
alpha-HCH	The carcinogenic potency factor is based on the occurance of liver tumors in exposed mice; no other species are sensitive to alpha-HCH carcinogenicity (U.S. EPA 1984c). No data are available for their teratogenic or reproductive toxicological potentials. Human data are similarly unavailable.

TABLE 5. (Continued)

Noncarcinogens	
Cadmium	The major toxic endpoint of concern for low-level chronic oral ingestion of cadmium is kidney damage (proteinuria), resulting from cadmium accumulation in the renal cortex (Friberg et al. 1974). Cadmium has been shown in animal studies to be potentially fetotoxic.
Lead	Lead is associated with a variety of blood, neurological, and reproductive disorders (U.S. EPA 1984d). Special populations at risk are children, prenatal infants, and pregnant women. Anemia, due to inhibition of hemoglobin systhesis and a reduction in the lifespan of circulating red blood cells, is an early manifestation of lead poisoning. Exposure to relatively low levels of lead may cause lesions in the central and peripheral nervous systems and permanent learning disabilities in children that are clinically undetectable. Lead has a toxic effect on conception, pregnancy, and the fetus in both humans and experimental animals.
Mercury	Mercury in aquatic organisms occurs principally as methyl mercury. The reference dose for mercury is based on toxicity studies of methyl mercury exposure to experimental animals. Methyl mercury damages primarily the central nervous system in both adults and prenatal infants, causing paresthesia as mild effects, and constricted visual field and ataxia as severe and irreversible effects (U.S. EPA 1984e). Populations at risk are pregnant women and young children.

potency. As indicated in Table 3, the frequency of detection for these substances ranged from 29-70 percent for PAH compounds, and 25-67 percent for other comparables. Thus, the absence of available dose-response information for some of the PAH constitutes an unquantifiable uncertainty in the risk assessment. However, it should be recognized that the phthalates and ketones (2-hexanone and 2-butanone, acetone) are often detected as analytical contaminants in environmental chemistry samples and may not be representative of environmental contamination.

Qualitative aspects of the range of target organs, toxic effects, and sensitive populations that may be affected by the eight chemicals of concern are provided in Table 5.

DOSE-RESPONSE ASSESSMENT

Available dose-response information for quantitative risk assessment is summarized in Table 6 for the 37 candidate chemicals. These variables were used for the preliminary risk determination and selection of the eight chemicals of concern described in the Hazard Assessment. Potency factors and weight of evidence ratings for carcinogens and RfD values, and confidence ratings for noncarcinogens were collated from a variety of sources, including the following:

- U.S. EPA Integrated Risk Information System database (IRIS)
- U.S. EPA Public Health Risk Evaluation Database (PHRED)
- U.S. EPA (1987a,b,c) health advisory documents
- U.S. EPA (1986d) Superfund Public Health Evaluation Manual
- U.S. EPA (1988) drinking water criteria for PCBs.

Several assumptions were made in compiling dose-response information for the candidate chemicals. For example, toxic potency of trace metals can vary

TABLE 6. DOSE-RESPONSE INFORMATION FOR CHEMICALS DETECTED IN FISH, SHELLFISH, AND MACROALGAE

Chemical Class	Chemical	Carcinogens		Noncarcinogens	
		Potency Factor $(mg/kg/day)^{-1}$	Weight of Evidence[a]	RfD (mg/kg/day)	Confidence[b]
Metals	Antimony			0.0004	1
	Arsenic	1.500[c]	A		
	Cadmium			0.0003	
	Chromium (VI)			0.0050	1
	Copper			0.0370	
	Lead			0.0014	
	Mercury (methyl)			0.0003	2
	Nickel			0.0200	2
	Selenium			0.0030	
	Silver			0.0030	
	Zinc			0.2100	
LPAH	Anthracene				
	Phenanthrene		D		
HPAH	Benzo(a)anthracene	11.500	B2		
	Benzo(a)pyrene	11.500	B2		
	Benzo(b)fluoranthene	11.500	B2		
	Benzo(k)fluoranthene		D		
	Chrysene	11.500	B2		
	Fluoranthene				
	Pyrene				
Chlorinated aliphatic compounds	Hexachlorobutadiene	0.078	C	0.0020	1
Chlorinated aromatic compounds	Hexachlorobenzene	1.670	B2		
Phthalates	Bis(2-ethylhexyl)phthalate			0.0200	2
	Di-n-octyl phthalate				
PCBs	PCBs-total	7.700	B2		
	PCB-1254	7.700	B2		
	PCB-1260	7.700	B2		
Pesticides	alpha-HCH	11.120	B2		
	DDD, 4,4'	0.340	B2		
	DDE, 4,4'	0.340	B2		
	DDT, 4,4'	0.340	B2	0.0005	2
	Endosulfan-alpha			0.0001	2
	Heptachlor	4.500	B2		1
Ketones	2-Butanone			0.0500	2
	2-Hexanone				
	Acetone			0.1000	2
Unsaturated alcohols	Vinyl acetate				

[a] Weight of evidence ratings are (A) human carcinogen, (B1) probable human carcinogen based on limited epidemiological evidence, (B2) probable human carcinogen based on evidence from animal studies, (C) possible human carcinogen, (D) not classifiable as to human carcinogenicity, (E) evidence of noncarcinogenicity in humans.
[b] Confidence ratings are low (1), medium (2), and high (3).
[c] Potency factor based on interim recommendation of the U.S. EPA Risk Assessment Forum.

with trace metal speciation, but only total trace metal concentrations were measured. Consequently, the RfD for chromium VI (0.005 mg/kg/day) was used instead of that for chromium III (1 mg/kg/day) to provide a protective estimate of potential risks associated with chromium ingestion. For mercury, the RfD for methyl mercury was assumed because other studies have shown that methyl mercury is the principal species present in fish (U.S. EPA 1984e).

The published carcinogenic potency factor [15 $(mg/kg/day)^{-1}$] for inorganic arsenic is under revision by the U.S. EPA Risk Assessment Forum. U.S. EPA Region X has adopted the Risk Assessment Forum's recommendation for an interim arsenic potency of 1.5 $(mg/kg/day)^{-1}$, which is the value assumed for the seafood risk assessment (Cirone, P., 9 September 1988, personal communication). Also, the carcinogenic potency factor for arsenic is based on ingestion of inorganic arsenic. Arsenic in seafood occurs primarily as complex methylated or organic chemical species, which are less toxic and more readily excreted than inorganic arsenic. Research on arsenic speciation in seafood indicates that approximately 1 percent of the total arsenic is in the inorganic form (Crecelius, E., 21 March 1988, personal communication; Crecelius and Apts 1985; Cullen, W., 24 March 1988, personal communication; Landolt et al. 1987). Hence, because total arsenic was measured in biota collected from various locations in Puget Sound, 1 percent of the concentration of total arsenic was used to estimate risks associated with seafood consumption.

Benzo(a)pyrene is the only PAH with an established carcinogenic potency factor. Consequently, the carcinogenic potency factor for benzo(a)pyrene [11.5 $(mg/kg/day)^{-1}$] was assumed for other PAH that are either known or probable human carcinogens.

As indicated in Table 6, the carcinogenic PAH are potentially the most toxic of the carcinogens, and alpha endosulfan is potentially the most toxic of the noncarcinogens. However, health risks depend on two factors: toxic potency (expressed as a carcinogenic potency factor for carcinogens or as a RfD for noncarcinogens) and dose, which is a function of contaminant

concentration in a medium of exposure. Thus, as indicated in the Hazard Assessment, preliminary risk estimates based on maximum detected concentrations of contaminants in biota collected from Puget Sound indicate that the chemicals or compound groups of concern are: arsenic, cadmium, lead, mercury, carcinogenic PAH, PCB, alpha-HCH, and Σ DDT.

EXPOSURE ASSESSMENT

The exposure assessment for consumption of chemically contaminated seafood from Puget Sound was performed in three parts. First, the concentrations of the eight chemicals of concern in Puget Sound biota were summarized by seafood category and sampling location, and were compared with available FDA tolerances or action levels. Second, seafood consumption rates based in part on recent surveys of recreational harvesters in Puget Sound were summarized. Finally, chemical concentration data and consumption rates were combined to estimate the average daily dose associated with each chemical of concern.

Concentrations of Chemicals of Concern

Data for the eight chemicals of concern were summarized using SAS, a statistical software program. The following variables were entered into SAS files for tracking and evaluation of the available data: project, sample location, sample number, species sampled, concentration of each of the chemicals of concern in each sample, and detection limits and data qualifiers associated with the concentration of each chemical in each sample. These data are listed in Appendix B. A summary of the total number of data values for each chemical of concern in the various seafood categories and locations in Puget Sound is provided in Table 7. For many locations and seafood categories, data were either unavailable or extremely limited for some of the chemicals of concern. This uneven representation of chemicals, sampling areas, and seafood categories represents a major limitation in spatial characterization of risks.

TABLE 7. TOTAL NUMBER OF QUALIFIED AND UNQUALIFIED DATA VALUES FOR CHEMICALS OF CONCERN IN VARIOUS CATEGORIES OF SEAFOOD COLLECTED IN PUGET SOUND

Area	Seafood Category	Trace Metals				PAH				PCBs			Chlorinated Pesticides			
		Arsenic	Cadmium	Lead	Mercury	B(a)A	B(b)F	Chrysene	B(a)P	1254	1260	Total	HCH	DDD	DDE	DDT
Alki Point	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	12	13	9	11	2	2	2	2	3	2	--	2	2	3	3
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Anacortes	Fish	2	2	2	2	--	--	--	--	2	2	--	2	2	2	2
	Shellfish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Birch Bay	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	10	11	9	8	2	2	2	2	3	2	--	2	2	3	3
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Budd Inlet	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	10	11	8	9	4	4	4	4	1	--	--	--	--	1	1
	Kelp/Ulva	4	4	4	4	1	1	1	1	4	4	--	4	4	4	4
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Burley Lagoon	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	6	7	5	5	1	1	1	1	2	1	--	1	1	2	2
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Quartermaster Harbor	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	13	14	12	12	3	3	3	3	4	3	--	3	3	4	4
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Commencement Bay	Fish	27	27	27	17	1	1	1	1	7	7	16	7	19	18	19
	Shellfish	2	2	2	--	--	--	--	--	--	--	1	--	--	--	--
	Kelp/Ulva	9	9	9	9	1	1	1	1	9	9	--	9	9	9	9
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dash Point	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	12	12	8	10	3	3	3	3	4	3	--	3	3	3	3
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Elliott Bay	Fish	40	38	37	73	2	2	2	2	9	9	82	64	73	73	73
	Shellfish	3	3	3	3	--	--	--	--	--	--	3	--	3	3	3
	Kelp/Ulva	9	9	9	9	1	1	1	1	9	9	--	9	9	9	9
	Nori	4	4	4	4	--	--	--	--	4	4	--	4	4	4	4

TABLE 7. (Continued)

Area	Seafood Category	Trace Metals				PAH				PCBs			Chlorinated Pesticides			
		Arsenic	Cadmium	Lead	Mercury	B(a)A	B(b)F	Chrysene	B(a)P	1254	1260	Total	HCH	DDD	DDE	DDT
Everett Harbor	Fish	1	1	1	55	1	1	1	1	1	1	54	55	55	55	55
	Shellfish	3	3	3	15	3	3	3	3	3	3	12	15	15	15	15
	Kelp/Ulva	3	3	3	3	1	1	1	1	3	3	--	3	3	4	4
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mukilteo	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	12	13	11	11	3	3	3	3	4	3	--	3	3	3	3
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Point No Point	Fish	7	7	7	7	--	--	--	--	7	7	--	7	7	7	7
	Shellfish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Kelp/Ulva	8	8	8	8	1	1	1	1	8	8	--	8	8	8	8
	Nori	3	3	3	3	--	--	--	--	3	3	--	3	3	3	3
Sinclair Inlet	Fish	19	18	18	4	--	--	--	--	--	--	12	--	5	5	5
	Shellfish	12	13	10	10	2	2	2	2	3	2	2	2	4	5	5
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Point Pulley	Fish	--	--	--	5	--	--	--	--	--	--	5	5	5	5	5
	Shellfish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Port Susan	Fish	--	--	--	5	--	--	--	--	--	--	5	5	5	5	5
	Shellfish	--	--	--	1	--	--	--	--	--	--	1	1	1	1	1
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Edmonds	Fish	27	25	25	9	--	--	--	--	--	--	17	--	10	10	10
	Shellfish	6	7	7	2	--	--	--	--	--	--	7	--	2	2	2
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Agate Pass	Fish	4	4	4	4	--	--	--	--	--	--	4	--	4	4	4
	Shellfish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Point Madison	Fish	11	11	11	11	--	--	--	--	--	--	11	--	10	10	10
	Shellfish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 7. (Continued)

Area	Seafood Category	Trace Metals				PAH				PCBs			Chlorinated Pesticides			
		Arsenic	Cadmium	Lead	Mercury	B(a)A	B(b)F	Chrysene	B(a)P	1254	1260	Total	HCH	DDD	DDE	DDT
Manchester	Fish	4	4	4	4	--	--	--	--	--	--	4	--	5	5	5
	Shellfish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Point Jefferson	Fish	5	5	5	5	--	--	--	--	--	--	5	--	5	5	5
	Shellfish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rolling Bay	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	--	--	--	--	1	1	1	1	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eagle Harbor	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	8	8	8	8	12	12	12	12	8	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Point Blakely	Fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Shellfish	1	1	1	1	1	1	1	1	1	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Risk assessment depends on a wide range of assumptions, each of which generate some level of uncertainty in the risk characterization. Some of the major uncertainties in the available data, and the approaches that were used to minimize or eliminate these uncertainties, are outlined below.

Although Dungeness crab and other crab species are an important recreational fishery in Puget Sound, limited chemical concentration data in crabs were only available for a few locations. Additional uncertainty in the use of the crab data concerned compatibility of assumed ingestion rates for crab and those for other shellfish species. Consequently, crab data were not used in either the exposure assessment or the risk characterization.

A major uncertainty associated with chemical concentration data concerns the use of values where chemical analyses did not meet data quality objectives (see Compilation and Review of Data above). To eliminate this uncertainty from the risk characterization, only those data that met all the data quality objectives of their respective studies were used in the exposure assessment and subsequently in the risk characterization of the eight chemicals of concern. The total number of unqualified data values for each chemical of concern in the various seafood categories and locations in Puget Sound are presented in Table 8. For all of Puget Sound, the total numbers of unqualified data values ranged from 7 for trace metals and chlorinated organic compounds in nori to 185 for PCBs in fish.

An additional uncertainty associated with chemical concentration data concerns the use of quantification limits of substances that were not detected. All chemical analytical methods have a lower limit below which chemicals cannot be quantified. The use of this quantification limit provides additional uncertainty in the exposure assessment. There are three options for handling data associated with substances that were not detected:

- Option 1. Omit the sample entirely from the exposure assessment

TABLE 8. NUMBER OF UNQUALIFIED DATA VALUES FOR CHEMICALS OF CONCERN IN VARIOUS SEAFOOD CATEGORIES FROM LOCATIONS THROUGHOUT PUGET SOUND

Area	Seafood Category	Arsenic	Cadmium	Lead	Mercury	PAH[a]	Total PCBs[b]	HCH	ΣDDT[c]
Alki Point	Fish	--	--	--	--	--	--	--	--
	Shellfish	12	13	9	11	2	2	2	2
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Anacortes	Fish	2	2	2	2	--	2	2	2
	Shellfish	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Birch Bay	Fish	--	--	--	--	--	--	--	--
	Shellfish	10	11	9	8	2	2	2	2
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Budd Inlet	Fish	--	--	--	--	--	--	--	--
	Shellfish	10	11	8	9	4	--	--	--
	Kelp/Ulva	4	4	4	4	1	4	4	4
	Nori	--	--	--	--	--	--	--	--
Burley Lagoon	Fish	--	--	--	--	--	--	--	--
	Shellfish	6	7	5	5	1	1	1	1
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Quartermaster Harbor	Fish	--	--	--	--	--	--	--	--
	Shellfish	13	14	12	12	3	3	3	3
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Commencement Bay	Fish	27	27	27	17	--	23	7	19
	Shellfish	2	2	2	--	--	1	--	--
	Kelp/Ulva	9	9	9	9	1	9	9	9
	Nori	--	--	--	--	--	--	--	--
Dash Point	Fish	--	--	--	--	--	--	--	--
	Shellfish	12	12	8	10	3	3	3	3
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Elliott Bay	Fish	40	38	37	18	--	59	64	73
	Shellfish	3	3	3	3	--	3	--	3
	Kelp/Ulva	9	9	9	9	1	9	9	9
	Nori	4	4	4	4	--	4	4	4
Everett Harbor	Fish	1	1	1	1	--	40	53	55
	Shellfish	3	3	3	3	3	3	3	3
	Kelp/Ulva	3	3	3	3	1	3	3	3
	Nori	--	--	--	--	--	--	--	--
Mukilteo	Fish	--	--	--	--	--	--	--	--
	Shellfish	12	13	11	11	3	3	3	3
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Point No Point	Fish	7	7	7	7	--	7	7	7
	Shellfish	--	--	--	--	--	--	--	--
	Kelp/Ulva	8	8	8	8	1	8	8	8
	Nori	3	3	3	3	--	3	3	3

TABLE 8. (Continued)

Area	Seafood Category	Arsenic	Cadmium	Lead	Mercury	PAH[a]	Total PCBs[b]	HCH	ΣDDT[c]
Sinclair Inlet	Fish	19	18	18	4	--	12	--	5
	Shellfish	12	13	10	10	2	4	2	4
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Point Pulley	Fish	--	--	--	--	--	--	5	5
	Shellfish	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Port Susan	Fish	--	--	--	--	--	1	5	5
	Shellfish	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Edmonds	Fish	27	25	25	9	--	17	--	10
	Shellfish	6	7	7	2	--	7	--	2
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Agate Pass	Fish	4	4	4	4	--	4	--	4
	Shellfish	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Point Madison	Fish	11	11	11	11	--	11	--	10
	Shellfish	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Manchester	Fish	4	4	4	4	--	4	--	5
	Shellfish	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Point Jefferson	Fish	5	5	5	5	--	5	--	5
	Shellfish	--	--	--	--	--	--	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Eagle Harbor	Fish	--	--	--	--	--	--	--	--
	Shellfish	8	8	8	8	8	8	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
Point Blakely	Fish	--	--	--	--	--	--	--	--
	Shellfish	1	1	1	1	1	1	--	--
	Kelp/Ulva	--	--	--	--	--	--	--	--
	Nori	--	--	--	--	--	--	--	--
All Puget Sound	Fish	147	142	141	82	--	185	143	205
	Shellfish	110	118	96	93	32	41	19	26
	Kelp/Ulva	33	33	33	33	5	33	33	33
	Nori	7	7	7	7	--	7	7	7

[a] Includes benzo(a)anthracene, benzo(b)fluorouthene, chrysene, and benzo(a)pyrene as total carcinogenic PAH.

[b] Includes some of PCB-1254 and PCB-1260 as surrogate indicator of total PCBs.

[c] Includes DDD, DDE, and DDT.

- Option 2. Use the quantification limit as a sample value in the exposure assessment and, hence, in the risk characterization

- Option 3. Assume a value lower than the quantification limit (i.e., 0.5 x quantification limit) and use it in the exposure assessment and risk characterization.

Option 1 results in a loss of useful information, particularly when the frequency of detection is low. Assuming that most actual values below the quantification limits are greater than zero, both Options 1 and 2 tend to overestimate the average concentration. To offset this possible overestimation and to retain the available information, values of one-half the quantification limits were assumed for substances that were not detected (Option 3). This assumption is often used in public health risk assessments at Superfund sites (Cirone, P., 2 September 1988, personal communication) to retain the available information and to offset possible biases in estimates of average concentration.

Concentration data for the chemicals of concern in various categories of seafood from all Puget Sound locations (i.e., fish, shellfish, kelp and *Ulva*, and nori) are summarized in Table 9. The data summary provided in Table 9 is based on only those data that met all data quality objectives, and on the assumption of one-half the quantification limits for those substances that were not detected. Thus, for some substances the numbers of samples and ranges of values given in Table 9 may differ substantially in comparison with the data listing provided in Appendix B, which identifies actual quantification limits and includes both qualified and unqualified data. Major limitations in the data in Table 9 are the relatively small number of macroalgae samples, the absence of PAH data for fishes, and the negligible (i.e., 0-3 percent) frequency of detection of alpha-HCH. Alpha-HCH was only detected in fish (chinook salmon) from Commencement Bay, Elliott Bay and Point-No-Point (see Appendix C and Appendix D).

TABLE 9. SUMMARY DATA[a] FOR CHEMICALS OF CONCERN IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Chemical	Seafood Category	No. Samples	Percent Detected	Concentration (ug/kg wet wt)[b] Mean	SE	Minimum	Maximum	95 Percent Confidence Limits[c] Lower	Upper
Arsenic	Fish	147	100	3,441	354	190	20,700	2,740	4,141
	Shellfish	110	100	3,252	254	1,200	22,100	2,749	3,756
	Kelp/Ulva	33	100	2,559	380	340	9,200	1,785	3,333
	Nori	7	100	2,279	499	470	3,880	1,057	3,500
Cadmium	Fish	142	76	5.4	0.6	0.5	66.0	4.1	6.6
	Shellfish	118	100	219.1	16.2	2.0	1,280.0	187.0	251.2
	Kelp/Ulva	33	100	173.2	19.4	46.0	437.0	133.7	212.6
	Nori	7	100	213.1	48.6	62.0	394.0	94.3	332.0
Lead	Fish	141	50	16.3	3.0	0.5	200.0	10.4	22.1
	Shellfish	96	81	199.3	33.1	1.0	1,980.0	133.5	265.1
	Kelp/Ulva	33	85	338.0	135.7	2.5	4,460.0	61.6	614.3
	Nori	7	57	76.8	36.8	2.5	240.0	0.0	166.9
Mercury	Fish	82	87	26.6	4.2	0.5	260.0	18.3	34.9
	Shellfish	93	100	22.5	1.6	1.0	103.0	19.3	25.6
	Kelp/Ulva	33	48	1.7	0.5	0.5	15.0	0.8	2.6
	Nori	7	43	1.0	0.3	0.5	3.0	0.2	1.8
DDT, DDE, DDD	Fish	205	40	11.15	2.24	0.85	415.00	6.72	15.57
	Shellfish	26	69	1.60	0.49	0.15	11.33	0.60	2.61
	Kelp/Ulva	33	100	4.03	0.11	3.00	7.00	3.80	4.26
	Nori	7	100	3.86	0.14	3.00	4.00	3.51	4.21
alpha-HCH	Fish	143	3	0.60	0.09	0.05	6.00	0.42	0.78
	Shellfish	19	-	0.05	0.00	0.05	0.10	0.05	0.06
	Kelp/Ulva	33	-	0.53	0.03	0.50	1.50	0.47	0.59
	Nori	7	-	0.50	0.00	0.50	0.50	0.50	0.50
Carcinogenic PAH	Fish	-	-	-	-	-	-	-	-
	Shellfish	32	47	61.9	25.2	2.5	748.0	10.6	113.2
	Kelp/Ulva	5	-	261.7	62.6	120.0	480.0	87.9	435.5
	Nori	-	-	-	-	-	-	-	-
PCB	Fish	185	99	138.2	17.6	1.8	2,060.0	103.5	172.9
	Shellfish	41	83	44.7	10.2	1.0	230.0	24.0	65.5
	Kelp/Ulva	33	-	10.6	0.6	10.0	30.0	9.4	11.8
	Nori	7	-	10.0	0.0	10.0	10.0	10.0	10.0

[a] Only those values that met data quality objectives were used in the data summary, and in the subsequent risk characterization. Consequently, the number of samples and summary statistics indicated herein may differ substantially from those based on both qualified and unqualified data, which are summarized in Appendix B.

[b] One-half the quantitation limits was assumed for values that were not detected.

[c] The 95 percent confidence interval was determined as follows:

Lower confidence limit (LCL) = mean - $t_{0.05\ (n-1)} \times SE$
Upper confidence limit (UCL) = mean + $t_{0.05\ (n-1)} \times SE$

where:

$t_{0.05\ (n-1)}$ = Student's two-tailed t value for alpha = 0.05 and n-1 degrees of freedom.

SE = The standard error of the mean.

Based on qualitative comparisons of the 95 percent confidence intervals, several aspects of the data are noteworthy. Concentrations of arsenic were approximately the same within all categories of seafood despite extremely high maximum values observed in some fish and shellfish. Cadmium concentrations were much lower in fish than in other seafood categories. Mercury concentrations in fish and shellfish were higher than those for macroalgae. Also, concentrations of PCBs and Σ DDT were much higher in fish than in either shellfish or macroalgae. Detailed data summaries by individual sampling locations are provided in Appendix C for various categories of seafood and in Appendix D for individual taxa.

Concentrations of chemicals of concern in Puget Sound seafood were compared with available federal guidelines governing acceptable concentrations of toxic substances in fish and shellfish to determine whether these guidelines suggested the need for regulatory action. The U.S. Food and Drug Administration (FDA) (1982, 1984) has established tolerances and action levels that set an upper limit for the unavoidable concentrations of chemical contaminants in commercial fish and shellfish products that are sold in interstate commerce. The criteria used by the FDA (21 CFR 109) to establish tolerance levels are:

- The substance cannot be avoided
- The tolerance level is sufficient for the protection of public health, taking into account the extent to which the presence of the substance cannot be avoided and other ways in which consumers might be affected by the substance
- No technological or other changes are foreseeable in the near future that would affect the extent to which such substances are unavoidable.

Criteria for FDA action levels (21 CFR 109) are the same as those for tolerances, with the exception that there are foreseeable technological or other changes that would affect the extent to which such substances are

unavoidable. In setting tolerances and action levels, FDA takes into consideration socioeconomic and technological factors to the extent that such factors are consistent with the protection of public health in the general population.

The FDA has established tolerances or action levels for three of the eight chemicals that are of concern in this risk assessment:

- Mercury - 1 mg/kg wet weight (1,000 ug/kg) - Action level for fish and shellfish

- PCBs - 2 mg/kg wet weight (2,000 ug/kg) - Tolerance level for fish and shellfish

- Σ DDT - 5 mg/kg wet weight (5,000 ug/kg) - Action level for fish only.

Overall, average concentrations of these substances in the various species and categories of seafood were less than the FDA tolerances or action levels for all locations in Puget Sound (see Table 9 and Appendices C and D). The only notable exception to this generalization was the concentration of PCBs [2.06 mg/kg (2,060 ug/kg) wet weight] in a single sample of English sole from Elliott Bay. U.S. FDA action levels have not been established for other chemicals of concern in Puget Sound seafood.

Although the foregoing comparisons with tolerances or action levels for mercury, PCBs, and Σ DDT are reassuring, such comparisons do not address a number of key issues, including:

- Potential health risks associated with substances for which tolerances or action levels have not been established (i.e., arsenic, cadmium, lead, PAH, and alpha-HCH)

- Cumulative health risks associated with multiple chemical exposure

- Health risks for those recreational harvesters whose seafood consumption rates may be much higher than those of the general population

- Health risks for recreational harvesters who take a majority of their seafood from a localized contaminated area rather than from a "national market basket" representing a range of locations and environmental conditions.

These and other issues are addressed in the remaining sections of this report.

Seafood Consumption Rates

Concern over the potential health risks associated with consumption of seafood prompted several recent studies of catch and consumption patterns for recreational harvesters in Puget Sound (Pierce et al. 1981; McCallum 1985; Landolt et al. 1985, 1987). These surveys ranged widely in objectives, study design, interview methods, and spatial and temporal coverage of harvest areas. The following locations and modes of angling were covered by the various surveys:

- Pierce et al. (1981) - Shore angling and boat angling in Commencement Bay

- McCallum (1985) - Shore angling in Elliott Bay, Everett Harbor (Port Gardner), and Sinclair Inlet

- Landolt et al. (1985) - Shore angling in Commencement Bay, Elliott Bay, Sinclair Inlet, and Edmonds

- Landolt et al. (1987) - Boat angling in Elliott Bay and Commencement Bay.

Each of the surveys were examined as part of this risk assessment, and although each included information on shellfish harvesting, they focused primarily on the angling segments of the seafood harvesting community. Consequently, the information from the various surveys that could be readily translated into seafood consumption rates was limited to fish and pelagic shellfish (i.e., market squid) caught by recreational anglers. No surveys were available on local recreational shellfish consumption.

The results of each of these studies were summarized and reported in widely ranging formats. Information common to all of the surveys was reviewed to generate a range of seafood consumption rates characteristic of recreational anglers in Puget Sound. Because of limitations in the reporting of the available catch and consumption data, species-specific seasonal variability in estimated consumption rates was not considered. Instead, the focus was on an annualized daily consumption rate for all species combined that could be attributed to various levels of fishing effort, and which could be used to predict potential risks over a 70 year lifetime of exposure. The following variables were used to determine seafood consumption rates:

- Angler fishing effort (E) expressed in units of day/yr
- The proportion of anglers (P) associated with each level of fishing effort
- The average daily weight (W) of all fish caught during the survey period expressed in units of g/day
- The edible fraction of fish (F), which ranged from 0.3 to 0.49 depending on the survey and species caught
- The average number of consumers (C) that eat the catch.

A range of average daily consumption rates were calculated using the equation:

$$ADC_i = (E_i \times W \times F)/(C \times 365 \text{ day/yr}) \quad (1)$$

where:

ADC_i = Average daily consumption rate expressed as g/person/day for the ith level of fishing effort.

The maximum fish consumption rate generated from these data was 407 g/day for Commencement Bay anglers who reported a fishing-level-of-effort of 304 days/yr (Pierce et al. 1981). This value is in agreement with the maximum value (454 g/day) generated in Versar's (1985) analysis of the Commencement Bay data, but, as indicated below, is an extremely high value representative of a small fraction of the recreational fishing community.

Statistical analyses were then performed by linear regression of angle transformed [i.e., arcsin $(P)^{0.5}$] estimates of the cumulative proportion of anglers associated with the various levels of fishing effort against the log transformed estimates of the average daily consumption rate (Figures 4 and 5). Results of these analyses were then used to derive a number of independent estimates of seafood consumption rates for the 5th, 50th (i.e., median), and 95th percentiles of the angling population (Table 10).

The median (i.e., 50th percentile) fish consumption rates for recreational anglers ranged from 1.9 to 26.1 g/day, with an overall median of 12.3 g/day. Estimates of the 95th percentile of fish consumption rates ranged from 24.3 to 246 g/day, with a median of 95.1 g/day. Thus, the overall indication is that less than 5 percent of the recreational anglers consume more than 95.1 g/day. Based on these results, a consumption rate of 12.3 g/day was used to estimate average exposure, and a consumption rate of 95.1 g/day was used to estimate high exposure to chemically contaminated fish from Puget Sound.

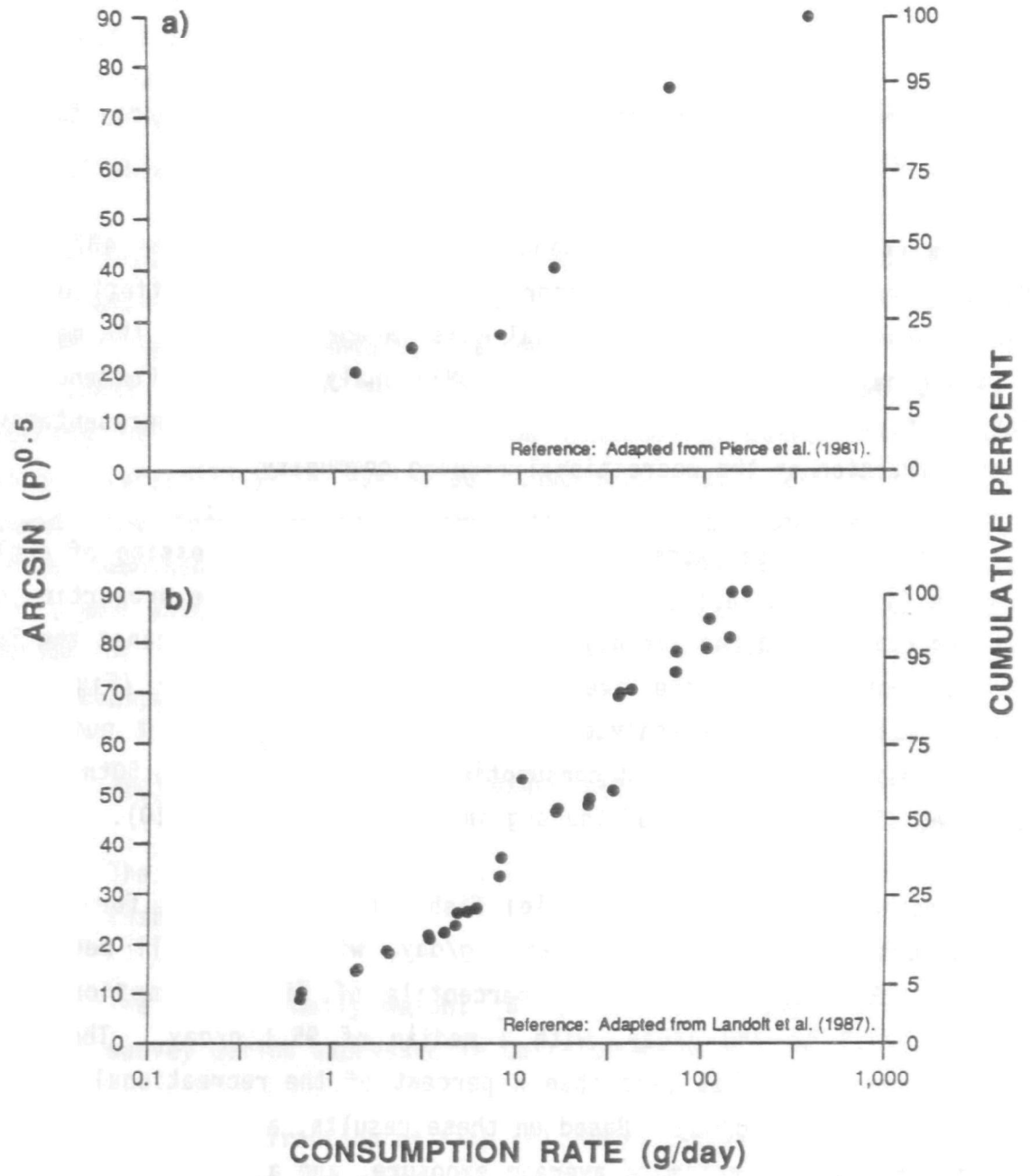


Figure 4. Estimates of fish consumption rates as a function of cumulative percent of the angler population for shore and boat anglers surveyed by the Tacoma-Pierce County Health Department (a), and for boat anglers surveyed by NOAA (b).

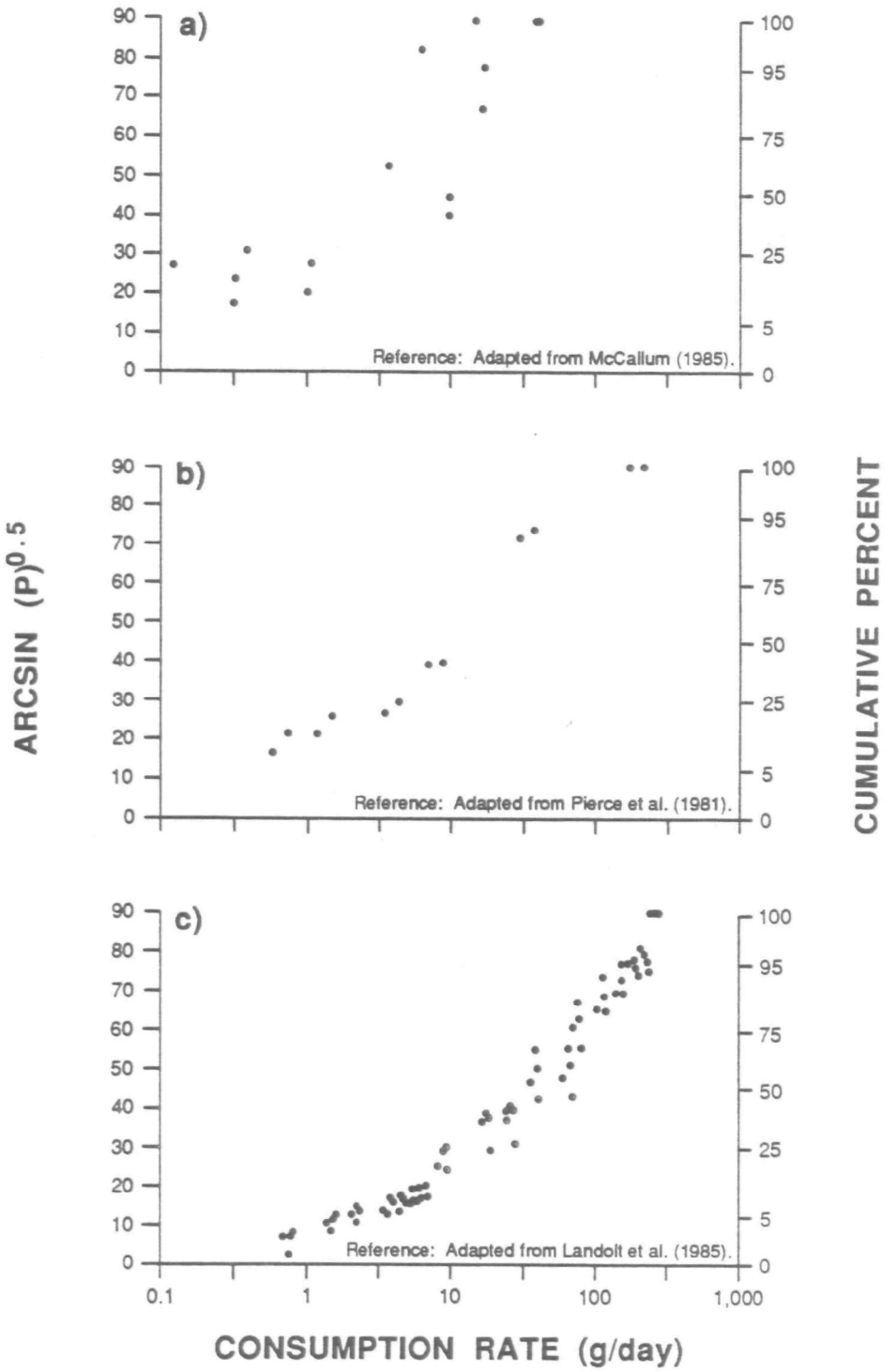


Figure 5. Estimates of fish consumption rates as a function of cumulative percent of the angler population for shore anglers surveyed by the Washington Department of Social and Health Services (a), the Tacoma-Pierce County Health Department (b), and NOAA (c).

TABLE 10. ESTIMATED FISH CONSUMPTION RATES (G/DAY) FOR VARIOUS PROPORTIONS OF URBAN ANGLER POPULATIONS SURVEYED IN PUGET SOUND

Angler Population	Cumulative Percentile[a] of Angler Population			Study
	5	50	95	
Shore[b]	2.8	26.1	246.2	Landolt et al. (1985)
Shore[c]	0.2	1.9	24.3	McCallum (1985)
Shore[d]	0.6	7.1	78.2	Pierce et al. (1981)
Shore/boat[d]	1.3	13.6	147.1	Pierce et al. (1981)
Boat[e]	1.6	12.3	95.1	Landolt et al. (1987)
Median value[f]	1.3	12.3	95.1	

[a] For example, the McCallum (1985) study indicates that the consumption rate for 95 percent of the population surveyed is $\leq$ 24.3 g/day, and that the average (i.e., 50th percentile) consumption rate is 1.9 g/day.

[b] Commencement Bay, Elliott Bay, Sinclair Inlet, Edmonds.

[c] Elliott Bay, Everett Harbor (Port Gardner), Sinclair Inlet.

[d] Commencement Bay.

[e] Elliott Bay and Commencement Bay.

[f] Median values were used to construct risk graphics.

Reference: Adapted from data presented by Landolt et al. (1985, 1987), Pierce et al. (1981), and McCallum (1985).

There are a number of uncertainties and potential biases associated with these overall estimates of median consumption rates. Major uncertainties include variability associated with:

- Different modes of angling activity (boat vs. shore)
- Different subpopulations (and sample sizes) of recreational anglers
- Different rates of angling success associated with each survey location or fishery zone
- Different survey methods and periods (i.e., 5 to 13 mo).

Consequently, the overall median values indicated in Table 10 provide only a general indication of the range of fish consumption rates for Puget Sound anglers. As indicated in Table 10, higher or lower estimates may be obtained for specific modes of angling at specific locations. These survey-specific values may be used in combination with the risk graphics (see Graphical Risk Characterization below) to estimate health risks for specific modes of angling activity at the various survey locations cited in Table 10.

Consumption rates specific to Puget Sound were not available for shellfish or for macroalgae. In developing ambient water quality criteria, the U.S. EPA (1980) used 0.8 g/day as a national average shellfish consumption rate. Nash (1971) compiled regional (e.g., Pacific coast, middle Atlantic states, New England states) information on per capita consumption of fish and shellfish indicating that shellfish consumption rates for the general population range from 0.6 to 1.9 g/day, with a median value of 1.1 g/day. Hence, a value of 1.1 g/day was used to estimate average exposure. The value of 1.9 g/day was not used as an estimate of high shellfish consumption because it only represents approximately 2.7 servings (assuming 151 g/serving) of shellfish per year (see Graphical Risk Characterization below). Consequently, an estimate of the high shellfish consumption rate was developed using the following assumptions:

- There is approximately 0.333 lb (151 g) per shellfish serving

- An individual may eat 1 serving/wk (i.e., 52 servings/yr).

Based on these assumptions, a consumption rate of 21.5 g/day was used to estimate high exposure to chemically contaminated shellfish from Puget Sound.

Uncertainty associated with the average exposure value for shellfish consumption concerns extrapolating from per capita statistics for regional or national populations to populations of recreational shellfish harvesters in the vicinity of a major seafood-producing estuary. Thus, the actual average rate of consumption for recreational harvesters of shellfish from Puget Sound may be greater than that estimated here. Uncertainty associated with the high exposure value for consumption of shellfish concerns the validity of the assumptions outlined above. Although not substantiated by recreational catch and consumption statistics, it is entirely reasonable to assume that some individuals who live in the vicinity of a major maritime region such as Puget Sound may harvest or purchase shellfish for personal consumption on a weekly basis.

Average and high exposure estimates for consumption of macroalgae were based on marketing information developed by a local mariculture facility specializing in the production of algae of the genus *Porphyra*, which is commonly known as nori (Merrill, J., 8 February 1988, personal communication). Estimates of average U.S. consumption rates were used to determine average exposure, and estimates of average consumption rates in Japan were used to determine high consumption exposure, which may be representative of ethnic minorities who harvest macroalgae from Puget Sound. For kelp, the average consumption rate in the U.S. is 0.023 g/day, and that in Japan is 16.2 g/day. For nori, the average consumption rate in the U.S. is 0.006 g/day, and that in Japan is 4.1 g/day.

Dose-Estimation

All risk estimates are based on determination of chemical doses. Because the consumption rate information described above was based on averages for all species within a category, dose estimates were only derived for major categories of seafood (i.e., fish, shellfish, kelp and *Ulva*, and nori). The expression used for dose estimation was:

$$D_{ij} = (C_{ij} \times I_j \times A_i)/B \qquad (2)$$

where:

D_{ij} = Dose of chemical i in seafood category j (mg/kg body weight/day)
C_{ij} = Concentration of chemical i in seafood category j (mg/kg seafood)
I_j = Ingestion rate for seafood category j (kg seafood/day)
A_i = Absorption coefficient for chemical i (unitless)
B = Standard assumption for average lifetime body weight (70 kg).

Note that Equation 2 is a general expression for dose estimation that can be derived from average estimates of contaminant concentrations at specific locations in Puget Sound or on a Puget Sound-wide basis. Aspects of spatial characterization of risks are discussed below.

Major assumptions used in dose-estimation were:

- Exposure occurs daily over a 70-yr lifetime
- A representative body weight for a lifetime of exposure is 70 kg
- The absorption coefficient is 1 percent for ingested arsenic and 100 percent for the other chemicals.

As indicated above in the Toxicity Assessment, approximately 1 percent of the total arsenic in seafood is in the inorganic form. Because the carcinogenic

potency factor for arsenic is based on ingestion of inorganic arsenic, 1 percent of the total arsenic concentration was used to estimate risks associated with seafood consumption. An absorption coefficient of 100 percent was used for mercury and the organic chemicals of concern, because they are highly assimilative (95-100 percent absorption efficiency). An absorption coefficient of 100 percent was assumed for cadmium and lead, because the RfD values for these substances are based on exposure to an ingested dose rather than an assimilated dose.

The average consumption rates described previously for various categories of seafood were used to estimate average lifetime doses for the various chemicals of concern. Uncertainty in dose estimation was determined to a degree by estimating doses associated with the upper 95 percent confidence limit of mean concentrations in various seafood categories, and the high-case estimates for consumption of each category of seafood. Thus, dose-estimation was based on a range of values representative of average exposure conditions and high exposure conditions. The assumptions used in dose estimation and in subsequent risk calculations are outlined in the following section (Risk Characterization).

RISK CHARACTERIZATION

Dose-response variables summarized in the Dose-Response Assessment section were used with the dose estimates summarized in the Exposure Assessment section to characterize potential health risks associated with chemically contaminated seafood from Puget Sound. The following risk characterization provides

- A summary of how these variables were used to characterize risks
- An overview of the range of assumptions associated with the risk calculations
- A discussion of the results of the risk estimates.

Risk Characterization Methods and Assumptions

Potential risks associated with each carcinogen of concern in various categories of seafood were estimated as the probability of excess cancer using the equation:

$$R_{ij} = 1 - \exp(-P_i \times D_{ij}) \tag{3}$$

where:

R_{ij} = Risk associated with chemical i in seafood category j
P_i = Carcinogenic potency factor for chemical i $(mg/kg/day)^{-1}$
D_{ij} = Dose of chemical i in seafood category j (mg/kg/day).

Attributes of carcinogenic potency factors and methods of dose estimation are as described above (see Dose Response Assessment and Exposure Assessment).

Nonprobabilistic hazards associated with ingestion of noncarcinogens in various seafood categories were expressed as a ratio:

$$RI_{ij} = D_{ij}/RfD_i \tag{4}$$

where:

RI_{ij} = Risk index for chemical i in seafood category j
D_{ij} = Dose of chemical i in seafood category j (mg/kg/day)
RfD_i = Reference dose for chemical i (mg/kg/day).

Characteristics of the RfD and methods of dose estimation are as described above.

Finally, potential cumulative health risks associated with exposure to multiple carcinogenic chemicals or multiple noncarcinogenic chemicals in

various categories of seafood were determined by summing the risks for individual contaminants within a seafood category and then summing the risks across all seafood categories. Cumulative risks for carcinogens were calculated using the expression:

$$\text{Cumulative Carcinogenic Risk} = \sum_{i=1}^{5} \sum_{j=1}^{4} R_{ij} \qquad (5)$$

where:

R_{ij} = The same as that defined above for Equation 3.

Cumulative risks for noncarcinogens were calculated using the expression:

$$\text{Cumulative Noncarcinogenic Risk Index} = \sum_{i=1}^{3} \sum_{j=1}^{4} RI_{ij} \qquad (6)$$

where:

RI_{ij} = The same as that defined above for Equation 4.

Summation of multiple chemical risks across the various categories of seafood assumes that all individuals in the exposed population eat fish, shellfish, kelp and *Ulva*, and nori at the consumption rates described above in the Exposure Assessment. Depending on individual preferences, this may or may not be the case. Nevertheless, such an approach provides an appropriate means of calculating risk based on all routes of exposure.

The cumulative risk estimate for carcinogens provides an indication of the lifetime probability of excess cancer that may occur through exposure to one or more substances, each of which may act independently on various target organs. In general, U.S. EPA decisions concerning individual lifetime risk estimates in the range of 10^{-7} to 10^{-3} are made on a case-by-

case basis and are strongly influenced by considerations of the population risk (Travis et al. 1987, Travis and Haltemer-Frey 1988). Individual risk levels greater than 10^{-3} are usually subject to regulatory action, and those less than 10^{-7} are rarely subject to regulatory action. Under Superfund, EPA (1986d) has established a target range of 10^{-7} to 10^{-4} for remedial action alternatives that are designed to mitigate exposure to hazardous substances.

The cumulative risk index for noncarcinogens assumes simple additivity of effects and provides a numerical indication of the nearness to acceptable limits of exposure or the degree to which acceptable exposure limits are exceeded (U.S. EPA 1986c). A cumulative risk index greater than 1.0 suggests that exposure to an individual substance or all substances collectively exceeds a generalized level of concern for a common toxicological endpoint or target organ.

The risk characterization equations described above incorporate a number of assumptions and numerical estimates that were developed in the Dose-Response and Exposure Assessments. Dose estimates based on mean chemical concentrations and average consumption rates were used to estimate average-case risks. Dose estimates based on upper 95 percent confidence limits of mean chemical concentrations and high consumption rates were used to estimate high-case risks. A summary of the assumptions, numerical estimates, and calculations that were used in the risk characterization is provided in Table 11.

Characterization of Risks

Potential health risks associated with chemicals of concern in Puget Sound biota are summarized in Table 12 for noncarcinogens and Table 13 for carcinogens. The values in Table 12 and Table 13 are based on mean chemical concentrations and upper 95 percent confidence limits for these mean values in the different categories of seafood averaged over all locations in Puget Sound (see Figure 3). The risk estimates in Tables 12 and 13 are presented in four ways:

TABLE 11. SUMMARY OF ASSUMPTIONS, NUMERICAL ESTIMATES, AND CALCULATIONS USED FOR CHARACTERIZATION OF HEALTH RISKS ASSOCIATED WITH CHEMICAL CONTAMINANTS IN PUGET SOUND SEAFOOD

Assessment Stage	Parameter	Assumptions	Numerical Estimates and Calculations: Average-case	Numerical Estimates and Calculations: High-case
Exposure Assessment	Chemical concentration[a] (ug/kg wet wt)	Adequate sample sizes, normal probability distribution	Mean[b] values	Upper 95-percent[b] confidence limits
	Exposure duration (yr)	Lifetime	70	70
	Body weight (kg)	Average adult male	70	70
	Gastrointestinal absorption coefficient	Arsenic[c]	0.01	0.01
		Other substances	1	1
	Consumption rates (g/day)	Fish	12.3	95.1
		Shellfish	1.1	21.5
		Kelp and Ulva	0.023	16.2
		Nori	0.006	4.1
Toxicity Assessment	Carcinogenic potency factor $(mg/kg/day)^{-1}$	Arsenic[d]	1.5	1.5
		PAH[e]	11.5	11.5
		PCBs[e]	4.34	4.34
		DDTs[e]	0.34	0.34
		alpha-HCH[e]	11.12	11.12
	Reference dose (mg/kg/day)	Cadmium[f]	0.0003	0.0003
		Lead[g]	0.0014	0.0014
		Mercury[h]	0.0003	0.0003
Risk characterization	Dose estimation	Single chemical[i] and medium	$D_{ij} = (C_{ij} x I_j x A_i)/B$[j]	$D_{ij} = (C_{ij} x I_j x A_i)/B$[k]
	Carcinogenic risk	Probabilistic method[l,m] based on the linearized multistage model	$R_{ij} = 1-\exp(-P_i x D_{ij})$[j]	$R_{ij} = 1-\exp(-P_i x D_{ij})$[k]
	Noncarcinogenic risk	Nonprobabilistic quotient[n] method based on comparison of RfD with estimated dose	$RI_{ij} = D_{ij}/RfD_i$	$RI_{ij} = D_{ij}/RfD_i$
	Multimedia chemical exposure	Simple additivity of risks for carcinogens	$\sum_{i=1}^{5} \sum_{j=1}^{4} R_{ij}$	$\sum_{i=1}^{5} \sum_{j=1}^{4} R_{ij}$
		Simple additivity of risks for noncarcinogens	$\sum_{i=1}^{3} \sum_{j=1}^{4} RI_{ij}$	$\sum_{i=1}^{3} \sum_{j=1}^{4} RI_{ij}$

TABLE 11. (Continued)

[a] Assumes no effect of cooking.

[b] Summarized in Table 6 and Appendix C.

[c] Assumed proportion of inorganic arsenic to total arsenic in seafood (see text).

[d] Maximum likelihood estimate based on epidemiological study of exposure via drinking water.

[e] Upper 95 percent confidence limit based on low dose extrapolation in experimental animals.

[f] Based on human and animal evidence for kidney accumulation, and an uncertainty factor of 10.

[g] Based on incremental increase in blood lead concentrations in human populations.

[h] Based on human epidemiological evidence for central nervous system disorders, and an uncertainty factor of 10.

[i] Where: D_{ij} = dose of chemical i in seafood category j (mg/kg body weight/day)
C_{ij} = concentration of chemical i in seafood category j (mg/kg seafood)
I_j = ingestion rate for seafood category j (kg seafood/day)
A_i = absorption coefficient for chemical i (unitless)
B = standard assumption for average lifetime body weight (70 kg).

[j] Average-case values used in calculation.

[k] High-case values used in calculation.

[l] Where: R_{ij} = risk associated with chemical i in seafood category j
P_i = potency factory for chemical i $(mg/kg/day)^{-1}$
D_{ij} = dose of chemical i in seafood category j (mg/kg body weight/day).

[m] Equivalent to $R_{ij} = P_i x D_{ij}$ for risks less than 10^{-2}.

[n] Where: RI_{ij} = risk index associated with chemical i in seafood category j.
RfD_i = reference dose for chemical i
D_{ij} = dose of chemical i in seafood category (mg/kg body weight/day).

TABLE 12. NONCARCINOGENIC RISK CHARACTERIZATION FOR CHEMICALS OF CONCERN IN PUGET SOUND SEAFOOD

Chemical	Reference Dose (mg/kg/day)[c]	Confidence Rating[c]	Absorption Coefficient	Seafood Category	Ingestion Rate (g/day) Average[d]	Ingestion Rate (g/day) High[d]	No. Samples	Percent Detected	Concentration (ug/kg wet wt)[a] Mean	Concentration (ug/kg wet wt)[a] SE	Concentration (ug/kg wet wt)[a] UCL[e]	Noncarcinogen Risk Index[b] Average Case[f]	Noncarcinogen Risk Index[b] High Case[g]
Cadmium	0.0003	-	1.0	Fish	12.3	95.1	142	76	5.4	0.6	6.6	$3x10^{-3}$[h]	$3x10^{-2}$
				Shellfish	1.1	21.5	118	100	219.1	16.2	251.2	$1x10^{-2}$	$3x10^{-1}$
				Kelp/Ulva	0.023	16.2	33	100	173.2	19.4	212.6	$2x10^{-4}$	$2x10^{-1}$
				Nori	0.006	4.1	7	100	213.1	48.6	332.0	$6x10^{-5}$	$6x10^{-2}$
				Cumulative Risk Index								$1x10^{-2}$[i]	$5x10^{-1}$
Lead	0.0014	-	1.0	Fish	12.3	95.1	141	50	16.3	3.0	22.1	$2x10^{-3}$	$2x10^{-2}$
				Shellfish	1.1	21.5	96	81	199.3	33.1	265.1	$2x10^{-3}$	$6x10^{-2}$
				Kelp/Ulva	0.023	16.2	33	85	338.0	135.7	614.3	$8x10^{-5}$	$1x10^{-1}$
				Nori	0.006	4.1	7	57	76.8	36.8	166.9	$5x10^{-6}$	$7x10^{-3}$
				Cumulative Risk Index								$4x10^{-3}$	$2x10^{-1}$
Mercury	0.0003	2	1.0	Fish	12.3	95.1	82	87	26.6	4.2	34.9	$2x10^{-2}$	$2x10^{-1}$
				Shellfish	1.1	21.5	93	100	22.5	1.6	25.6	$1x10^{-3}$	$3x10^{-2}$
				Kelp/Ulva	0.023	16.2	33	48	1.7	0.5	2.6	$2x10^{-6}$	$2x10^{-3}$
				Nori	0.006	4.1	7	43	1.0	0.3	1.8	$3x10^{-7}$	$4x10^{-4}$
				Cumulative Risk Index								$2x10^{-2}$	$2x10^{-1}$
				Multiple Chemical Exposure							Fish	$2x10^{-2}$[j]	$2x10^{-1}$
											Shellfish	$1x10^{-2}$	$3x10^{-1}$
											Kelp/Ulva	$3x10^{-4}$	$3x10^{-1}$
											Nori	$6x10^{-5}$	$7x10^{-2}$
											Cumulative Risk Index	$4x10^{-2}$[k]	$9x10^{-1}$

[a] Data as summarized in Table 9.

[b] Noncarcinogenic risk index = (estimated dose)/(reference dose),
where estimated dose = [concentration (mg/kg food) x ingestion rate (kg food/day) x absorption coefficient]/[body weight (70 kg)].

[c] Reference dose values (RfD) and confidence ratings from Table 6.

[d] Ingestion rate assumptions are explained in the exposure assessment and are summarized in Table 11.

[e] Upper 95 percent confidence limit (UCL) for mean concentration.

[f] Based on average ingestion rate and mean contaminant concentration.

[g] Based on high ingestion rate and UCL for mean contaminant concentration in seafood.

[h] Risk estimate for exposure to a single chemical in a single seafood category.

[i] Cumulative risk associated with exposure to a single chemical via multiple seafoods.

[j] Cumulative risk associated with multiple chemical exposure via a single seafood category.

[k] Cumulative risk associated with multiple chemical exposure via multiple seafood categories.

TABLE 13. CARCINOGENIC RISK CHARACTERIZATION FOR CHEMICALS OF CONCERN IN PUGET SOUND SEAFOOD

Chemical	Potency Factor[c] (mg/kg/day)[-1]	Weight of Evidence[c]	Absorption Coefficient	Seafood Category	Ingestion Rates (g/day) Average[d]	Ingestion Rates (g/day) High[d]	No. Samples	Percent Detected	Concentration (ug/kg wet wt)[a] Mean	Concentration (ug/kg wet wt)[a] SE	Concentration (ug/kg wet wt)[a] UCL[e]	Carcinogenic Risk[b] Probable Case[f]	Carcinogenic Risk[b] High Case[g]
Arsenic	1.5	A	0.01	Fish	12.3	95.1	147	100	3,441	354	4,141	9×10^{-6}[h]	8×10^{-5}
				Shellfish	1.1	21.5	110	100	3,252	254	3,756	8×10^{-7}	2×10^{-5}
				Kelp/Ulva	0.023	16.2	33	100	2,559	380	3,333	1×10^{-8}	1×10^{-5}
				Nori	0.006	4.1	7	100	2,279	499	3,500	3×10^{-9}	3×10^{-6}
				Cumulative Risk								1×10^{-5}[i]	1×10^{-4}
DDT, DDD, DDE	0.34	B2	1	Fish	12.3	95.1	205	40	11.15	2.24	15.57	7×10^{-7}	7×10^{-6}
				Shellfish	1.1	21.5	26	69	1.60	0.49	2.61	9×10^{-9}	3×10^{-7}
				Kelp/Ulva	0.023	16.2	33	100	4.03	0.11	4.26	5×10^{-10}	3×10^{-7}
				Nori	0.006	4.1	7	100	3.86	0.14	4.21	1×10^{-10}	8×10^{-8}
				Cumulative Risk								7×10^{-7}	8×10^{-6}
alpha-HCH	11.12	B2	1	Fish	12.3	95.1	143	3	0.60	0.09	0.78	1×10^{-6}	1×10^{-5}
				Shellfish	1.1	21.5	19	-	0.05	0.00	0.06	9×10^{-9}	2×10^{-7}
				Kelp/Ulva	0.023	16.2	33	-	0.53	0.03	0.59	2×10^{-9}	2×10^{-6}
				Nori	0.006	4.1	7	-	0.50	0.00	0.50	5×10^{-10}	3×10^{-7}
				Cumulative Risk								1×10^{-6}	1×10^{-5}
Carcinogenic PAH	11.5	B2	1	Fish	12.3	95.1	-	-	-	-		-	-
				Shellfish	1.1	21.5	32	47	61.9	25.2	113.2	1×10^{-5}	4×10^{-4}
				Kelp/Ulva	0.023	16.2	5	-	261.7	62.6	435.5	1×10^{-6}	1×10^{-3}
				Nori	0.006	4.1	-	-	-	-		-	-
				Cumulative Risk								1×10^{-5}	2×10^{-3}
PCB	7.7	B2	1	Fish	12.3	95.1	185	99	138.2	17.6	172.9	2×10^{-4}	2×10^{-3}
				Shellfish	1.1	21.5	41	83	44.7	10.2	65.5	5×10^{-6}	2×10^{-4}
				Kelp/Ulva	0.023	16.2	33	-	10.6	0.6	11.8	3×10^{-8}	2×10^{-5}
				Nori	0.006	4.1	7	-	10.0	0.0	10.0	7×10^{-9}	5×10^{-6}
				Cumulative Risk								2×10^{-4}	2×10^{-3}
				Multiple Chemical Exposure					Fish			2×10^{-4}[j]	2×10^{-3}
									Shellfish			2×10^{-5}	6×10^{-4}
									Kelp/Ulva			1×10^{-6}	1×10^{-3}
									Nori			1×10^{-8}	8×10^{-6}
									Cumulative Risk			2×10^{-4}[k]	4×10^{-3}

[a] Data as summarized in Table 9.
[b] Carcinogenic risk = 1- exp[-(potency factor)x(estimated dose)],
where estimated dose = [concentration (mg/kg food) x ingestion rate (kg food/day) x absorption coefficient]/[body weight (70 kg)].
[c] Potency factors and weight of evidence ratings from Table 6.
[d] Ingestion rate assumptions are explained in the exposure assessment and are summarized in Table 11.
[e] Upper 95 percent confidence limit (UCL) for mean concentration.
[f] Based on average ingestion rate and mean contaminant concentration.
[g] Based on high ingestion rate and UCL for mean contaminant concentration in seafood.
[h] Risk estimate for exposure to a single chemical in a single seafood category.
[i] Cumulative risk associated with exposure to a single chemical via multiple seafoods.
[j] Cumulative risk associated with multiple chemical exposure via a single seafood category.
[k] Cumulative risk associated with multiple chemical exposure via multiple seafood categories.

- Individual media and chemicals - risks associated with exposure to individual chemicals in a single seafood category

- Multiple media - cumulative risks associated with exposure to individual chemicals via all categories of seafood

- Multiple chemicals - cumulative risks associated with exposure to multiple chemicals in a single category of seafood

- Multiple chemicals and multiple media - cumulative risks associated with multiple chemicals via all categories of seafood.

As indicated above (see Overview of the Risk Assessment Process), cumulative risk estimates must be regarded as tentative because technological considerations preclude analyzing seafood samples for all potentially toxic chemicals. Additional limitations to cumulative risk estimates concern the assumption of additivity. Some substances in combination may act antagonistically (i.e., less than additive) or synergistically (i.e., greater than additive). However, the information and methods needed to predict antagonistic or synergistic interactions are not available.

Noncarcinogenic risk index values for cumulative exposure to all three chemicals via consumption of all categories of seafood ranged from 0.04 for average exposure conditions to 0.9 for high exposure conditions. Risk index values for individual noncarcinogens were typically low and ranged from less than 0.001 for all three substances (i.e., cadmium, lead and mercury) in kelp and nori to 0.3 for cadmium in shellfish.

Carcinogenic risks for cumulative exposure to arsenic and the four organic chemicals of concern ranged from $2x10^{-4}$ for average exposure conditions to $4x10^{-3}$ for high exposure conditions. These relatively high cumulative carcinogen risk levels were driven primarily by potential exposure to PCBs in fish from specific locations in Puget Sound (Commencement Bay,

Elliott Bay, Manchester, and Sinclair Inlet). PCBs in fish from these areas accounted for most of the risk, although arsenic in fish and PCB in squid from Commencement Bay were contributing factors.

It was originally hoped that estimation of risks for specific locations in Puget Sound, and comparison of risks among areas would be part of this evaluation. However, a number of uncertainties compromised our ability to compare risks among locations with any confidence. Differences in the number of samples and types of seafood categories available for each area further limited our ability to develop meaningful estimates of site specific risks that could be compared among locations. Hence, it was determined by the sponsoring agency that uncertainties associated with the database precluded a meaningful evaluation of this sort. Nevertheless, summaries of contaminant concentrations and associated health risks for various seafood categories and locations in Puget Sound are presented in Appendix C to be used only at the discretion of the reader. The risk estimates in Appendix C provide only a tentative indication of site-specific problems associated with chemically contaminated seafood. Because of disparities in species sampled and total numbers of samples from each location, the information in Appendix C should only be used to assess the amount of available site-specific information, and to determine whether additional information is needed for a comprehensive risk assessment. Additional uncertainties and limitations for risk comparisons among individual locations in Puget Sound are described below.

A major uncertainty in characterizing health risks for specific locations in Puget Sound concerns the mobility of the various organisms that comprise the categories of seafood. The various species of bivalve shellfish and macroalgae are immobile benthic-dwelling or attached organisms. Thus, contaminant concentrations and associated health risks in bivalve shellfish and macroalgae are representative of the specific locations where they were collected. However, squid and the various species of pelagic, bottom-feeding, or bottom-dwelling fishes (see Table 2) are highly mobile and often migratory. Some species of bottom-dwelling fishes (e.g., English sole) may be seasonal residents in a particular nearshore location, whereas highly

migratory pelagic species (e.g., salmon) may only be transient residents in a particular nearshore location. Thus, the degree to which contaminant concentrations in fishes are actually representative of the locations from which they were caught depends on species-specific patterns of mobility and migration.

Additional uncertainty in risk estimates for specific locations in Puget Sound concerns species-specific differences in contaminant bioaccumulation, particularly for PCBs in fishes. Bioaccumulation is the overall process of biological uptake and retention of chemical contaminants obtained from food, water, contact with sediments, or any combination of exposure pathways. Species-specific factors that affect bioaccumulation of a substance are habitat, feeding preferences, and physiological mechanisms of chemical uptake, retention, and elimination. PCB concentrations in fishes sampled at three or more locations in Puget Sound are shown in Figure 6. Although the range of PCB concentrations overlap considerably among species, sound-wide averages indicate that PCB concentrations in bottom-dwelling or bottom-feeding fishes (e.g., English sole, Pacific cod, starry flounder) are higher than those in pelagic fishes (e.g., Pacific hake, rockfish, chinook salmon). This is an important consideration for risk interpretation because the same species were not sampled at each location in Puget Sound. For example, the high cumulative carcinogenic risk estimate for Manchester is based primarily on the concentration of PCBs in the only species of fish (Pacific cod) sampled in that area. With the exception of Sinclair Inlet, concentrations of PCBs in Pacific cod from other locations in Puget Sound were generally comparable to those at Manchester (see Table D-6 in Appendix D). High risks that were attributed to PCBs concentrations in fishes from other areas were based on a wider representation of species, habitats, and trophic groups. For example, representative species of pelagic, bottom-feeding, and bottom-dwelling fishes were sampled at Commencement Bay and Elliott Bay.

In summary, potential health risks associated with noncarcinogenic substances were within acceptable levels (i.e., risk index values were less than 1) on a Puget Sound-wide basis and for individual locations within Puget

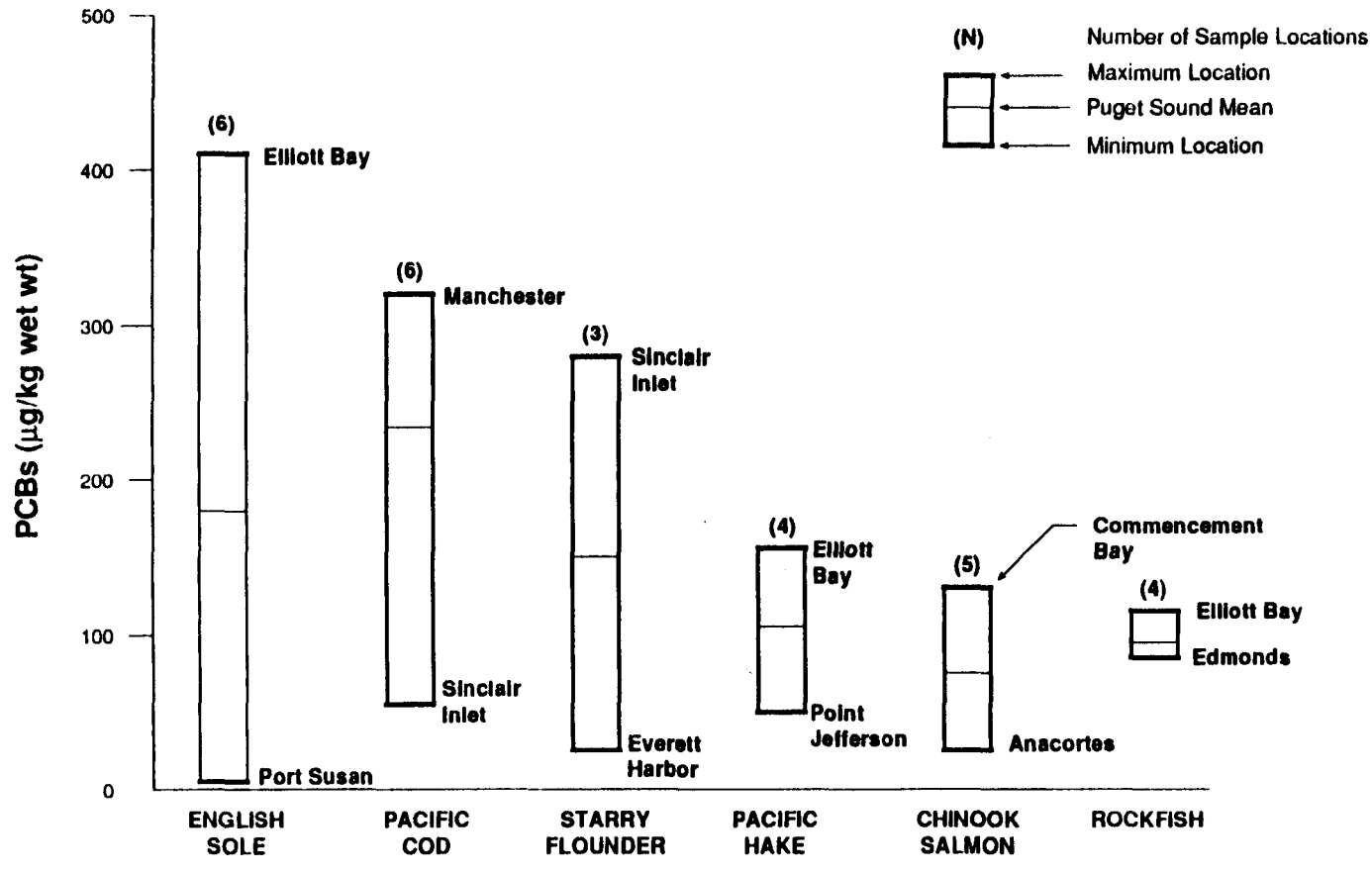


Figure 6. Range of average PCB concentrations for fishes sampled from three or more locations in Puget Sound.

Sound. However, potential health risks associated with carcinogenic substances were substantially elevated at some locations in Puget Sound, which resulted in high sound-wide risk estimates. These risk estimates are based on assumptions of average-case and high-case consumption rates for various categories of seafood. Hence, potential health risks associated with Puget Sound seafood are highly dependent on site-specific contaminant concentrations in various species and categories of seafood, and on actual consumption rates that may vary enormously among individual consumers.

COMPARISONS OF CONTAMINANT CONCENTRATIONS WITH LOCATIONS OUTSIDE OF PUGET SOUND

To place the foregoing health risk assessment into a national perspective, contaminant concentrations and associated health risks in Puget Sound biota were compared with those in biota from outside of Puget Sound. The health risk assessment indicated that risks associated with the noncarcinogenic chemicals of concern were within acceptable levels (i.e., <1). Consequently, comparisons with contaminant concentrations in biota located outside of Puget Sound were limited to the carcinogenic chemicals of concern (i.e., arsenic, carcinogenic PAH, PCB, alpha-HCH, and Σ DDT).

In developing monitoring guidance for contaminant bioaccumulation, the U.S. EPA sponsored an extensive review of available bioaccumulation data for a wide number of marine fishes and shellfish from U.S. coastal and territorial waters (Tetra Tech 1987). The review recommended 7 species of fishes and 11 species of shellfish for bioaccumulation monitoring. In general, the recommended target species consisted of large bottom-dwelling or bottom-feeding species that are:

- Widely distributed within a geographic region
- Regionally abundant
- Economically important to commercial or recreational fisheries.

Data on chemical concentrations of priority pollutants in the target species were then compiled, evaluated, and summarized from 59 reports and journal articles published between 1974 and 1985. To ensure meaningful high-quality information, only those data that were in compliance with accepted practices of sample identification, sample handling and processing, chemical analysis,

QA/QC procedures, and peer review were summarized. A total of 34 data sets were accepted for inclusion in the bioaccumulation summary. These data were compiled by study and then sorted by species, tissue, and general sampling area. The data were then classified into two general kinds of sampling areas: 1) areas near known sources of contamination, and 2) areas removed from known sources of contamination. This classification scheme indicated a general lack of substantial differences in tissue contaminant concentrations between areas near and removed from known contaminant sources, which was attributed to:

- Subjective classification of sites by the original authors or by the reviewers
- A wide range of reference conditions represented by samples collected from a broad geographic area
- Small numbers of samples
- Movement of mobile organisms.

Given these limitations, it was decided to use the entire unclassified data set presented in the appendixes of the bioaccumulation review for comparisons with the Puget Sound data used in this risk assessment. In this way comparisons could be made entirely on the basis of the range of actual contaminant concentrations, and would not be encumbered by arbitrary or subjective classification schemes.

In conclusion, although only a selected number of target species were considered in the bioaccumulation review, it was based on high quality information that is generally comparable to that used for the risk assessment of chemically contaminated seafood in Puget Sound (see Compilation and Review of Puget Sound Data). Hence, the following comparisons with locations outside of Puget Sound are based primarily on the U.S. EPA-sponsored review (Tetra Tech 1987) of bioaccumulation data in selected species that are representative of marine biota from coastal regions

throughout the U.S. The major limitation in the use of these data for comparisons with Puget Sound biota concerns the habitats in which they typically reside. Most of the target species included in the bioaccumulation review are benthic organisms, whereas the species included in this risk assessment are representative of a wide range of benthic, bottom-dwelling, bottom-feeding, or pelagic habitats.

Chemical concentration data for carcinogens of concern were available for fishes and shellfish from coastal and offshore areas ranging from Nova Scotia to Virginia on the Atlantic coast, and from Washington to Oregon on the Pacific coast. These data are representative of a range of chemical concentrations in biota from relatively clean sites (e.g., Bodega Head, CA), and from areas of known contamination (e.g., Raritan Bay, NY). Data for carcinogens of concern in macroalgae outside of Puget Sound were not available for comparison. Average concentration values for locations outside of Puget Sound are listed by seafood category, species, and location in Appendix E.

Comparisons with contaminant concentrations in Puget Sound biota are summarized in Table 14. For each chemical, overall average concentrations for all locations as well as the range of average values from various locations are summarized by seafood category (i.e., fish and shellfish). These data indicate that arsenic in Puget Sound shellfish is generally elevated in comparison with other regions. Average arsenic concentration in shellfish from Elliott Bay is approximately three times greater than the maximum observed for locations outside of Puget Sound. Arsenic concentrations in fish from locations outside of Puget Sound were not available for comparison. Average concentrations of carcinogenic PAH in Puget Sound shellfish are approximately 6 times as high as the overall average for other locations. The maximum PAH concentration in Puget Sound shellfish was found at Eagle Harbor. Only a single location (Yaquina Bay, OR) from outside Puget Sound approached this concentration (156 ug/kg, see Appendix E). Data for PAH in fish from Puget Sound were not available for comparison. However, it is reasonable to expect that PAH concentrations in fishes from Puget Sound should be less than those for shellfish. In general, PAH are more rapidly

TABLE 14. COMPARISONS OF CONCENTRATIONS (ug/kg, WET WEIGHT) OF CARCINOGENS OF CONCERN IN FISH AND SHELLFISH FROM PUGET SOUND WITH THOSE FROM LOCATIONS OUTSIDE OF PUGET SOUND

		Outside of Puget Sound[a]			Within Puget Sound[b]		
Chemical	Seafood Category	Grand Mean	Range of Means Minimum	Range of Means Maximum	Grand Mean	Range of Means Minimum	Range of Means Maximum
Arsenic	Fish	--	--	--	3,441	474	6,602[c]
	Shellfish	1,871	1,100	2,995[d]	3,252	1,820	9,667[e]
Carcinogenic PAH	Fish	2.4	1.9	2.8[f]	--	--	--
	Shellfish	11.0	0.2	156[g]	61.9	3.2	177.9[h]
PCBs	Fish	306	19.6	1,750[i]	138.2	1.8	320.3[j]
	Shellfish	73.0	0.9	886[k]	44.7	1.0	177.0[l]
alpha-HCH	Fish	--	--	--	0.60	0.05	1.36[m]
	Shellfish	1.3	0.3	8.2[n]	0.05	0.05	0.07[o]
DDT	Fish	1,624	5.8	14,846[p]	11.15	0.85	28.36[m]
	Shellfish	88	0.2	888[q]	1.60	0.15	5.61[e]

[a] Summarized from data from Appendix E.

[b] Summarized from data in Appendix C.

[c] Sinclair Inlet, WA.

[d] Mid-Atlantic coast.

[e] Elliott Bay, WA.

[f] Raritan Bay, NY.

[g] Yaquina Bay, OR.

[h] Eagle Harbor, WA.

[i] Santa Monica Bay, CA.

[j] Manchester, WA.

[k] Newport Harbor, CA.

[l] Commencement Bay, WA.

[m] Point No Point, WA.

[o] Dash Point, WA.

[p] Palos Verdes Shelf, CA.

[q] Elkhorn, CA.

metabolized, transformed, and eliminated by fishes than by shellfish. In contrast to these substances, concentrations of chlorinated carcinogens of concern (i.e., PCB, alpha-HCH, and Σ DDT) in Puget Sound fish and shellfish were less than those in locations outside of Puget Sound. These trends presumably reflect the lower use and production of these chemicals in the Puget Sound area (Matta et al. 1986).

Because most of the data available from the bioaccumulation review (Tetra Tech 1987) consist of mean or median chemical concentrations, the following risk comparisons are based on average values from the Puget Sound data. To estimate a range of potential health risks associated with carcinogens of concern in other regions, the contaminant concentration data for locations outside of Puget Sound were combined with exposure assumptions for Puget Sound (see Exposure Assessment) and risk estimates were calculated as for risks associated with Puget Sound seafood. These risk estimates for regions outside of Puget Sound were derived for comparative purposes only. Risk estimates for other regions may vary from those calculated here because of regional differences in exposure conditions (e.g., Belton et al. 1986).

Comparisons based on these estimated risk levels are summarized in Table 15 and shown graphically in Figure 7. Although mean concentrations of carcinogenic chemicals of concern in fish and shellfish from Puget Sound differed in some instances from those in fish and shellfish from other regions, these differences did not always result in substantially different risk estimates because the significance of risk levels is typically judged on a logarithmic (i.e., order-of-magnitude) scale.

For shellfish, average-case risk levels were less than or equal to 10^{-5} for all substances both within and outside of Puget sound. However, high-case risk levels for individual locations exceeded EPA's regulatory target range of 10^{-7} to 10^{-4} for PAH and PCBs both within and outside of Puget Sound. In general, both average-case and high-case risk estimates for PCBs, alpha-HCH, and Σ DDT in shellfish from Puget Sound were either comparable to or substantially (i.e., an order-of-magnitude) less than those in shellfish from outside of Puget Sound. Although risk levels associated with arsenic

TABLE 15. RISK COMPARISONS WITH LOCATIONS OUTSIDE OF PUGET SOUND BASED ON AVERAGE CONTAMINANT CONCENTRATIONS[a] IN FISH AND SHELLFISH

Chemical	Potency Factor $(mg/kg/d)^{-1}$	Absorption Coefficient	Seafood Category	Ingestion Rate (g/day) Average	Ingestion Rate (g/day) High	Carcinogenic Risk Levels[b] Outside of Puget Sound: All Areas[c]	Outside of Puget Sound: Range Minimum[c]	Outside of Puget Sound: Range Maximum[d,e]	Within Puget Sound: All Areas[c]	Within Puget Sound: Range Minimum[c]	Within Puget Sound: Range Maximum[d,e]
Arsenic	1.5	0.01	Fish	12.3	95.1	--	--	--	$9x10^{-6}$	$1x10^{-6}$	$1x10^{-4}$
			Shellfish	1.1	21.5	$4x10^{-7}$	$3x10^{-7}$	$1x10^{-5}$	$8x10^{-7}$	$4x10^{-7}$	$4x10^{-5}$
Carcinogenic PAH	11.5	1.0	Fish	12.3	95.1	$5x10^{-6}$	$4x10^{-6}$	$4x10^{-5}$	--	--	--
			Shellfish	1.1	21.5	$2x10^{-6}$	$4x10^{-8}$	$6x10^{-4}$	$1x10^{-5}$	$6x10^{-7}$	$6x10^{-4}$
PCBs	7.7	1.0	Fish	12.3	95.1	$4x10^{-4}$	$3x10^{-5}$	$2x10^{-2}$	$2x10^{-4}$	$2x10^{-6}$	$3x10^{-3}$
			Shellfish	1.1	21.5	$9x10^{-6}$	$1x10^{-7}$	$2x10^{-3}$	$5x10^{-6}$	$1x10^{-7}$	$4x10^{-4}$
alpha-HCH	11.12	1.0	Fish	12.3	95.1	--	--	--	$1x10^{-6}$	$1x10^{-7}$	$2x10^{-5}$
			Shellfish	1.1	21.5	$2x10^{-7}$	$5x10^{-8}$	$3x10^{-5}$	$9x10^{-9}$	$9x10^{-9}$	$2x10^{-7}$
DDT	0.34	1.0	Fish	12.3	95.1	$1x10^{-4}$	$3x10^{-7}$	$7x10^{-3}$	$7x10^{-7}$	$5x10^{-8}$	$1x10^{-5}$
			Shellfish	1.1	21.5	$5x10^{-7}$	$1x10^{-9}$	$9x10^{-5}$	$9x10^{-9}$	$8x10^{-10}$	$6x10^{-7}$

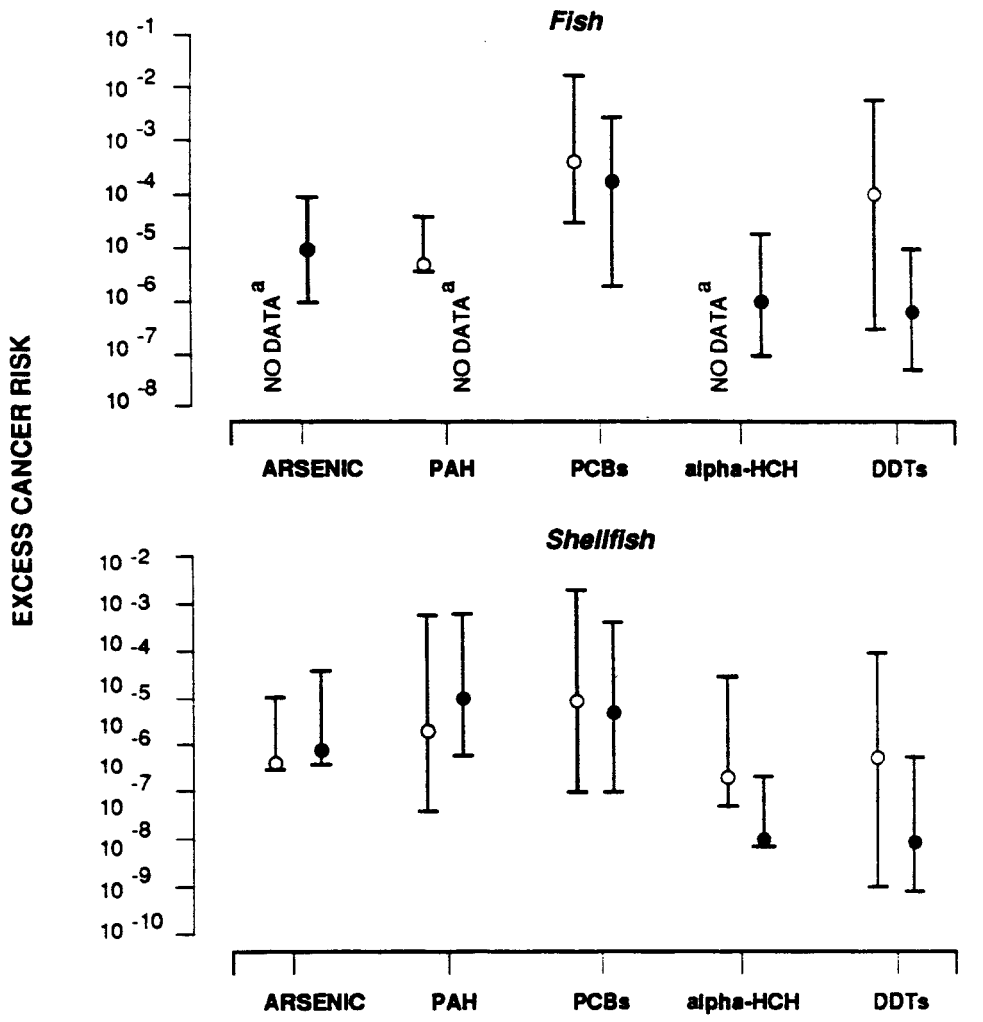
[a] Risk estimates are based on concentration data presented in Table 14.

[b] Carcinogenic risk = 1 - exp[-(potency factor)x(dose)], where:
dose = [concentration (mg/kg food) x ingestion rate (kg food/day) x absorption coefficient]/[body weight (70 kg)].

[c] Based on average ingestion rates for fish and shellfish.

[d] Based on high ingestion rates for fish and shellfish.

[e] Locations for maximum risk estimates are the same as those identified in Table 14 for maximum concentrations.



a Absence of data may be an artifact of the studies selected for the risk assessment. Data may be available from other studies.

Figure 7. Comparison of the ranges of risk estimates for carcinogenic chemicals of concern in Puget Sound fish and shellfish with those in fish and shellfish from locations outside of Puget Sound.

were within EPA's regulatory target range, average-case and high-case values for shellfish in Puget Sound were greater than those for shellfish from locations from outside of Puget Sound. For PAH in shellfish, average-case risks within Puget Sound were substantially higher than those outside Puget Sound.

For PCBs in fish, average-case and high-case risk levels exceeded EPA's regulatory target range of 10^{-7} to 10^{-4} both inside and outside of Puget Sound. Average-case risks for PCBs in fish were approximately the same ($2x10^{-4}$ vs. $4x10^{-4}$) within and outside Puget Sound. However, the high-case risk level for individual locations within Puget Sound was substantially less than that for locations outside of Puget Sound. Both average-case and high-case risk levels associated with Σ DDT in fish from Puget Sound were less than those for fish from locations outside of Puget Sound. In Puget Sound, risk levels associated with Σ DDT in fish were approximately 10^{-6} for average exposure conditions, and were approximately 10^{-5} for high exposure conditions. In contrast, risks associated with Σ DDT exposure to fish from locations outside of Puget Sound ranged from 10^{-4} for average exposure conditions to approximately 10^{-2} for high exposure conditions.

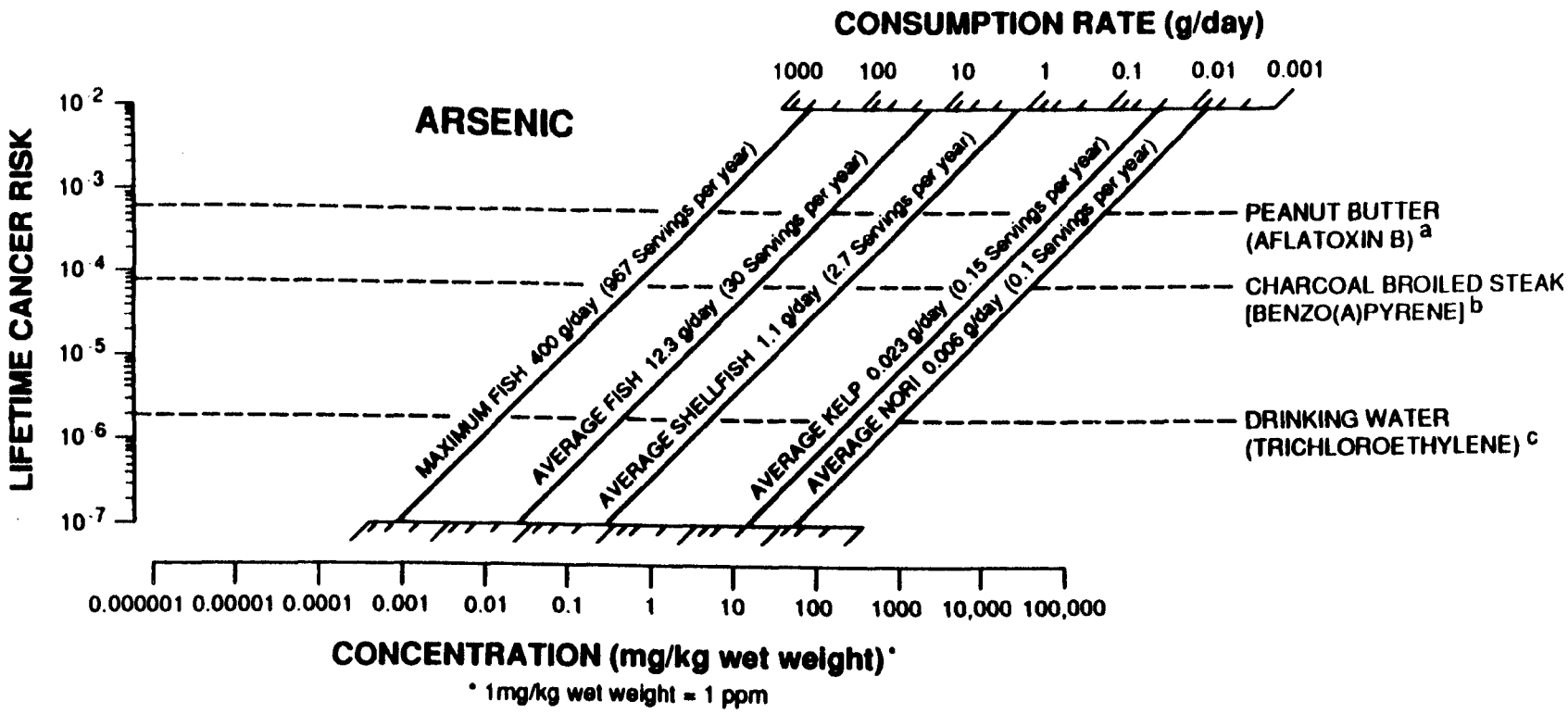
GRAPHICAL RISK CHARACTERIZATION

As indicated above (see Exposure Assessment), existing data on contaminant bioaccumulation are fragmentary for some species and locations in Puget Sound. Thus, a secondary objective of this report was to develop a tool that would give health agencies and the public a means to easily estimate potential health risks associated with chemicals in Puget Sound seafood as additional data becomes available in the future.

To characterize the range of variation in potential health risks associated with chemical contaminants in Puget Sound seafood, graphs of potential health risks were plotted as a function of a wide range of possible contaminant concentrations and consumption rates for each chemical of concern (Figures 8-15). These graphs allow estimation of potential health risks associated with chemicals of concern in Puget Sound seafood for a range of seafood types, possible consumption rates and locations. To assist in carcinogenic risk interpretation, risk levels associated with naturally occurring contaminants in food (i.e., aflatoxin B in peanut butter and PAH in charcoal broiled steaks), or anthropogenic contaminants in drinking water (i.e., trichloroethylene) are indicated by horizontal dashed lines. Additional examples of cancer risks from common carcinogens are shown in Table 16.

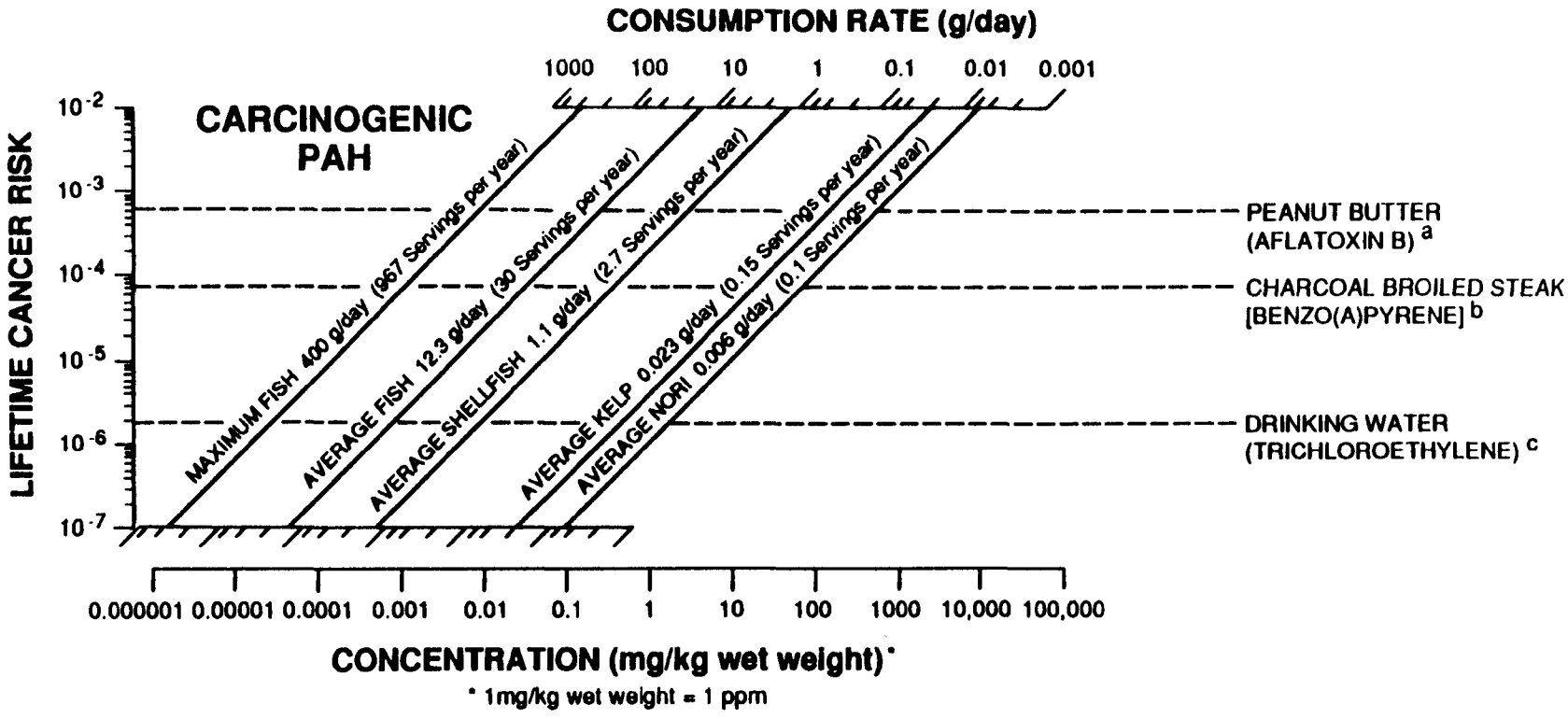
Using the methods and assumptions outlined above, potential health risks were plotted for five consumption rates (see Exposure Assessment):

- Average daily consumption of nori (0.006 g/day)
- Average daily consumption of kelp and *Ulva* (0.023 g/day)
- Average daily consumption of shellfish (1.1 g/day)



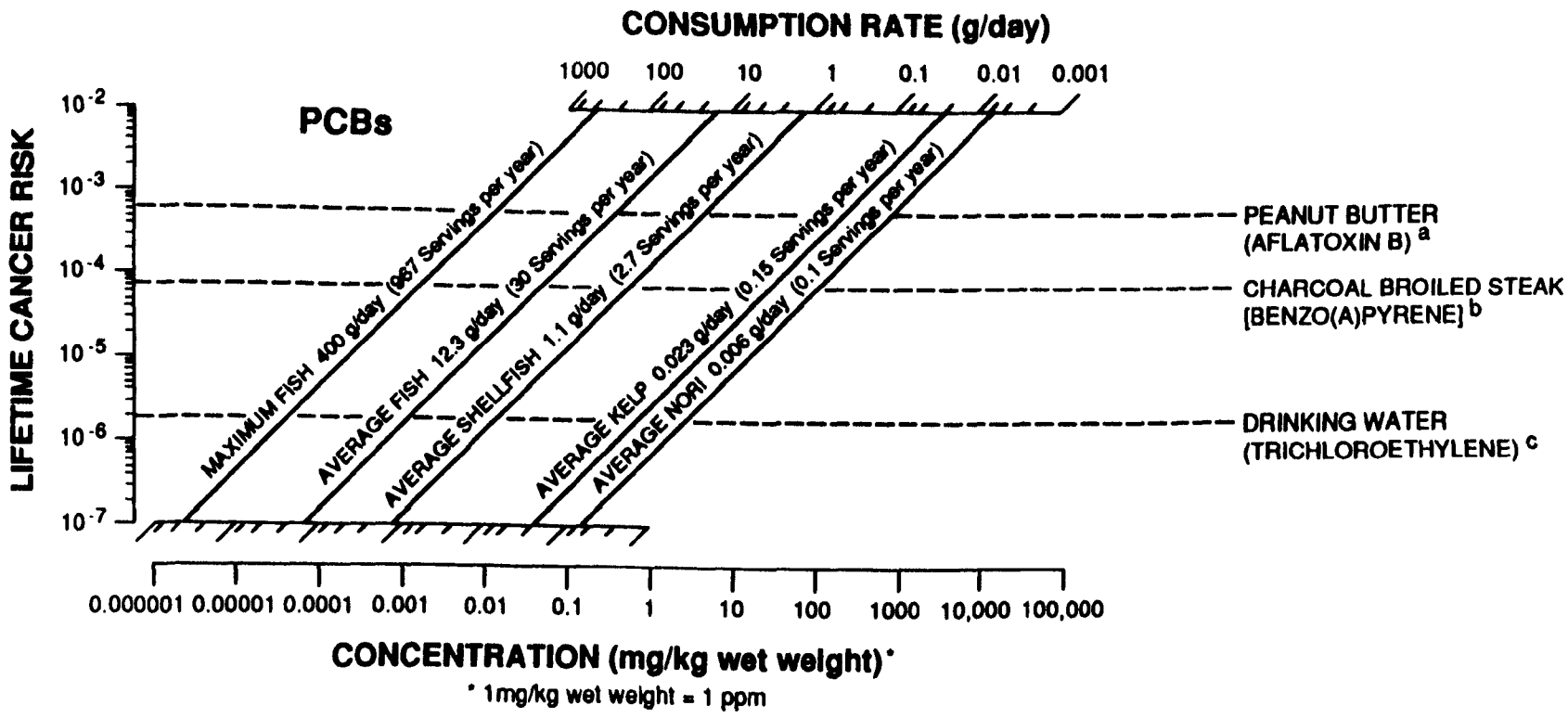
a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure 8. Graphical risk characterization for arsenic in seafood.



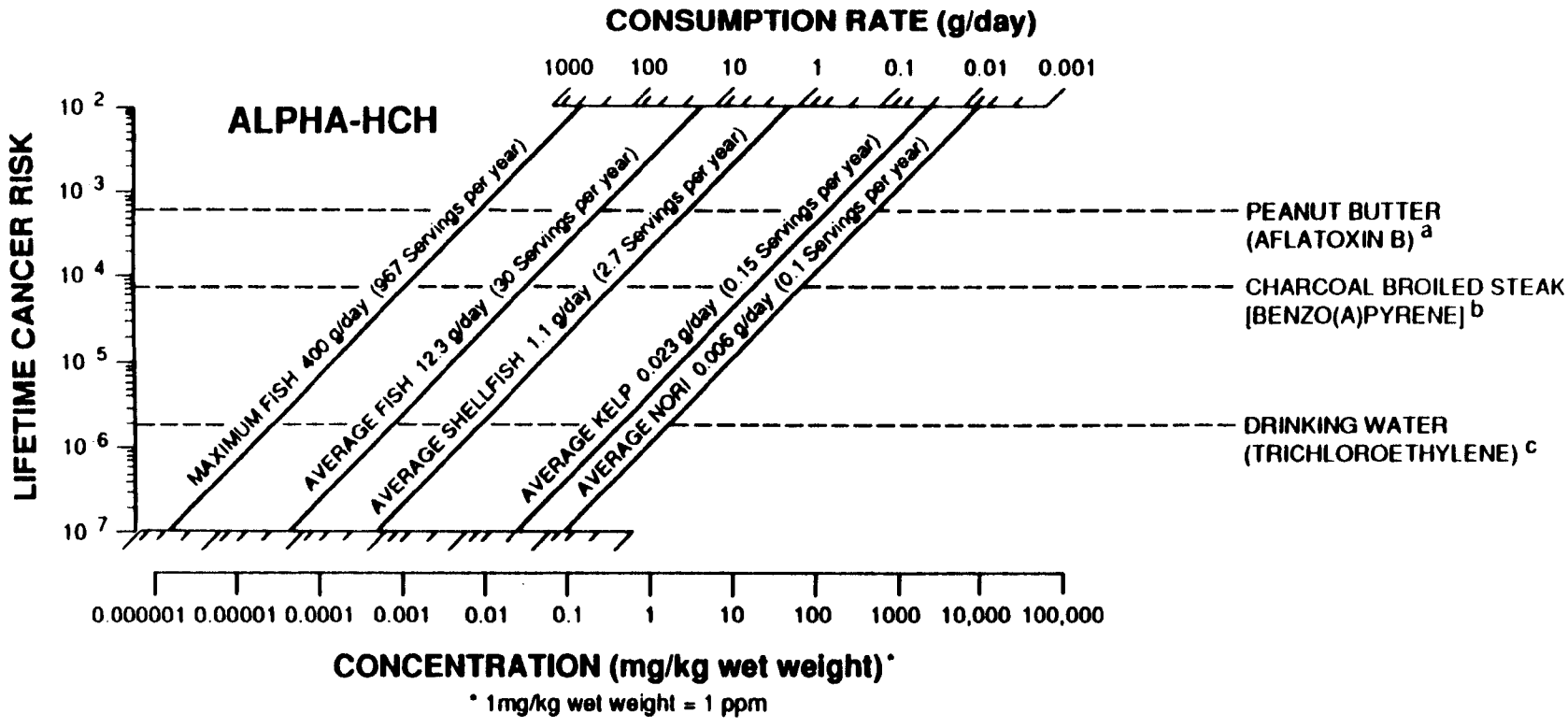
a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure 9. Graphical risk characterization for carcinogenic PAH in seafood.



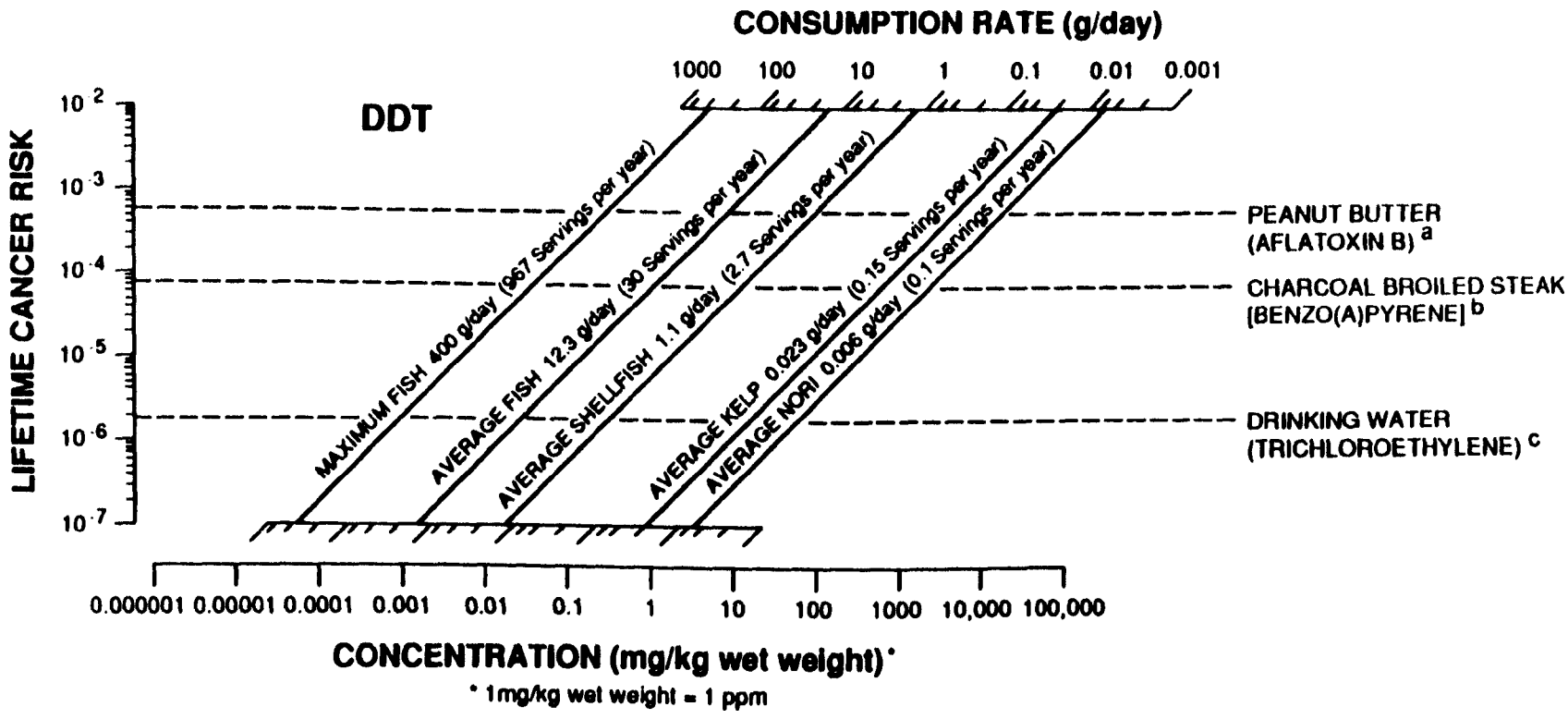
a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure 10. Graphical risk characterization for PCBs in seafood.



a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure 11. Graphical risk characterization for alpha-HCH in seafood.



a Four tablespoons per day
b 100 steaks per year
c 2 L per day at the U.S. EPA limit (0.005 mg/L)

Figure 12. Graphical risk characterization for DDT, DDD, and DDE in seafood.

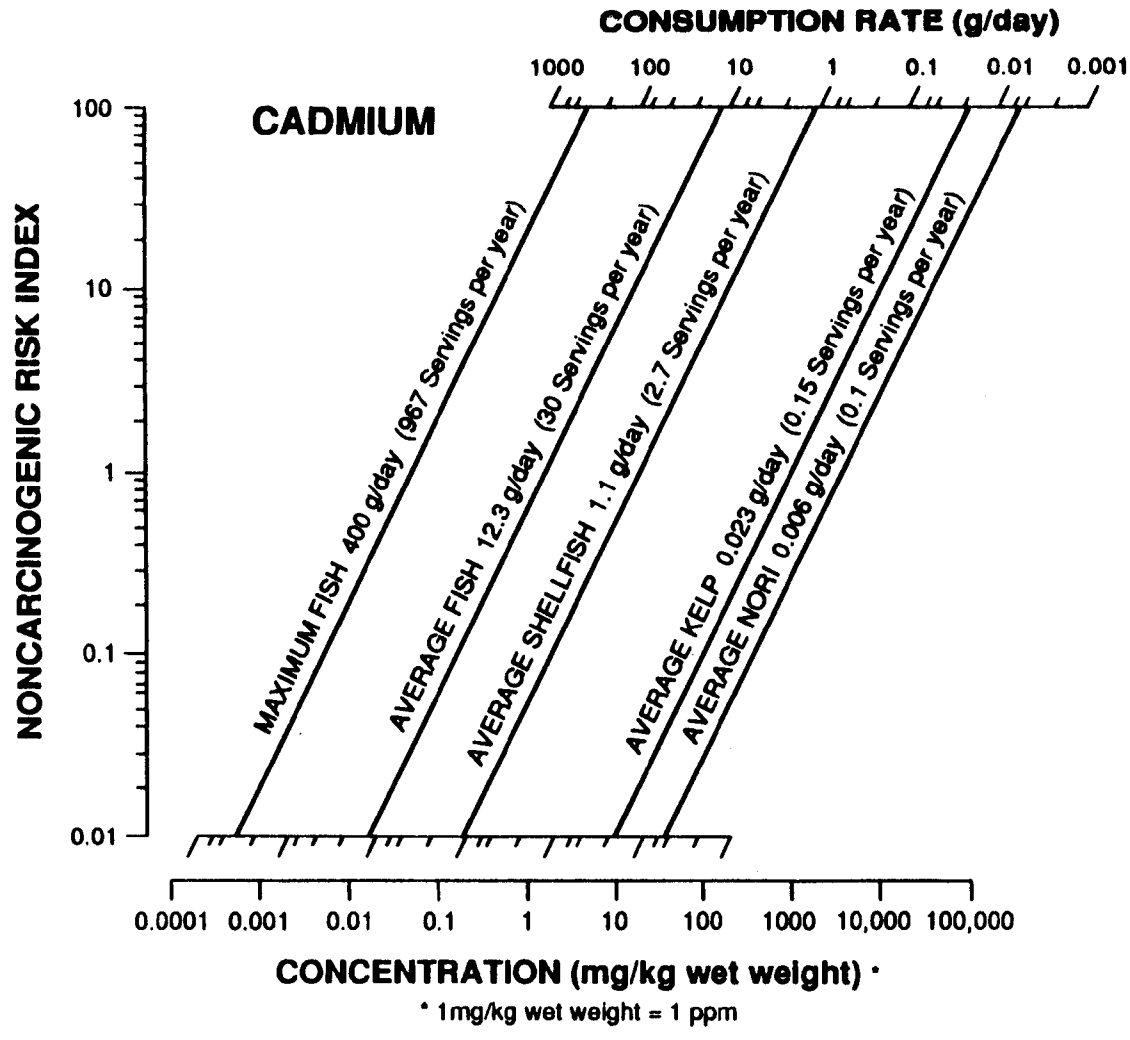


Figure 13. Graphical risk characterization for cadmium in seafood.

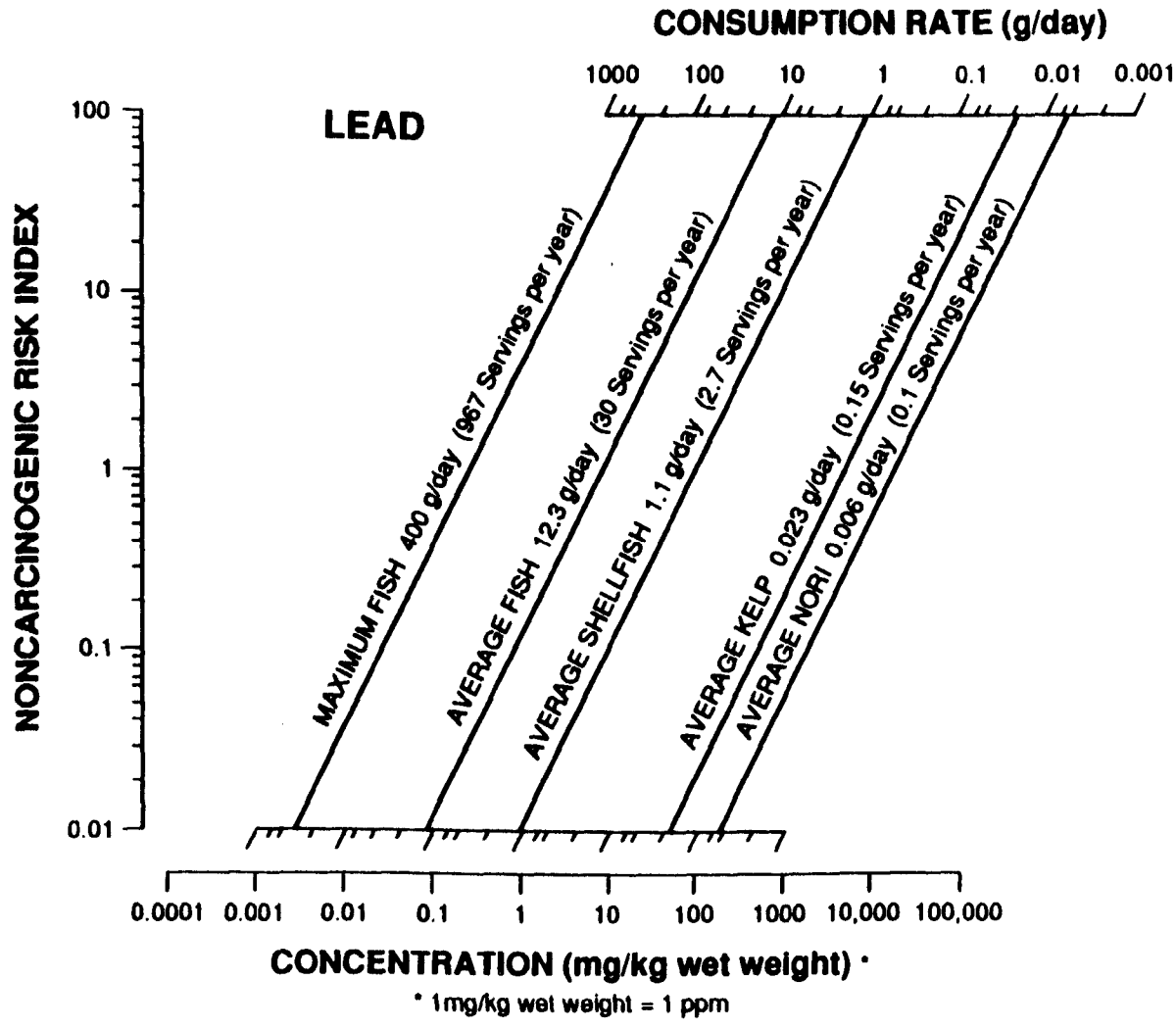


Figure 14. Graphical risk characterization for lead in seafood.

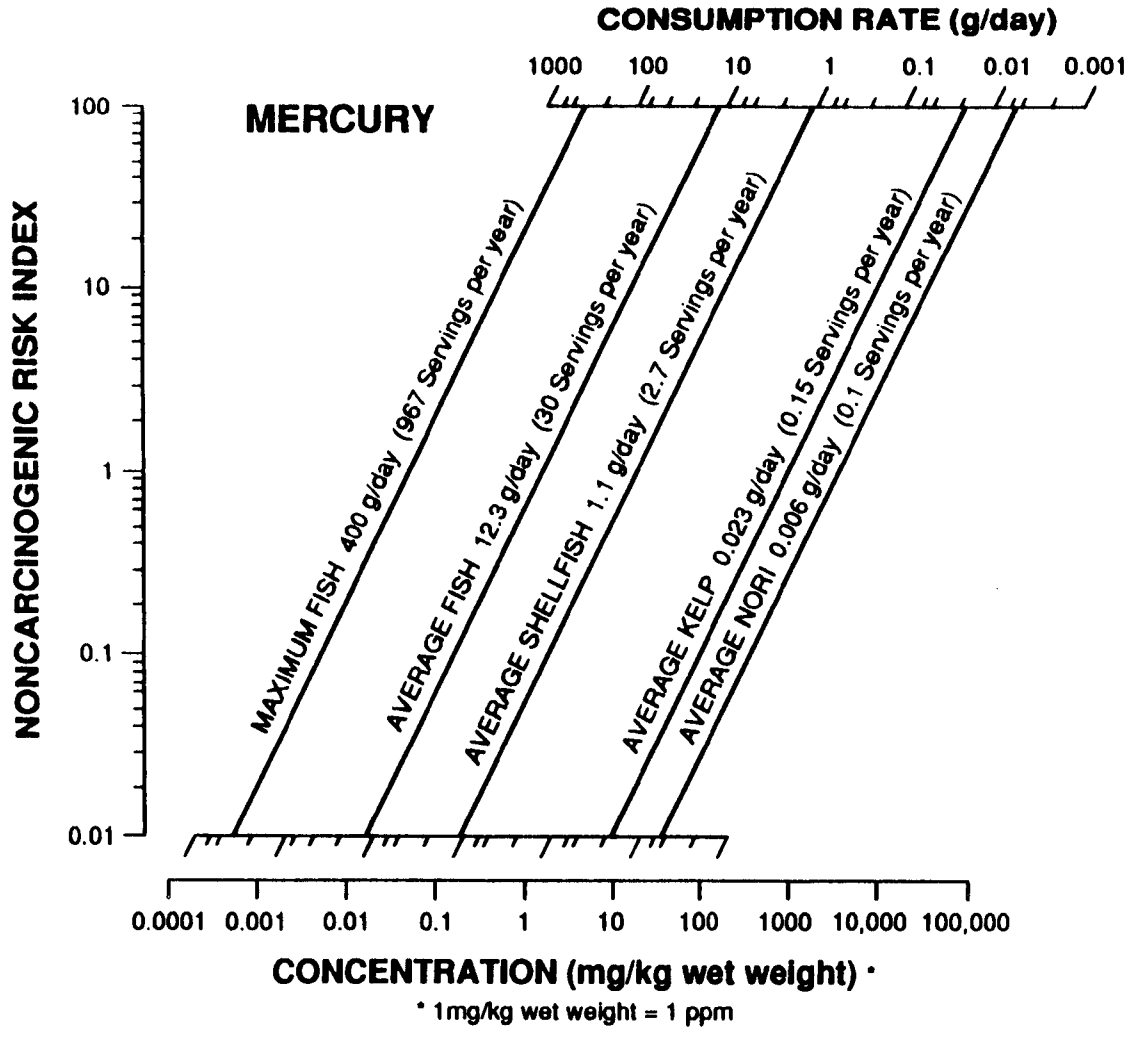


Figure 15. Graphical risk characterization for mercury in seafood.

TABLE 16. EXAMPLES OF CANCER RISKS FROM COMMON CARCINOGENS

	Average Lifetime Risk[a]	Average Annual Risk
Diet soda (saccharin) - 12.5 oz/day	$7x10^{-4}$	$1x10^{-5}$
Average saccharin consumption	$1x10^{-4}$	$2x10^{-6}$
Peanut butter (aflatoxins) - 4 tbsp/day	$6x10^{-4}$	$8x10^{-6}$
Milk (aflatoxins) - 1 pt/day	$1x10^{-4}$	$2x10^{-6}$
Miami/New Orleans drinking water - 2 L/day	$7x10^{-5}$	$1x10^{-6}$
Charcoal broiled steak (PAH) - 100/year	$7x10^{-5}$	$1x10^{-6}$
Average smoker (PAH)[b]	$8x10^{-2}$	$1.2x10^{-3}$
Person sharing room with smoker	$7x10^{-4}$	$1x10^{-5}$

[a] Average lifetime risks were calculated from average annual risks during preparation of this report assuming a lifetime of 70 yr.

[b] Risk estimate based on human data.

Reference: Crouch and Wilson (1984) and Allman (1985).

- Average daily consumption of fish (12.3 g/day)

- Maximum daily consumption of fish (400 g/day).

The lines plotted for these consumption rates are only intended as examples. A scale is provided on each graph so that health risks can be estimated for any consumption rate in the range of 0.001 to 1,000 g/day. The major tick marks on this scale are spaced at order-of-magnitude intervals (e.g., 1 g/day, 10 g/day, 100 g/day etc.). The minor tick marks are spaced at quartile intervals (e.g., 2.5 g/day, 5.0 g/day, and 7.5 g/day). This scale allows each graph to be used like a nomograph for any seafood category and consumption rate. For example, risks associated with a fish consumption rate of 95.1 g/day can be estimated by placing a straight-edged ruler parallel to the existing lines, and drawing a line that intersects the consumption rate scale between the major tick mark indicating a consumption rate of 100 g/day and the minor tick mark indicating a consumption rate of 75 g/day.

Concentrations of chemicals of concern in various categories or species of seafood are summarized in Table 9 on a sound-wide basis and in Appendices C and D for specific locations in Puget Sound. Using these or other data and the risk graphs (Figures 8-15), potential health risks associated with chemicals of concern in Puget Sound seafood may be estimated for a range of possible consumption rates and locations. For example, the average concentration of PCBs in English sole from Everett Harbor is 26 ug/kg (0.026 mg/kg) (Appendix D, Table D-6). Depending on the consumption rate selected, the estimated carcinogenic risks associated with lifetime exposure to PCBs in English sole from Everett Harbor ranges from 10^{-7} to $2x10^{-3}$ (estimated using Figure 10).

For most individuals, consumption rates expressed in units of g/day are an abstract representation of the number of servings or meals consumed annually. To provide perspective on use and interpretation of the various graphs, consumption rates for various categories of seafood were converted to numbers of servings per year using the following assumptions:

- 151 g/serving (0.333 lb/serving) for fish and shellfish
- 21.4 g/serving for nori
- 56.8 g/serving for kelp.

Servings for nori and kelp are based on portions in an average meal in Japan (Merrill, J., 8 February 1988, personal communication). The seafood consumption rates used in the Exposure Assessment section of this report were converted to numbers of servings per year as summarized in Table 17. The relationship between the number of servings per year and consumption rate is shown in Figure 16. For example, individuals that eat about 30 servings/yr of fish have a corresponding consumption rate of 12.3 g/day, which is the median estimate used in the various graphs.

TABLE 17. SUMMARY OF CONSUMPTION PATTERNS

Seafood Category	Serving Size [g (lb)]	Consumption Pattern		
		Relative Consumption	g (lb)/day	Servings/yr[b]
Fish	151.0 (0.333)	Low	1.3 (0.003)	3.1
	151.0 (0.333)	Average	12.3 (0.027)	30
	151.0 (0.333)	High	95.1 (0.209)	230
	151.0 (0.333)	Maximum	400.0 (0.882)	967
Shellfish	151.0 (0.333)	Low	0.6 (0.001)	1.5
	151.0 (0.333)	Average	1.1 (0.002)	2.7
	151.0 (0.333)	High	21.5 (0.047)	52
Kelp	56.8 (0.125)	Average	0.023 (0.00005)	0.15
	56.8 (0.125)	High	16.2 (0.036)	104
Nori	21.4 (0.047)	Average	0.006 (0.000013)	0.10
	21.4 (0.047)	High	4.1 (0.009)	70

[a] 454 g/lb.

[b] Example for calculation:

$$\text{Fish: } \frac{12.3\ \text{g}}{\text{day}} \times \frac{1\ \text{serving}}{151.0\ \text{g}} \times \frac{365\ \text{day}}{\text{yr}} = 29.2\ \text{servings/yr}$$

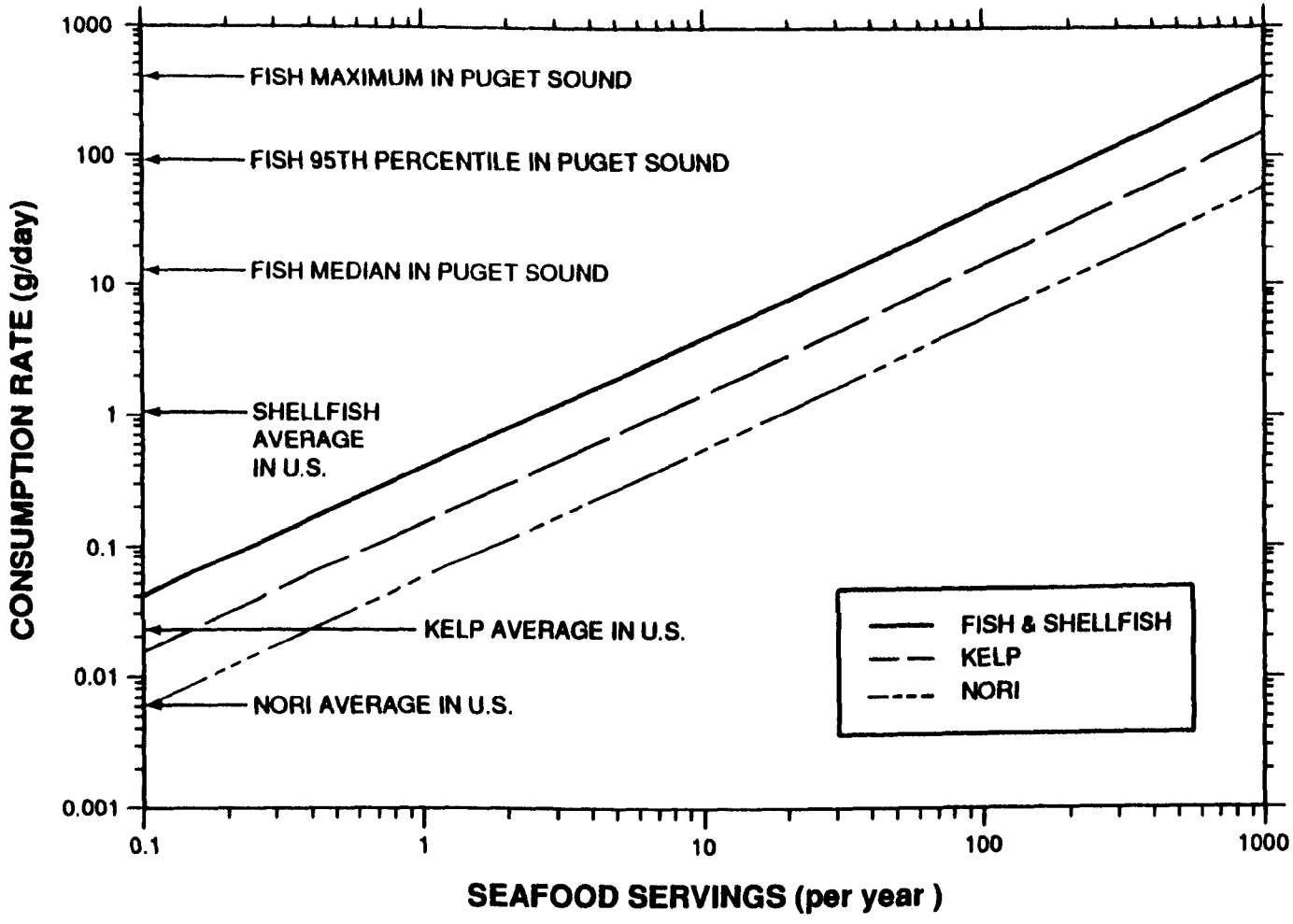


Figure 16. Consumption rate as a function of the number of servings per year of fish and shellfish, kelp and *Ulva*, and nori.

CONCLUSIONS

In summary, potential health risks associated with consumption of chemically contaminated seafood from Puget Sound are primarily attributable to PCB concentrations in fishes and the additive contributions of other substances in other categories of seafood. For consumption of seafood from Puget Sound, potential health risks, exclusive of the contribution of PCB, are within the generally acceptable range of 10^{-6} to 10^{-5}. However, with the inclusion of PCB-contaminated fish, the potential cumulative health risks associated with the consumption of chemically contaminated seafood may exceed 10^{-4} for certain locations in Puget Sound. These elevated risk levels do not imply the existence of unique or pervasive chemical contamination in Puget Sound biota, but serve to indicate that portions of Puget Sound, like other U.S. coastal areas, are subject to the legacy of past uses and management of potentially toxic chemicals. In general, PCB contamination in fish is a long-recognized, ubiquitous and persistent problem in various regions of the U.S. and in other industrialized nations (Landrigan 1980; Belton et al. 1986; Swain 1988; Friberg 1988).

Finally, it should also be recognized that the method of risk estimation used herein provides generally conservative estimates of health risk, and focuses exclusively on recreational harvesters of Puget Sound seafood who comprise a subset of the general population in the Puget Sound basin. Because of the conservative nature of U.S. EPA's risk assessment procedure, and because of limitations in the available data, the results of this effort should not be viewed as a definitive indication of potential health risks associated with consumption of Puget Sound seafoods. The intent of the report is to provide a framework for characterization of the relative hazard associated with chemical contaminants in various seafood categories in Puget Sound. Although not specifically addressed in this report, risks associated with consumption of commercially harvested Puget Sound seafood should be similar to risks associated with consumption of recreationally harvested

Puget Sound seafood, assuming similar seafood consumption patterns and seafood contamination levels. However, actual estimation of risks to the general public or to consumers of commercially harvested seafood requires information concerning background levels of chemical contamination in seafood and in alternative foods, which is beyond the scope of this investigation.

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APPENDIX A

DATA FOR 1986-1987 STUDIES OF CHEMICAL CONTAMINANTS IN SALMON, SHELLFISH, AND MACROALGAE

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APPENDIX A-1

SALMON DATA AND QA REVIEWS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10 LABORATORY
MANCHESTER, WASHINGTON 98353

REPLY TO ATTN OF M/S Lab September 24, 1987

MEMORANDUM

SUBJECT: REVIEW PUGET SOUND SALMON CONTAMINATION STUDY DATA

FROM: Joseph N. Blazevich, Region 10 Chemist
Raleigh Farlow, Region 10 QA Officer

TO: File

We have completed our review of the Puget Sound salmon contamination study data. The study was conducted during the first quarter of 1987 and includes samples numbered 87040500 - 87040556. All results are judged acceptable but the following comments should be considered by the data user.

PESTICIDES

Pesticides were analyzed using EPA Region 10 procedure for pesticides in tissue samples employing the determinative steps found in method 608.

Holding Times: All fish were held frozen for one to four months until extraction. EPA has not established holding times for fish tissue.
Blanks: All blanks are acceptable. No pesticides were detected at or above method detection limits.
Spike Results: Surrogate spike, matrix spike and duplicate matrix spikes are acceptable. Each matrix spike contains at least 12 different pesticides. A summary of the surrogate and spike recovery data is found in Table 1. Selected individual spiked recovery data is found in Table 2. No standard reference material for pesticides in fish tissue is available.

Table 1. SUMMARY - PESTICIDE SURROGATE and MATRIX SPIKE RESULTS

Parameter	Mean(%)	Std.Dev.	RSD(%)	Range
Surrogate 1	97.1	15.6	16.1	63-130
Matrix spike 1	72.1	8.6	11.7	60-90
Matrix spike 2	69.9	10.4	14.9	39-82
Matrix spike 3	85.0	33.5	39.4	38-157*
Matrix spike 4	64.7	11.9	18.4	48-97

* severe matrix interference resulted in high recoveries for p,p'-DDE.

Table 2 PERCENT RECOVERIES OF SELECTED PESTICIDES IN SPIKED TISSUES (1-5ppb)

Compound	spike 1	spike 2	spike 3	spike 4	Mean	Std.Dev.	RSD
aldrin	65	73	82	65	71	8.1	11.3
dieldrin	67	66	43	54	58	11.3	19.7
4,4'-DDT	86	77	80	65	77	8.8	11.5
4,4'-DDE	70	82	157	97	102	38.6	38.0
4,4'-DDD	90	81	72	77	80	7.6	9.5
alpha endosulfan	62	39	38	48	47	11.1	23.8
beta endosulfan	71	65	73	74	71	4.0	5.7
endosulfan sulfate	73	71	a	54	66	10.4	15.8
endrin	75	68	a	69	71	3.8	5.4
heptachlor	72	74	92	57	74	14.3	19.4
heptachlor epoxide	79	74	68	67	72	5.6	7.8
alpha BHC	60	65	123	58	77	31.1	40.7
beta BHC	69	69	116	63	79	24.7	31.1
delta BHC	79	75	76	65	74	6.1	8.2

a = not determined for this analyte.

METALS

Metals were analyzed using EPA Region 10 procedure for metals in tissue samples. This method employs the determinative steps described in EPA's "Methods for Chemical Analyses for Water and Waste Water".

Holding Times: All fish were held frozen for one to three months until digestion. EPA has not established holding times for fish tissue.

Blanks: Standard laboratory practice is to group method procedure blanks from two or more sample sets when a "true" blank sample is not available (e.g. fish tissue, soil and sediment). Procedure blanks analyzed before, during and after the salmon tissue samples were found to be acceptable and constitute a method blank for the sample set.

Spike Results: Although spike data show low recoveries for some arsenic and mercury spikes (49 to 70%), all others fall within the CLP required 75 to 125% range. This range was established for water and sediment/soil. Since EPA has not established an acceptable range for spike metal recoveries in fish and since fish tissue, particularly fatty tissue, is considered a difficult matrix, the CLP ranges for acceptance are used only as a guide. In fact, 48% of the spiked parameters fall within ±3% of the actual spiked value. Similarly, 68% fall within ±7% and 78% fall within ±15% of the actual spiked value. The metal recovery data is found in Table 3.

Table 3. PERCENT RECOVERIES OF METALS IN SELECTED SPIKED TISSUES (0.2 to 10 ppm)

Metal	Spike 1	Spike 2	Spike 3	Spike 4	Mean	Std.Dev.	RSD
chromium	102	106	102	100	102.5	2.5	2.5
zinc	92	98	113	106	102.3	9.2	9.0
nickel	100	97	96	99	98.0	1.8	1.9
copper	100	95	111	103	102.3	6.7	6.6
antimony	97	103	100	103	100.8	2.9	2.9
arsenic	120	64	66	101	87.8	27.4	31.2
cadmium	107	93	88	95	95.8	8.1	8.4
lead	82	79	88	101	87.5	9.7	11.1
mercury	49	50	54	66	54.8	7.8	14.3
silver	98	98	95	98	97.3	1.5	1.5

All average recovery results for EPA Standard Reference Material are acceptable. Recovery data for NBS Research Material "50" Albacore tuna is acceptable. Although observed zinc values are high and arsenic levels are low, they are consistent and considered acceptable for a research grade material. Recoveries for both reference materials are found in Table 4.

Table 4. EPA STANDARD REFERENCE and NBS RESEARCH MATERIAL SAMPLE RECOVERIES

Metal	Standard Range	Sample 1	Sample 2	Sample 3	Sample 4	% Diff
EPA STANDARD REFERENCE SAMPLE						
chromium	MDL-1.34	0.60	0.70	a	a	15.3
zinc	35.5-51.7	43.7	42.9	a	a	1.8
nickel	MDL-1.10	0.75	0.65	a	a	14.3
copper	0.93-3.49	3.7	2.9	a	a	24.2
arsenic	0.85-4.01	3.7	4.15	a	a	11.5
cadmium	MDL-0.32	0.165	0.145	a	a	12.9
lead	MDL-0.62	0.05u	0.05u	a	a	-
mercury	1.24-3.80	1.94	1.98	a	a	2.0
NBS RESEARCH MATERIAL "50"						
zinc	11.4-14.6	16.1	16.3	15.8	16.2	1.3*
arsenic	2.76-4.6	2.6	2.45	a	a	5.9

a = sample not analyzed for this analyte.
* = relative standard deviation rather than % difference is shown.

VOA's

Analysis of fish tissue was conducted using EPA Region 10 procedure for VOA's in tissue samples, employing heated purge and trap with GC/MS. All VOA data was collected under acceptable BFB tune.

Holding Times: All fish tissue were held frozen up to one month until VOA analysis was performed. EPA has not established holding times for fish tissue.

Blanks: All blanks are acceptable eventhough less than 1ppb of toluene and methylene chloride and 4ppb of 2-butanone were detected.

Spike Results: At least 34 different volatile compounds were added to each matrix spike. Three surrogate compounds were added to all matrix spikes, duplicate matrix spikes, samples and blanks. Individual compound recoveries with percent differences are found in Table 5. A summary of the surrogate and spike recovery data is found in Table 6.

Table 5. PERCENT RECOVERIES OF VOA's IN SELECTED SPIKED TISSUES (250ppb)

Compound	Spike 1	Spike 2	% Difference
chloromethane	110	76	36.6
bromomethane	92	120	26.4
vinyl chloride	24	87	113.5
chloroethane	140	110	24.0
methylene chloride	100	69	36.7
acetone	220	240	8.7
carbon disulfide	70	55	24.0
1,1-dichloroethene	89	68	26.8
1,1-dichloroethane	97	87	10.9
trans-1,2-dichloroethene	86	77	11.0
chloroform	88	85	3.5
1,2-dichloroethane	70	97	32.3
2-butanone	160	160	0.0
1,1,1-trichloroethane	75	76	1.3
carbon tetrachloride	66	82	21.6
vinyl acetate	74	78	5.3
bromodichloromehtane	100	100	0.0
1,2-dichloropropane	98	110	11.5
trans-1,3-dichloropropene	84	89	5.8
trichloroethene	99	93	6.3
dibromochloromethane	72	69	4.3
1,1,2-trichloroethane	91	94	3.2
benzene	110	110	0.0
cis-1,3-dichloropropene	84	89	5.8
bromoform	63	60	4.9
2-hexanone	120	140	15.4
4-methyl-2-pentanone	120	110	8.7
tetrachloroethene	90	92	2.2
1,1,2,2-tetrachloroethane	64	57	11.6
toluene	95	90	5.4
chlorobenzene	92	84	6.8
ethylbenzene	90	93	3.3
styrene	84	74	12.7

Table 6. SUMMARY - VOA SURROGATE and MATRIX SPIKE RESULTS

Parameter	Mean (%)	Std.Dev	RSD(%)	Range
Surrogate 1	98.0	23.5	24.0	78-136
Surrogate 2	102.8	5.6	5.5	97-112
Surrogate 3	74.0	13.8	18.6	63-97
Matrix spike 1	93.8	32.7	34.8	24-220*
Matrix spike 2	94.1	33.9	36.0	60-240*

* severe matrix interference resulted in high recoveries of acetone and 2-butanone.

All surrogate recoveries fall within CLP required ranges. Although the ranges were established for water and sediment/soil, they may be used as a guide for tissue samples, a more complex matrix. Also, matrix spike results are considered acceptable.

BASE-NEUTRAL/ACIDS

Analysis of fish tissue was conducted using EPA Region 10 BN/A tissue procedure. The method employs acetone extraction with a polytron blender. After extract concentration, the total is added to acidic water and extracted with methylene chloride. Following clean-up of the resulting water extract with GPC, MW 2000 and MW 400, analysis is performed by GC/MS. All BN/A data was collected under acceptable DFTPP tune.

Holding Times: All fish tissue were held frozen for one to three months until extraction. EPA has not established holding times for fish tissue.

Blanks: All blanks were acceptable. Although bis(2-ethylhexyl) phthalate (<110ppb), dioctyl phthalate (<560ppb), butylbenzyl phthalate (<10ppb) and a trace of PCP (<25ppb) were found in the blanks, only dioctyl phthalate was detected in the samples.

Spike Results: Recovery accuracy and precision data are found in Tables 7, 8 and 9. Results cover 51 compounds spiked at three levels (80, 160 and 800 ppb). The results presented in Tables 7, 8, and 9 represent four analyses at each spiking level for a total of twelve matrix spikes. All spiked compounds were found to be recovered within acceptable ranges except for PCP, which was consistently high. Estimated method detection limits (MDL) for base-neutral/acid compounds fall between 70 and 100 ppb. MDL's represent real sample detection limits, not projected or calculated values. Of course, MDL's will change when dilution, amount of fish extracted, etc. change for each sample.

All surrogate results fall within CLP required ranges. The ranges were established for water and sediment/soil and are used only as a guide for tissue analyses. A summary of the surrogate spike recovery data for the fish tissue samples is found in Table 10. Matrix spike and surrogate recoveries are acceptable.

Table 7

Fish Spike Data (80ppb)	Mean %	Std. Dev.	RSD %
Compound			
1,2,4-TRICHLOROBENZENE	74.19	6.72	9.1%
1,2-DICHLOROBENZENE	58.11	14.16	24.4%
1,3-DICHLOROBENZENE	42.09	7.70	18.3%
1,4-DICHLOROBENZENE	51.74	11.66	22.5%
2,4,5-TRICHLOROPHENOL	79.22	18.03	22.8%
2,4,6-TRICHLOROPHENOL	139.84	20.56	14.7%
2,4-DICHLOROPHENOL	90.53	4.94	5.5%
2,4-DIMETHYLPHENOL	129.41	36.63	28.3%
2,4-DINITROTOLUENE	70.09	18.36	26.2%
2,6-DINITROTOLUENE	73.00	11.92	16.3%
2-CHLORONAPHTHALENE	89.92	5.92	6.6%
2-CHLOROPHENOL	72.77	27.84	38.3%
2-METHYLNAPHTHALENE	85.47	5.72	6.7%
2-METHYLPHENOL	110.81	14.81	13.4%
2-NITROPHENOL	66.97	3.99	6.0%
4,6-DINITRO-2-METHYLPHEN	33.88		
4-BROMOPHENYL-PHENYLETHE	105.91	27.99	26.4%
4-CHLOROPHENYL-PHENYLETH	102.16	16.24	15.9%
4-CHLORO-3-METHYLPHENOL	82.31	12.95	15.7%
4-METHYLPHENOL	139.00	37.12	26.7%
ACENAPHTHENE	103.16	8.70	8.4%
ACENAPHTHYLENE	99.50	5.01	5.0%
ANTHRACENE	79.03	24.55	31.1%
BENZO(A)ANTHRACENE	114.88	12.47	10.9%
BENZO(A)PYRENE	103.00	12.47	12.1%
BENZO(B)FLUORANTHENE	106.75	7.08	6.6%
BENZO(G,H,I)PERYLENE	83.91	7.24	8.6%
BENZO(K)FLUORANTHENE	106.75	7.08	6.6%
BIS(2-CHLOROETHOXY)METHA	88.31	6.21	7.0%
BIS(2-CHLOROETHYL)ETHER	67.34	16.81	25.0%
BIS(2-CHLOROISOPROPYL)ET	68.94	11.47	16.6%
BUTYLBENZYLPHTHALATE	156.67	41.27	26.3%
CHRYSENE	89.16	13.37	15.0%
DIBENZOFURAN	94.41	8.91	9.4%
DIBENZ(A,H)ANTHRACENE	83.38	12.85	15.4%
DIETHYLPHTHALATE	115.91	20.79	17.9%
DIMETHYL PHTHALATE	109.84	9.75	8.9%
FLUORANTHENE	88.06	14.38	16.3%
FLUORENE	101.50	7.28	7.2%
HEXACHLOROBENZENE	106.91	19.85	18.6%
HEXACHLOROBUTADIENE	71.06	6.84	9.6%
HEXACHLOROETHANE	44.19	18.69	42.3%
INDENO(1,2,3-CD)PYRENE	81.47	11.43	14.0%
ISOPHORONE	147.91	61.27	41.4%
NAPHTHALENE	81.44	7.19	8.8%
NITROBENZENE	94.89	41.15	43.4%
N-NITROSO-DI-N-PROPYLAMI	70.34	9.66	13.7%
PENTACHLOROPHENOL	214.13	64.40	30.1%
PHENANTHRENE	140.50	21.85	15.6%
PHENOL	89.50	24.06	26.9%
PYRENE	111.88	13.78	12.3%
Ave	94.35	17.02	17.5%
Min	33.88	3.99	5.0%
Max	214.13	64.40	43.4%

Table 8

Fish Spike Data (160ppb) Compound	Mean %	Std. Dev.	RSD %
1,2,4-TRICHLOROBENZENE	61.56	13.09	21.3%
1,2-DICHLOROBENZENE	41.13	14.96	36.4%
1,3-DICHLOROBENZENE	31.85	17.26	54.2%
1,4-DICHLOROBENZENE	35.58	16.26	45.7%
2,4,5-TRICHLOROPHENOL	108.56	33.73	31.1%
2,4,6-TRICHLOROPHENOL	126.00	7.50	6.0%
2,4-DICHLOROPHENOL	86.63	7.35	8.5%
2,4-DIMETHYLPHENOL	104.06	22.11	21.2%
2,4-DINITROTOLUENE	65.38	22.42	34.3%
2,6-DINITROTOLUENE	75.25	10.37	13.8%
2-CHLORONAPHTHALENE	79.56	6.03	7.6%
2-CHLOROPHENOL	71.50	11.88	16.6%
2-METHYLNAPHTHALENE	80.63	9.96	12.4%
2-METHYLPHENOL	111.88	35.13	31.4%
2-NITROPHENOL	56.88	7.17	12.6%
4,6-DINITRO-2-METHYLPHEN	37.30	14.95	40.1%
4-BROMOPHENYL-PHENYLETHE	80.69	10.97	13.6%
4-CHLOROPHENYL-PHENYLETH	90.44	4.80	5.3%
4-CHLORO-3-METHYLPHENOL	126.19	66.19	52.5%
4-METHYLPHENOL	117.25	37.74	32.2%
ACENAPHTHENE	88.88	4.32	4.9%
ACENAPHTHYLENE	92.06	2.48	2.7%
ANTHRACENE	84.49	40.05	47.4%
BENZO(A)ANTHRACENE	110.44	10.46	9.5%
BENZO(A)PYRENE	92.75	4.61	5.0%
BENZO(B)FLUORANTHENE	93.19	7.30	7.8%
BENZO(G,H,I)PERYLENE	90.94	20.33	22.4%
BENZO(K)FLUORANTHENE	93.92	8.44	9.0%
BIS(2-CHLOROETHOXY)METHA	74.13	7.10	9.6%
BIS(2-CHLOROETHYL)ETHER	51.56	9.01	17.5%
BIS(2-CHLOROISOPROPYL)ET	48.18	15.99	33.2%
BUTYLBENZYLPHTHALATE	109.42	21.64	19.8%
CHRYSENE	88.25	14.99	17.0%
DIBENZOFURAN	88.58	3.40	3.8%
DIBENZ(A,H)ANTHRACENE	98.63	19.99	20.3%
DIETHYLPHTHALATE	105.88	9.83	9.3%
DIMETHYL PHTHALATE	101.94	5.39	5.3%
FLUORANTHENE	101.75	35.08	34.5%
FLUORENE	95.88	6.11	6.4%
HEXACHLOROBENZENE	96.44	11.10	11.5%
HEXACHLOROBUTADIENE	54.98	15.80	28.7%
HEXACHLOROETHANE	30.25	14.32	47.3%
INDENO(1,2,3-CD)PYRENE	93.44	19.14	20.5%
ISOPHORONE	71.94	6.55	9.1%
NAPHTHALENE	69.69	12.61	18.1%
NITROBENZENE	89.25	15.10	16.9%
N-NITROSO-DI-N-PROPYLAMI	61.56	5.58	9.1%
PENTACHLOROPHENOL	172.50	27.00	15.7%
PHENANTHRENE	88.19	27.61	31.3%
PHENOL	76.31	23.49	30.8%
PYRENE	94.06	18.59	19.8%
Ave	84.27	15.95	20.4%
Min	30.25	2.48	2.7%
Max	172.50	66.19	54.2%

Table 9

Fish Spike Data (800ppb) Compound	Mean %	Std. Dev.	RSD %
1,2,4-TRICHLOROBENZENE	63.75	4.15	6.5%
1,2-DICHLOROBENZENE	36.00	2.35	6.5%
1,3-DICHLOROBENZENE	24.25	2.17	8.9%
1,4-DICHLOROBENZENE	27.75	2.28	8.2%
2,4,5-TRICHLOROPHENOL	88.75	21.28	24.0%
2,4,6-TRICHLOROPHENOL	100.00	15.67	15.7%
2,4-DICHLOROPHENOL	82.50	7.89	9.6%
2,4-DIMETHYLPHENOL	60.00	35.80	59.7%
2,4-DINITROTOLUENE	76.75	5.54	7.2%
2,6-DINITROTOLUENE	80.50	9.86	12.3%
2-CHLORONAPHTHALENE	81.25	8.70	10.7%
2-CHLOROPHENOL	73.50	6.54	8.9%
2-METHYLNAPHTHALENE	81.50	7.92	9.7%
2-METHYLPHENOL	78.75	19.56	24.8%
2-NITROPHENOL	66.00	7.55	11.4%
4,6-DINITRO-2-METHYLPHEN	62.25	11.71	18.8%
4-BROMOPHENYL-PHENYLETHE	85.50	5.94	6.9%
4-CHLOROPHENYL-PHENYLETH	91.00	5.79	6.4%
4-CHLORO-3-METHYLPHENOL	96.50	12.34	12.8%
4-METHYLPHENOL	95.25	6.53	6.9%
ACENAPHTHENE	82.25	8.50	10.3%
ACENAPHTHYLENE	90.25	14.10	15.6%
ANTHRACENE	72.25	22.25	30.8%
BENZO(A)ANTHRACENE	103.25	5.63	5.5%
BENZO(A)PYRENE	86.75	10.16	11.7%
BENZO(B)FLUORANTHENE	92.75	13.37	14.4%
BENZO(G,H,I)PERYLENE	72.75	16.84	23.2%
BENZO(K)FLUORANTHENE	92.50	12.97	14.0%
BIS(2-CHLOROETHOXY)METHA	67.75	9.91	14.6%
BIS(2-CHLOROETHYL)ETHER	45.75	4.49	9.8%
BIS(2-CHLOROISOPROPYL)ET	48.75	10.03	20.6%
BUTYLBENZYLPHTHALATE	92.25	42.63	46.2%
CHRYSENE	90.75	13.55	14.9%
DIBENZOFURAN	86.75	7.66	8.8%
DIBENZ(A,H)ANTHRACENE	77.75	13.05	16.8%
DIETHYLPHTHALATE	94.25	6.22	6.6%
DIMETHYL PHTHALATE	91.50	1.50	1.6%
FLUORANTHENE	92.75	8.64	9.3%
FLUORENE	91.00	9.25	10.2%
HEXACHLOROBENZENE	92.25	10.03	10.9%
HEXACHLOROBUTADIENE	51.00	5.79	11.3%
HEXACHLOROETHANE	22.50	2.50	11.1%
INDENO(1,2,3-CD)PYRENE	78.25	12.97	16.6%
ISOPHORONE	65.25	10.57	16.2%
NAPHTHALENE	66.50	6.87	10.3%
NITROBENZENE	55.25	7.33	13.6%
N-NITROSO-DI-N-PROPYLAMI	58.75	6.76	11.5%
PENTACHLOROPHENOL	160.00	37.42	23.4%
PHENANTHRENE	93.50	5.72	6.1%
PHENOL	71.00	12.14	17.1%
PYRENE	93.00	13.36	14.4%
Ave	77.08	11.02	14.2%
Min	22.50	1.50	1.6%
Max	160.00	42.63	59.7%

Table 10. SUMMARY - BASE-NEUTRAL/ACIDS SURROGATE RESULTS

Parameter	Mean (%)	Std.Dev.	RSD(%)	Range
Acid surrogate 1	48	16	33	32-66
Acid surrogate 2	47	14	30	28-59
B/N surrogate 1	58	3.9	6.8	54-63
B/N surrogate 2	85	8.1	9.5	76-95
B/N surrogate 3	92	4.9	5.3	88-97
B/N surrogate 4	103	4.0	3.9	99-106

TETRA TECH, INC.
A HONEYWELL SUBSIDIARY
1420 NORTHUP WY. STE. 100
BELLEVUE, WA 98005-1927
TELEPHONE (206) 822-9596

INTEROFFICE MEMO

TO Project File, TC-3338-28, QA/QC DATE 12/23/87

FROM Lynne Kilpatrick-Howard

SUBJECT QA/QC Review of the Puget Sound Salmon Contamination Study Data and Report Generated by Joseph N. Blazevich, U.S. EPA Region X

My review of the Puget Sound Salmon Contamination Study data and the memorandum generated by Joseph N. Blazevich and Raleigh Farlow of U.S. Environmental Protection Agency (EPA) Region X has been completed. Unless noted otherwise, the results are judged acceptable and comments noted by the U.S. EPA reviewer are appropriate.

The following database qualifiers were assigned to the Puget Sound salmon data submitted:

U = Undetected
J = Estimated value for one of the following reasons: compound verified but not quantified because value exceeded the five-point calibration curve, compound is tentatively identified, response factor may be low, or the standard was not within the allowed 25 percent response factor difference
M = Compound verified below quantification limit
B = Compound detected in associated blank
NAR = No analysis results
NAI = Not analyzed because of interference.

HOLDING TIME OF PESTICIDES IN TISSUE

The reviewer noted that "all fish were held frozen for one to four months until extraction. U.S. EPA has not established holding times for fish tissue." The Puget Sound Estuary Program (PSEP) (Tetra Tech 1986)

recommends a maximum holding time for frozen tissue samples of 6 mo. Therefore, the 1- to 4-mo actual holding time for the samples is within PSEP guidelines.

HOLDING TIME OF METALS IN TISSUE

The U.S. EPA reviewer noted that "all fish were held for one to three months until digestion," and that "EPA has not established holding times for fish tissue." PSEP recommends a maximum holding time for frozen fish samples of 6 mo for all metals except mercury, which has a recommended holding time of 28 days. Because precise holding times were not provided, it was not possible to determine whether the PSEP holding time guideline for mercury was exceeded.

COMPOUNDS DETECTED IN BLANKS

The U.S. EPA reviewer noted that toluene and methylene chloride were detected in the blanks at concentrations <1 ppb, 2-butanone was detected at 4 ppb, and dioctylphthalate was present at <560 ppb. Based on the available data, it is not likely that the sample results have been corrected for the above blank contributions.

REFERENCES

Tetra Tech. 1986. Recommended protocols for measuring selected environmental variables in Puget Sound. Final Report. Prepared for Puget Sound Estuary Program. Tetra Tech, Inc., Bellevue, WA.

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTS Account: AMLB2F

Sample No: 87 040500 Begin Sample Date: 87/01/19 16:00 Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: ANACORTES

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.64	mg/kg-wt
Nickel	Ni-Tiss	0.07	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.043	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	1.25	mg/kg-wt
Zinc	Zn-Tiss	3.5	mg/kg-wt
Chromium	Cr-Tiss	0.01	mg/kg-wt
Cadmium	Cd-Tiss	0.002U	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.24	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	9	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	NAR	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	24	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Sample No: 87 040501 Begin Sample Date: 87/01/20 11:30 Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: ANACORTES

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.39	mg/kg-wt
Nickel	Ni-Tiss	0.12	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.026	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	1.04	mg/kg-wt
Zinc	Zn-Tiss	3.7	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.002U	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.073	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	4	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1M	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	96%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	16	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A

Officer: DTE Account: AMLB2F

Sample No: 87 040510 Begin Sample Date: 87/01/17 09:30 Source: Fish Tissue

Depth: QA Code:

Laboratory: RX Description: EVERETT HARBOR, FIN TAG 10562

Comment: B/N/A DETECTION LIMITS ARE ESTIMATED

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.93	mg/kg-wt
Nickel	Ni-Tiss	0.38	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.035	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.58	mg/kg-wt
Zinc	Zn-Tiss	3.4	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.004	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.082	Percent

VOA - PP Scan (GCMS) Parameter	Tissue Result	Units
Carbon Tetrachloride	27U	ug/kg
Acetone	49J	ug/kg
Chloroform	27U	ug/kg
Benzene	27U	ug/kg
1,1,1-Trichloroethane	27U	ug/kg
Bromomethane	54U	ug/kg
Chloromethane	54U	ug/kg
Chloroethane	54U	ug/kg
Vinyl Chloride	54U	ug/kg
Methylene Chloride	14UJ	ug/kg
Carbon Disulfide	27U	ug/kg
Bromoform	27U	ug/kg
Bromodichloromethane	27U	ug/kg
1,1-Dichloroethane	27U	ug/kg
1,1-Dichloroethene	27U	ug/kg
1,2-Dichloropropane	27U	ug/kg
2-Butanone	54U	ug/kg
1,1,2-Trichloroethane	27U	ug/kg
Trichloroethene	27U	ug/kg
1,1,2,2-Tetrachloroetha	54U	ug/kg
Total Xylenes	27U	ug/kg
Ethylbenzene	27U	ug/kg
Styrene	27U	ug/kg
1,2-Dichloroethane	27U	ug/kg

VOA - PP Scan (GCMS) *** Continued *** Parameter	Tissue Result	Units
Vinyl Acetate	54U	ug/kg
4-Methyl-2-Pentanone	54U	ug/kg
Toluene	1.4BJ	ug/kg
Chlorobenzene	27U	ug/kg
2-Chloroethylvinylether	54U	ug/kg
Dibromochloromethane	27U	ug/kg
Tetrachloroethene	27U	ug/kg
trans-1,2-Dichloroethen	27U	ug/kg
2-Hexanone	54U	ug/kg
Spike D4-1,2-Dichloroet	78%	ug/kg
Spike 1,4-Bromofluorobe	97%	ug/kg
Spike D8-Toluene	112%	ug/kg
cis-1,3-Dichloropropene	27U	ug/kg
trans-1,3-Dichloroprope	27U	ug/kg

B/N Extract Scan Parameter	Tissue Result	Units
Benzo(a)pyrene	190UJ	ug/kg
Dibenzo(a,h)anthracene	190UJ	ug/kg
Benzo(a)anthracene	190UJ	ug/kg
Hexachloroethane	190UJ	ug/kg
Hexachlorocyclopentadie	190UJ	ug/kg
Isophorone	190UJ	ug/kg
Acenaphthene	190UJ	ug/kg
Diethylphthalate	17JB	ug/kg
Di-n-Butylphthalate	190UJ	ug/kg
Phenanthrene	190UJ	ug/kg
Butylbenzylphthalate	190UJ	ug/kg
N-Nitrosodiphenylamine	190UJ	ug/kg
Fluorene	190UJ	ug/kg
Hexachlorobutadiene	190UJ	ug/kg
2-Nitroaniline	930UJ	ug/kg
Naphthalene	190UJ	ug/kg
2-Methylnaphthalene	190UJ	ug/kg
2-Chloronaphthalene	190UJ	ug/kg
3,3'-Dichlorobenzidine	380UJ	ug/kg
1,2-Dichlorobenzene	190UJ	ug/kg
Nitrobenzene	190UJ	ug/kg
3-Nitroaniline	930UJ	ug/kg
4-Nitroaniline	930UJ	ug/kg
4-Bromophenyl-phenyleth	190UJ	ug/kg
1,4-Dichlorobenzene	190UJ	ug/kg

B/N Extract Scan *** Continued *** Parameter	Tissue Result	Units
4-Chloroaniline	190UJ	ug/kg
bis(2-Chloroethyl)Ether	190UJ	ug/kg
bis(2-Chloroethoxy)Meth	190UJ	ug/kg
bis(2-Ethylhexyl)Phthal	190UJ	ug/kg
Di-n-Octyl Phthalate	730BJ	ug/kg
Hexachlorobenzene	190UJ	ug/kg
Anthracene	190UJ	ug/kg
1,2,4-Trichlorobenzene	190UJ	ug/kg
2,4-Dinitrotoluene	190UJ	ug/kg
Pyrene	190UJ	ug/kg
Dimethylphthalate	190UJ	ug/kg
Dibenzofuran	190UJ	ug/kg
Benzo(ghi)perylene	190UJ	ug/kg
Indeno(1,2,3-cd)pyrene	190UJ	ug/kg
Benzo(b)fluoranthene	190UJ	ug/kg
Fluoranthene	190UJ	ug/kg
Benzo(k)fluoranthene	190UJ	ug/kg
Acenaphthylene	190UJ	ug/kg
Chrysene	190UJ	ug/kg
1,3-Dichlorobenzene	190UJ	ug/kg
2,6-Dinitrotoluene	190UJ	ug/kg
N-Nitroso-di-n-Propylam	190BUJ	ug/kg
Spike D10-Pyrene	96%	ug/kg
Spike D5-Nitrobenzene	56%	ug/kg
Spike 2-Fluorobiphenyl	82%	ug/kg
Spike D14-Terphenyl	106%	ug/kg
4-Chlorophenyl-phenylet	190UJ	ug/kg
bis(2-Chloroisopropyl)E	190UJ	ug/kg

Acid Extract Scan Parameter	Tissue Result	Units
2,4-Dinitrophenol	470UJ	ug/kg
4-Chloro-3-Methylphenol	97UJ	ug/kg
Benzoic acid	470UJ	ug/kg
Pentachlorophenol	470BUJ	ug/kg
2,4,6-Trichlorophenol	97UJ	ug/kg
2-Nitrophenol	97UJ	ug/kg
2-Methylphenol	97UJ	ug/kg
o-Chlorophenol	97UJ	ug/kg
2,4,5-Trichlorophenol	470UJ	ug/kg
4-Nitrophenol	470UJ	ug/kg
Benzyl Alcohol	97UJ	ug/kg

(Continued on next page)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Sample No: 87 040510 Begin Sample Date: 87/01/17 09:30 Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: EVERETT HARBOR, FIN TAG 10562

Comment: B/N/A DETECTION LIMITS ARE ESTIMATED

Acid Extract Scan Tissue
*** Continued ***

Parameter	Result	Units
2,4-Dimethylphenol	97UJ	ug/kg
4-Methylphenol	97UJ	ug/kg
Phenol	97UJ	ug/kg
2,4-Dichlorophenol	97UJ	ug/kg
4,6-Dinitro-2-methylphe	470UJ	ug/kg
Spike D5-Phenol	28%	ug/kg
Spike 2-Fluorophenol	32%	ug/kg

Pest/PCB - PP Scan Tissue

Parameter	Result	Units
4,4'-DDT	5	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	8	ug/kg
4,4'-DDE	17	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	119%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	99	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A — PUGET SOUND SALMON CONTAMINATION STUDY — Officer: DTE — Account: AMLB3F

Station No: 10791

Sample No: 87 040520 — Begin Sample Date: 87/01/17 : — Source: Fish Tissue — Depth: — QA Code:

Laboratory: RX — Description: POINT NO POINT, TAG 10719

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.57	mg/kg-wt
Nickel	Ni-Tiss	0.23	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.041	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.66	mg/kg-wt
Zinc	Zn-Tiss	4.0	mg/kg-wt
Chromium	Cr-Tiss	0.05	mg/kg-wt
Cadmium	Cd-Tiss	0.010	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	6.05	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	10M	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	12	ug/kg
4,4'-DDE	36	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1M	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	5	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	NAR	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	47	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10674

Sample No: 87 040521 Begin Sample Date: 87/01/17 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: POINT NO POINT, TAG 10674

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.43	mg/kg-wt
Nickel	Ni-Tiss	0.27	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.022	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.99	mg/kg-wt
Zinc	Zn-Tiss	3.8	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.013	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.105	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	102%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	16	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: RTE Account: AMLB3F

Station No: 10782

Sample No: 87 040522 Begin Sample Date: 87/01/17 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: POINT NO POINT, TAG 10782

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.88	mg/kg-wt
Nickel	Ni-Tiss	0.19	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.049	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.72	mg/kg-wt
Zinc	Zn-Tiss	3.9	mg/kg-wt
Chromium	Cr-Tiss	0.08	mg/kg-wt
Cadmium	Cd-Tiss	0.004	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	1.89	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	5	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	9	ug/kg
4,4'-DDE	20	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	81%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	48	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10760

Sample No: 87 040523 Begin Sample Date: 87/01/17 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: POINT NO POINT, TAG 10760

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.66	mg/kg-wt
Nickel	Ni-Tiss	0.29	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.029	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.54	mg/kg-wt
Zinc	Zn-Tiss	3.5	mg/kg-wt
Chromium	Cr-Tiss	0.04	mg/kg-wt
Cadmium	Cd-Tiss	0.004	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	2.89	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	10M	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	10M	ug/kg
4,4'-DDE	42	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1M	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	93%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	140	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2P

Station No: 10802

Sample No: 87 040524 Begin Sample Date: 87/01/17 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: POINT NO POINT, TAG 10802

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.21	mg/kg-wt
Nickel	Ni-Tiss	0.55	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.037	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.54	mg/kg-wt
Zinc	Zn-Tiss	3.6	mg/kg-wt
Chromium	Cr-Tiss	0.01	mg/kg-wt
Cadmium	Cd-Tiss	0.003	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	1.11	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	6	ug/kg
4,4'-DDE	35	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	2	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	NAR	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	38	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10753

Sample No: 87 040525 Begin Sample Date: 87/01/17 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: POINT NO POINT, TAG 10753

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.19	mg/kg-wt
Nickel	Ni-Tiss	1.00	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.024	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.72	mg/kg-wt
Zinc	Zn-Tiss	3.9	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.014	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.71	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	5	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	NAR	ug/kg
Hexachlorobenzene	1M	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	93%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	16	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-0654 PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB3P

Station No: 10792

Sample No: 87 040526 Begin Sample Date: 87/01/17 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: POINT NO POINT, TAG 10792

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.38	mg/kg-wt
Nickel	Ni-Tiss	0.42	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.035	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.69	mg/kg-wt
Zinc	Zn-Tiss	3.4	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.008	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.29	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	7	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	83%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	16	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: ELLIOTT

Sample No: 87 040530 Begin Sample Date: 87/01/17 08:40 Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: TAG 10671

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.34	mg/kg-wt
Nickel	Ni-Tiss	0.26	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.040	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	1.06	mg/kg-wt
Zinc	Zn-Tiss	5.2	mg/kg-wt
Chromium	Cr-Tiss	0.05	mg/kg-wt
Cadmium	Cd-Tiss	0.005	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	1.56	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	18	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	27	ug/kg
4,4'-DDE	18	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	NAI	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	96	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Station No: ELLIOTT

Sample No: 87 040531 Begin Sample Date: 87/01/17 08:40 Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: TAG 10729

Comment: B/N/A DETECTION LIMITS ARE ESTIMATED

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.01	mg/kg-wt
Nickel	Ni-Tiss	0.11	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.020	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.64	mg/kg-wt
Zinc	Zn-Tiss	4.5	mg/kg-wt
Chromium	Cr-Tiss	0.12	mg/kg-wt
Cadmium	Cd-Tiss	0.005	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	NAR	Percent

VOA - PP Scan (GCMS) Parameter	Tissue Result	Units
Carbon Tetrachloride	14U	ug/kg
Acetone	360J	ug/kg
Chloroform	14U	ug/kg
Benzene	14U	ug/kg
1,1,1-Trichloroethane	14U	ug/kg
Bromomethane	28U	ug/kg
Chloromethane	28U	ug/kg
Chloroethane	28U	ug/kg
Vinyl Chloride	28U	ug/kg
Methylene Chloride	13UJ	ug/kg
Carbon Disulfide	14U	ug/kg
Bromoform	14U	ug/kg
Bromodichloromethane	14U	ug/kg
1,1-Dichloroethane	14U	ug/kg
1,1-Dichloroethene	14U	ug/kg
1,2-Dichloropropane	14U	ug/kg
2-Butanone	12UJ	ug/kg
1,1,2-Trichloroethane	14U	ug/kg
Trichloroethene	14U	ug/kg
1,1,2,2-Tetrachloroetha	28U	ug/kg
Total Xylenes	14U	ug/kg
Ethylbenzene	14U	ug/kg
Styrene	14U	ug/kg
1,2-Dichloroethane	14U	ug/kg

VOA - PP Scan (GCMS) *** Continued *** Parameter	Tissue Result	Units
Vinyl Acetate	28U	ug/kg
4-Methyl-2-Pentanone	28U	ug/kg
Toluene	14U	ug/kg
Chlorobenzene	14U	ug/kg
2-Chloroethylvinylether	28U	ug/kg
Dibromochloromethane	14U	ug/kg
Tetrachloroethene	14U	ug/kg
trans-1,2-Dichloroethen	14U	ug/kg
2-Hexanone	28U	ug/kg
Spike D4-1,2-Dichloroet	136%	ug/kg
Spike 1,4-Bromofluorobe	75%	ug/kg
Spike D8-Toluene	97%	ug/kg
cis-1,3-Dichloropropene	14U	ug/kg
trans-1,3-Dichloroprope	14U	ug/kg

B/N Extract Scan Parameter	Tissue Result	Units
Benzo(a)pyrene	74UJ	ug/kg
Dibenzo(a,h)anthracene	74UJ	ug/kg
Benzo(a)anthracene	74UJ	ug/kg
Hexachloroethane	74UJ	ug/kg
Hexachlorocyclopentadie	74UJ	ug/kg
Isophorone	74UJ	ug/kg
Acenaphthene	74UJ	ug/kg
Diethylphthalate	74UJ	ug/kg
Di-n-Butylphthalate	74UJ	ug/kg
Phenanthrene	74UJ	ug/kg
Butylbenzylphthalate	74UJ	ug/kg
N-Nitrosodiphenylamine	74UJ	ug/kg
Fluorene	74UJ	ug/kg
Hexachlorobutadiene	74UJ	ug/kg
2-Nitroaniline	360UJ	ug/kg
Naphthalene	74UJ	ug/kg
2-Methylnaphthalene	74UJ	ug/kg
2-Chloronaphthalene	74UJ	ug/kg
3,3'-Dichlorobenzidine	150UJ	ug/kg
1,2-Dichlorobenzene	74UJ	ug/kg
Nitrobenzene	74UJ	ug/kg
3-Nitroaniline	360UJ	ug/kg
4-Nitroaniline	360UJ	ug/kg
4-Bromophenyl-phenyleth	74UJ	ug/kg
1,4-Dichlorobenzene	74UJ	ug/kg

B/N Extract Scan *** Continued *** Parameter	Tissue Result	Units
4-Chloroaniline	74UJ	ug/kg
bis(2-Chloroethyl)Ether	74UJ	ug/kg
bis(2-Chloroethoxy)Meth	74UJ	ug/kg
bis(2-Ethylhexyl)Phthal	74UJ	ug/kg
Di-n-Octyl Phthalate	91JB	ug/kg
Hexachlorobenzene	74UJ	ug/kg
Anthracene	74UJ	ug/kg
1,2,4-Trichlorobenzene	74UJ	ug/kg
2,4-Dinitrotoluene	74UJ	ug/kg
Pyrene	74UJ	ug/kg
Dimethylphthalate	74UJ	ug/kg
Dibenzofuran	74UJ	ug/kg
Benzo(ghi)perylene	74UJ	ug/kg
Indeno(1,2,3-cd)pyrene	74UJ	ug/kg
Benzo(b)fluoranthene	74UJ	ug/kg
Fluoranthene	74UJ	ug/kg
Benzo(k)fluoranthene	74UJ	ug/kg
Acenaphthylene	74UJ	ug/kg
Chrysene	74UJ	ug/kg
1,3-Dichlorobenzene	74UJ	ug/kg
2,6-Dinitrotoluene	74UJ	ug/kg
N-Nitroso-di-n-Propylam	74BUJ	ug/kg
Spike D10-Pyrene	88%	ug/kg
Spike D5-Nitrobenzene	54%	ug/kg
Spike 2-Fluorobiphenyl	76%	ug/kg
Spike D14-Terphenyl	99%	ug/kg
4-Chlorophenyl-phenylet	74UJ	ug/kg
bis(2-Chloroisopropyl)E	74UJ	ug/kg

Acid Extract Scan Parameter	Tissue Result	Units
2,4-Dinitrophenol	340UJ	ug/kg
4-Chloro-3-Methylphenol	70UJ	ug/kg
Benzoic acid	340UJ	ug/kg
Pentachlorophenol	340BUJ	ug/kg
2,4,6-Trichlorophenol	70UJ	ug/kg
2-Nitrophenol	70UJ	ug/kg
2-Methylphenol	70UJ	ug/kg
o-Chlorophenol	70UJ	ug/kg
2,4,5-Trichlorophenol	340UJ	ug/kg
4-Nitrophenol	340UJ	ug/kg
Benzyl Alcohol	70UJ	ug/kg

(Continued on next page)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: ELLIOTT

Sample No: 87 040531 Begin Sample Date: 87/01/17 08:40 Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: TAG 10729

Comment: B/N/A DETECTION LIMITS ARE ESTIMATED

Acid Extract Scan *** Continued ***	Tissue	
Parameter	Result	Units
2,4-Dimethylphenol	70UJ	ug/kg
4-Methylphenol	70UJ	ug/kg
Phenol	70UJ	ug/kg
2,4-Dichlorophenol	70UJ	ug/kg
4,6-Dinitro-2-methylphe	340UJ	ug/kg
Spike D5-Phenol	59%	ug/kg
Spike 2-Fluorophenol	66%	ug/kg

Pest/PCB - PP Scan	Tissue	
Parameter	Result	Units
4,4'-DDT	1M	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1M	ug/kg
4,4'-DDE	7	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1M	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	115%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	35	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10678

Sample No: 87 040532 Begin Sample Date: 87/01/24 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: COMM BAY, FIN TAG 10678

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.90	mg/kg-wt
Nickel	Ni-Tiss	0.03	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.042	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.67	mg/kg-wt
Zinc	Zn-Tiss	4.0	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.008	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.65	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	11	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1M	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	81%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	57	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10698

Sample No: 87 040533 Begin Sample Date: 87/01/24 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: COMM BAY, FIN TAG 10698 (VOA)

Comment: B/N/A DETECTION LIMITS ARE ESTIMATED

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.90	mg/kg-wt
Nickel	Ni-Tiss	0.14	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.054	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.66	mg/kg-wt
Zinc	Zn-Tiss	4.8	mg/kg-wt
Chromium	Cr-Tiss	0.02	mg/kg-wt
Cadmium	Cd-Tiss	0.005	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	3.60	Percent

VOA - PP Scan (GCMS) Parameter	Tissue Result	Units
Carbon Tetrachloride	13U	ug/kg
Acetone	49J	ug/kg
Chloroform	13U	ug/kg
Benzene	13U	ug/kg
1,1,1-Trichloroethane	13U	ug/kg
Bromomethane	25U	ug/kg
Chloromethane	25U	ug/kg
Chloroethane	25U	ug/kg
Vinyl Chloride	25U	ug/kg
Methylene Chloride	6.2UJ	ug/kg
Carbon Disulfide	13U	ug/kg
Bromoform	13U	ug/kg
Bromodichloromethane	13U	ug/kg
1,1-Dichloroethane	13U	ug/kg
1,1-Dichloroethene	13U	ug/kg
1,2-Dichloropropane	13U	ug/kg
2-Butanone	16UJ	ug/kg
1,1,2-Trichloroethane	13U	ug/kg
Trichloroethene	13U	ug/kg
1,1,2,2-Tetrachloroetha	25U	ug/kg
Total Xylenes	13U	ug/kg
Ethylbenzene	13U	ug/kg
Styrene	13U	ug/kg
1,2-Dichloroethane	13U	ug/kg

VOA - PP Scan (GCMS) *** Continued *** Parameter	Tissue Result	Units
Vinyl Acetate	25U	ug/kg
4-Methyl-2-Pentanone	25U	ug/kg
Toluene	1.1BJ	ug/kg
Chlorobenzene	13U	ug/kg
2-Chloroethylvinylether	25U	ug/kg
Dibromochloromethane	13U	ug/kg
Tetrachloroethene	13U	ug/kg
trans-1,2-Dichloroethen	13U	ug/kg
2-Hexanone	25U	ug/kg
Spike D4-1,2-Dichloroet	84%	ug/kg
Spike 1,4-Bromofluorobe	63%	ug/kg
Spike D8-Toluene	102%	ug/kg
cis-1,3-Dichloropropene	13U	ug/kg
trans-1,3-Dichloroprope	13U	ug/kg

B/N Extract Scan Parameter	Tissue Result	Units
Benzo(a)pyrene	70UJ	ug/kg
Dibenzo(a,h)anthracene	70UJ	ug/kg
Benzo(a)anthracene	70UJ	ug/kg
Hexachloroethane	70UJ	ug/kg
Hexachlorocyclopentadie	70UJ	ug/kg
Isophorone	70UJ	ug/kg
Acenaphthene	70UJ	ug/kg
Diethylphthalate	70UJ	ug/kg
Di-n-Butylphthalate	70UJ	ug/kg
Phenanthrene	70UJ	ug/kg
Butylbenzylphthalate	70UJ	ug/kg
N-Nitrosodiphenylamine	70UJ	ug/kg
Fluorene	70UJ	ug/kg
Hexachlorobutadiene	70UJ	ug/kg
2-Nitroaniline	340UJ	ug/kg
Naphthalene	70UJ	ug/kg
2-Methylnaphthalene	70UJ	ug/kg
2-Chloronaphthalene	70UJ	ug/kg
3,3'-Dichlorobenzidine	140U	ug/kg
1,2-Dichlorobenzene	70UJ	ug/kg
Nitrobenzene	70UJ	ug/kg
3-Nitroaniline	340UJ	ug/kg
4-Nitroaniline	340UJ	ug/kg
4-Bromophenyl-phenyleth	70UJ	ug/kg
1,4-Dichlorobenzene	70UJ	ug/kg

(Continued on next page)

B/N Extract Scan *** Continued *** Parameter	Tissue Result	Units
4-Chloroaniline	70UJ	ug/kg
bis(2-Chloroethyl)Ether	70UJ	ug/kg
bis(2-Chloroethoxy)Meth	70UJ	ug/kg
bis(2-Ethylhexyl)Phthal	70UJ	ug/kg
Di-n-Octyl Phthalate	560UJ	ug/kg
Hexachlorobenzene	70UJ	ug/kg
Anthracene	70UJ	ug/kg
1,2,4-Trichlorobenzene	70UJ	ug/kg
2,4-Dinitrotoluene	70UJ	ug/kg
Pyrene	70UJ	ug/kg
Dimethylphthalate	70UJ	ug/kg
Dibenzofuran	70UJ	ug/kg
Benzo(ghi)perylene	70UJ	ug/kg
Indeno(1,2,3-cd)pyrene	70UJ	ug/kg
Benzo(b)fluoranthene	70UJ	ug/kg
Fluoranthene	70UJ	ug/kg
Benzo(k)fluoranthene	70UJ	ug/kg
Acenaphthylene	70UJ	ug/kg
Chrysene	70UJ	ug/kg
1,3-Dichlorobenzene	70UJ	ug/kg
2,6-Dinitrotoluene	70UJ	ug/kg
N-Nitroso-di-n-Propylam	70BUJ	ug/kg
Spike D10-Pyrene	88%	ug/kg
Spike D5-Nitrobenzene	63%	ug/kg
Spike 2-Fluorobiphenyl	95%	ug/kg
Spike D14-Terphenyl	99%	ug/kg
4-Chlorophenyl-phenylet	70UJ	ug/kg
bis(2-Chloroisopropyl)E	70UJ	ug/kg

Acid Extract Scan Parameter	Tissue Result	Units
2,4-Dinitrophenol	360UJ	ug/kg
4-Chloro-3-Methylphenol	74UJ	ug/kg
Benzoic acid	360UJ	ug/kg
Pentachlorophenol	360BUJ	ug/kg
2,4,6-Trichlorophenol	74UJ	ug/kg
2-Nitrophenol	74UJ	ug/kg
2-Methylphenol	74UJ	ug/kg
o-Chlorophenol	74UJ	ug/kg
2,4,5-Trichlorophenol	360UJ	ug/kg
4-Nitrophenol	360UJ	ug/kg
Benzyl Alcohol	74UJ	ug/kg

(Continued on next page)

Station No: 10698

Sample No: 87 040533 Begin Sample Date: 87/01/24 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: COMM BAY, FIN TAG 10698 (VOA)

Comment: B/N/A DETECTION LIMITS ARE ESTIMATED

Acid Extract Scan *** Continued *** Parameter	Tissue Result	Units
2,4-Dimethylphenol	74UJ	ug/kg
4-Methylphenol	74UJ	ug/kg
Phenol	74UJ	ug/kg
2,4-Dichlorophenol	74UJ	ug/kg
4,6-Dinitro-2-methylphe	360UJ	ug/kg
Spike D5-Phenol	57%	ug/kg
Spike 2-Fluorophenol	59%	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	5	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	9	ug/kg
4,4'-DDE	51	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	115%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	210	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10690

Sample No: 87 040534 Begin Sample Date: 87/01/24 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: COMM BAY, FIN TAG 10690

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.90	mg/kg-wt
Nickel	Ni-Tiss	0.01U	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.039	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.79	mg/kg-wt
Zinc	Zn-Tiss	4.2	mg/kg-wt
Chromium	Cr-Tiss	0.07	mg/kg-wt
Cadmium	Cd-Tiss	0.008	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	1.60	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1M	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1M	ug/kg
4,4'-DDE	10	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	99%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	140	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10692

Sample No: 87 040535 Begin Sample Date: 87/01/24 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: COMM BAY, FIN TAG 10692

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.71	mg/kg-wt
Nickel	Ni-Tiss	0.09	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.052	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.54	mg/kg-wt
Zinc	Zn-Tiss	3.6	mg/kg-wt
Chromium	Cr-Tiss	0.03	mg/kg-wt
Cadmium	Cd-Tiss	0.009	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	3.37	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	11	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	23	ug/kg
4,4'-DDE	35	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	4	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	2	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	107%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	160	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10683

Sample No: 87 040536 Begin Sample Date: 87/01/24 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: COMM BAY, FIN TAG 10683

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.10	mg/kg-wt
Nickel	Ni-Tiss	0.01U	mg/kg-wt
Antimony	Sb-Tiss	0.01U	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.051	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.58	mg/kg-wt
Zinc	Zn-Tiss	3.3	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.003	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	1.45	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	22	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	16	ug/kg
4,4'-DDE	7	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	81%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	61	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB3F

Station No: 10712

Sample No: 87 040537 Begin Sample Date: 87/03/11 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: LENGTH 27.0 CM, WT 259 G

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.1	mg/kg-wt
Nickel	Ni-Tiss	0.01U	mg/kg-wt
Antimony	Sb-Tiss	0.03	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.059	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.63	mg/kg-wt
Zinc	Zn-Tiss	4.02	mg/kg-wt
Chromium	Cr-Tiss	0.10	mg/kg-wt
Cadmium	Cd-Tiss	0.002U	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.47	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	4	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	3	ug/kg
4,4'-DDE	9	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	110%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	69	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10727

Sample No: 87 040538 Begin Sample Date: 87/03/11 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: LENGTH 31.2 CM, WT 307 G (COHO)

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.9	mg/kg-wt
Nickel	Ni-Tiss	0.01U	mg/kg-wt
Antimony	Sb-Tiss	0.02	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.041	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	0.37	mg/kg-wt
Zinc	Zn-Tiss	4.09	mg/kg-wt
Chromium	Cr-Tiss	0.08	mg/kg-wt
Cadmium	Cd-Tiss	0.005	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.51	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	28	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	22	ug/kg
4,4'-DDE	29	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	130%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	93	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Sample No: 87 040550 Begin Sample Date: 87/02/04 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: CHINOOK LGHT66.3 WGHT4790 GMS FEMALE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.5	mg/kg-wt
Nickel	Ni-Tiss	0.10	mg/kg-wt
Antimony	Sb-Tiss	0.07	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.063	mg/kg-wt
Lead	Pb-Tiss	0.2	mg/kg-wt
Copper	Cu-Tiss	0.40	mg/kg-wt
Zinc	Zn-Tiss	3.0	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.009	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	8.45	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	3	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	31	ug/kg
4,4'-DDE	34	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	7	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	6	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	63%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	170	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Sample No: 87 040551 Begin Sample Date: 87/02/04 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: CHINOOK LGHT50.5 WGHT1640GMS MALE

Comment: B/N/A DETECTION LIMITS ARE ESTIMATED

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.9	mg/kg-wt
Nickel	Ni-Tiss	0.05U	mg/kg-wt
Antimony	Sb-Tiss	0.06	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.076	mg/kg-wt
Lead	Pb-Tiss	0.05U	mg/kg-wt
Copper	Cu-Tiss	0.18	mg/kg-wt
Zinc	Zn-Tiss	3.1	mg/kg-wt
Chromium	Cr-Tiss	0.02	mg/kg-wt
Cadmium	Cd-Tiss	0.010	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	1.05	Percent

B/N Extract Scan Parameter	Tissue Result	Units
Benzo(a)pyrene	370UJ	ug/kg
Dibenzo(a,h)anthracene	370UJ	ug/kg
Benzo(a)anthracene	370UJ	ug/kg
Hexachloroethane	370UJ	ug/kg
Hexachlorocyclopentadie	370UJ	ug/kg
Isophorone	370UJ	ug/kg
Acenaphthene	370UJ	ug/kg
Diethylphthalate	370BUJ	ug/kg
Di-n-Butylphthalate	370UJ	ug/kg
Phenanthrene	370UJ	ug/kg
Butylbenzylphthalate	370BUJ	ug/kg
N-Nitrosodiphenylamine	370BUJ	ug/kg
Fluorene	370UJ	ug/kg
Hexachlorobutadiene	370UJ	ug/kg
2-Nitroaniline	1800UJ	ug/kg
Naphthalene	370UJ	ug/kg
2-Methylnaphthalene	370UJ	ug/kg
2-Chloronaphthalene	370UJ	ug/kg
3,3'-Dichlorobenzidine	740UJ	ug/kg
1,2-Dichlorobenzene	370UJ	ug/kg
Nitrobenzene	370UJ	ug/kg
3-Nitroaniline	1800UJ	ug/kg
4-Nitroaniline	1800UJ	ug/kg
4-Bromophenyl-phenyleth	370UJ	ug/kg

B/N Extract Scan *** Continued *** Parameter	Tissue Result	Units
1,4-Dichlorobenzene	370UJ	ug/kg
4-Chloroaniline	370UJ	ug/kg
bis(2-Chloroethyl)Ether	370UJ	ug/kg
bis(2-Chloroethoxy)Meth	370UJ	ug/kg
bis(2-Ethylhexyl)Phthal	64BJ	ug/kg
Di-n-Octyl Phthalate	540BJ	ug/kg
Hexachlorobenzene	370UJ	ug/kg
Anthracene	370UJ	ug/kg
1,2,4-Trichlorobenzene	370UJ	ug/kg
2,4-Dinitrotoluene	370UJ	ug/kg
Pyrene	370UJ	ug/kg
Dimethylphthalate	370UJ	ug/kg
Dibenzofuran	370UJ	ug/kg
Benzo(ghi)perylene	370UJ	ug/kg
Indeno(1,2,3-cd)pyrene	370UJ	ug/kg
Benzo(b)fluoranthene	370UJ	ug/kg
Fluoranthene	370UJ	ug/kg
Benzo(k)fluoranthene	370UJ	ug/kg
Acenaphthylene	370UJ	ug/kg
Chrysene	370UJ	ug/kg
1,3-Dichlorobenzene	370UJ	ug/kg
2,6-Dinitrotoluene	370UJ	ug/kg
N-Nitroso-di-n-Propylam	370UJ	ug/kg
Spike D10-Pyrene	97%	ug/kg
Spike D5-Nitrobenzene	59%	ug/kg
Spike 2-Fluorobiphenyl	88%	ug/kg
Spike D14-Terphenyl	106%	ug/kg
4-Chlorophenyl-phenylet	370UJ	ug/kg
bis(2-Chloroisopropyl)E	370UJ	ug/kg

Acid Extract Scan Parameter	Tissue Result	Units
2,4-Dinitrophenol	720UJ	ug/kg
4-Chloro-3-Methylphenol	150UJ	ug/kg
Benzoic acid	720UJ	ug/kg
Pentachlorophenol	720BUJ	ug/kg
2,4,6-Trichlorophenol	150UJ	ug/kg
2-Nitrophenol	150UJ	ug/kg
2-Methylphenol	150UJ	ug/kg
o-Chlorophenol	150UJ	ug/kg
2,4,5-Trichlorophenol	720UJ	ug/kg
4-Nitrophenol	720UJ	ug/kg

Acid Extract Scan *** Continued *** Parameter	Tissue Result	Units
Benzyl Alcohol	150UJ	ug/kg
2,4-Dimethylphenol	150UJ	ug/kg
4-Methylphenol	150UJ	ug/kg
Phenol	150UJ	ug/kg
2,4-Dichlorophenol	150UJ	ug/kg
4,6-Dinitro-2-methylphe	720UJ	ug/kg
Spike D5-Phenol	45%	ug/kg
Spike 2-Fluorophenol	39%	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	6	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	5	ug/kg
4,4'-DDE	27	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	111%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	120	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTS Account: AMLB3P

Sample No: 87 040552 Begin Sample Date: 87/02/04 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: CHINOOK LGHT49.8 WGHT1180GMS MALE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.4	mg/kg-wt
Nickel	Ni-Tiss	0.05U	mg/kg-wt
Antimony	Sb-Tiss	0.08	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.032	mg/kg-wt
Lead	Pb-Tiss	0.05U	mg/kg-wt
Copper	Cu-Tiss	0.13	mg/kg-wt
Zinc	Zn-Tiss	3.2	mg/kg-wt
Chromium	Cr-Tiss	0.06	mg/kg-wt
Cadmium	Cd-Tiss	0.003	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.14	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	8	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	NAR	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	29	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10707

Sample No: 87 040553 Begin Sample Date: 87/02/04 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: CHINOOK, FIN TAG 10707

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.9	mg/kg-wt
Nickel	Ni-Tiss	0.05U	mg/kg-wt
Antimony	Sb-Tiss	0.06	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.053	mg/kg-wt
Lead	Pb-Tiss	0.09	mg/kg-wt
Copper	Cu-Tiss	0.65	mg/kg-wt
Zinc	Zn-Tiss	3.4	mg/kg-wt
Chromium	Cr-Tiss	0.03	mg/kg-wt
Cadmium	Cd-Tiss	0.005	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.11	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	5	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	10	ug/kg
4,4'-DDE	11	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1M	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	107%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	54	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

"Sample/Project Analysis Results"

Project: AMB-065A — PUGET SOUND SALMON CONTAMINATION STUDY — Officer: DTE — Account: AMLB2K

Station No: 10667

Sample No: 87 040554 — Begin Sample Date: 87/02/04 : — Source: Fish Tissue — Depth: — QA Code:

Laboratory: 2K — Description: CHINOOK, FIN TAG 10667

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.2	mg/kg-wt
Nickel	Ni-Tiss	0.10	mg/kg-wt
Antimony	Sb-Tiss	0.08	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.064	mg/kg-wt
Lead	Pb-Tiss	0.16	mg/kg-wt
Copper	Cu-Tiss	0.21	mg/kg-wt
Zinc	Zn-Tiss	3.3	mg/kg-wt
Chromium	Cr-Tiss	0.05	mg/kg-wt
Cadmium	Cd-Tiss	0.002U	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.11	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	3	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	1M	ug/kg
4,4'-DDE	7	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	83%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	39	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-065A PUGET SOUND SALMON CONTAMINATION STUDY Officer: DTE Account: AMLB2F

Station No: 10691

Sample No: 87 040555 Begin Sample Date: 87/02/04 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: CHINOOK, FIN TAG 10691

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.2	mg/kg-wt
Nickel	Ni-Tiss	0.05U	mg/kg-wt
Antimony	Sb-Tiss	0.07	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.067	mg/kg-wt
Lead	Pb-Tiss	0.09	mg/kg-wt
Copper	Cu-Tiss	0.29	mg/kg-wt
Zinc	Zn-Tiss	3.4	mg/kg-wt
Chromium	Cr-Tiss	0.01	mg/kg-wt
Cadmium	Cd-Tiss	0.009	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.073	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	9	ug/kg
4,4'-DDE	1	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1M	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	3	ug/kg
Spike Hexabromobenzene	77%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	41	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Station No: 10944

Sample No: 87 040556 Begin Sample Date: 87/02/04 : Source: Fish Tissue Depth: QA Code:

Laboratory: RX Description: CHINOOK, FIN TAG 10944

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.6	mg/kg-wt
Nickel	Ni-Tiss	0.05U	mg/kg-wt
Antimony	Sb-Tiss	0.06	mg/kg-wt
Silver	Ag-Tiss	0.002U	mg/kg-wt
Mercury	Hg-Tiss	0.044	mg/kg-wt
Lead	Pb-Tiss	0.13	mg/kg-wt
Copper	Cu-Tiss	0.36	mg/kg-wt
Zinc	Zn-Tiss	3.3	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.013	mg/kg-wt

Organics - General Parameter		Tissue Result	Units
Fat	Hex Extr	0.038	Percent

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	2	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	4	ug/kg
4,4'-DDE	6	ug/kg
Heptachlor	1U	ug/kg
Hexachlorobutadiene	1U	ug/kg
Hexachlorobenzene	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Spike Hexabromobenzene	90%	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	45	ug/kg
PCB - 1221	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

APPENDIX A-2

SHELLFISH DATA AND QA REVIEWS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10 LABORATORY
MANCHESTER, WASHINGTON 98353

REPLY TO ATTN OF M/S Lab October 5, 1987

MEMORANDUM

SUBJECT: Review - Puget Sound Shellfish Data

FROM: Joseph N. Blazevich, Region 10 chemist JNB
Raleigh Farlow, Region 10 QA officer RF

TO: File

We have completed our review of Puget Sound shellfish tissue data. This review covers samples 86320100 - 86320118. All results are judged acceptable except as noted. The following comments should be considered by the data user. Although sampling occurred in early August 1986, samples were not received at the Manchester laboratory until September 1986.

METALS

Metals were analyzed using EPA Region 10 procedures for metals in tissue samples. This method employs the determinative steps described in EPA's "Methods for Chemical Analyses for Water and Waste Water".

Holding Times: All shellfish tissue samples were held frozen up to three weeks from date of sampling to date of digestion. Although EPA has not established holding times for metals in shellfish tissue, all samples were analyzed within established water and soil holding time periods.

Blanks: All method blanks are acceptable. No metals were detected in method blanks at or above the detection limits.

Spike Results: Matrix spike results fall within the Manchester laboratory required range of 60 to 140 percent recovery for tissue and are acceptable. This range is expanded for tissue compared to water and soil, which are 75 to 125 percent, due to the complexity of the matrix. Spike recovery data is found in Table 1. No shellfish tissue standard reference material is available and as a consequence none were analyzed.

TABLE 1 PERCENT RECOVERIES OF METALS IN SELECTED SPIKED TISSUES (0.2 to 10 ppm)

Parameter	spike 1	spike 2	spike3
lead	91	a	a
cadmium	101	a	a
arsenic	95	a	a
copper	101	a	a
zinc	106	a	a
mercury	a	73	80

a = Sample was not analyzed for this analyte.

All duplicate sample results for metals gave percent differences less than 20 percent with the majority less than 15 percent. Results of duplicate analyses are found in Table 2. Duplicate results meet the Manchester laboratory required limit of less than 20 percent and are considered acceptable. Method detection limits range from 0.001 ug/gm for mercury to 0.01 ug/gm for all others.

TABLE 2 RESULTS OF DUPLICATE METAL ANALYSES (UG/GM)

Parameter		run 1	run 2	% Difference
lead	sample 1	0.26	0.26	0
	2	0.26	0.22	17
cadmium	sample 1	0.07	0.08	13
	2	0.10	0.10	0
arsenic	sample 1	3.3	3.3	0
	2	1.6	1.7	7
zinc	sample 1	16.5	17.0	3
	2	12.2	13.1	7
mercury	sample 1	0.016	0.016	0
	2	0.014	0.016	13

PESTICIDES/PCB's

Pesticides/PCB's were analyzed using the EPA Region 10 procedure for pesticides/PCB's in tissue samples employing the determinative steps found in method 608 using dual column confirmation and quantitation.

Holding Times: All shellfish tissues were held frozen up to six weeks from date of collection until date of extraction. Although EPA has not established holding times for pesticides/PCB's in shellfish tissues, it is noted that established holding times for water and soil were exceeded for this sample set.

Blanks: All method blanks are acceptable. No pesticides/PCB's were detected at or above the detection limits of 0.001 to 0.01 ug/gm.

Spike Results: Surrogate, matrix and duplicate matrix spikes are acceptable except for aldrin, alpha-BHC, beta-BHC, and lindane, which gave recoveries outside the Manchester laboratory required range of 50 to 150 percent for spiked tissue samples. Any data or detection limits for these compounds are considered estimates for this sample set. All percent differences for pesticides in duplicate matrix spikes fall within the Manchester laboratory limit of less than 50 percent and are considered acceptable except for alpha-BHC, beta-BHC, delta-BHC and lindane. Matrix and duplicate matrix spike recovery data with percent differences for selected pesticides are found in Table 3. Pesticide/PCB's standard reference materials for shellfish tissue are not available and as a consequence were not analyzed.

TABLE 3 PERCENT RECOVERIES OF SELECTED PESTICIDES IN SPIKED SHELLFISH (4-20ppb)

Compound	run 1	run 2	% difference
aldrin	38	54	34.7
4,4'-DDT	120	128	6.5
4,4'-DDE	106	141	28.3
4,4'-DDD	116	149	24.9
heptachlor	53	62	15.7
delta-BHC	58	129	75.9*
alpha-BHC	>>100	>>100	*
beta-BHC	-	180	*
lindane	>>100	67	*
surrogate 1	75	64	15.8

* = Severe interference was found for these analytes.

Surrogate recoveries for samples, blanks and matrix spikes are acceptable. A summary of pesticide surrogate and matrix spike results is found in Table 4. All spike pesticide values are included with the matrix spike results except for alpha-HBC, beta-BHC and lindane.

TABLE 4 SUMMARY -PESTICIDE SURROGATE AND MATRIX SPIKE RESULTS *

Parameter	mean(%)	Std.Dev.	RSD(%)	Range	N
surrogate	83.7	20.0	23.9	35-123	27
matrix spike 1	80.9	33.1	40.9	38-120	7
matrix spike 2	108.2	46.7	43.1	54-180	9

* = Initial surrogate results for samples 320100, 320104, 320108 and blank BH6259TJ were low. Reanalysis of each produced acceptable surrogate recoveries. Only the second run results are used.

PNA

PNA's were analyzed using the EPA Region 10 procedure for tissue with cleanup and determinative steps found in EPA method 610. The PNA data is considered acceptable for screening only, due to the lack of acceptable spike data and unsubstantiated method detection limits.

Holding Times: All shellfish were held frozen up to two months from date of collection until extraction. EPA has not established holding times for PNA's in shellfish tissue.

Blanks: All method blanks are acceptable. One blank, BN6259TJ, contained small amounts of phenanthrene (8 ug/kg),anthracene (0.4J ug/kg) and chrysene (8 ug/kg). These parameters are given the qualifier "B" for those samples associated with this blank.

Spike Results: Matrix and duplicate matrix spikes were spiked at too low a level for the interferences present in the samples. As a consequence, no useable spike results were obtained. Replicate results provide some data on precision even though data for phenanthrene and anthracene are questionable due to the detection of these compounds at similar levels in one of two method blanks. The replicate data with standard deviation and RSD's are found in Table 5.

TABLE 5 RESULTS OF PNA REPLICATES IN SPIKED SHELLFISH

Compound	Run 1	Run 2	Run 3	Mean(UG/KG)	Std.Dev.	RSD(%)
phenanthrene	10B	20B	4B	11.3	8.1	71.3
anthracene	6B	0.8B	.4UB	2.4	3.1	130.2
fluoranthene	20	30	10	20	10	50

No standard reference material for shellfish was available and as a consequence not analyzed.

INTEROFFICE MEMO

TETRA TECH, INC.
A HONEYWELL SUBSIDIARY
1900 NORTHRUP WY. STE. 100
BELLEVUE, WA 98005-1927
TELEPHONE (206) 822-9596

TO Project File, TC-3338-28, QA/QC DATE 12/23/87

FROM Lynne Kilpatrick-Howard

SUBJECT QA/QC Review of the Puget Sound Shellfish Data and the Report Generated by Joseph N. Blazevich, U.S. EPA Region X

My review of the Puget Sound shellfish data and the report generated by Joseph N. Blazevich and Raleigh Farlow of U.S. Environmental Protection Agency (EPA) Region X has been completed. Unless noted otherwise, the results and comments (Blazevich, J., 5 October 1987, personal communication) by the U.S. EPA reviewer are judged acceptable.

The following database qualifiers were assigned to the Puget Sound shellfish data submitted:

U = Undetected

J = Estimated value for one of the following reasons: compound verified but not quantified because value exceeded the five-point calibration curve, compound is tentatively identified, response factor may be low, or the standard was not within the allowed 25 percent response factor difference

M = Compound verified below quantification limit

B = Compound detected in associated blank

S = Data may be used for screening purposes only

NAR = No analysis results

NAI = Not analyzed because of interference.

HOLDING TIMES OF PESTICIDES/PCBS IN TISSUE

The reviewer reported that, "Although EPA has not established holding times for pesticides/PCBs in shellfish tissues, it is noted that established holding times for water and soil were exceeded..." (Blazevich, J., 5 October 1987, personal communication). The Puget Sound Estuary Program (PSEP) (Tetra Tech 1986) recommends a maximum holding time for frozen tissue samples of 6 mo. The 6-wk actual holding time for the samples is within PSEP guidelines.

MATRIX SPIKE RESULTS OF PESTICIDES/PCBS IN TISSUE

The reviewer noted that "any data or detection limits for these compounds [aldrin, alpha-BHC, beta-BHC, and lindane] are considered estimates for this sample set" (Blazevich, J., 5 October 1987, personal communication). None of these compounds were quantified in any sample at or above the detection limit.

MATRIX SPIKE RESULTS OF POLYNUCLEAR AROMATIC HYDROCARBONS IN TISSUE

The U.S. EPA reviewer noted that the PNA data is "considered acceptable for screening purposes only due to lack of acceptable spike data and unsubstantiated method detection limits" (Blazevich, J., 5 October 1987, personal communication). Therefore, the data qualifier S was assigned to all PNA data.

REFERENCES

Blazevich, J. 5 October 1987. Personal Communication (memorandum to file, U.S. Environmental Protection Agency Region X Laboratory). U.S. EPA Region X Laboratory, Manchester, WA. 4 pp.

Tetra Tech. 1986. Recommended protocols for measuring selected environmental variables in Puget Sound. Final Report. Prepared for Puget Sound Estuary Program. Tetra Tech, Inc., Bellevue, WA.

Station No: DP66

Sample No: 86 320100 Begin Sample Date: 86/08/04 10:20 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: NATIVE LITTLENECKS - DASH POINT

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.1	mg/kg-wt
Mercury	Hg-Tiss	0.007	mg/kg-wt
Lead	Pb-Tiss	0.10	mg/kg-wt
Copper	Cu-Tiss	1.4	mg/kg-wt
Zinc	Zn-Tiss	18.4	mg/kg-wt
Cadmium	Cd-Tiss	.42	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	5	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	1	ug/kg
Pyrene	20	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	10	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1U	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.1M	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	3.4	ug/kg
PCB - 1254	1.0M	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: DP67

Sample No: 86 320101 Begin Sample Date: 86/08/04 10:20 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: MACOMA SP - DASH POINT

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.5	mg/kg-wt
Mercury	Hg-Tiss	0.052	mg/kg-wt
Lead	Pb-Tiss	1.63	mg/kg-wt
Copper	Cu-Tiss	5.1	mg/kg-wt
Zinc	Zn-Tiss	32.3	mg/kg-wt
Cadmium	Cd-Tiss	.17	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	5	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	2	ug/kg
Fluorene	30U	ug/kg
Naphthalene	130U	ug/kg
Anthracene	0.4J	ug/kg
Pyrene	20	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	2	ug/kg
Fluoranthene	10	ug/kg
Benzo(k)fluoranthene	1	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1U	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.16	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	1.0M	ug/kg
PCB - 1254	2.7	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53827

Station No: PR121

Sample No: 86 320102 Begin Sample Date: 86/08/04 10:35 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: PRIEST POINT PARK - NATIVE LITTLENECKS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.5	mg/kg-wt
Mercury	Hg-Tiss	0.012	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	1.1	mg/kg-wt
Zinc	Zn-Tiss	15.6	mg/kg-wt
Cadmium	Cd-Tiss	.46	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	20	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	0.8	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	2	ug/kg
Fluoranthene	30	ug/kg
Benzo(k)fluoranthene	0.4J	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1M	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.4	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	3.2	ug/kg
PCB - 1254	4.0	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: PR122

Sample No: 86 320103 Begin Sample Date: 86/08/04 10:35 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: PRIEST POINT PARK - BUTTER CLAMS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.3	mg/kg-wt
Mercury	Hg-Tiss	0.010	mg/kg-wt
Lead	Pb-Tiss	0.21	mg/kg-wt
Copper	Cu-Tiss	1.1	mg/kg-wt
Zinc	Zn-Tiss	14.9	mg/kg-wt
Cadmium	Cd-Tiss	.13	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	4	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	0.4U	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	10	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2J	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1U	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.15	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	2.7	ug/kg
PCB - 1254	3.5	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: PR123

Sample No: 86 320104 Begin Sample Date: 86/08/04 10:35 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: PRIEST POINT PARK - SAND CLAMS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.4	mg/kg-wt
Mercury	Hg-Tiss	0.030	mg/kg-wt
Lead	Pb-Tiss	0.39	mg/kg-wt
Copper	Cu-Tiss	2.3	mg/kg-wt
Zinc	Zn-Tiss	38.9	mg/kg-wt
Cadmium	Cd-Tiss	.08	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	3	ug/kg
Fluorene	30U	ug/kg
Naphthalene	130U	ug/kg
Anthracene	0.4U	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	0.8	ug/kg
Fluoranthene	8	ug/kg
Benzo(k)fluoranthene	0.4J	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1M	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1M	ug/kg
4,4'-DDE	0.1M	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	3.1	ug/kg
PCB - 1254	8.6	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A5382F

Station No: MK35A

Sample No: 86 320105 Begin Sample Date: 86/08/04 11:15 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: MUKILTEO - LITTLENECKS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.6	mg/kg-wt
Mercury	Hg-Tiss	0.003	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	1.6	mg/kg-wt
Zinc	Zn-Tiss	14.9	mg/kg-wt
Cadmium	Cd-Tiss	.27	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	10U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	300U	ug/kg
Phenanthrene	4	ug/kg
Fluorene	30U	ug/kg
Naphthalene	170U	ug/kg
Anthracene	0.5J	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	10U	ug/kg
Indeno(1,2,3-cd)pyrene	5U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	7	ug/kg
Benzo(k)fluoranthene	0.5U	ug/kg
Acenaphthylene	300U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1M	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	MAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.1M	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	3.0	ug/kg
PCB - 1254	3.4	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Station No: BB1

Sample No: 86 320106 Begin Sample Date: 86/08/05 : Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: BIRCH BAY - BUTTER CLAMS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.7	mg/kg-wt
Mercury	Hg-Tiss	0.001	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	1.3	mg/kg-wt
Zinc	Zn-Tiss	13.3	mg/kg-wt
Cadmium	Cd-Tiss	.14	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	2U	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	0.4U	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	4U	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1U	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.1U	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	1U	ug/kg
PCB - 1254	1U	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: BB2

Sample No: 86 320107 Begin Sample Date: 86/08/05 : Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: BIRCH BAY LITTLENECK CLAMS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.2	mg/kg-wt
Mercury	Hg-Tiss	0.005	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	1.0	mg/kg-wt
Zinc	Zn-Tiss	13.9	mg/kg-wt
Cadmium	Cd-Tiss	.18	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	2U	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	0.4U	ug/kg
Pyrene	12U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	4U	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1U	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.19	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	1U	ug/kg
PCB - 1254	1U	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Station No: AP46

Sample No: 86 320108 Begin Sample Date: 86/08/05 10:30 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: ALKI POINT NATIVE LITTLENECKS - A

End Sample Date: 86/08/05 11:30 Comp: Freq:

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.3	mg/kg-wt
Mercury	Hg-Tiss	0.010	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	2.2	mg/kg-wt
Zinc	Zn-Tiss	12.3	mg/kg-wt
Cadmium	Cd-Tiss	.23	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	10U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	300U	ug/kg
Phenanthrene	2U	ug/kg
Fluorene	30U	ug/kg
Naphthalene	170U	ug/kg
Anthracene	0.5U	ug/kg
Pyrene	15U	ug/kg
Benzo(ghi)perylene	10U	ug/kg
Indeno(1,2,3-cd)pyrene	5U	ug/kg
Benzo(b)fluoranthene	2U	ug/kg
Fluoranthene	5U	ug/kg
Benzo(k)fluoranthene	0.5U	ug/kg
Acenaphthylene	300U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1M	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.1U	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	1.0M	ug/kg
PCB - 1254	2.0	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: AP46

Sample No: 86 320109 Begin Sample Date: 86/08/05 10:30 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: ALKI POINT BUTTER - B

End Sample Date: 86/08/05 11:30 Comp: Freq:

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.3	mg/kg-wt
Mercury	Hg-Tiss	0.008	mg/kg-wt
Lead	Pb-Tiss	0.26	mg/kg-wt
Copper	Cu-Tiss	5.4	mg/kg-wt
Zinc	Zn-Tiss	16.5	mg/kg-wt
Cadmium	Cd-Tiss	.07	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	4	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	0.4U	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	5	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.3	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.57	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	2.2	ug/kg
PCB - 1254	3.9	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Station No: MK35B

Sample No: 86 320110 Begin Sample Date: 86/08/04 : Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: MUKILTEO BUTTER CLAMS

Comment: SEE ALSO #86320118 MK35

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.8	mg/kg-wt
Mercury	Hg-Tiss	0.004	mg/kg-wt
Lead	Pb-Tiss	0.06	mg/kg-wt
Copper	Cu-Tiss	1.9	mg/kg-wt
Zinc	Zn-Tiss	13.7	mg/kg-wt
Cadmium	Cd-Tiss	.11	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	9U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	300U	ug/kg
Phenanthrene	2U	ug/kg
Fluorene	30U	ug/kg
Naphthalene	160U	ug/kg
Anthracene	0.4J	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	9U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	10J	ug/kg
Fluoranthene	10	ug/kg
Benzo(k)fluoranthene	0.4J	ug/kg
Acenaphthylene	300U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1M	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.1M	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	2.0	ug/kg
PCB - 1254	1.7	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: BC76

Sample No: 86 320111 Begin Sample Date: 86/08/06 10:00 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: BURTON COUNTY PARK - BUTTER CLAMS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	4.2	mg/kg-wt
Mercury	Hg-Tiss	0.016	mg/kg-wt
Lead	Pb-Tiss	0.57	mg/kg-wt
Copper	Cu-Tiss	2.3	mg/kg-wt
Zinc	Zn-Tiss	13.9	mg/kg-wt
Cadmium	Cd-Tiss	.08	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	10	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	0.4J	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1J	ug/kg
Fluoranthene	30	ug/kg
Benzo(k)fluoranthene	0.4J	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	3	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.16	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.35	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	2.4	ug/kg
PCB - 1254	4.1	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Station No: BC77

Sample No: 86 320112 Begin Sample Date: 86/08/06 10:00 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: BURTON COUNTY PARK - MANILA CLAMS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.1	mg/kg-wt
Mercury	Hg-Tiss	0.014	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	1.0	mg/kg-wt
Zinc	Zn-Tiss	14.8	mg/kg-wt
Cadmium	Cd-Tiss	.29	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	5	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	16	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	4J	ug/kg
Pyrene	10	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	40	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	8	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1M	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.35	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	2.9	ug/kg
PCB - 1254	4.0	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: BC78

Sample No: 86 320113 Begin Sample Date: 86/08/06 10:00 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: BURTON COUNTY PARK - LITTLENECK CLAMS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.7	mg/kg-wt
Mercury	Hg-Tiss	0.014	mg/kg-wt
Lead	Pb-Tiss	0.01U	mg/kg-wt
Copper	Cu-Tiss	1.4	mg/kg-wt
Zinc	Zn-Tiss	12.2	mg/kg-wt
Cadmium	Cd-Tiss	.33	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	10	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	0.4J	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	30	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.10M	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.1M	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	2.1	ug/kg
PCB - 1254	2.7	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: RP86

Sample No: 86 320114 Begin Sample Date: 86/08/06 11:45 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: ROSS POINT BUTTER CLAMS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	4.9	mg/kg-wt
Mercury	Hg-Tiss	0.021	mg/kg-wt
Lead	Pb-Tiss	0.20	mg/kg-wt
Copper	Cu-Tiss	5.0	mg/kg-wt
Zinc	Zn-Tiss	17.3	mg/kg-wt
Cadmium	Cd-Tiss	.06	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	10	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	8	ug/kg
Pyrene	40	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	40	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.89	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.68	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	13	ug/kg
PCB - 1254	10	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: RP88

Sample No: 86 320115 Begin Sample Date: 86/08/06 11:45 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: ROSS POINT NATIVE LITTLENECKS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.2	mg/kg-wt
Mercury	Hg-Tiss	0.015	mg/kg-wt
Lead	Pb-Tiss	0.27	mg/kg-wt
Copper	Cu-Tiss	1.9	mg/kg-wt
Zinc	Zn-Tiss	12.5	mg/kg-wt
Cadmium	Cd-Tiss	.19	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	10	ug/kg
Fluorene	30U	ug/kg
Naphthalene	140U	ug/kg
Anthracene	0.8	ug/kg
Pyrene	20	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	2	ug/kg
Fluoranthene	30	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1M	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.57	ug/kg
4,4'-DDE	0.54	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	11	ug/kg
PCB - 1254	8.6	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTB Account: A51837

Station No: BL112

Sample No: 86 320116 Begin Sample Date: 86/08/06 13:30 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: BURLY LAGOON BUTTER CLAMS

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.4	mg/kg-wt
Mercury	Hg-Tiss	0.004	mg/kg-wt
Lead	Pb-Tiss	0.09	mg/kg-wt
Copper	Cu-Tiss	1.8	mg/kg-wt
Zinc	Zn-Tiss	15.2	mg/kg-wt
Cadmium	Cd-Tiss	.09	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	200U	ug/kg
Phenanthrene	2J	ug/kg
Fluorene	30U	ug/kg
Naphthalene	130U	ug/kg
Anthracene	0.7	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1U	ug/kg
Fluoranthene	4J	ug/kg
Benzo(k)fluoranthene	0.4U	ug/kg
Acenaphthylene	200U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1U	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.22	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	3.4	ug/kg
PCB - 1254	3.8	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: PD67B

Sample No: 86 320117 Begin Sample Date: 86/08/05 : Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: BENT NOSE SUBSAMPLE - DASH POINT

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.6	mg/kg-wt
Mercury	Hg-Tiss	0.031	mg/kg-wt
Lead	Pb-Tiss	0.99	mg/kg-wt
Copper	Cu-Tiss	12.4	mg/kg-wt
Zinc	Zn-Tiss	49.3	mg/kg-wt
Cadmium	Cd-Tiss	.08	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	4U	ug/kg
Dibenzo(a,h)anthracene	20U	ug/kg
Benzo(a)anthracene	20	ug/kg
Acenaphthene	500U	ug/kg
Phenanthrene	10	ug/kg
Fluorene	60U	ug/kg
Naphthalene	280U	ug/kg
Anthracene	4	ug/kg
Pyrene	20U	ug/kg
Benzo(ghi)perylene	20U	ug/kg
Indeno(1,2,3-cd)pyrene	8U	ug/kg
Benzo(b)fluoranthene	6	ug/kg
Fluoranthene	100	ug/kg
Benzo(k)fluoranthene	3	ug/kg
Acenaphthylene	500U	ug/kg
Chrysene	20	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.2U	ug/kg
Chlordane	0.2U	ug/kg
gamma-BHC (Lindane)	0.2U	ug/kg
Dieldrin	0.2U	ug/kg
Endrin	0.2U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.2U	ug/kg
4,4'-DDE	0.65	ug/kg
Heptachlor	0.2U	ug/kg
Hexachlorobutadiene	0.2U	ug/kg
Hexachlorobenzene	0.2U	ug/kg
Aldrin	0.2U	ug/kg
alpha-BHC	0.2U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.2U	ug/kg
delta-BHC	0.2U	ug/kg
alpha-Endosulfan	0.2U	ug/kg
Heptachlor epoxide	0.2U	ug/kg
Endosulfan sulfate	0.2U	ug/kg
Endrin aldehyde	0.2U	ug/kg
Toxaphene	6U	ug/kg
PCB - 1260	7	ug/kg
PCB - 1254	6	ug/kg
PCB - 1221	2U	ug/kg
PCB - 1232	2U	ug/kg
PCB - 1248	2U	ug/kg
PCB - 1016	2U	ug/kg
beta-Endosulfan	0.2U	ug/kg
PCB - 1242	2U	ug/kg

(Sample Complete)

Project: AMB-060A PUGET SOUND SHELLFISH HARVEST STUDY Officer: DTE Account: A53B2F

Station No: MK35

Sample No: 86 320118 Begin Sample Date: 86/08/06 12:45 Source: Shellfish Tissue Depth: QA Code:

Laboratory: RX Description: MUKILTEO - BUTTER

Comment: SEE ALSO #86320110 MK35B

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.6	mg/kg-wt
Mercury	Hg-Tiss	0.001	mg/kg-wt
Lead	Pb-Tiss	0.26	mg/kg-wt
Copper	Cu-Tiss	1.8	mg/kg-wt
Zinc	Zn-Tiss	12.2	mg/kg-wt
Cadmium	Cd-Tiss	.10	mg/kg-wt

Poly Arom Hydrocrbn Parameter	Tissue Result	Units
Benzo(a)pyrene	2U	ug/kg
Dibenzo(a,h)anthracene	8U	ug/kg
Benzo(a)anthracene	2U	ug/kg
Acenaphthene	230U	ug/kg
Phenanthrene	2	ug/kg
Fluorene	30U	ug/kg
Naphthalene	130U	ug/kg
Anthracene	0.4J	ug/kg
Pyrene	10U	ug/kg
Benzo(ghi)perylene	8U	ug/kg
Indeno(1,2,3-cd)pyrene	4U	ug/kg
Benzo(b)fluoranthene	1J	ug/kg
Fluoranthene	8	ug/kg
Benzo(k)fluoranthene	0.4J	ug/kg
Acenaphthylene	230U	ug/kg
Chrysene	2U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	0.1U	ug/kg
Chlordane	0.1U	ug/kg
gamma-BHC (Lindane)	0.1U	ug/kg
Dieldrin	0.1U	ug/kg
Endrin	0.1U	ug/kg
Methoxychlor	NAR	ug/kg
4,4'-DDD	0.1U	ug/kg
4,4'-DDE	0.1M	ug/kg
Heptachlor	0.1U	ug/kg
Hexachlorobutadiene	0.1U	ug/kg
Hexachlorobenzene	0.1U	ug/kg
Aldrin	0.1U	ug/kg
alpha-BHC	0.1U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
beta-BHC	0.1U	ug/kg
delta-BHC	0.1U	ug/kg
alpha-Endosulfan	0.1U	ug/kg
Heptachlor epoxide	0.1U	ug/kg
Endosulfan sulfate	0.1U	ug/kg
Endrin aldehyde	0.1U	ug/kg
Toxaphene	3U	ug/kg
PCB - 1260	2.8	ug/kg
PCB - 1254	2.9	ug/kg
PCB - 1221	1U	ug/kg
PCB - 1232	1U	ug/kg
PCB - 1248	1U	ug/kg
PCB - 1016	1U	ug/kg
beta-Endosulfan	0.1U	ug/kg
PCB - 1242	1U	ug/kg

APPENDIX A-3

MACROALGAE DATA AND QA REVIEWS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10 LABORATORY
MANCHESTER, WASHINGTON 98353

REPLY TO ATTN OF: M/S Lab

October 19, 1987

MEMORANDUM

SUBJECT: Review - Puget Sound Macroalgae Data

FROM: Joseph N. Blazevich, Region 10 chemist JNB
Raleigh Farlow, Region 10 QA officer RF

TO: File

We have completed our review of Puget Sound macroalgae data. This review covers samples 86261000 - 86261084. All results are judged acceptable except as noted. The following comments should be considered by the data reviewer.

METALS

Metals were analyzed using EPA Region 10 procedures for metals in tissue/vegetation samples. This method employs the determinative steps described in EPA's "Methods for Chemical Analyses for Water and Waste Water".

Holding Times: All macroalgae samples were held frozen after homogenization up to five weeks from date of sampling to date of digestion. Although EPA has not established holding times for tissue/vegetation, all samples were analyzed within holding times established for soil/sediment by the CLP.

Blanks: All method blanks are acceptable. No metals were detected in method blanks at or above detection limits.

Spike Results: Except for those of mercury, matrix spike results fall within Manchester Laboratory range of acceptance of 60 to 140 percent for tissue/vegetation and are acceptable. This range is expanded for tissue/vegetation compared to that for soil and water, which are 75 to 125 percent, due to the complexity of the matrix. Spike recovery data is found in Table 1.

TABLE 1. PERCENT RECOVERIES OF METALS IN SELECTED SPIKED VEGETATION SAMPLES (%)
2 to 280 ug/Kg (ppb)

Parameter	Spike 1	Spike 2	Spike 3	Spike 4	Spike 5	Mean	Std.Dev.	RSD
arsenic	102	86	116	108	73	97	17	17.8
cadmium	a	a	a	101	71	86	35 *	-
zinc	102	101	92	97	77	94	10.1	10.9
mercury	58	58	63	3	64	49	26	53
copper	108	108	79	103	108	101	12.6	12.4
lead	104	114	95	111	96	104	8.6	8.2
chromium	104	100	103	89	115	102	9.3	9.1

a = spike level too low to quantify accurately.
* = percent difference rather than standard deviation is shown.

Except for spike 4, the mercury recovery values are consistent but low. Therefore, all mercury values are considered estimates and should be given the qualifier "J". The mercury recovery value associated with spike 4, sample 261062, is unacceptable. As a consequence, the mercury value reported for that sample is unacceptable and should be given the qualifier "R".

Except for mercury and cadmium, the precision for these results meet the Manchester Laboratory required limit of less than 20 percent and are acceptable. If one rejects the mercury result of spike 4 as an outlier, the precision of the mercury recovery results becomes acceptable.

Instrument performance was checked using three aqueous reference materials containing one or more of the target metals. The results of these analyses are found in Table 2. All are acceptable. Method detection limits range from

TABLE 2. REFERENCE MATERIAL SAMPLE RECOVERIES (%)
(0.0085 to 0.893 ug/ ml)

Metal	WP16#1	WP16#2	WP15#1	WS17#1	WS17#2
arsenic	97	100	a	95	a
cadmium	96	102	a	98	104
zinc	100	108	a	a	a
copper	98	97	108	a	a
lead	102	a	a	a	a
chromium	101	102	a	a	a

a = sample not analyzed for this analyte.

0.001 ug/gm for mercury and 0.1 ug/gm for cadmium to 1 ug/gm for all others.

PESTICIDES/PCBs

Pesticides/PCBs were analyzed using the EPA Region 10 procedure for pesticides/PCBs in tissue/vegetation samples employing the determinative steps found in method 608 using dual column confirmation and quantitation.

Holding Times: All macroalgae samples were held two days at 4°C before extraction. Although EPA has not established holding times for pesticides/PCBs in vegetation and tissues samples, it is noted that established holding times for water and soil/sediment were not exceeded for this sample set.

Blanks: All method blanks are acceptable. No pesticides/PCBs were detected at or above method detection limits of 0.001 to 0.03 ug/gm (ppm).

Spike Results: Matrix spike results are acceptable for target pesticides. Also, all surrogate recovery results are acceptable except for samples 261001, 261009, 261020, 261041, 261047, 261052 and 261065, which were low due to loss of sample during sample preparation. A summary of both matrix and surrogate results is found in Table 3. Results for individual pesticides recoveries are found in Table 4. Sample 261060 was not spiked with any pesticide surrogate. Therefore, all pesticide values associated with this sample and those listed above with low surrogate recoveries are considered estimates and should be given the qualifier "J". Replicate spike analyses give RSDs less than 50 percent, the Manchester Laboratory recommended limit, and are considered acceptable.

TABLE 3. SUMMARY - PESTICIDE SURROGATE AND MATRIX SPIKE RESULTS

Parameter	Mean(%)	Std.Dev.	RSD(%)	N	Range
Surrogate 1	89.5	10.9	12.1	46	61-107
Matrix spike 1	92.5	14.7	15.9	15	69-114
Matrix spike 2	75.1	19.8	26.4	15	46-105
Matrix spike 3	84.3	16.5	19.5	15	44-106
Matrix spike 4	88.6	19.1	21.6	15	67-129
Matrix spike 5	102.8	24.8	24.2	15	64-154

TABLE 4. PERCENT RECOVERIES OF SELECTED PESTICIDES IN SPIKED VEGETATION SAMPLES
4-20 ug/kg (ppb)

Compound	Spike 1	Spike 2	Spike 3	Spike 4	Spike 5	Mean(%)	Std.Dev.	RSD(%)
aldrin	105	78	94	74	93	89	12.7	14.2
dieldrin	72	62	90	100	81	81	14.9	18.4
4,4'-DDT	95	85	90	110	98	96	9.4	9.9
4,4'-DDE	95	94	106	129	103	105	14.2	13.4
4,4'-DDT	74	55	83	79	76	73	10.8	14.8
a-endosulfan	108	100	99	81	105	99	10.5	10.7
b-endosulfan	71	57	96	95	94	83	17.7	21.4
endrin	88	77	92	105	100	92	10.9	11.8
endrin ald.	69	52	44	69	64	60	11.1	18.7
heptachlor	100	46	89	73	89	79	21	26.5
heptachlor ep.	108	105	82	70	109	95	17.7	18.7
alpha-BHC	92	100	94	113	103	100	8.3	8.3
beta-BHC	98	82	62	89	154	97	34.5	35.6
lindane	98	82	62	87	154	93	37	40.1
delta-BHC	114	52	82	75	119	88	28	31.7

PNAs

PNAs were analyzed using the Region 10 procedure for tissue/vegetation with cleanup steps found in EPA method 610 and determinative steps found in the CLP "Statement of Work for Organic Analysis", Rev 2/87. The PNA results are considered acceptable for screening only, due to the lack of acceptable low level spike data and unsubstantiated detection limits. All data was collected under an acceptable GC/MS tune that meets DFTPP criteria.

Holding Times: All macroalgae samples were held at 4°C up to three days before extraction and analyzed within two months of extraction. EPA has not established holding times for PNAs in macroalgae.

Blanks: No PNAs were detected in either the blanks or samples at the estimated detection limit of 7.5 ug/Kg. All PNA detection limits should be given the qualifier "J".

Spike Results: Recoveries for PNAs and some related neutral compounds along with percent differences are found in Table 5. The results indicate low to

moderate recoveries with good precision, less than 50 percent, for most target analytes. Only naphthalene and 2-chloronaphthalene gave a percent difference greater than 50 percent.

TABLE 5. PERCENT RECOVERIES OF PNAs AND SELECTED COMPOUNDS IN MACROALGAE (1.6 ug/gm)

Parameter	Run 1	Run 2	Mean	% Diff.
naphthalene	52	26	39	66
2-methylnaphthalene	43	33	38	26
2-chloronaphthalene	31	17	24	56
acenaphthylene	51	49	50	4
acenaphthene	52	45	48.5	14.4
dibenzofuran	42	47	44.5	11.2
4-chlorophenyl phenyl ether	31	37	34	17.6
fluorene	53	58	55.5	9
4-bromophenyl phenyl ether	22	25	23.5	6.4
phenanthrene	45	45	45	0
anthracene	29	25	27	14.8
fluoranthene	54	58	56	7.1
pyrene	58	64	61	9.8
benzo(a)anthracene	49	52	50.5	5.9
chrysene	56	65	60.5	14.9
benzo(b or k)fluoranthene	55	61	58	10.3
benzo(a)pyrene	50	56	53	11.3
indeno(1,2,3-cd)pyrene	57	64	60.5	11.6
dibenzo(a,h)anthracene	51	45	48	12.5
benzo(ghi)perylene	62	67	64.5	7.8

Surrogate recoveries for the six samples, two blanks and two matrix spikes are found in summary form in Table 6. Although EPA has not established acceptance limits for tissue/vegetation surrogate recoveries, all surrogate recoveries fall within EPA established surrogate limits for water and soil/sediment. Also precision for the three surrogates is within 50 percent, the Manchester Laboratory recommended acceptance limit. Since EPA has not established precision acceptance limits for tissue/vegetation, this limit is used as a guide only.

TABLE 6. SUMMARY OF SURROGATE SPIKE RECOVERY RESULTS

surrogate	Mean(%)	Std.Dev.	RSD(%)	N
2-fluorobiphenyl	50	15.7	31	10
d10-pyrene	75.5	24.3	32.2	10
d14-terphenyl	62.6	14.1	22.6	10

OTHER ACID/NEUTRAL ANALYTES

The remainder of the acid/neutral compounds were analyzed using the EPA Region 10 procedure for tissue/vegetation. The method employs acetone extraction with a polytron high speed blender. The determinative steps outlined in the CLP "Methods for Analysis of Organics", Rev 2/87 was used. All data was collected under an acceptable tune that meets DFTPP criteria.

Holding Times: All samples were held frozen for up to one month before extraction and analyzed within one month after extraction. EPA has not established holding times for acid/neutral analytes in tissue/vegetation samples.

Blanks: No compounds were found in the blanks at or above estimated detection limits except for di-n-butyl phthalate(65ng/gm), bis(2-ethylhexyl) phthalate(130 ng/gm) and di-n-octyl phthalate(100ng/gm). di-n-Octyl phthalate was detected in each sample. Since this analyte was also detected in the blanks, these results should be given the qualifier "B". Also, benzyl alcohol was detected in sample 86261081 and given the qualifier "J" since the value fell outside the initial five point calibration curve. All detection limits are derived from instrument detection limits and analytical parameters used during the analysis and should be considered estimates. The qualifier "J" should be given to all detection limits.

Spike Results: All samples were diluted such that only limited surrogate recovery data was determined. Although acceptable surrogate recovery ranges have not been established for macroalgae, the sample surrogate results obtained were within the acceptance limits for soil/sediments. Except for phenol, 4-nitrophenol, dibenz(a,h)anthracene and benzo(g,h,i)perylene, spiked acid/neutral analytes gave acceptable recoveries. Both phenol and 4-nitrophenol were not detected in the matrix spikes. As a consequence, all phenol and 4-nitrophenol data in the sample set should be given the qualifier "R". Since the two PNAs, dibenz(a,h)anthracene and benzo(g,h,i)perylene, show unusually high recoveries, results for these analytes for the sample set should be given the qualifier "J". Spike recoveries are found in Table 7.

VOLATILES

Volatiles were analyzed using EPA Region 10 procedure for VOAs in tissue/vegetation. The procedure employs heated purge and trap along with the determinative steps found in the CLP "Statement of Work for Organic Analysis", Rev 2/87. All VOA data was collected under an acceptable tune that meets BFB criteria.

Holding Times: All macroalgae were held frozen up to two months until analyzed. EPA has not established holding times for VOAs in tissue/vegetation. However, holding times for water and solids, which maybe taken as guidelines for tissue/vegetation, were exceeded. Consequently, all VOA results must be given the qualifier "J".

Blanks: All blanks are acceptable. Only the common blank contaminates methylene chloride, 2-butanone and acetone were found. All results for these analytes should be given the qualifier "B".

Spike Results: VOA surrogate and matrix spike recoveries are acceptable except for the following analytes. The recoveries of chloromethane, bromomethane, vinyl chloride and acetone are extremely high. All values reported for each of these analytes should be given the qualifier "J". A summary of

TABLE 7. PERCENT RECOVERY RESULTS FOR ACID/NEUTRAL ANALYTES [4 ug/gm (ppm)]

Parameter	Spike 1	Spike 2	Mean	% diff.
phenol	ND	ND	-	-
bis(2-chloroethyl) ether	89	70	79.5	23.9
2-chlorophenol	76	63	69.5	18.7
1,3-dichlorobenzene	68	54	61	23
1,4-dichlorobenzene	69	56	62.5	20.8
benzyl alcohol	100	82	91	19.8
1,2-dichlorobenzene	71	59	65	18.5
2-methylphenol	89	73	81	19.8
bis(2-chloroisopropyl) ether	79	69	74	13.5
4-methylphenol	90	73	81.5	20.9
N-nitroso-di-n-propylamine	85	62	73.5	31.3
hexachloroethane	47	38	42.5	21.2
nitrobenzene	73	57	65	24.6
isophorone	79	65	72	19.4
2-nitrophenol	75	62	68.5	19
2,4-dimethylphenol	120	100	110	18.2
benzoic acid	90	71	80.5	23.6
bis(2-chloroethoxy)methane	82	66	74	21.6
dichlorophenol	75	60	67.5	22.2
1,2,4-trichlorobenzene	64	56	60	13.3
naphthalene	88	81	84.5	8.3
hexachlorobutadiene	46	43	44.5	6.7
4-chloro-3-methylphenol	86	73	79.5	16.4
2-methylnaphthalene	83	70	76.5	17
hexachlorocyclopentadiene	26	31	28.5	17.5
2,4,6-trichlorophenol	94	78	86	18.6
2,4,5-trichlorophenol	60	49	54.5	20.2
2-chloronaphthalene	76	64	70	17.1
dimethyl phthalate	88	71	79.5	20.1
acenaphthylene	94	86	90	8.9
acenaphthene	81	77	79	5.1
2,4-dinitrophenol	46	15	30.5	101.6
4-nitrophenol	ND	ND	-	-
dibenzofuran	80	69	74.5	14.8
2,4-dinitrotoluene	74	58	66	24.2
2,6-dinitrotoluene	86	62	74	32.4
diethyl phthalate	85	72	78.5	16.6
4-chlorophenyl phenyl ether	64	53	58.5	18.8
fluorene	86	81	83.5	6
4,6-dinitro-2-methylphenol	73	53	63	31.7
4-bromophenyl phenyl ether	70	53	61.5	27.6
hexachlorobenzene	68	61	64.5	10.9
pentachlorophenol	42	27	34.5	43.5
phenanthrene	88	80	84	9.5
anthracene	77	64	70.5	18.4
di-n-butyl phthalate	100	80	90	22.2
fluoranthene	80	70	75	13.3
pyrene	88	78	83	12
butylbenzyl phthalate	85	67	76	23.7
benzo(a)anthracene	110	92	101	17.8
bis(2-ethylhexyl) phthalate	110	76	93	36.6
chrysene	73	68	70.5	7.1
di-n-octyl phthalate	86	160	122.5	60.4
benzo(b and k)fluoranthene	79	71	75	10.7
benzo(a)pyrene	77	73	75	5.3
indeno(1,2,3-cd)pyrene	98	99	98.5	1
dibenz(a,h)anthracene	240	230	235	4.3
benzo(g,h,i)perylene	180	180	180	0

both surrogate and matrix spike results is found in Table 8. Individual results are displayed in Table 9. All spiked analytes show acceptable precision. 24 of 29 (82.8%) fall below 10 percent difference with the remainder below 25 percent difference.

TABLE 8 SUMMARY - VOA SURROGATE AND MATRIX SPIKE RECOVERIES

Parameter	Mean(%)	Std.Dev.	RSD	N	Range
surrogate 1	92.4	10.7	11.5	7	83-111
surrogate 2	118.7	6.7	5.6	7	111-128
surrogate 3	77.7	5.6	7.2	7	73-87
matrix spike 1	95.8	16.4	17.1	29	61-130
matrix spike 2	94.7	15.3	16.1	29	63-120

TABLE 9 PERCENT RECOVERY RESULTS FOR VOA IN MATRIX SPIKES [250 ug/kg(ppb)]

Parameter	Spike 1	Spike 2	Mean	% diff.
chloroethane	130	120	125	8
methylene chloride	120	100	110	18.2
carbon disulfide	78	63	70.5	17
1,1-dichloroethene	68	76	72	11.1
1,1-dichloroethane	110	110	110	0
trans-1,2-dichloroethane	120	120	120	0
chloroform	110	110	110	0
1,2-dichloroethane	110	86	98	24.5
2-butanone	98	120	109	20.2
1,1,1-trichloroethane	94	93	93.5	1.1
carbon tetrachloride	84	86	85	2.4
bromodichloromethane	95	94	94.5	1.1
1,2-dichloropropane	99	98	98.5	2
trans-1,3-dichloropropene	94	94	94	0
trichloroethene	95	95	95	0
dibromochloromethane	79	81	80	2.5
1,1,2-trichloroethane	85	86	85.5	1.2
benzene	100	100	100	0
cis-1,3-dichloropropene	88	89	88.5	1.1
bromoform	61	65	63	6.3
2-hexanone	96	106	101	9.9
4-methyl-2-pentanone	100	100	100	0
tetrachloroethene	96	94	95	2.1
1,1,2,2-tetrachloroethane	64	64	64	0
toluene	120	110	115	8.7
chlorobenzene	100	99	99.5	1
ethylbenzene	100	98	99	2
styrene	92	94	93	2.2
total xylenes	95	95	95	0

INTEROFFICE MEMO

TRA TECH, INC.
HONEYWELL SUBSIDIARY
NORTHLAP WY. STE 100
LLEVUE, WA 98005-1927
LEPHONE (206) 822-9596

TO Project File, TC 3338-28, QA/QC DATE 12/23/87

FROM Lynne Kilpatrick-Howard

SUBJECT QA/QC Review of the Puget Sound Macroalgae Data and the Report generated by Joseph N. Blazevich, U.S. EPA Region X

My review of the Puget Sound macroalgae data and the memorandum generated by Joseph N. Blazevich and Raleigh Farlow of the U.S. Environmental Protection Agency (EPA) Region X has been completed. The data are judged acceptable and the recommendations made by the U.S. EPA reviewer are appropriate. The guidance provided by the U.S. EPA reviewer was followed and the recommended data qualifiers were assigned to the data.

The following database qualifiers were assigned to the Puget Sound macroalgae data submitted:

U = Undetected

J = Estimated value for one of the following reasons: compound verified but not quantified because value exceeded the five-point calibration curve, compound is tentatively identified, response factor may be low, or the standard was not within the allowed 25 percent response factor difference

M = Compound verified below quantification limit

B = Compound detected in associated blank

S = Data may be used for screening purposes only

NAR = No analysis results

NAI = Not analyzed because of interference.

Project: ANB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTB Account: ANLBIF

Station No: PNA1

Sample No: 86 261000 Begin Sample Date: 86/06/23 10:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: *PT NO PT, ULVA SPP, NR LIGHTHOUSE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.82	mg/kg-wt
Mercury	Hg-Tiss	0.002	mg/kg-wt
Lead	Pb-Tiss	0.25	mg/kg-wt
Copper	Cu-Tiss	14.34	mg/kg-wt
Zinc	Zn-Tiss	4.2	mg/kg-wt
Chromium	Cr-Tiss	1.5	mg/kg-wt
Cadmium	Cd-Tiss	0.118	mg/kg-wt

VOA - PP Scan (GCMS) Parameter	Tissue Result	Units
Carbon Tetrachloride	12U	ug/kg
Acetone	5000B	ug/kg
Chloroform	12U	ug/kg
Benzene	3.8J	ug/kg
1,1,1-Trichloroethane	12U	ug/kg
Bromomethane	25U	ug/kg
Chloromethane	25U	ug/kg
Chloroethane	25U	ug/kg
Vinyl Chloride	25U	ug/kg
Methylene Chloride	9.7BJ	ug/kg
Carbon Disulfide	12U	ug/kg
Bromoform	12U	ug/kg
Bromodichloromethane	12U	ug/kg
1,1-Dichloroethane	12U	ug/kg
1,1-Dichloroethene	12U	ug/kg
1,2-Dichloropropane	12U	ug/kg
2-Butanone	85	ug/kg
1,1,2-Trichloroethane	12U	ug/kg
Trichloroethene	12U	ug/kg
1,1,2,2-Tetrachloroetha	25U	ug/kg
Total Xylenes	12U	ug/kg
Ethylbenzene	12U	ug/kg
Styrene	12U	ug/kg
1,2-Dichloroethane	12U	ug/kg
Vinyl Acetate	25U	ug/kg
4-Methyl-2-Pentanone	25U	ug/kg
Toluene	12U	ug/kg
Chlorobenzene	12U	ug/kg
2-Chloroethylvinylether	25U	ug/kg
Dibromochloromethane	12U	ug/kg
Tetrachloroethene	12U	ug/kg
Cis-1,2-Dichloroethene	REQ	
trans-1,2-Dichloroethen	12U	ug/kg

VOA - PP Scan (GCMS) *** Continued *** Parameter	Tissue Result	Units
2-Hexanone	57UJ	ug/kg
cis-1,3-Dichloropropene	12U	ug/kg
trans-1,3-Dichloroprope	12U	ug/kg

Misc GCMS Specified Parameter	Tissue Result	Units
Benzo(a)pyrene	7.0U	ug/kg
Dibenzo(a,h)anthracene	7.0U	ug/kg
Benzo(a)anthracene	7.0U	ug/kg
Acenaphthene	7.0U	ug/kg
Phenanthrene	7.0U	ug/kg
Fluorene	7.0U	ug/kg
Naphthalene	7.0U	ug/kg
2-Methylnaphthalene	7.0U	ug/kg
2-Chloronaphthalene	7.0U	ug/kg
4-Bromophenyl-phenyleth	7.0U	ug/kg
Anthracene	7.0U	ug/kg
Pyrene	7.0U	ug/kg
Dibenzofuran	7.0U	ug/kg
Benzo(ghi)perylene	7.0U	ug/kg
Indeno(1,2,3-cd)pyrene	7.0U	ug/kg
Benzo(b)fluoranthene	7.0U	ug/kg
Fluoranthene	7.0U	ug/kg
Benzo(k)fluoranthene	7.0U	ug/kg
Acenaphthylene	7.0U	ug/kg
Chrysene	7.0U	ug/kg
4-Chlorophenyl-phenylet	7.0U	ug/kg

B/N/Acid Scan Parameter	Tissue Result	Units
Benzo(a)pyrene	110U	ug/kg
2,4-Dinitrophenol	560U	ug/kg
Dibenzo(a,h)anthracene	110U	ug/kg
Benzo(a)anthracene	110U	ug/kg
4-Chloro-3-Methylphenol	110U	ug/kg
Benzoic acid	560U	ug/kg
Hexachloroethane	110U	ug/kg
Hexachlorocyclopentadie	110U	ug/kg
Isophorone	110U	ug/kg
Acenaphthene	110U	ug/kg

B/N/Acid Scan *** Continued *** Parameter	Tissue Result	Units
Diethylphthalate	110BU	ug/kg
Di-n-Butylphthalate	110BU	ug/kg
Phenanthrene	110U	ug/kg
Butylbenzylphthalate	110U	ug/kg
N-Nitrosodiphenylamine	950B	ug/kg
Fluorene	110U	ug/kg
Hexachlorobutadiene	110U	ug/kg
Pentachlorophenol	560BU	ug/kg
2,4,6-Trichlorophenol	110U	ug/kg
2-Nitroaniline	560U	ug/kg
2-Nitrophenol	110U	ug/kg
Naphthalene	110U	ug/kg
2-Methylnaphthalene	110U	ug/kg
2-Chloronaphthalene	110U	ug/kg
3,3'-Dichlorobenzidine	220U	ug/kg
2-Methylphenol	110U	ug/kg
1,2-Dichlorobenzene	110U	ug/kg
o-Chlorophenol	110U	ug/kg
2,4,5-Trichlorophenol	560U	ug/kg
Nitrobenzene	110U	ug/kg
3-Nitroaniline	560U	ug/kg
4-Nitroaniline	560U	ug/kg
4-Nitrophenol	560U	ug/kg
Benzyl Alcohol	110U	ug/kg
4-Bromophenyl-phenyleth	110U	ug/kg
2,4-Dimethylphenol	110U	ug/kg
4-Methylphenol	110U	ug/kg
1,4-Dichlorobenzene	110U	ug/kg
4-Chloroaniline	110U	ug/kg
Phenol	110U	ug/kg
bis(2-Chloroethyl)Ether	110U	ug/kg
bis(2-Chloroethoxy)Meth	110U	ug/kg
bis(2-Ethylhexyl)Phthal	1000B	ug/kg
Di-n-Octyl Phthalate	1700	ug/kg
Hexachlorobenzene	110U	ug/kg
Anthracene	110U	ug/kg
1,2,4-Trichlorobenzene	110U	ug/kg
2,4-Dichlorophenol	110U	ug/kg
2,4-Dinitrotoluene	110U	ug/kg
Pyrene	110U	ug/kg
Dimethylphthalate	110U	ug/kg
Dibenzofuran	110U	ug/kg
Benzo(ghi)perylene	110U	ug/kg
Indeno(1,2,3-cd)pyrene	110U	ug/kg

(Continued on next page)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: PNA1

Sample No: 86 261000 Begin Sample Date: 86/06/23 10:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: *PT NO PT, ULVA SPP, NR LIGHTHOUSE

B/N/Acid Scan *** Continued ***	Tissue	
Parameter	Result	Units
Benzo(b)fluoranthene	110U	ug/kg
Fluoranthene	110U	ug/kg
Benzo(k)fluoranthene	110U	ug/kg
Acenaphthylene	110U	ug/kg
Chrysene	110U	ug/kg
4,6-Dinitro-2-methylphe	560U	ug/kg
1,3-Dichlorobenzene	110U	ug/kg
2,6-Dinitrotoluene	110U	ug/kg
N-Nitroso-di-n-Propylam	110U	ug/kg
4-Chlorophenyl-phenylet	110U	ug/kg
bis(2-Chloroisopropyl)E	110U	ug/kg

Pest/PCB - PP Scan	Tissue	
Parameter	Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg

Pest/PCB - PP Scan *** Continued ***	Tissue	
Parameter	Result	Units
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTM Account: AMLE2F

Station No: PNA2

Sample No: 86 261001 Begin Sample Date: 86/06/23 10:30 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, PORPHYRA SPP, NR LIGHTHOUSE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.59	mg/kg-wt
Mercury	Hg-Tiss	0.001	mg/kg-wt
Lead	Pb-Tiss	0.005U	mg/kg-wt
Copper	Cu-Tiss	0.93	mg/kg-wt
Zinc	Zn-Tiss	2.8	mg/kg-wt
Chromium	Cr-Tiss	0.44	mg/kg-wt
Cadmium	Cd-Tiss	0.222	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: PNA3

Sample No: 86 261002 Begin Sample Date: 86/06/23 10:45 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, LAMINARIA, SPP, NR LIGHTHOUSE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.38	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.005U	mg/kg-wt
Copper	Cu-Tiss	0.63	mg/kg-wt
Zinc	Zn-Tiss	1.8	mg/kg-wt
Chromium	Cr-Tiss	0.08	mg/kg-wt
Cadmium	Cd-Tiss	0.128	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTS Account: AMLB2F

Station No: PNB1

Sample No: 86 261003 Begin Sample Date: 86/06/23 12:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, LAMINARIA SPP, HANSVILLE PIER

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	7.50	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.02	mg/kg-wt
Copper	Cu-Tiss	1.45	mg/kg-wt
Zinc	Zn-Tiss	2.8	mg/kg-wt
Chromium	Cr-Tiss	0.20	mg/kg-wt
Cadmium	Cd-Tiss	0.067	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: PNB2

Sample No: 86 261004 Begin Sample Date: 86/06/23 12:10 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, ULVA SPP, HANSVILLE PIER

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.37	mg/kg-wt
Mercury	Hg-Tiss	0.004	mg/kg-wt
Lead	Pb-Tiss	0.005U	mg/kg-wt
Copper	Cu-Tiss	11.36	mg/kg-wt
Zinc	Zn-Tiss	6.6	mg/kg-wt
Chromium	Cr-Tiss	1.86	mg/kg-wt
Cadmium	Cd-Tiss	0.125	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-06IA PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB3F

Station No: PMB3

Sample No: 86 261005 Begin Sample Date: 86/06/23 12:15 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, NEREOCYSTIS SPP, HANSVILLE PIE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	4.45	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.155	mg/kg-wt
Copper	Cu-Tiss	0.44	mg/kg-wt
Zinc	Zn-Tiss	2.2	mg/kg-wt
Chromium	Cr-Tiss	0.16	mg/kg-wt
Cadmium	Cd-Tiss	0.363	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: PNB4

Sample No: 86 261006 Begin Sample Date: 86/06/23 12:20 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, PORPHYRA SPP, HANSVILLE PIER

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.47	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.005U	mg/kg-wt
Copper	Cu-Tiss	2.88	mg/kg-wt
Zinc	Zn-Tiss	3.5	mg/kg-wt
Chromium	Cr-Tiss	0.64	mg/kg-wt
Cadmium	Cd-Tiss	0.394	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: ANB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: ANLB3F

Station No: PNC1

Sample No: 86 261007 Begin Sample Date: 86/06/23 13:30 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, ULVA SPP, SKUNK BAY

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.10	mg/kg-wt
Mercury	Hg-Tiss	0.001	mg/kg-wt
Lead	Pb-Tiss	0.02	mg/kg-wt
Copper	Cu-Tiss	3.99	mg/kg-wt
Zinc	Zn-Tiss	3.8	mg/kg-wt
Chromium	Cr-Tiss	0.74	mg/kg-wt
Cadmium	Cd-Tiss	0.297	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: PNC2

Sample No: 86 261008 Begin Sample Date: 86/06/23 13:40 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, LAMINARIA SPP, SKUNK BAY

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	4.75	mg/kg-wt
Mercury	Hg-Tiss	0.001	mg/kg-wt
Lead	Pb-Tiss	0.10	mg/kg-wt
Copper	Cu-Tiss	0.86	mg/kg-wt
Zinc	Zn-Tiss	1.4	mg/kg-wt
Chromium	Cr-Tiss	0.20	mg/kg-wt
Cadmium	Cd-Tiss	0.130	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB3F

Sample No: 86 261009 Begin Sample Date: 86/06/23 13:45 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, NEREOCYSTIS SPP, SKUNK BAY

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.35	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.005U	mg/kg-wt
Copper	Cu-Tiss	5.73	mg/kg-wt
Zinc	Zn-Tiss	3.3	mg/kg-wt
Chromium	Cr-Tiss	1.43	mg/kg-wt
Cadmium	Cd-Tiss	0.365	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	2	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: PNC4

Sample No: 86 261010 Begin Sample Date: 86/06/23 13:50 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: PT NO PT, PORPHYRA SPP, SKUNK BAY

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.00	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.005U	mg/kg-wt
Copper	Cu-Tiss	8.66	mg/kg-wt
Zinc	Zn-Tiss	3.8	mg/kg-wt
Chromium	Cr-Tiss	1.38	mg/kg-wt
Cadmium	Cd-Tiss	0.207	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EHD1

Sample No: 86 261020 Begin Sample Date: 86/06/23 11:15 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: EVRT HRBR, ULVA, DARLINGTON BEACH

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.43	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.10	mg/kg-wt
Copper	Cu-Tiss	3.75	mg/kg-wt
Zinc	Zn-Tiss	2.2	mg/kg-wt
Chromium	Cr-Tiss	1.07	mg/kg-wt
Cadmium	Cd-Tiss	0.048	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EHC1

Sample No: 86 261021 Begin Sample Date: 86/06/23 12:45 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: EVRT HRBR, ULVA, HOWARTH PARK

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.41	mg/kg-wt
Mercury	Hg-Tiss	0.001	mg/kg-wt
Lead	Pb-Tiss	0.085	mg/kg-wt
Copper	Cu-Tiss	2.21	mg/kg-wt
Zinc	Zn-Tiss	2.1	mg/kg-wt
Chromium	Cr-Tiss	0.85	mg/kg-wt
Cadmium	Cd-Tiss	0.053	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Station No: EHA1

Sample No: 86 261022 Begin Sample Date: 86/06/23 15:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: *EVRT HRBR, ULVA, PRIEST POINT

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.68	mg/kg-wt
Mercury	Hg-Tiss	0.002	mg/kg-wt
Lead	Pb-Tiss	0.37	mg/kg-wt
Copper	Cu-Tiss	9.20	mg/kg-wt
Zinc	Zn-Tiss	4.3	mg/kg-wt
Chromium	Cr-Tiss	1.96	mg/kg-wt
Cadmium	Cd-Tiss	0.058	mg/kg-wt

VOA - PP Scan (GCMS) Parameter	Tissue Result	Units
Carbon Tetrachloride	12U	ug/kg
Acetone	24UJ	ug/kg
Chloroform	12U	ug/kg
Benzene	0.87J	ug/kg
1,1,1-Trichloroethane	12U	ug/kg
Bromomethane	24U	ug/kg
Chloromethane	24U	ug/kg
Chloroethane	24U	ug/kg
Vinyl Chloride	24U	ug/kg
Methylene Chloride	60B	ug/kg
Carbon Disulfide	12U	ug/kg
Bromoform	12U	ug/kg
Bromodichloromethane	12U	ug/kg
1,1-Dichloroethane	12U	ug/kg
1,1-Dichloroethene	12U	ug/kg
1,2-Dichloropropane	12U	ug/kg
2-Butanone	31B	ug/kg
1,1,2-Trichloroethane	12U	ug/kg
Trichloroethene	12U	ug/kg
1,1,2,2-Tetrachloroetha	24U	ug/kg
Total Xylenes	12U	ug/kg
Ethylbenzene	12U	ug/kg
Styrene	12U	ug/kg
1,2-Dichloroethane	12U	ug/kg
Vinyl Acetate	28J	ug/kg
4-Methyl-2-Pentanone	5.3J	ug/kg
Toluene	1.3J	ug/kg
Chlorobenzene	12U	ug/kg
2-Chloroethylvinylether	24U	ug/kg
Dibromochloromethane	12U	ug/kg
Tetrachloroethene	12U	ug/kg
Cis-1,2-Dichloroethene	REQ	
trans-1,2-Dichloroethen	12U	ug/kg

VOA - PP Scan (GCMS) *** Continued *** Parameter	Tissue Result	Units
2-Hexanone	34	ug/kg
cis-1,3-Dichloropropene	12U	ug/kg
trans-1,3-Dichloroprope	12U	ug/kg

B/N/Acid Scan Parameter	Tissue Result	Units
Benzo(a)pyrene	120U	ug/kg
2,4-Dinitrophenol	580U	ug/kg
Dibenzo(a,h)anthracene	120U	ug/kg
Benzo(a)anthracene	120U	ug/kg
4-Chloro-3-Methylphenol	120U	ug/kg
Benzoic acid	580U	ug/kg
Hexachloroethane	120U	ug/kg
Hexachlorocyclopentadie	120U	ug/kg
Isophorone	120U	ug/kg
Acenaphthene	120U	ug/kg
Diethylphthalate	120BU	ug/kg
Di-n-Butylphthalate	120BU	ug/kg
Phenanthrene	120U	ug/kg
Butylbenzylphthalate	120U	ug/kg
N-Nitrosodiphenylamine	120BU	ug/kg
Fluorene	120U	ug/kg
Hexachlorobutadiene	120U	ug/kg
Pentachlorophenol	580BU	ug/kg
2,4,6-Trichlorophenol	120U	ug/kg
2-Nitroaniline	580U	ug/kg
2-Nitrophenol	120U	ug/kg
Naphthalene	120U	ug/kg
2-Methylnaphthalene	120U	ug/kg
2-Chloronaphthalene	120U	ug/kg
3,3'-Dichlorobenzidine	230U	ug/kg
2-Methylphenol	120U	ug/kg
1,2-Dichlorobenzene	120U	ug/kg
o-Chlorophenol	120U	ug/kg
2,4,5-Trichlorophenol	580U	ug/kg
Nitrobenzene	120U	ug/kg
3-Nitroaniline	580U	ug/kg
4-Nitroaniline	580U	ug/kg
4-Nitrophenol	580U	ug/kg
Benzyl Alcohol	120U	ug/kg
4-Bromophenyl-phenyleth	120U	ug/kg
2,4-Dimethylphenol	120U	ug/kg

B/N/Acid Scan *** Continued *** Parameter	Tissue Result	Units
4-Methylphenol	120U	ug/kg
1,4-Dichlorobenzene	120U	ug/kg
4-Chloroaniline	120U	ug/kg
Phenol	120U	ug/kg
bis(2-Chloroethyl)Ether	120U	ug/kg
bis(2-Chloroethoxy)Meth	120U	ug/kg
bis(2-Ethylhexyl)Phthal	730B	ug/kg
Di-n-Octyl Phthalate	1300	ug/kg
Hexachlorobenzene	120U	ug/kg
Anthracene	120U	ug/kg
1,2,4-Trichlorobenzene	120U	ug/kg
2,4-Dichlorophenol	120U	ug/kg
2,4-Dinitrotoluene	120U	ug/kg
Pyrene	120U	ug/kg
Dimethylphthalate	120U	ug/kg
Dibenzofuran	120U	ug/kg
Benzo(ghi)perylene	120U	ug/kg
Indeno(1,2,3-cd)pyrene	120U	ug/kg
Benzo(b)fluoranthene	120U	ug/kg
Fluoranthene	120U	ug/kg
Benzo(k)fluoranthene	120U	ug/kg
Acenaphthylene	120U	ug/kg
Chrysene	120U	ug/kg
4,6-Dinitro-2-methylphe	580U	ug/kg
1,3-Dichlorobenzene	120U	ug/kg
2,6-Dinitrotoluene	120U	ug/kg
N-Nitroso-di-n-Propylam	120U	ug/kg
4-Chlorophenyl-phenylet	120U	ug/kg
bis(2-Chloroisopropyl)E	120U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	4	ug/kg
Heptachlor	1U	ug/kg

(Continued on next page)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EHA1

Sample No: 86 261022 Begin Sample Date: 86/06/23 15:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: *EVRT HRBR, ULVA, PRIEST POINT

Pest/PCB - PP Scan Tissue
*** Continued ***

Parameter	Result	Units
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB3F

Station No: EBA1

Sample No: 86 261040 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, PORPHYRA, SMITZ VIEW PARK

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.08	mg/kg-wt
Mercury	Hg-Tiss	0.001	mg/kg-wt
Lead	Pb-Tiss	0.145	mg/kg-wt
Copper	Cu-Tiss	1.60	mg/kg-wt
Zinc	Zn-Tiss	3.0	mg/kg-wt
Chromium	Cr-Tiss	0.45	mg/kg-wt
Cadmium	Cd-Tiss	0.367	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBA2

Sample No: 86 261041 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, MEREOCYSTIS, SMITS VIEW PARK

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.60	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.10	mg/kg-wt
Copper	Cu-Tiss	0.32	mg/kg-wt
Zinc	Zn-Tiss	4.4	mg/kg-wt
Chromium	Cr-Tiss	0.06	mg/kg-wt
Cadmium	Cd-Tiss	0.429	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	2	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND NEBULE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBA4

Sample No: 86 261043 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, LAMINARIA, SMITH VIEW PARK

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.70	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.10	mg/kg-wt
Copper	Cu-Tiss	0.23	mg/kg-wt
Zinc	Zn-Tiss	1.8	mg/kg-wt
Chromium	Cr-Tiss	0.01	mg/kg-wt
Cadmium	Cd-Tiss	0.172	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBB1

Sample No: 86 261044 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, PORPHYRA, ALKI

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.20	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.24	mg/kg-wt
Copper	Cu-Tiss	3.95	mg/kg-wt
Zinc	Zn-Tiss	2.5	mg/kg-wt
Chromium	Cr-Tiss	0.39	mg/kg-wt
Cadmium	Cd-Tiss	0.155	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Station No: EBB2

Sample No: 86 261045 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, NEREOCYSTIS, ALKI

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.35	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.15	mg/kg-wt
Copper	Cu-Tiss	0.18	mg/kg-wt
Zinc	Zn-Tiss	4.0	mg/kg-wt
Chromium	Cr-Tiss	0.08	mg/kg-wt
Cadmium	Cd-Tiss	0.437	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBB3

Sample No: 86 261046 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, ULVA, ALKI

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.73	mg/kg-wt
Mercury	Hg-Tiss	0.002	mg/kg-wt
Lead	Pb-Tiss	0.16	mg/kg-wt
Copper	Cu-Tiss	2.07	mg/kg-wt
Zinc	Zn-Tiss	2.5	mg/kg-wt
Chromium	Cr-Tiss	0.49	mg/kg-wt
Cadmium	Cd-Tiss	0.122	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBB4

Sample No: 86 261047 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, LAMINARIA, ALKI

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	4.25	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.005U	mg/kg-wt
Copper	Cu-Tiss	0.45	mg/kg-wt
Zinc	Zn-Tiss	2.1	mg/kg-wt
Chromium	Cr-Tiss	0.05	mg/kg-wt
Cadmium	Cd-Tiss	0.104	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBC1

Sample No: 86 261048 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, PORPHYRA, DENNY WAY

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.88	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.14	mg/kg-wt
Copper	Cu-Tiss	1.55	mg/kg-wt
Zinc	Zn-Tiss	5.4	mg/kg-wt
Chromium	Cr-Tiss	0.11	mg/kg-wt
Cadmium	Cd-Tiss	0.062	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-861A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBC2

Sample No: 86 261049 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, NEREOCYSTIS, DENNY WAY

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	3.98	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.16	mg/kg-wt
Copper	Cu-Tiss	0.21	mg/kg-wt
Zinc	Zn-Tiss	4.5	mg/kg-wt
Chromium	Cr-Tiss	0.07	mg/kg-wt
Cadmium	Cd-Tiss	0.272	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBC3

Sample No: 86 261050 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: *E BAY, ULVA, DENNY WAY

Comment: BNA UNDOABLE, SEE SAMPLE 86261054

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.96	mg/kg-wt
Mercury	Hg-Tiss	0.004	mg/kg-wt
Lead	Pb-Tiss	1.16	mg/kg-wt
Copper	Cu-Tiss	4.23	mg/kg-wt
Zinc	Zn-Tiss	4.1	mg/kg-wt
Chromium	Cr-Tiss	0.27	mg/kg-wt
Cadmium	Cd-Tiss	0.046	mg/kg-wt

VOA - PP Scan (GCMS) Parameter	Tissue Result	Units
Carbon Tetrachloride	12U	ug/kg
Acetone	8700B	ug/kg
Chloroform	12U	ug/kg
Benzene	12U	ug/kg
1,1,1-Trichloroethane	12U	ug/kg
Bromomethane	25U	ug/kg
Chloromethane	25U	ug/kg
Chloroethane	25U	ug/kg
Vinyl Chloride	25U	ug/kg
Methylene Chloride	17B	ug/kg
Carbon Disulfide	12U	ug/kg
Bromoform	12U	ug/kg
Bromodichloromethane	12U	ug/kg
1,1-Dichloroethane	12U	ug/kg
1,1-Dichloroethene	12U	ug/kg
1,2-Dichloropropane	12U	ug/kg
2-Butanone	53	ug/kg
1,1,2-Trichloroethane	12U	ug/kg
Trichloroethene	12U	ug/kg
1,1,2,2-Tetrachloroetha	25U	ug/kg
Total Xylenes	12U	ug/kg
Ethylbenzene	12U	ug/kg
Styrene	12U	ug/kg
1,2-Dichloroethane	12U	ug/kg
Vinyl Acetate	43	ug/kg
4-Methyl-2-Pentanone	25U	ug/kg
Toluene	12U	ug/kg
Chlorobenzene	12U	ug/kg
2-Chloroethylvinylether	25U	ug/kg
Dibromochloromethane	12U	ug/kg
Tetrachloroethene	12U	ug/kg
Cis-1,2-Dichloroethene	REQ	
trans-1,2-Dichloroethen	12U	ug/kg

VOA - PP Scan (GCMS) *** Continued *** Parameter	Tissue Result	Units
2-Hexanone	25U	ug/kg
cis-1,3-Dichloropropene	12U	ug/kg
trans-1,3-Dichloroprope	12U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Program: [illegible]

PUGET SOUND EDIBLE MACROALGAE INVESTIGAT

Officer: BTE Account: [illegible]

Station No: EBD1

Sample No: 86 261052 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, PORPHYRA, PIER 91

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.73	mg/kg-wt
Mercury	Hg-Tiss	0.003	mg/kg-wt
Lead	Pb-Tiss	0.005	mg/kg-wt
Copper	Cu-Tiss	8.42	mg/kg-wt
Zinc	Zn-Tiss	2.3	mg/kg-wt
Chromium	Cr-Tiss	0.16	mg/kg-wt
Cadmium	Cd-Tiss	0.085	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	2	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBD2

Sample No: 86 261053 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, MEREOCYSTIS, PIER 91

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.60	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.14	mg/kg-wt
Copper	Cu-Tiss	0.20	mg/kg-wt
Zinc	Zn-Tiss	4.5	mg/kg-wt
Chromium	Cr-Tiss	0.05	mg/kg-wt
Cadmium	Cd-Tiss	0.340	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: EBD3

Sample No: 86 261054 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: E BAY, ULVA, PIER 91

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.90	mg/kg-wt
Mercury	Hg-Tiss	0.003	mg/kg-wt
Lead	Pb-Tiss	0.54	mg/kg-wt
Copper	Cu-Tiss	11.60	mg/kg-wt
Zinc	Zn-Tiss	5.3	mg/kg-wt
Chromium	Cr-Tiss	2.33	mg/kg-wt
Cadmium	Cd-Tiss	0.074	mg/kg-wt

B/N/Acid Scan Parameter	Tissue Result	Units
Benzo(a)pyrene	150U	ug/kg
2,4-Dinitrophenol	730U	ug/kg
Dibenzo(a,h)anthracene	150U	ug/kg
Benzo(a)anthracene	150U	ug/kg
4-Chloro-3-Methylphenol	150U	ug/kg
Benzoic acid	730U	ug/kg
Hexachloroethane	150U	ug/kg
Hexachlorocyclopentadie	150U	ug/kg
Isophorone	150U	ug/kg
Acenaphthene	150U	ug/kg
Diethylphthalate	150U	ug/kg
Di-n-Butylphthalate	150U	ug/kg
Phenanthrene	150U	ug/kg
Butylbenzylphthalate	150U	ug/kg
N-Nitrosodiphenylamine	150U	ug/kg
Fluorene	150U	ug/kg
Hexachlorobutadiene	150U	ug/kg
Pentachlorophenol	730U	ug/kg
2,4,6-Trichlorophenol	150U	ug/kg
2-Nitroaniline	730U	ug/kg
2-Nitrophenol	150U	ug/kg
Naphthalene	150U	ug/kg
2-Methylnaphthalene	150U	ug/kg
2-Chloronaphthalene	150U	ug/kg
3,3'-Dichlorobenzidine	290U	ug/kg
2-Methylphenol	150U	ug/kg
1,2-Dichlorobenzene	150U	ug/kg
o-Chlorophenol	150U	ug/kg
2,4,5-Trichlorophenol	730U	ug/kg
Nitrobenzene	150U	ug/kg
3-Nitroaniline	730U	ug/kg
4-Nitroaniline	730U	ug/kg
4-Nitrophenol	730U	ug/kg

B/N/Acid Scan *** Continued *** Parameter	Tissue Result	Units
Benzyl Alcohol	150U	ug/kg
4-Bromophenyl-phenyleth	150U	ug/kg
2,4-Dimethylphenol	150U	ug/kg
4-Methylphenol	150U	ug/kg
1,4-Dichlorobenzene	150U	ug/kg
4-Chloroaniline	150U	ug/kg
Phenol	150U	ug/kg
bis(2-Chloroethyl)Ether	150U	ug/kg
bis(2-Chloroethoxy)Meth	150U	ug/kg
bis(2-Ethylhexyl)Phthal	150BU	ug/kg
Di-n-Octyl Phthalate	540B	ug/kg
Hexachlorobenzene	150U	ug/kg
Anthracene	150U	ug/kg
1,2,4-Trichlorobenzene	150U	ug/kg
2,4-Dichlorophenol	150U	ug/kg
2,4-Dinitrotoluene	150U	ug/kg
Pyrene	150U	ug/kg
Dimethylphthalate	150U	ug/kg
Dibenzofuran	150U	ug/kg
Benzo(ghi)perylene	150U	ug/kg
Indeno(1,2,3-cd)pyrene	150U	ug/kg
Benzo(b)fluoranthene	150U	ug/kg
Fluoranthene	150U	ug/kg
Benzo(k)fluoranthene	150U	ug/kg
Acenaphthylene	150U	ug/kg
Chrysene	150U	ug/kg
4,6-Dinitro-2-methylphe	730U	ug/kg
1,3-Dichlorobenzene	150U	ug/kg
2,6-Dinitrotoluene	150U	ug/kg
N-Nitroso-di-n-Propylam	150U	ug/kg
4-Chlorophenyl-phenylet	150U	ug/kg
bis(2-Chloroisopropyl)E	150U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg

Pest/PCB - PP Scan *** Continued *** Parameter	Tissue Result	Units
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: CBB1

Sample No: 86 261060 Begin Sample Date: 86/06/23 10:35 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: C BAY, ULVA, TACOMA FISHING PIER

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.24	mg/kg-wt
Mercury	Hg-Tiss	0.002	mg/kg-wt
Lead	Pb-Tiss	0.46	mg/kg-wt
Copper	Cu-Tiss	3.08	mg/kg-wt
Zinc	Zn-Tiss	3.2	mg/kg-wt
Chromium	Cr-Tiss	0.18	mg/kg-wt
Cadmium	Cd-Tiss	0.085	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	3U	ug/kg
DDD, o,p'-	3U	ug/kg
Chlordane	3U	ug/kg
gamma-BHC (Lindane)	3U	ug/kg
Dieldrin	3U	ug/kg
Endrin	3U	ug/kg
Methoxychlor	30U	ug/kg
4,4'-DDD	3U	ug/kg
4,4'-DDE	4	ug/kg
Heptachlor	3U	ug/kg
Aldrin	3U	ug/kg
alpha-BHC	3U	ug/kg
beta-BHC	3U	ug/kg
delta-BHC	3U	ug/kg
DDT, o,p'-	3U	ug/kg
alpha-Endosulfan	3U	ug/kg
Heptachlor epoxide	3U	ug/kg
Endosulfan sulfate	3U	ug/kg
DDE, o,p'-	3U	ug/kg
Endrin aldehyde	3U	ug/kg
Toxaphene	90U	ug/kg
PCB - 1260	30U	ug/kg
PCB - 1254	30U	ug/kg
PCB - 1221	30U	ug/kg
PCB - 1232	30U	ug/kg
PCB - 1248	30U	ug/kg
PCB - 1016	30U	ug/kg
beta-Endosulfan	3U	ug/kg
trans-Nonachlor	3U	ug/kg
PCB - 1242	30U	ug/kg

(Sample Complete)

Project: AMB-06IA PUGET SOUND BREBLE MACROALGAE INVESTIGAT Officer: DTB Account: AMLB2F

Station No: CBB2

Sample No: 86 261061 Begin Sample Date: 86/06/23 10:35 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: C BAY, LAMINARIA, TACOMA FISHING PIER

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	4.20	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.085	mg/kg-wt
Copper	Cu-Tiss	0.52	mg/kg-wt
Zinc	Zn-Tiss	3.4	mg/kg-wt
Chromium	Cr-Tiss	0.07	mg/kg-wt
Cadmium	Cd-Tiss	0.208	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: CBA1

Sample No: 86 261062 Begin Sample Date: 86/06/23 12:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: C BAY, NEREOCYSTIS, W PT DEP BOAT HOUSE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.55	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.005U	mg/kg-wt
Copper	Cu-Tiss	0.11	mg/kg-wt
Zinc	Zn-Tiss	2.8	mg/kg-wt
Chromium	Cr-Tiss	0.01U	mg/kg-wt
Cadmium	Cd-Tiss	0.171	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Station No: CBA2

Sample No: 86 261063 Begin Sample Date: 86/06/23 12:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: C BAY, LAMINARIA, W PT DEF BOAT HOUSE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	4.80	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.34	mg/kg-wt
Copper	Cu-Tiss	0.92	mg/kg-wt
Zinc	Zn-Tiss	3.5	mg/kg-wt
Chromium	Cr-Tiss	0.10	mg/kg-wt
Cadmium	Cd-Tiss	0.152	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: CBA3

Sample No: 86 261064 Begin Sample Date: 86/06/23 12:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: C BAY, ULVA, W PT DEF BOAT HOUSE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	2.78	mg/kg-wt
Mercury	Hg-Tiss	0.015	mg/kg-wt
Lead	Pb-Tiss	4.46	mg/kg-wt
Copper	Cu-Tiss	19.15	mg/kg-wt
Zinc	Zn-Tiss	10.2	mg/kg-wt
Chromium	Cr-Tiss	1.59	mg/kg-wt
Cadmium	Cd-Tiss	0.102	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

30-OCT-87
14:06:55

EPA Region X Lab Management System
Sample/Project Analysis Results

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: CBC1

Sample No: 86 261065 Begin Sample Date: 86/06/23 12:30 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: C BAY, ULVA, SOUTH OF ASARCO PLANT

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	1.19	mg/kg-wt
Mercury	Hg-Tiss	0.003	mg/kg-wt
Lead	Pb-Tiss	0.37	mg/kg-wt
Copper	Cu-Tiss	2.37	mg/kg-wt
Zinc	Zn-Tiss	2.4	mg/kg-wt
Chromium	Cr-Tiss	0.21	mg/kg-wt
Cadmium	Cd-Tiss	0.111	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	2	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: CBC2

Sample No: 86 261066 Begin Sample Date: 86/06/23 12:30 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: C BAY, LAMINARIA, SOUTH OF ASARCO PLANT

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	9.20	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.19	mg/kg-wt
Copper	Cu-Tiss	0.72	mg/kg-wt
Zinc	Zn-Tiss	3.5	mg/kg-wt
Chromium	Cr-Tiss	0.07	mg/kg-wt
Cadmium	Cd-Tiss	0.280	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Station No: CBD1

Sample No: 86 261067 Begin Sample Date: 86/06/23 13:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: *C BAY, ULVA, RUSTON WAY PARK SITE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.94	mg/kg-wt
Mercury	Hg-Tiss	0.002	mg/kg-wt
Lead	Pb-Tiss	0.73	mg/kg-wt
Copper	Cu-Tiss	2.45	mg/kg-wt
Zinc	Zn-Tiss	4.1	mg/kg-wt
Chromium	Cr-Tiss	0.37	mg/kg-wt
Cadmium	Cd-Tiss	0.148	mg/kg-wt

VOA - PP Scan (GCMS) Parameter	Tissue Result	Units
Carbon Tetrachloride	12U	ug/kg
Acetone	13000B	ug/kg
Chloroform	12U	ug/kg
Benzene	2.1J	ug/kg
1,1,1-Trichloroethane	12U	ug/kg
Bromomethane	24U	ug/kg
Chloromethane	24U	ug/kg
Chloroethane	24U	ug/kg
Vinyl Chloride	24U	ug/kg
Methylene Chloride	19B	ug/kg
Carbon Disulfide	12U	ug/kg
Bromoform	12U	ug/kg
Bromodichloromethane	12U	ug/kg
1,1-Dichloroethane	12U	ug/kg
1,1-Dichloroethene	12U	ug/kg
1,2-Dichloropropane	12U	ug/kg
2-Butanone	48B	ug/kg
1,1,2-Trichloroethane	12U	ug/kg
Trichloroethene	12U	ug/kg
1,1,2,2-Tetrachloroetha	24U	ug/kg
Total Xylenes	12U	ug/kg
Ethylbenzene	12U	ug/kg
Styrene	12U	ug/kg
1,2-Dichloroethane	12U	ug/kg
Vinyl Acetate	39	ug/kg
4-Methyl-2-Pentanone	24U	ug/kg
Toluene	1.5J	ug/kg
Chlorobenzene	12U	ug/kg
2-Chloroethylvinylether	24U	ug/kg
Dibromochloromethane	12U	ug/kg
Tetrachloroethene	12U	ug/kg
Cis-1,2-Dichloroethene	REQ	
trans-1,2-Dichloroethen	12U	ug/kg

VOA - PP Scan (GCMS) *** Continued *** Parameter	Tissue Result	Units
2-Hexanone	12J	ug/kg
cis-1,3-Dichloropropene	12U	ug/kg
trans-1,3-Dichloroprope	12U	ug/kg

B/N/Acid Scan Parameter	Tissue Result	Units
Benzo(a)pyrene	240U	ug/kg
2,4-Dinitrophenol	1200U	ug/kg
Dibenzo(a,h)anthracene	240U	ug/kg
Benzo(a)anthracene	240U	ug/kg
4-Chloro-3-Methylphenol	240U	ug/kg
Benzoic acid	1200U	ug/kg
Hexachloroethane	240U	ug/kg
Hexachlorocyclopentadie	240U	ug/kg
Isophorone	240U	ug/kg
Acenaphthene	240U	ug/kg
Diethylphthalate	240BU	ug/kg
Di-n-Butylphthalate	240BU	ug/kg
Phenanthrene	240U	ug/kg
Butylbenzylphthalate	240U	ug/kg
N-Nitrosodiphenylamine	240BU	ug/kg
Fluorene	240U	ug/kg
Hexachlorobutadiene	240U	ug/kg
Pentachlorophenol	1200BU	ug/kg
2,4,6-Trichlorophenol	240U	ug/kg
2-Nitroaniline	1200U	ug/kg
2-Nitrophenol	240U	ug/kg
Naphthalene	240U	ug/kg
2-Methylnaphthalene	240U	ug/kg
2-Chloronaphthalene	240U	ug/kg
3,3'-Dichlorobenzidine	470U	ug/kg
2-Methylphenol	240U	ug/kg
1,2-Dichlorobenzene	240U	ug/kg
o-Chlorophenol	240U	ug/kg
2,4,5-Trichlorophenol	1200U	ug/kg
Nitrobenzene	240U	ug/kg
3-Nitroaniline	1200U	ug/kg
4-Nitroaniline	1200U	ug/kg
4-Nitrophenol	1200U	ug/kg
Benzyl Alcohol	240U	ug/kg
4-Bromophenyl-phenyleth	240U	ug/kg
2,4-Dimethylphenol	240U	ug/kg

B/N/Acid Scan *** Continued *** Parameter	Tissue Result	Units
4-Methylphenol	240U	ug/kg
1,4-Dichlorobenzene	240U	ug/kg
4-Chloroaniline	240U	ug/kg
Phenol	240U	ug/kg
bis(2-Chloroethyl)Ether	240U	ug/kg
bis(2-Chloroethoxy)Meth	240U	ug/kg
bis(2-Ethylhexyl)Phthal	240BU	ug/kg
Di-n-Octyl Phthalate	240U	ug/kg
Hexachlorobenzene	240U	ug/kg
Anthracene	240U	ug/kg
1,2,4-Trichlorobenzene	240U	ug/kg
2,4-Dichlorophenol	240U	ug/kg
2,4-Dinitrotoluene	240U	ug/kg
Pyrene	240U	ug/kg
Dimethylphthalate	240U	ug/kg
Dibenzofuran	240U	ug/kg
Benzo(ghi)perylene	240U	ug/kg
Indeno(1,2,3-cd)pyrene	240U	ug/kg
Benzo(b)fluoranthene	240U	ug/kg
Fluoranthene	240U	ug/kg
Benzo(k)fluoranthene	240U	ug/kg
Acenaphthylene	240U	ug/kg
Chrysene	240U	ug/kg
4,6-Dinitro-2-methylphe	1200U	ug/kg
1,3-Dichlorobenzene	240U	ug/kg
2,6-Dinitrotoluene	240U	ug/kg
N-Nitroso-di-n-Propylam	240U	ug/kg
4-Chlorophenyl-phenylet	240U	ug/kg
bis(2-Chloroisopropyl)E	240U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg

(Continued on next page)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: CBD1

Sample No: 86 261067 Begin Sample Date: 86/06/23 13:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: *C BAY, ULVA, RUSTON WAY PARK SITE

Pest/PCB - PP Scan Tissue
*** Continued ***

Parameter	Result	Units
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Station No: CBD2

Sample No: 86 261068 Begin Sample Date: 86/06/23 13:00 Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: C BAY, LAMINARIA, RUSTON WAY PARK SITE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	5.30	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.44	mg/kg-wt
Copper	Cu-Tiss	1.11	mg/kg-wt
Zinc	Zn-Tiss	3.4	mg/kg-wt
Chromium	Cr-Tiss	0.15	mg/kg-wt
Cadmium	Cd-Tiss	0.171	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: BIA1

Sample No: 86 261080 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: BD INLT, ULVA, TYKLE COVE

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.54	mg/kg-wt
Mercury	Hg-Tiss	0.001	mg/kg-wt
Lead	Pb-Tiss	0.165	mg/kg-wt
Copper	Cu-Tiss	2.02	mg/kg-wt
Zinc	Zn-Tiss	2.5	mg/kg-wt
Chromium	Cr-Tiss	1.14	mg/kg-wt
Cadmium	Cd-Tiss	0.144	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Station No: BIB1

Sample No: 86 261081 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: *BD INLT, ULVA, DNR DOCK

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.34	mg/kg-wt
Mercury	Hg-Tiss	0.003	mg/kg-wt
Lead	Pb-Tiss	0.09	mg/kg-wt
Copper	Cu-Tiss	1.51	mg/kg-wt
Zinc	Zn-Tiss	2.4	mg/kg-wt
Chromium	Cr-Tiss	0.35	mg/kg-wt
Cadmium	Cd-Tiss	0.102	mg/kg-wt

VOA - PP Scan (GCMS) Parameter	Tissue Result	Units
Carbon Tetrachloride	12U	ug/kg
Acetone	1600B	ug/kg
Chloroform	12U	ug/kg
Benzene	0.85J	ug/kg
1,1,1-Trichloroethane	12U	ug/kg
Bromomethane	24U	ug/kg
Chloromethane	24U	ug/kg
Chloroethane	24U	ug/kg
Vinyl Chloride	24U	ug/kg
Methylene Chloride	31B	ug/kg
Carbon Disulfide	12U	ug/kg
Bromoform	12U	ug/kg
Bromodichloromethane	12U	ug/kg
1,1-Dichloroethane	12U	ug/kg
1,1-Dichloroethene	12U	ug/kg
1,2-Dichloropropane	12U	ug/kg
2-Butanone	31B	ug/kg
1,1,2-Trichloroethane	12U	ug/kg
Trichloroethene	12U	ug/kg
1,1,2,2-Tetrachloroetha	24U	ug/kg
Total Xylenes	12U	ug/kg
Ethylbenzene	12U	ug/kg
Styrene	12U	ug/kg
1,2-Dichloroethane	12U	ug/kg
Vinyl Acetate	39	ug/kg
4-Methyl-2-Pentanone	24U	ug/kg
Toluene	12U	ug/kg
Chlorobenzene	12U	ug/kg
2-Chloroethylvinylether	24U	ug/kg
Dibromochloromethane	12U	ug/kg
Tetrachloroethene	12U	ug/kg
Cis-1,2-Dichloroethene	REQ	
trans-1,2-Dichloroethen	12U	ug/kg

VOA - PP Scan (GCMS) *** Continued *** Parameter	Tissue Result	Units
2-Hexanone	24U	ug/kg
cis-1,3-Dichloropropene	12U	ug/kg
trans-1,3-Dichloroprope	12U	ug/kg

B/N/Acid Scan Parameter	Tissue Result	Units
Benzo(a)pyrene	60U	ug/kg
2,4-Dinitrophenol	300U	ug/kg
Dibenzo(a,h)anthracene	60U	ug/kg
Benzo(a)anthracene	60U	ug/kg
4-Chloro-3-Methylphenol	60U	ug/kg
Benzoic acid	300U	ug/kg
Hexachloroethane	60U	ug/kg
Hexachlorocyclopentadie	60U	ug/kg
Isophorone	60U	ug/kg
Acenaphthene	60U	ug/kg
Diethylphthalate	60U	ug/kg
Di-n-Butylphthalate	60U	ug/kg
Phenanthrene	60U	ug/kg
Butylbenzylphthalate	60U	ug/kg
N-Nitrosodiphenylamine	1200U	ug/kg
Fluorene	60U	ug/kg
Hexachlorobutadiene	60U	ug/kg
Pentachlorophenol	300U	ug/kg
2,4,6-Trichlorophenol	60U	ug/kg
2-Nitroaniline	300U	ug/kg
2-Nitrophenol	60U	ug/kg
Naphthalene	60U	ug/kg
2-Methylnaphthalene	60U	ug/kg
2-Chloronaphthalene	60U	ug/kg
3,3'-Dichlorobenzidine	120U	ug/kg
2-Methylphenol	60U	ug/kg
1,2-Dichlorobenzene	60U	ug/kg
o-Chlorophenol	60U	ug/kg
2,4,5-Trichlorophenol	300U	ug/kg
Nitrobenzene	60U	ug/kg
3-Nitroaniline	300U	ug/kg
4-Nitroaniline	300U	ug/kg
4-Nitrophenol	300U	ug/kg
Benzyl Alcohol	280J	ug/kg
4-Bromophenyl-phenyleth	60U	ug/kg
2,4-Dimethylphenol	60U	ug/kg

B/N/Acid Scan *** Continued *** Parameter	Tissue Result	Units
4-Methylphenol	60U	ug/kg
1,4-Dichlorobenzene	60U	ug/kg
4-Chloroaniline	60U	ug/kg
Phenol	60U	ug/kg
bis(2-Chloroethyl)Ether	60U	ug/kg
bis(2-Chloroethoxy)Meth	60U	ug/kg
bis(2-Ethylhexyl)Phthal	470	ug/kg
Di-n-Octyl Phthalate	60U	ug/kg
Hexachlorobenzene	60U	ug/kg
Anthracene	60U	ug/kg
1,2,4-Trichlorobenzene	60U	ug/kg
2,4-Dichlorophenol	60U	ug/kg
2,4-Dinitrotoluene	60U	ug/kg
Pyrene	60U	ug/kg
Dimethylphthalate	60U	ug/kg
Dibenzofuran	60U	ug/kg
Benzo(ghi)perylene	60U	ug/kg
Indeno(1,2,3-cd)pyrene	60U	ug/kg
Benzo(b)fluoranthene	60U	ug/kg
Fluoranthene	60U	ug/kg
Benzo(k)fluoranthene	60U	ug/kg
Acenaphthylene	60U	ug/kg
Chrysene	60U	ug/kg
4,6-Dinitro-2-methylphe	300U	ug/kg
1,3-Dichlorobenzene	60U	ug/kg
2,6-Dinitrotoluene	60U	ug/kg
N-Nitroso-di-n-Propylam	60U	ug/kg
4-Chlorophenyl-phenylet	60U	ug/kg
bis(2-Chloroisopropyl)E	60U	ug/kg

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg

(Continued on next page)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: BIB1

Sample No: 86 261081 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: *BD INLT, ULVA, DNR DOCK

Pest/PCB - PP Scan Tissue
*** Continued ***

Parameter	Result	Units
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Station No: BIC1

Sample No: 86 261082 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: BD INLT, ULVA, BOSTON HRBR

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.59	mg/kg-wt
Mercury	Hg-Tiss	0.001	mg/kg-wt
Lead	Pb-Tiss	0.005	mg/kg-wt
Copper	Cu-Tiss	1.76	mg/kg-wt
Zinc	Zn-Tiss	3.3	mg/kg-wt
Chromium	Cr-Tiss	0.50	mg/kg-wt
Cadmium	Cd-Tiss	0.147	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

Project: AMB-061A PUGET SOUND EDIBLE MACROALGAE INVESTIGAT Officer: DTE Account: AMLB2F

Station No: BID1

Sample No: 86 261084 Begin Sample Date: 86/06/23 : Source: Plant/Vegetation Depth: QA Code:

Laboratory: RX Description: BD INLT, ULVA, COOPER POINT

Metals - Specified Parameter		Tissue Result	Units
Arsenic	As-Tiss	0.47	mg/kg-wt
Mercury	Hg-Tiss	0.001U	mg/kg-wt
Lead	Pb-Tiss	0.195	mg/kg-wt
Copper	Cu-Tiss	2.44	mg/kg-wt
Zinc	Zn-Tiss	1.7	mg/kg-wt
Chromium	Cr-Tiss	0.21	mg/kg-wt
Cadmium	Cd-Tiss	0.146	mg/kg-wt

Pest/PCB - PP Scan Parameter	Tissue Result	Units
4,4'-DDT	1U	ug/kg
DDD, o,p'-	1U	ug/kg
Chlordane	1U	ug/kg
gamma-BHC (Lindane)	1U	ug/kg
Dieldrin	1U	ug/kg
Endrin	1U	ug/kg
Methoxychlor	10U	ug/kg
4,4'-DDD	1U	ug/kg
4,4'-DDE	3	ug/kg
Heptachlor	1U	ug/kg
Aldrin	1U	ug/kg
alpha-BHC	1U	ug/kg
beta-BHC	1U	ug/kg
delta-BHC	1U	ug/kg
DDT, o,p'-	1U	ug/kg
alpha-Endosulfan	1U	ug/kg
Heptachlor epoxide	1U	ug/kg
Endosulfan sulfate	1U	ug/kg
DDE, o,p'-	1U	ug/kg
Endrin aldehyde	1U	ug/kg
Toxaphene	30U	ug/kg
PCB - 1260	10U	ug/kg
PCB - 1254	10U	ug/kg
PCB - 1221	10U	ug/kg
PCB - 1232	10U	ug/kg
PCB - 1248	10U	ug/kg
PCB - 1016	10U	ug/kg
beta-Endosulfan	1U	ug/kg
trans-Nonachlor	1U	ug/kg
PCB - 1242	10U	ug/kg

(Sample Complete)

APPENDIX B

DATA LISTINGS FOR CHEMICALS OF CONCERN IN PUGET SOUND SEAFOOD

TABLES

Number		Page
B-1	Data listing for arsenic (ug/kg wet) in Puget Sound fish, shellfish, and macroalgae	B-3
B-2	Data listing for cadmium (ug/kg wet) in Puget Sound fish, shellfish, and macroalgae	B-9
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B-7	Data listing for alpha-HCH (ug/kg wet) in Puget Sound fish, shellfish, and macroalgae	B-33
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DESCRIPTION OF DATA FIELDS

1. Project. Acronyms used for the various studies from which the data were compiled are:

   EPA/DSHS - The 1986 U.S. EPA and DSHS study of chemical contaminants in shellfish (Appendix A)

   EPA/WDF - The 1987 U.S. EPA and WDF study of chemicals contaminants in salmon (Appendix A)

   EPA/WDOE - The 1987 U.S. EPA and Ecology study of chemical contaminants in macroalgae (Appendix A)

   UBAP/EB - The U.S. EPA Urban Bay Action Program for toxic substances in fish from Elliott Bay (PTI and Tetra Tech 1988a)

   UBAP/EH - The U.S. EPA Urban Bay Action Program for toxic substances in fish and crabs from Everett Harbor (PTI and Tetra Tech 1988b)

   DSHS - The DSHS study of chemical contaminants in shellfish (Faigenblum 1988)

   NOAA1 - Preliminary report for the National Oceanic and Atmospheric Administration study of potential toxicant exposure among consumers of fish caught recreationally in Puget Sound (Landolt et al. 1985).

   NOAA2 - Final report for the National Oceanic and Atmospheric Administration study of potential toxicant exposure among consumers of fish caught recreationally in Puget Sound (Landolt et al. 1987).

   WDOE1 - Ecology survey of chemical contaminants in shellfish from Eagle Harbor (Yake et al. 1984)

   WDOE2 - Ecology survey of chemical contaminants in shellfish from Budd Inlet (Norton, D., 5 February 1986, personal communication).

2. Area. Geographical area where the sample was collected.

3. Species. Common name of the species analyzed. Scientific names are provided in Table 2 of the report.

4. Data field. The data field is identified by the name of the substance being reported. Acronyms used for chemical names were:

   Benzo(a)anthracene - B(A)A

Benzo(b)fluoranthene - B(b)F

Benzo(a)pyrene - B(a)P

All values are reported in units of ug/kg wet wt. Quantitation limits are reported for substances that were not detected.

5. Detection Limits. Substances that were not detected are indicated by a "U" in the detection limit field. When a "U" appears in this field, the corresponding data value represents the detection limit for that substance.

6. Data Quality. Symbols used to describe data quality concerns are:

   J - Estimated value for one of the following reasons: compound verified by not quantified because value exceeded the five-point calibration curve, compound is tentatively identified, response factor may be low, standard was not with the allowed 25 percent response-factor difference

   M - Compound verified below quantification limit. Substances with this qualifier were reported at the quantification limit and assigned a "U" in the detection limit field. An "M" qualifier did not affect selection of data based on data quality objectives.

   B - Compound detected in associated blank.

   G - Geometric mean

TABLE B-1. DATA LISTING FOR ARSENIC (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Arsenic	Det. Limit	Data Qual.
EPA/DSHS	Dash Point	Bentnose clam	1,500.00		
EPA/DSHS	Dash Point	Bentnose clam	2,600.00		
EPA/DSHS	Everett Harbor	Sand clam	1,400.00		
EPA/DSHS	Alki Point	Littleneck clam	2,300.00		
EPA/DSHS	Birch Bay	Littleneck clam	1,200.00		
EPA/DSHS	Quartermaster Harbor	Littleneck clam	2,700.00		
EPA/DSHS	Dash Point	Littleneck clam	2,100.00		
EPA/DSHS	Everett Harbor	Littleneck clam	2,500.00		
EPA/DSHS	Mukilteo	Littleneck clam	1,600.00		
EPA/DSHS	Sinclair Inlet	Littleneck clam	2,200.00		
EPA/DSHS	Alki Point	Butter clam	3,300.00		
EPA/DSHS	Birch Bay	Butter clam	1,700.00		
EPA/DSHS	Burley Lagoon	Butter clam	2,400.00		
EPA/DSHS	Quartermaster Harbor	Butter clam	4,200.00		
EPA/DSHS	Everett Harbor	Butter clam	2,300.00		
EPA/DSHS	Mukilteo	Butter clam	1,800.00		
EPA/DSHS	Mukilteo	Butter clam	1,600.00		
EPA/DSHS	Sinclair Inlet	Butter clam	4,900.00		
EPA/DSHS	Quartermaster Harbor	Manila clam	3,100.00		
EPA/WDOE	Commencement Bay	Laminaria	4,200.00		
EPA/WDOE	Commencement Bay	Laminaria	4,800.00		
EPA/WDOE	Commencement Bay	Laminaria	9,200.00		
EPA/WDOE	Commencement Bay	Laminaria	5,300.00		
EPA/WDOE	Elliott Bay	Laminaria	2,700.00		
EPA/WDOE	Elliott Bay	Laminaria	4,250.00		
EPA/WDOE	Point No Point	Laminaria	3,380.00		
EPA/WDOE	Point No Point	Laminaria	7,500.00		
EPA/WDOE	Point No Point	Laminaria	4,750.00		
EPA/WDOE	Commencement Bay	Nereocystis	1,550.00		
EPA/WDOE	Elliott Bay	Nereocystis	3,600.00		
EPA/WDOE	Elliott Bay	Nereocystis	3,350.00		
EPA/WDOE	Elliott Bay	Nereocystis	3,980.00		
EPA/WDOE	Elliott Bay	Nereocystis	2,600.00		
EPA/WDOE	Point No Point	Nereocystis	4,450.00		
EPA/WDOE	Point No Point	Nereocystis	3,350.00		
EPA/WDOE	Budd Inlet	Ulva	540.00		
EPA/WDOE	Budd Inlet	Ulva	340.00		
EPA/WDOE	Budd Inlet	Ulva	590.00		
EPA/WDOE	Budd Inlet	Ulva	470.00		
EPA/WDOE	Commencement Bay	Ulva	1,240.00		
EPA/WDOE	Commencement Bay	Ulva	2,780.00		
EPA/WDOE	Commencement Bay	Ulva	1,190.00		
EPA/WDOE	Commencement Bay	Ulva	940.00		
EPA/WDOE	Elliott Bay	Ulva	730.00		
EPA/WDOE	Elliott Bay	Ulva	960.00		
EPA/WDOE	Elliott Bay	Ulva	900.00		
EPA/WDOE	Everett Harbor	Ulva	430.00		
EPA/WDOE	Everett Harbor	Ulva	410.00		
EPA/WDOE	Everett Harbor	Ulva	680.00		
EPA/WDOE	Point No Point	Ulva	820.00		
EPA/WDOE	Point No Point	Ulva	1,370.00		
EPA/WDOE	Point No Point	Ulva	1,100.00		
EPA/WDOE	Elliott Bay	Nori	3,080.00		

TABLE B-1. DATA LISTING FOR ARSENIC (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Arsenic	Det. Limit	Data Qual.
EPA/WDOE	Elliott Bay	Nori	3,200.00		
EPA/WDOE	Elliott Bay	Nori	3,880.00		
EPA/WDOE	Elliott Bay	Nori	2,730.00		
EPA/WDOE	Point No Point	Nori	590.00		
EPA/WDOE	Point No Point	Nori	470.00		
EPA/WDOE	Point No Point	Nori	2,000.00		
EPA/WDF	Anacortes	Chinook salmon	640.00		
EPA/WDF	Anacortes	Chinook salmon	390.00		
EPA/WDF	Commencement Bay	Chinook salmon	1,900.00		
EPA/WDF	Commencement Bay	Chinook salmon	900.00		
EPA/WDF	Commencement Bay	Chinook salmon	1,900.00		
EPA/WDF	Commencement Bay	Chinook salmon	710.00		
EPA/WDF	Commencement Bay	Chinook salmon	1,100.00		
EPA/WDF	Elliott Bay	Chinook salmon	340.00		
EPA/WDF	Elliott Bay	Chinook salmon	1,010.00		
EPA/WDF	Elliott Bay	Chinook salmon	1,500.00		
EPA/WDF	Elliott Bay	Chinook salmon	900.00		
EPA/WDF	Elliott Bay	Chinook salmon	400.00		
EPA/WDF	Elliott Bay	Chinook salmon	1,900.00		
EPA/WDF	Elliott Bay	Chinook salmon	3,200.00		
EPA/WDF	Elliott Bay	Chinook salmon	1,200.00		
EPA/WDF	Elliott Bay	Chinook salmon	1,600.00		
EPA/WDF	Everett Harbor	Chinook salmon	930.00		
EPA/WDF	Point No Point	Chinook salmon	570.00		
EPA/WDF	Point No Point	Chinook salmon	430.00		
EPA/WDF	Point No Point	Chinook salmon	880.00		
EPA/WDF	Point No Point	Chinook salmon	660.00		
EPA/WDF	Point No Point	Chinook salmon	210.00		
EPA/WDF	Point No Point	Chinook salmon	190.00		
EPA/WDF	Point No Point	Chinook salmon	380.00		
EPA/WDF	Commencement Bay	Coho salmon	2,100.00		
EPA/WDF	Commencement Bay	Coho salmon	2,900.00		
DSHS	Dash Point	Heart cockle	1,400.00		
DSHS	Birch Bay	M. inquinata	1,720.00		
DSHS	Budd Inlet	M. inquinata	2,070.00		
DSHS	Dash Point	M. inquinata	3,760.00		
DSHS	Dash Point	Bentnose clam	3,460.00		
DSHS	Dash Point	Bentnose clam	4,980.00		
DSHS	Budd Inlet	Softshell clam	1,330.00		
DSHS	Alki Point	Littleneck clam	1,850.00		
DSHS	Alki Point	Littleneck clam	3,290.00		
DSHS	Alki Point	Littleneck clam	3,500.00		
DSHS	Alki Point	Littleneck clam	2,100.00		
DSHS	Alki Point	Littleneck clam	2,220.00		
DSHS	Alki Point	Littleneck clam	2,420.00		
DSHS	Birch Bay	Littleneck clam	3,170.00		
DSHS	Birch Bay	Littleneck clam	2,300.00		
DSHS	Birch Bay	Littleneck clam	2,110.00		
DSHS	Birch Bay	Littleneck clam	2,370.00		
DSHS	Birch Bay	Littleneck clam	2,850.00		
DSHS	Budd Inlet	Littleneck clam	4,060.00		
DSHS	Budd Inlet	Littleneck clam	3,220.00		
DSHS	Budd Inlet	Littleneck clam	2,130.00		

TABLE B-1. DATA LISTING FOR ARSENIC (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Arsenic	Det. Limit	Data Qual.
DSHS	Budd Inlet	Littleneck clam	3,120.00		
DSHS	Budd Inlet	Littleneck clam	2,420.00		
DSHS	Quartermaster Harbor	Littleneck clam	3,700.00		
DSHS	Quartermaster Harbor	Littleneck clam	4,030.00		
DSHS	Quartermaster Harbor	Littleneck clam	3,640.00		
DSHS	Quartermaster Harbor	Littleneck clam	2,810.00		
DSHS	Quartermaster Harbor	Littleneck clam	3,360.00		
DSHS	Dash Point	Littleneck clam	3,680.00		
DSHS	Dash Point	Littleneck clam	1,980.00		
DSHS	Dash Point	Littleneck clam	1,900.00		
DSHS	Mukilteo	Littleneck clam	2,400.00		
DSHS	Mukilteo	Littleneck clam	2,020.00		
DSHS	Mukilteo	Littleneck clam	1,470.00		
DSHS	Mukilteo	Littleneck clam	1,260.00		
DSHS	Mukilteo	Littleneck clam	1,520.00		
DSHS	Sinclair Inlet	Littleneck clam	3,600.00		
DSHS	Sinclair Inlet	Littleneck clam	2,000.00		
DSHS	Sinclair Inlet	Littleneck clam	2,270.00		
DSHS	Sinclair Inlet	Littleneck clam	2,130.00		
DSHS	Alki Point	Butter clam	1,900.00		
DSHS	Alki Point	Butter clam	4,500.00		
DSHS	Alki Point	Butter clam	2,980.00		
DSHS	Birch Bay	Butter clam	2,120.00		
DSHS	Birch Bay	Butter clam	3,330.00		
DSHS	Budd Inlet	Butter clam	1,950.00		
DSHS	Burley Lagoon	Butter clam	2,460.00		
DSHS	Burley Lagoon	Butter clam	2,720.00		
DSHS	Burley Lagoon	Butter clam	3,490.00		
DSHS	Burley Lagoon	Butter clam	2,960.00		
DSHS	Burley Lagoon	Butter clam	2,650.00		
DSHS	Quartermaster Harbor	Butter clam	4,570.00		
DSHS	Quartermaster Harbor	Butter clam	5,220.00		
DSHS	Dash Point	Butter clam	3,080.00		
DSHS	Dash Point	Butter clam	2,350.00		
DSHS	Mukilteo	Butter clam	1,650.00		
DSHS	Mukilteo	Butter clam	2,240.00		
DSHS	Mukilteo	Butter clam	2,080.00		
DSHS	Mukilteo	Butter clam	2,200.00		
DSHS	Sinclair Inlet	Butter clam	3,470.00		
DSHS	Sinclair Inlet	Butter clam	4,800.00		
DSHS	Sinclair Inlet	Butter clam	3,140.00		
DSHS	Budd Inlet	Manila clam	3,110.00		
DSHS	Budd Inlet	Manila clam	1,990.00		
DSHS	Quartermaster Harbor	Manila clam	1,960.00		
DSHS	Quartermaster Harbor	Manila clam	4,060.00		
DSHS	Alki Point	Horseneck clam	1,530.00		
DSHS	Quartermaster Harbor	Horseneck clam	1,550.00		
DSHS	Sinclair Inlet	Horseneck clam	2,680.00		
NOAA1	Edmonds	Pacific hake	4,050.00		
NOAA1	Edmonds	Striped perch	600.00		
NOAA1	Edmonds	Striped perch	400.00		
NOAA1	Elliott Bay	Rockfish	1,200.00		
NOAA1	Edmonds	Rockfish	2,400.00		

TABLE B-1. DATA LISTING FOR ARSENIC (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Arsenic	Det. Limit	Data Qual.
NOAA1	Edmonds	Rockfish	1,700.00		
NOAA1	Edmonds	Rockfish	1,100.00		
NOAA1	Edmonds	Rockfish	1,840.00		
NOAA1	Elliott Bay	Sablefish	500.00		
NOAA1	Elliott Bay	Sablefish	1,600.00		
NOAA1	Elliott Bay	Sablefish	500.00		
NOAA1	Elliott Bay	Sablefish	600.00		
NOAA1	Elliott Bay	Sablefish	1,300.00		
NOAA1	Elliott Bay	Sablefish	2,900.00		
NOAA1	Elliott Bay	Sablefish	3,900.00		
NOAA1	Elliott Bay	Sablefish	1,000.00		
NOAA1	Elliott Bay	Sablefish	2,500.00		
NOAA1	Elliott Bay	Sablefish	2,300.00		
NOAA1	Elliott Bay	Sablefish	800.00		
NOAA1	Elliott Bay	Sablefish	5,300.00		
NOAA1	Elliott Bay	Sablefish	600.00		
NOAA1	Elliott Bay	Pacific cod	2,000.00		
NOAA1	Sinclair Inlet	Pacific cod	3,600.00		
NOAA1	Sinclair Inlet	Pacific cod	5,400.00		
NOAA1	Sinclair Inlet	Pacific cod	12,600.00		
NOAA1	Sinclair Inlet	Pacific cod	5,800.00		
NOAA1	Edmonds	Pacific cod	3,600.00		
NOAA1	Edmonds	Pacific cod	2,000.00		
NOAA1	Commencement Bay	Tomcod	820.00		
NOAA1	Commencement Bay	Tomcod	4,020.00		
NOAA1	Commencement Bay	English sole	14,030.00		
NOAA1	Commencement Bay	English sole	16,500.00		
NOAA1	Commencement Bay	English sole	20,400.00		
NOAA1	Commencement Bay	English sole	20,240.00		
NOAA1	Elliott Bay	English sole	1,800.00		
NOAA1	Elliott Bay	English sole	6,500.00		
NOAA1	Elliott Bay	English sole	3,800.00		
NOAA1	Elliott Bay	English sole	3,400.00		
NOAA1	Elliott Bay	English sole	4,200.00		
NOAA1	Elliott Bay	English sole	3,020.00		
NOAA1	Sinclair Inlet	English sole	5,900.00		
NOAA1	Sinclair Inlet	English sole	7,100.00		
NOAA1	Sinclair Inlet	English sole	5,700.00		
NOAA1	Sinclair Inlet	English sole	11,100.00		
NOAA1	Sinclair Inlet	English sole	2,100.00		
NOAA1	Edmonds	English sole	3,900.00		
NOAA1	Edmonds	English sole	1,800.00		
NOAA1	Edmonds	English sole	1,300.00		
NOAA1	Edmonds	English sole	1,000.00		
NOAA1	Edmonds	English sole	1,400.00		
NOAA1	Edmonds	English sole	1,900.00		
NOAA1	Commencement Bay	Pacific sanddab	20,700.00		
NOAA1	Commencement Bay	Rock sole	7,700.00		
NOAA1	Commencement Bay	Rock sole	20,600.00		
NOAA1	Elliott Bay	Rock sole	2,900.00		
NOAA1	Sinclair Inlet	Rock sole	5,340.00		
NOAA1	Sinclair Inlet	Rock sole	5,000.00		
NOAA1	Sinclair Inlet	Rock sole	19,600.00		

TABLE B-1. DATA LISTING FOR ARSENIC (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Arsenic	Det. Limit	Data Qual.
NOAA1	Sinclair Inlet	Rock sole	6,500.00		
NOAA1	Sinclair Inlet	Rock sole	16,300.00		
NOAA1	Sinclair Inlet	Rock sole	6,500.00		
NOAA1	Edmonds	Rock sole	3,400.00		
NOAA1	Edmonds	Rock sole	2,700.00		
NOAA1	Edmonds	Rock sole	1,200.00		
NOAA1	Commencement Bay	Buffalo sculpin	1,000.00		
NOAA1	Commencement Bay	Market squid	6,900.00		
NOAA1	Commencement Bay	Market squid	6,400.00		
NOAA1	Edmonds	Market squid	4,400.00		
NOAA1	Edmonds	Market squid	8,700.00		
NOAA1	Edmonds	Market squid	5,400.00		
NOAA1	Edmonds	Market squid	22,100.00		
NOAA1	Edmonds	Market squid	4,600.00		
NOAA2	Commencement Bay	Pacific hake	3,200.00		
NOAA2	Elliott Bay	Pacific hake	2,500.00		
NOAA2	Elliott Bay	Pacific hake	500.00		
NOAA2	Point Jefferson	Pacific hake	1,000.00		
NOAA2	Point Jefferson	Pacific hake	1,400.00		
NOAA2	Point Jefferson	Pacific hake	3,500.00		
NOAA2	Point Jefferson	Pacific hake	1,800.00		
NOAA2	Commencement Bay	Rockfish	1,900.00		
NOAA2	Commencement Bay	Rockfish	800.00		
NOAA2	Commencement Bay	Rockfish	2,800.00		
NOAA2	Elliott Bay	Rockfish	2,000.00		
NOAA2	Elliott Bay	Rockfish	1,200.00		
NOAA2	Elliott Bay	Rockfish	1,300.00		
NOAA2	Edmonds	Rockfish	800.00		
NOAA2	Edmonds	Rockfish	2,300.00		
NOAA2	Edmonds	Rockfish	2,200.00		
NOAA2	Edmonds	Rockfish	1,700.00		
NOAA2	Edmonds	Rockfish	1,500.00		
NOAA2	Agate Pass	Rockfish	2,400.00		
NOAA2	Agate Pass	Rockfish	2,100.00		
NOAA2	Agate Pass	Rockfish	1,100.00		
NOAA2	Agate Pass	Rockfish	2,900.00		
NOAA2	Point Madison	Sablefish	800.00		
NOAA2	Point Madison	Sablefish	1,700.00		
NOAA2	Point Madison	Pacific cod	3,500.00		
NOAA2	Manchester	Pacific cod	5,400.00		
NOAA2	Manchester	Pacific cod	4,000.00		
NOAA2	Manchester	Pacific cod	9,400.00		
NOAA2	Manchester	Pacific cod	700.00		
NOAA2	Point Jefferson	Pacific cod	3,400.00		
NOAA2	Commencement Bay	Walleye pollock	11,400.00		
NOAA2	Commencement Bay	Walleye pollock	9,400.00		
NOAA2	Point Madison	Walleye pollock	1,400.00		
NOAA2	Point Madison	Walleye pollock	1,100.00		
NOAA2	Point Madison	Walleye pollock	4,400.00		
NOAA2	Point Madison	Walleye pollock	2,500.00		
NOAA2	Point Madison	Walleye pollock	2,300.00		
NOAA2	Point Madison	Tomcod	1,100.00		
NOAA2	Point Madison	Tomcod	1,400.00		

TABLE B-1. DATA LISTING FOR ARSENIC (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Arsenic	Det. Limit	Data Qual.
NOAA2	Point Madison	Tomcod	500.00		
NOAA2	Commencement Bay	Starry flounder	2,600.00		
NOAA2	Commencement Bay	Starry flounder	1,000.00		
NOAA2	Commencement Bay	Starry flounder	500.00		
NOAA2	Commencement Bay	Starry flounder	800.00		
NOAA2	Sinclair Inlet	Starry flounder	1,700.00		
NOAA2	Sinclair Inlet	Starry flounder	2,200.00		
NOAA2	Sinclair Inlet	Starry flounder	1,800.00		
NOAA2	Sinclair Inlet	Starry flounder	1,200.00		
NOAA2	Elliott Bay	Rock sole	2,400.00		
NOAA2	Elliott Bay	Rock sole	3,300.00		
NOAA2	Elliott Bay	Rock sole	4,300.00		
NOAA2	Elliott Bay	Rock sole	3,500.00		
NOAA2	Edmonds	Rock sole	3,800.00		
NOAA2	Edmonds	Rock sole	3,200.00		
NOAA2	Edmonds	Rock sole	3,700.00		
NOAA2	Edmonds	Rock sole	2,200.00		
NOAA2	Elliott Bay	Market squid	11,800.00		
NOAA2	Elliott Bay	Market squid	15,900.00		
NOAA2	Elliott Bay	Market squid	1,300.00		
NOAA2	Sinclair Inlet	Market squid	1,300.00		
NOAA2	Sinclair Inlet	Market squid	4,400.00		
NOAA2	Edmonds	Market squid	3,600.00		
WDOE1	Eagle Harbor	Bivalve spp.	2,300.00		
WDOE1	Eagle Harbor	Bivalve spp.	1,500.00		
WDOE1	Eagle Harbor	Bivalve spp.	2,600.00		
WDOE1	Eagle Harbor	Bivalve spp.	3,100.00		
WDOE1	Eagle Harbor	Bivalve spp.	3,300.00		
WDOE1	Eagle Harbor	Bivalve spp.	3,800.00		
WDOE1	Eagle Harbor	Bivalve spp.	4,400.00		
WDOE1	Eagle Harbor	Bivalve spp.	2,500.00		
WDOE1	Point Blakely	Bivalve spp.	3,700.00		

TABLE B-2. DATA LISTING FOR CADMIUM (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Cadmium	Det. Limit	Data Qual.
EPA/DSHS	Dash Point	Bentnose clam	170.00		
EPA/DSHS	Dash Point	Bentnose clam	80.00		
EPA/DSHS	Everett Harbor	Sand clam	80.00		
EPA/DSHS	Alki Point	Littleneck clam	230.00		
EPA/DSHS	Birch Bay	Littleneck clam	180.00		
EPA/DSHS	Quartermaster Harbor	Littleneck clam	330.00		
EPA/DSHS	Dash Point	Littleneck clam	420.00		
EPA/DSHS	Everett Harbor	Littleneck clam	460.00		
EPA/DSHS	Mukilteo	Littleneck clam	270.00		
EPA/DSHS	Sinclair Inlet	Littleneck clam	190.00		
EPA/DSHS	Alki Point	Butter clam	70.00		
EPA/DSHS	Birch Bay	Butter clam	140.00		
EPA/DSHS	Burley Lagoon	Butter clam	90.00		
EPA/DSHS	Quartermaster Harbor	Butter clam	80.00		
EPA/DSHS	Everett Harbor	Butter clam	130.00		
EPA/DSHS	Mukilteo	Butter clam	110.00		
EPA/DSHS	Mukilteo	Butter clam	100.00		
EPA/DSHS	Sinclair Inlet	Butter clam	60.00		
EPA/DSHS	Quartermaster Harbor	Manila clam	290.00		
EPA/WDOE	Commencement Bay	Laminaria	208.00		
EPA/WDOE	Commencement Bay	Laminaria	152.00		
EPA/WDOE	Commencement Bay	Laminaria	280.00		
EPA/WDOE	Commencement Bay	Laminaria	171.00		
EPA/WDOE	Elliott Bay	Laminaria	172.00		
EPA/WDOE	Elliott Bay	Laminaria	104.00		
EPA/WDOE	Point No Point	Laminaria	128.00		
EPA/WDOE	Point No Point	Laminaria	67.00		
EPA/WDOE	Point No Point	Laminaria	130.00		
EPA/WDOE	Commencement Bay	Nereocystis	171.00		
EPA/WDOE	Elliott Bay	Nereocystis	429.00		
EPA/WDOE	Elliott Bay	Nereocystis	437.00		
EPA/WDOE	Elliott Bay	Nereocystis	272.00		
EPA/WDOE	Elliott Bay	Nereocystis	340.00		
EPA/WDOE	Point No Point	Nereocystis	363.00		
EPA/WDOE	Point No Point	Nereocystis	365.00		
EPA/WDOE	Budd Inlet	Ulva	144.00		
EPA/WDOE	Budd Inlet	Ulva	102.00		
EPA/WDOE	Budd Inlet	Ulva	147.00		
EPA/WDOE	Budd Inlet	Ulva	146.00		
EPA/WDOE	Commencement Bay	Ulva	85.00		
EPA/WDOE	Commencement Bay	Ulva	102.00		
EPA/WDOE	Commencement Bay	Ulva	111.00		
EPA/WDOE	Commencement Bay	Ulva	148.00		
EPA/WDOE	Elliott Bay	Ulva	122.00		
EPA/WDOE	Elliott Bay	Ulva	46.00		
EPA/WDOE	Elliott Bay	Ulva	74.00		
EPA/WDOE	Everett Harbor	Ulva	48.00		
EPA/WDOE	Everett Harbor	Ulva	53.00		
EPA/WDOE	Everett Harbor	Ulva	58.00		
EPA/WDOE	Point No Point	Ulva	118.00		
EPA/WDOE	Point No Point	Ulva	125.00		
EPA/WDOE	Point No Point	Ulva	297.00		
EPA/WDOE	Elliott Bay	Nori	367.00		

TABLE B-2. DATA LISTING FOR CADMIUM (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Cadmium	Det. Limit	Data Qual.
EPA/WDOE	Elliott Bay	Nori	155.00		
EPA/WDOE	Elliott Bay	Nori	62.00		
EPA/WDOE	Elliott Bay	Nori	85.00		
EPA/WDOE	Point No Point	Nori	222.00		
EPA/WDOE	Point No Point	Nori	394.00		
EPA/WDOE	Point No Point	Nori	207.00		
EPA/WDF	Anacortes	Chinook salmon	2.00	U	
EPA/WDF	Anacortes	Chinook salmon	2.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	8.00		
EPA/WDF	Commencement Bay	Chinook salmon	5.00		
EPA/WDF	Commencement Bay	Chinook salmon	8.00		
EPA/WDF	Commencement Bay	Chinook salmon	9.00		
EPA/WDF	Commencement Bay	Chinook salmon	3.00		
EPA/WDF	Elliott Bay	Chinook salmon	5.00		
EPA/WDF	Elliott Bay	Chinook salmon	5.00		
EPA/WDF	Elliott Bay	Chinook salmon	9.00		
EPA/WDF	Elliott Bay	Chinook salmon	10.00		
EPA/WDF	Elliott Bay	Chinook salmon	3.00		
EPA/WDF	Elliott Bay	Chinook salmon	5.00		
EPA/WDF	Elliott Bay	Chinook salmon	2.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	9.00		
EPA/WDF	Elliott Bay	Chinook salmon	13.00		
EPA/WDF	Everett Harbor	Chinook salmon	4.00		
EPA/WDF	Point No Point	Chinook salmon	10.00		
EPA/WDF	Point No Point	Chinook salmon	13.00		
EPA/WDF	Point No Point	Chinook salmon	4.00		
EPA/WDF	Point No Point	Chinook salmon	4.00		
EPA/WDF	Point No Point	Chinook salmon	3.00		
EPA/WDF	Point No Point	Chinook salmon	14.00		
EPA/WDF	Point No Point	Chinook salmon	8.00		
EPA/WDF	Commencement Bay	Coho salmon	2.00	U	
EPA/WDF	Commencement Bay	Coho salmon	5.00		
DSHS	Dash Point	Heart cockle	180.00		
DSHS	Birch Bay	M. inquinata	140.00		
DSHS	Budd Inlet	M. inquinata	551.00		
DSHS	Dash Point	M. inquinata	1,280.00		
DSHS	Dash Point	Bentnose clam	40.00		
DSHS	Dash Point	Bentnose clam	80.00		
DSHS	Budd Inlet	Softshell clam	770.00		
DSHS	Alki Point	Littleneck clam	70.00		
DSHS	Alki Point	Littleneck clam	300.00		
DSHS	Alki Point	Littleneck clam	349.00		
DSHS	Alki Point	Littleneck clam	104.00		
DSHS	Alki Point	Littleneck clam	340.00		
DSHS	Alki Point	Littleneck clam	470.00		
DSHS	Alki Point	Littleneck clam	380.00		
DSHS	Birch Bay	Littleneck clam	220.00		
DSHS	Birch Bay	Littleneck clam	280.00		
DSHS	Birch Bay	Littleneck clam	364.00		
DSHS	Birch Bay	Littleneck clam	280.00		
DSHS	Birch Bay	Littleneck clam	330.00		
DSHS	Birch Bay	Littleneck clam	310.00		
DSHS	Budd Inlet	Littleneck clam	180.00		

TABLE B-2. DATA LISTING FOR CADMIUM (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Cadmium	Det. Limit	Data Qual.
DSHS	Budd Inlet	Littleneck clam	435.00		
DSHS	Budd Inlet	Littleneck clam	432.00		
DSHS	Budd Inlet	Littleneck clam	290.00		
DSHS	Budd Inlet	Littleneck clam	330.00		
DSHS	Budd Inlet	Littleneck clam	350.00		
DSHS	Burley Lagoon	Littleneck clam	350.00		
DSHS	Quartermaster Harbor	Littleneck clam	450.00		
DSHS	Quartermaster Harbor	Littleneck clam	274.00		
DSHS	Quartermaster Harbor	Littleneck clam	309.00		
DSHS	Quartermaster Harbor	Littleneck clam	400.00		
DSHS	Quartermaster Harbor	Littleneck clam	560.00		
DSHS	Quartermaster Harbor	Littleneck clam	500.00		
DSHS	Dash Point	Littleneck clam	400.00		
DSHS	Dash Point	Littleneck clam	360.00		
DSHS	Dash Point	Littleneck clam	340.00		
DSHS	Mukilteo	Littleneck clam	270.00		
DSHS	Mukilteo	Littleneck clam	250.00		
DSHS	Mukilteo	Littleneck clam	447.00		
DSHS	Mukilteo	Littleneck clam	200.00		
DSHS	Mukilteo	Littleneck clam	310.00		
DSHS	Mukilteo	Littleneck clam	220.00		
DSHS	Sinclair Inlet	Littleneck clam	150.00		
DSHS	Sinclair Inlet	Littleneck clam	238.00		
DSHS	Sinclair Inlet	Littleneck clam	230.00		
DSHS	Sinclair Inlet	Littleneck clam	240.00		
DSHS	Sinclair Inlet	Littleneck clam	350.00		
DSHS	Alki Point	Butter clam	40.00		
DSHS	Alki Point	Butter clam	70.00		
DSHS	Alki Point	Butter clam	387.00		
DSHS	Birch Bay	Butter clam	170.00		
DSHS	Birch Bay	Butter clam	190.00		
DSHS	Budd Inlet	Butter clam	120.00		
DSHS	Burley Lagoon	Butter clam	86.00		
DSHS	Burley Lagoon	Butter clam	157.00		
DSHS	Burley Lagoon	Butter clam	80.00		
DSHS	Burley Lagoon	Butter clam	120.00		
DSHS	Burley Lagoon	Butter clam	100.00		
DSHS	Quartermaster Harbor	Butter clam	97.00		
DSHS	Quartermaster Harbor	Butter clam	104.00		
DSHS	Dash Point	Butter clam	116.00		
DSHS	Dash Point	Butter clam	90.00		
DSHS	Mukilteo	Butter clam	180.00		
DSHS	Mukilteo	Butter clam	126.00		
DSHS	Mukilteo	Butter clam	118.00		
DSHS	Mukilteo	Butter clam	196.00		
DSHS	Sinclair Inlet	Butter clam	140.00		
DSHS	Sinclair Inlet	Butter clam	74.00		
DSHS	Sinclair Inlet	Butter clam	91.00		
DSHS	Budd Inlet	Manila clam	327.00		
DSHS	Budd Inlet	Manila clam	360.00		
DSHS	Quartermaster Harbor	Manila clam	300.00		
DSHS	Quartermaster Harbor	Manila clam	17.00		
DSHS	Alki Point	Horseneck clam	210.00		

TABLE B-2. DATA LISTING FOR CADMIUM (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Cadmium	Det. Limit	Data Qual.
DSHS	Quartermaster Harbor	Horseneck clam	260.00		
DSHS	Sinclair Inlet	Horseneck clam	310.00		
NOAA1	Edmonds	Pacific hake	1.00		
NOAA1	Edmonds	Striped perch	6.00		
NOAA1	Edmonds	Striped perch	1.00		
NOAA1	Elliott Bay	Rockfish	3.00		
NOAA1	Edmonds	Rockfish	1.00	U	
NOAA1	Edmonds	Rockfish	2.00		
NOAA1	Edmonds	Rockfish	18.00		
NOAA1	Elliott Bay	Sablefish	2.00		
NOAA1	Elliott Bay	Sablefish	8.00		
NOAA1	Elliott Bay	Sablefish	3.00		
NOAA1	Elliott Bay	Sablefish	1.00		
NOAA1	Elliott Bay	Sablefish	1.00		
NOAA1	Elliott Bay	Sablefish	1.00	U	
NOAA1	Elliott Bay	Sablefish	1.00		
NOAA1	Elliott Bay	Sablefish	1.00	U	
NOAA1	Elliott Bay	Sablefish	1.00		
NOAA1	Elliott Bay	Sablefish	1.00	U	
NOAA1	Elliott Bay	Sablefish	2.00		
NOAA1	Elliott Bay	Sablefish	2.00		
NOAA1	Elliott Bay	Pacific cod	66.00		
NOAA1	Sinclair Inlet	Pacific cod	1.00	U	
NOAA1	Sinclair Inlet	Pacific cod	1.00	U	
NOAA1	Sinclair Inlet	Pacific cod	2.00		
NOAA1	Sinclair Inlet	Pacific cod	1.00	U	
NOAA1	Edmonds	Pacific cod	1.00	U	
NOAA1	Edmonds	Pacific cod	1.00	U	
NOAA1	Commencement Bay	Tomcod	5.00		
NOAA1	Commencement Bay	Tomcod	4.00		
NOAA1	Commencement Bay	English sole	3.00		
NOAA1	Commencement Bay	English sole	2.00		
NOAA1	Commencement Bay	English sole	1.00		
NOAA1	Elliott Bay	English sole	1.00	U	
NOAA1	Elliott Bay	English sole	2.00		
NOAA1	Elliott Bay	English sole	1.00		
NOAA1	Elliott Bay	English sole	1.00	U	
NOAA1	Elliott Bay	English sole	1.00	U	
NOAA1	Sinclair Inlet	English sole	1.00	U	
NOAA1	Sinclair Inlet	English sole	1.00	U	
NOAA1	Sinclair Inlet	English sole	1.00	U	
NOAA1	Sinclair Inlet	English sole	1.00	U	
NOAA1	Sinclair Inlet	English sole	1.00	U	
NOAA1	Edmonds	English sole	2.00		
NOAA1	Edmonds	English sole	1.00	U	
NOAA1	Edmonds	English sole	1.00	U	
NOAA1	Edmonds	English sole	1.00	U	
NOAA1	Edmonds	English sole	1.00	U	
NOAA1	Commencement Bay	Pacific sanddab	2.00		
NOAA1	Commencement Bay	Rock sole	1.00	U	
NOAA1	Commencement Bay	Rock sole	1.00		
NOAA1	Elliott Bay	Rock sole	1.00	U	
NOAA1	Sinclair Inlet	Rock sole	1.00	U	

TABLE B-2. DATA LISTING FOR CADMIUM (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Cadmium	Det. Limit	Data Qual.
NOAA1	Binclair Inlet	Rock sole	1.00	U	
NOAA1	Binclair Inlet	Rock sole	1.00	U	
NOAA1	Binclair Inlet	Rock sole	1.00	U	
NOAA1	Binclair Inlet	Rock sole	1.00	U	
NOAA1	Edmonds	Rock sole	1.00		
NOAA1	Edmonds	Rock sole	1.00	U	
NOAA1	Edmonds	Rock sole	1.00	U	
NOAA1	Commencement Bay	Buffalo sculpin	2.00		
NOAA1	Commencement Bay	Market squid	4.00		
NOAA1	Commencement Bay	Market squid	63.00		
NOAA1	Edmonds	Market squid	5.00		
NOAA1	Edmonds	Market squid	37.00		
NOAA1	Edmonds	Market squid	2.00		
NOAA1	Edmonds	Market squid	12.00		
NOAA1	Edmonds	Market squid	250.00		
NOAA2	Commencement Bay	Pacific hake	3.00		
NOAA2	Elliott Bay	Pacific hake	20.00		
NOAA2	Elliott Bay	Pacific hake	11.00		
NOAA2	Point Jefferson	Pacific hake	5.00		
NOAA2	Point Jefferson	Pacific hake	20.00		
NOAA2	Point Jefferson	Pacific hake	15.00		
NOAA2	Point Jefferson	Pacific hake	4.00		
NOAA2	Commencement Bay	Rockfish	4.00		
NOAA2	Commencement Bay	Rockfish	10.00		
NOAA2	Commencement Bay	Rockfish	4.00		
NOAA2	Commencement Bay	Rockfish	2.00		
NOAA2	Elliott Bay	Rockfish	12.00		
NOAA2	Elliott Bay	Rockfish	4.00		
NOAA2	Elliott Bay	Rockfish	10.00		
NOAA2	Edmonds	Rockfish	16.00		
NOAA2	Edmonds	Rockfish	20.00		
NOAA2	Edmonds	Rockfish	7.00		
NOAA2	Edmonds	Rockfish	13.00		
NOAA2	Edmonds	Rockfish	6.00		
NOAA2	Agate Pass	Rockfish	20.00		
NOAA2	Agate Pass	Rockfish	7.00		
NOAA2	Agate Pass	Rockfish	4.00		
NOAA2	Agate Pass	Rockfish	9.00		
NOAA2	Point Madison	Sablefish	23.00		
NOAA2	Point Madison	Sablefish	15.00		
NOAA2	Point Madison	Pacific cod	1.00		
NOAA2	Manchester	Pacific cod	8.00		
NOAA2	Manchester	Pacific cod	5.00		
NOAA2	Manchester	Pacific cod	15.00		
NOAA2	Manchester	Pacific cod	10.00		
NOAA2	Point Jefferson	Pacific cod	2.00		
NOAA2	Commencement Bay	Walleye pollock	4.00		
NOAA2	Commencement Bay	Walleye pollock	5.00		
NOAA2	Point Madison	Walleye pollock	2.00		
NOAA2	Point Madison	Walleye pollock	4.00		
NOAA2	Point Madison	Walleye pollock	6.00		
NOAA2	Point Madison	Walleye pollock	3.00		
NOAA2	Point Madison	Walleye pollock	3.00		

TABLE B-2. DATA LISTING FOR CADMIUM (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Cadmium	Det. Limit	Data Qual.
NOAA2	Point Madison	Tomcod	2.00		
NOAA2	Point Madison	Tomcod	12.00		
NOAA2	Point Madison	Tomcod	4.00		
NOAA2	Commencement Bay	Starry flounder	2.00		
NOAA2	Commencement Bay	Starry flounder	5.00		
NOAA2	Commencement Bay	Starry flounder	3.00		
NOAA2	Commencement Bay	Starry flounder	3.00		
NOAA2	Sinclair Inlet	Starry flounder	10.00		
NOAA2	Sinclair Inlet	Starry flounder	4.00		
NOAA2	Sinclair Inlet	Starry flounder	3.00		
NOAA2	Sinclair Inlet	Starry flounder	7.00		
NOAA2	Elliott Bay	Rock sole	2.00		
NOAA2	Elliott Bay	Rock sole	2.00		
NOAA2	Elliott Bay	Rock sole	6.00		
NOAA2	Elliott Bay	Rock sole	20.00		
NOAA2	Edmonds	Rock sole	3.00		
NOAA2	Edmonds	Rock sole	4.00		
NOAA2	Edmonds	Rock sole	11.00		
NOAA2	Edmonds	Rock sole	4.00		
NOAA2	Elliott Bay	Market squid	39.00		
NOAA2	Elliott Bay	Market squid	41.00		
NOAA2	Elliott Bay	Market squid	32.00		
NOAA2	Sinclair Inlet	Market squid	17.00		
NOAA2	Sinclair Inlet	Market squid	26.00		
NOAA2	Edmonds	Market squid	120.00		
NOAA2	Edmonds	Market squid	8.00		
WDOE1	Eagle Harbor	Bivalve spp.	140.00		
WDOE1	Eagle Harbor	Bivalve spp.	140.00		
WDOE1	Eagle Harbor	Bivalve spp.	290.00		
WDOE1	Eagle Harbor	Bivalve spp.	110.00		
WDOE1	Eagle Harbor	Bivalve spp.	90.00		
WDOE1	Eagle Harbor	Bivalve spp.	80.00		
WDOE1	Eagle Harbor	Bivalve spp.	130.00		
WDOE1	Eagle Harbor	Bivalve spp.	290.00		
WDOE1	Point Blakely	Bivalve spp.	110.00		

TABLE B-3. DATA LISTING FOR LEAD (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Lead	Det. Limit	Data Qual.
EPA/DSHS	Dash Point	Bentnose clam	1,630.00		
EPA/DSHS	Dash Point	Bentnose clam	990.00		
EPA/DSHS	Everett Harbor	Sand clam	390.00		
EPA/DSHS	Alki Point	Littleneck clam	10.00	U	
EPA/DSHS	Birch Bay	Littleneck clam	10.00	U	
EPA/DSHS	Quartermaster Harbor	Littleneck clam	10.00	U	
EPA/DSHS	Dash Point	Littleneck clam	100.00		
EPA/DSHS	Everett Harbor	Littleneck clam	10.00	U	
EPA/DSHS	Mukilteo	Littleneck clam	10.00	U	
EPA/DSHS	Sinclair Inlet	Littleneck clam	270.00		
EPA/DSHS	Alki Point	Butter clam	260.00		
EPA/DSHS	Birch Bay	Butter clam	10.00	U	
EPA/DSHS	Burley Lagoon	Butter clam	90.00		
EPA/DSHS	Quartermaster Harbor	Butter clam	570.00		
EPA/DSHS	Everett Harbor	Butter clam	210.00		
EPA/DSHS	Mukilteo	Butter clam	60.00		
EPA/DSHS	Mukilteo	Butter clam	260.00		
EPA/DSHS	Sinclair Inlet	Butter clam	200.00		
EPA/DSHS	Quartermaster Harbor	Manila clam	10.00	U	
EPA/WDOE	Commencement Bay	Laminaria	85.00		
EPA/WDOE	Commencement Bay	Laminaria	340.00		
EPA/WDOE	Commencement Bay	Laminaria	190.00		
EPA/WDOE	Commencement Bay	Laminaria	440.00		
EPA/WDOE	Elliott Bay	Laminaria	100.00		
EPA/WDOE	Elliott Bay	Laminaria	5.00	U	
EPA/WDOE	Point No Point	Laminaria	5.00	U	
EPA/WDOE	Point No Point	Laminaria	20.00		
EPA/WDOE	Point No Point	Laminaria	100.00		
EPA/WDOE	Commencement Bay	Nereocystis	5.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	100.00		
EPA/WDOE	Elliott Bay	Nereocystis	150.00		
EPA/WDOE	Elliott Bay	Nereocystis	160.00		
EPA/WDOE	Elliott Bay	Nereocystis	140.00		
EPA/WDOE	Point No Point	Nereocystis	155.00		
EPA/WDOE	Point No Point	Nereocystis	5.00	U	
EPA/WDOE	Budd Inlet	Ulva	165.00		
EPA/WDOE	Budd Inlet	Ulva	90.00		
EPA/WDOE	Budd Inlet	Ulva	5.00		
EPA/WDOE	Budd Inlet	Ulva	195.00		
EPA/WDOE	Commencement Bay	Ulva	460.00		
EPA/WDOE	Commencement Bay	Ulva	4,460.00		
EPA/WDOE	Commencement Bay	Ulva	370.00		
EPA/WDOE	Commencement Bay	Ulva	730.00		
EPA/WDOE	Elliott Bay	Ulva	160.00		
EPA/WDOE	Elliott Bay	Ulva	1,160.00		
EPA/WDOE	Elliott Bay	Ulva	540.00		
EPA/WDOE	Everett Harbor	Ulva	100.00		
EPA/WDOE	Everett Harbor	Ulva	85.00		
EPA/WDOE	Everett Harbor	Ulva	370.00		
EPA/WDOE	Point No Point	Ulva	250.00		
EPA/WDOE	Point No Point	Ulva	5.00	U	
EPA/WDOE	Point No Point	Ulva	20.00		
EPA/WDOE	Elliott Bay	Nori	145.00		

TABLE B-3. DATA LISTING FOR LEAD (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Lead	Det. Limit	Data Qual.
EPA/WDOE	Elliott Bay	Nori	240.00		
EPA/WDOE	Elliott Bay	Nori	140.00		
EPA/WDOE	Elliott Bay	Nori	5.00		
EPA/WDOE	Point No Point	Nori	5.00	U	
EPA/WDOE	Point No Point	Nori	5.00	U	
EPA/WDOE	Point No Point	Nori	5.00	U	
EPA/WDF	Anacortes	Chinook salmon	10.00	U	
EPA/WDF	Anacortes	Chinook salmon	10.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	10.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	10.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	10.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	10.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	10.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	10.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	10.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	200.00		
EPA/WDF	Elliott Bay	Chinook salmon	50.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	50.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	90.00		
EPA/WDF	Elliott Bay	Chinook salmon	160.00		
EPA/WDF	Elliott Bay	Chinook salmon	90.00		
EPA/WDF	Elliott Bay	Chinook salmon	130.00		
EPA/WDF	Everett Harbor	Chinook salmon	10.00	U	
EPA/WDF	Point No Point	Chinook salmon	10.00	U	
EPA/WDF	Point No Point	Chinook salmon	10.00	U	
EPA/WDF	Point No Point	Chinook salmon	10.00	U	
EPA/WDF	Point No Point	Chinook salmon	10.00	U	
EPA/WDF	Point No Point	Chinook salmon	10.00	U	
EPA/WDF	Point No Point	Chinook salmon	10.00	U	
EPA/WDF	Point No Point	Chinook salmon	10.00	U	
EPA/WDF	Commencement Bay	Coho salmon	10.00	U	
EPA/WDF	Commencement Bay	Coho salmon	10.00	U	
DSHS	Dash Point	Heart cockle	230.00		
DSHS	Birch Bay	M. inquinata	270.00		
DSHS	Budd Inlet	Softshell clam	270.00		
DSHS	Alki Point	Littleneck clam	40.00		
DSHS	Alki Point	Littleneck clam	120.00		
DSHS	Alki Point	Littleneck clam	50.00		
DSHS	Alki Point	Littleneck clam	90.00		
DSHS	Birch Bay	Littleneck clam	40.00		
DSHS	Birch Bay	Littleneck clam	40.00		
DSHS	Birch Bay	Littleneck clam	40.00		
DSHS	Birch Bay	Littleneck clam	40.00		
DSHS	Budd Inlet	Littleneck clam	40.00		
DSHS	Budd Inlet	Littleneck clam	50.00		
DSHS	Budd Inlet	Littleneck clam	60.00		
DSHS	Budd Inlet	Littleneck clam	100.00		
DSHS	Quartermaster Harbor	Littleneck clam	40.00		
DSHS	Quartermaster Harbor	Littleneck clam	80.00		
DSHS	Quartermaster Harbor	Littleneck clam	140.00		
DSHS	Quartermaster Harbor	Littleneck clam	140.00		
DSHS	Dash Point	Littleneck clam	100.00		
DSHS	Dash Point	Littleneck clam	90.00		

TABLE B-3. DATA LISTING FOR LEAD (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Lead	Det. Limit	Data Qual.
DSHS	Mukilteo	Littleneck clam	40.00		
DSHS	Mukilteo	Littleneck clam	40.00		
DSHS	Mukilteo	Littleneck clam	40.00		
DSHS	Mukilteo	Littleneck clam	50.00		
DSHS	Sinclair Inlet	Littleneck clam	180.00		
DSHS	Sinclair Inlet	Littleneck clam	120.00		
DSHS	Sinclair Inlet	Littleneck clam	120.00		
DSHS	Alki Point	Butter clam	170.00		
DSHS	Alki Point	Butter clam	200.00		
DSHS	Alki Point	Butter clam	40.00		
DSHS	Birch Bay	Butter clam	40.00		
DSHS	Birch Bay	Butter clam	40.00		
DSHS	Budd Inlet	Butter clam	130.00		
DSHS	Burley Lagoon	Butter clam	140.00		
DSHS	Burley Lagoon	Butter clam	90.00		
DSHS	Burley Lagoon	Butter clam	40.00		
DSHS	Burley Lagoon	Butter clam	120.00		
DSHS	Quartermaster Harbor	Butter clam	420.00		
DSHS	Quartermaster Harbor	Butter clam	380.00		
DSHS	Dash Point	Butter clam	130.00		
DSHS	Dash Point	Butter clam	320.00		
DSHS	Mukilteo	Butter clam	120.00		
DSHS	Mukilteo	Butter clam	110.00		
DSHS	Mukilteo	Butter clam	80.00		
DSHS	Mukilteo	Butter clam	90.00		
DSHS	Sinclair Inlet	Butter clam	260.00		
DSHS	Sinclair Inlet	Butter clam	280.00		
DSHS	Sinclair Inlet	Butter clam	290.00		
DSHS	Budd Inlet	Manila clam	100.00		
DSHS	Budd Inlet	Manila clam	110.00		
DSHS	Quartermaster Harbor	Manila clam	150.00		
DSHS	Quartermaster Harbor	Manila clam	110.00		
DSHS	Quartermaster Harbor	Horseneck clam	300.00		
NOAA1	Edmonds	Pacific hake	13.00		
NOAA1	Edmonds	Striped perch	180.00		
NOAA1	Edmonds	Striped perch	10.00	U	
NOAA1	Elliott Bay	Rockfish	12.00	U	
NOAA1	Edmonds	Rockfish	16.00		
NOAA1	Edmonds	Rockfish	10.00	U	
NOAA1	Edmonds	Rockfish	30.00		
NOAA1	Elliott Bay	Sablefish	13.00		
NOAA1	Elliott Bay	Sablefish	14.00		
NOAA1	Elliott Bay	Sablefish	10.00	U	
NOAA1	Elliott Bay	Sablefish	10.00	U	
NOAA1	Elliott Bay	Sablefish	10.00	U	
NOAA1	Elliott Bay	Sablefish	13.00		
NOAA1	Elliott Bay	Sablefish	8.00	U	
NOAA1	Elliott Bay	Sablefish	20.00		
NOAA1	Elliott Bay	Sablefish	10.00	U	
NOAA1	Elliott Bay	Sablefish	10.00	U	
NOAA1	Elliott Bay	Sablefish	10.00	U	
NOAA1	Elliott Bay	Sablefish	10.00	U	
NOAA1	Elliott Bay	Pacific cod	15.00		

TABLE B-3. DATA LISTING FOR LEAD (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Lead	Det. Limit	Data Qual.
NOAA1	Sinclair Inlet	Pacific cod	10.00	U	
NOAA1	Sinclair Inlet	Pacific cod	10.00	U	
NOAA1	Sinclair Inlet	Pacific cod	8.00	U	
NOAA1	Sinclair Inlet	Pacific cod	10.00	U	
NOAA1	Edmonds	Pacific cod	200.00		
NOAA1	Edmonds	Pacific cod	10.00	U	
NOAA1	Commencement Bay	Tomcod	28.00		
NOAA1	Commencement Bay	Tomcod	30.00		
NOAA1	Commencement Bay	English sole	22.00		
NOAA1	Commencement Bay	English sole	48.00		
NOAA1	Commencement Bay	English sole	37.00		
NOAA1	Elliott Bay	English sole	10.00	U	
NOAA1	Elliott Bay	English sole	13.00		
NOAA1	Elliott Bay	English sole	45.00		
NOAA1	Elliott Bay	English sole	10.00	U	
NOAA1	Sinclair Inlet	English sole	32.00		
NOAA1	Sinclair Inlet	English sole	10.00	U	
NOAA1	Sinclair Inlet	English sole	10.00	U	
NOAA1	Sinclair Inlet	English sole	22.00		
NOAA1	Sinclair Inlet	English sole	28.00		
NOAA1	Edmonds	English sole	8.00	U	
NOAA1	Edmonds	English sole	8.00	U	
NOAA1	Edmonds	English sole	10.00	U	
NOAA1	Edmonds	English sole	8.00	U	
NOAA1	Edmonds	English sole	6.00	U	
NOAA1	Commencement Bay	Pacific sanddab	47.00		
NOAA1	Commencement Bay	Rock sole	6.00	U	
NOAA1	Commencement Bay	Rock sole	100.00		
NOAA1	Elliott Bay	Rock sole	10.00	U	
NOAA1	Sinclair Inlet	Rock sole	6.00	U	
NOAA1	Sinclair Inlet	Rock sole	10.00	U	
NOAA1	Sinclair Inlet	Rock sole	10.00	U	
NOAA1	Sinclair Inlet	Rock sole	83.00		
NOAA1	Sinclair Inlet	Rock sole	10.00	U	
NOAA1	Edmonds	Rock sole	16.00		
NOAA1	Edmonds	Rock sole	58.00		
NOAA1	Edmonds	Rock sole	10.00	U	
NOAA1	Commencement Bay	Buffalo sculpin	18.00		
NOAA1	Commencement Bay	Market squid	10.00	U	
NOAA1	Commencement Bay	Market squid	10.00	U	
NOAA1	Edmonds	Market squid	10.00	U	
NOAA1	Edmonds	Market squid	10.00	U	
NOAA1	Edmonds	Market squid	2.00		
NOAA1	Edmonds	Market squid	12.00	U	
NOAA1	Edmonds	Market squid	10.00	U	
NOAA2	Commencement Bay	Pacific hake	2.00		
NOAA2	Elliott Bay	Pacific hake	6.00		
NOAA2	Elliott Bay	Pacific hake	4.00		
NOAA2	Point Jefferson	Pacific hake	4.00		
NOAA2	Point Jefferson	Pacific hake	3.00		
NOAA2	Point Jefferson	Pacific hake	3.00		
NOAA2	Point Jefferson	Pacific hake	5.00		
NOAA2	Commencement Bay	Rockfish	3.00		

TABLE B-3. DATA LISTING FOR LEAD (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Lead	Det. Limit	Data Qual.
NOAA2	Commencement Bay	Rockfish	10.00		
NOAA2	Commencement Bay	Rockfish	3.00		
NOAA2	Commencement Bay	Rockfish	8.00		
NOAA2	Elliott Bay	Rockfish	23.00		
NOAA2	Elliott Bay	Rockfish	2.00	U	
NOAA2	Elliott Bay	Rockfish	4.00		
NOAA2	Edmonds	Rockfish	6.00		
NOAA2	Edmonds	Rockfish	2.00	U	
NOAA2	Edmonds	Rockfish	2.00		
NOAA2	Edmonds	Rockfish	2.00		
NOAA2	Edmonds	Rockfish	1.00	U	
NOAA2	Agate Pass	Rockfish	4.00		
NOAA2	Agate Pass	Rockfish	7.00		
NOAA2	Agate Pass	Rockfish	4.00		
NOAA2	Agate Pass	Rockfish	2.00	U	
NOAA2	Point Madison	Sablefish	1.00	U	
NOAA2	Point Madison	Sablefish	2.00	U	
NOAA2	Point Madison	Pacific cod	1.00		
NOAA2	Manchester	Pacific cod	2.00		
NOAA2	Manchester	Pacific cod	1.00		
NOAA2	Manchester	Pacific cod	2.00		
NOAA2	Manchester	Pacific cod	5.00		
NOAA2	Point Jefferson	Pacific cod	3.00		
NOAA2	Commencement Bay	Walleye pollock	4.00		
NOAA2	Commencement Bay	Walleye pollock	12.00		
NOAA2	Point Madison	Walleye pollock	1.00	U	
NOAA2	Point Madison	Walleye pollock	1.00	U	
NOAA2	Point Madison	Walleye pollock	1.00	U	
NOAA2	Point Madison	Walleye pollock	1.00	U	
NOAA2	Point Madison	Walleye pollock	3.00		
NOAA2	Point Madison	Tomcod	1.00	U	
NOAA2	Point Madison	Tomcod	1.00	U	
NOAA2	Point Madison	Tomcod	1.00	U	
NOAA2	Commencement Bay	Starry flounder	1.00	U	
NOAA2	Commencement Bay	Starry flounder	1.00	U	
NOAA2	Commencement Bay	Starry flounder	2.00		
NOAA2	Commencement Bay	Starry flounder	1.00		
NOAA2	Sinclair Inlet	Starry flounder	2.00		
NOAA2	Sinclair Inlet	Starry flounder	2.00		
NOAA2	Sinclair Inlet	Starry flounder	2.00		
NOAA2	Sinclair Inlet	Starry flounder	2.00		
NOAA2	Elliott Bay	Rock sole	2.00		
NOAA2	Elliott Bay	Rock sole	3.00		
NOAA2	Elliott Bay	Rock sole	6.00		
NOAA2	Elliott Bay	Rock sole	2.00	U	
NOAA2	Edmonds	Rock sole	2.00	U	
NOAA2	Edmonds	Rock sole	2.00	U	
NOAA2	Edmonds	Rock sole	7.00		
NOAA2	Edmonds	Rock sole	8.00		
NOAA2	Elliott Bay	Market squid	2.00	U	
NOAA2	Elliott Bay	Market squid	2.00	U	
NOAA2	Elliott Bay	Market squid	2.00		
NOAA2	Sinclair Inlet	Market squid	2.00	U	

TABLE B-3. DATA LISTING FOR LEAD (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Lead	Det. Limit	Data Qual.
NOAA2	Sinclair Inlet	Market squid	2.00	U	
NOAA2	Edmonds	Market squid	8.00		
NOAA2	Edmonds	Market squid	2.00	U	
WDOE1	Eagle Harbor	Bivalve spp.	450.00		
WDOE1	Eagle Harbor	Bivalve spp.	1,320.00		
WDOE1	Eagle Harbor	Bivalve spp.	1,030.00		
WDOE1	Eagle Harbor	Bivalve spp.	1,980.00		
WDOE1	Eagle Harbor	Bivalve spp.	430.00		
WDOE1	Eagle Harbor	Bivalve spp.	590.00		
WDOE1	Eagle Harbor	Bivalve spp.	490.00		
WDOE1	Eagle Harbor	Bivalve spp.	430.00		
WDOE1	Point Blakely	Bivalve spp.	380.00		

TABLE B-4. DATA LISTING FOR MERCURY (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Mercury	Det. Limit	Data Qual.
EPA/DSHS	Dash Point	Bentnose clam	52.00		
EPA/DSHS	Dash Point	Bentnose clam	31.00		
EPA/DSHS	Everett Harbor	Sand clam	30.00		
EPA/DSHS	Alki Point	Littleneck clam	10.00		
EPA/DSHS	Birch Bay	Littleneck clam	5.00		
EPA/DSHS	Quartermaster Harbor	Littleneck clam	14.00		
EPA/DSHS	Dash Point	Littleneck clam	7.00		
EPA/DSHS	Everett Harbor	Littleneck clam	12.00		
EPA/DSHS	Mukilteo	Littleneck clam	3.00		
EPA/DSHS	Sinclair Inlet	Littleneck clam	15.00		
EPA/DSHS	Alki Point	Butter clam	8.00		
EPA/DSHS	Birch Bay	Butter clam	1.00		
EPA/DSHS	Burley Lagoon	Butter clam	4.00		
EPA/DSHS	Quartermaster Harbor	Butter clam	16.00		
EPA/DSHS	Everett Harbor	Butter clam	10.00		
EPA/DSHS	Mukilteo	Butter clam	4.00		
EPA/DSHS	Mukilteo	Butter clam	1.00		
EPA/DSHS	Sinclair Inlet	Butter clam	21.00		
EPA/DSHS	Quartermaster Harbor	Manila clam	14.00		
EPA/WDOE	Commencement Bay	Laminaria	1.00	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U	
EPA/WDOE	Elliott Bay	Laminaria	1.00	U	
EPA/WDOE	Elliott Bay	Laminaria	1.00	U	
EPA/WDOE	Point No Point	Laminaria	1.00	U	
EPA/WDOE	Point No Point	Laminaria	1.00	U	
EPA/WDOE	Point No Point	Laminaria	1.00		
EPA/WDOE	Commencement Bay	Nereocystis	1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U	
EPA/WDOE	Point No Point	Nereocystis	1.00	U	
EPA/WDOE	Point No Point	Nereocystis	1.00	U	
EPA/WDOE	Budd Inlet	Ulva	1.00		
EPA/WDOE	Budd Inlet	Ulva	3.00		
EPA/WDOE	Budd Inlet	Ulva	1.00		
EPA/WDOE	Budd Inlet	Ulva	1.00	U	
EPA/WDOE	Commencement Bay	Ulva	2.00		
EPA/WDOE	Commencement Bay	Ulva	15.00		
EPA/WDOE	Commencement Bay	Ulva	3.00		
EPA/WDOE	Commencement Bay	Ulva	2.00		
EPA/WDOE	Elliott Bay	Ulva	2.00		
EPA/WDOE	Elliott Bay	Ulva	4.00		
EPA/WDOE	Elliott Bay	Ulva	3.00		
EPA/WDOE	Everett Harbor	Ulva	1.00	U	
EPA/WDOE	Everett Harbor	Ulva	1.00		
EPA/WDOE	Everett Harbor	Ulva	2.00		
EPA/WDOE	Point No Point	Ulva	2.00		
EPA/WDOE	Point No Point	Ulva	4.00		
EPA/WDOE	Point No Point	Ulva	1.00		
EPA/WDOE	Elliott Bay	Nori	1.00		

TABLE B-4. DATA LISTING FOR MERCURY (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Mercury	Det. Limit	Data Qual.
EPA/WDOE	Elliott Bay	Nori	1.00	U	
EPA/WDOE	Elliott Bay	Nori	1.00	U	
EPA/WDOE	Elliott Bay	Nori	3.00		
EPA/WDOE	Point No Point	Nori	1.00		
EPA/WDOE	Point No Point	Nori	1.00	U	
EPA/WDOE	Point No Point	Nori	1.00	U	
EPA/WDF	Anacortes	Chinook salmon	43.00		
EPA/WDF	Anacortes	Chinook salmon	260.00		
EPA/WDF	Commencement Bay	Chinook salmon	42.00		
EPA/WDF	Commencement Bay	Chinook salmon	54.00		
EPA/WDF	Commencement Bay	Chinook salmon	39.00		
EPA/WDF	Commencement Bay	Chinook salmon	52.00		
EPA/WDF	Commencement Bay	Chinook salmon	51.00		
EPA/WDF	Elliott Bay	Chinook salmon	40.00		
EPA/WDF	Elliott Bay	Chinook salmon	20.00		
EPA/WDF	Elliott Bay	Chinook salmon	63.00		
EPA/WDF	Elliott Bay	Chinook salmon	76.00		
EPA/WDF	Elliott Bay	Chinook salmon	32.00		
EPA/WDF	Elliott Bay	Chinook salmon	53.00		
EPA/WDF	Elliott Bay	Chinook salmon	64.00		
EPA/WDF	Elliott Bay	Chinook salmon	67.00		
EPA/WDF	Elliott Bay	Chinook salmon	44.00		
EPA/WDF	Everett Harbor	Chinook salmon	35.00		
EPA/WDF	Point No Point	Chinook salmon	41.00		
EPA/WDF	Point No Point	Chinook salmon	22.00		
EPA/WDF	Point No Point	Chinook salmon	49.00		
EPA/WDF	Point No Point	Chinook salmon	29.00		
EPA/WDF	Point No Point	Chinook salmon	37.00		
EPA/WDF	Point No Point	Chinook salmon	24.00		
EPA/WDF	Point No Point	Chinook salmon	35.00		
EPA/WDF	Commencement Bay	Coho salmon	59.00		
EPA/WDF	Commencement Bay	Coho salmon	41.00		
DSHS	Dash Point	Heart cockle	20.00		
DSHS	Birch Bay	M. inquinata	22.00		
DSHS	Budd Inlet	M. inquinata	57.00		
DSHS	Dash Point	M. inquinata	103.00		
DSHS	Dash Point	Bentnose clam	69.00		
DSHS	Dash Point	Bentnose clam	61.00		
DSHS	Budd Inlet	Softshell clam	20.00		
DSHS	Alki Point	Littleneck clam	26.00		
DSHS	Alki Point	Littleneck clam	22.00		
DSHS	Alki Point	Littleneck clam	20.00		
DSHS	Alki Point	Littleneck clam	20.00		
DSHS	Alki Point	Littleneck clam	20.00		
DSHS	Birch Bay	Littleneck clam	20.00		
DSHS	Birch Bay	Littleneck clam	20.00		
DSHS	Birch Bay	Littleneck clam	20.00		
DSHS	Budd Inlet	Littleneck clam	20.00		
DSHS	Budd Inlet	Littleneck clam	20.00		
DSHS	Budd Inlet	Littleneck clam	20.00		
DSHS	Budd Inlet	Littleneck clam	20.00		
DSHS	Burley Lagoon	Littleneck clam	20.00		
DSHS	Quartermaster Harbor	Littleneck clam	27.00		

TABLE B-4. DATA LISTING FOR MERCURY (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Mercury	Det. Limit	Data Qual.
DSHS	Quartermaster Harbor	Littleneck clam	20.00		
DSHS	Quartermaster Harbor	Littleneck clam	20.00		
DSHS	Quartermaster Harbor	Littleneck clam	23.00		
DSHS	Dash Point	Littleneck clam	20.00		
DSHS	Dash Point	Littleneck clam	20.00		
DSHS	Mukilteo	Littleneck clam	20.00		
DSHS	Mukilteo	Littleneck clam	20.00		
DSHS	Mukilteo	Littleneck clam	20.00		
DSHS	Mukilteo	Littleneck clam	20.00		
DSHS	Sinclair Inlet	Littleneck clam	30.00		
DSHS	Sinclair Inlet	Littleneck clam	32.00		
DSHS	Sinclair Inlet	Littleneck clam	34.00		
DSHS	Alki Point	Butter clam	20.00		
DSHS	Alki Point	Butter clam	20.00		
DSHS	Alki Point	Butter clam	20.00		
DSHS	Birch Bay	Butter clam	20.00		
DSHS	Birch Bay	Butter clam	20.00		
DSHS	Budd Inlet	Butter clam	20.00		
DSHS	Burley Lagoon	Butter clam	20.00		
DSHS	Burley Lagoon	Butter clam	20.00		
DSHS	Burley Lagoon	Butter clam	20.00		
DSHS	Quartermaster Harbor	Butter clam	20.00		
DSHS	Quartermaster Harbor	Butter clam	20.00		
DSHS	Dash Point	Butter clam	20.00		
DSHS	Mukilteo	Butter clam	20.00		
DSHS	Mukilteo	Butter clam	20.00		
DSHS	Mukilteo	Butter clam	20.00		
DSHS	Mukilteo	Butter clam	20.00		
DSHS	Sinclair Inlet	Butter clam	41.00		
DSHS	Sinclair Inlet	Butter clam	28.00		
DSHS	Sinclair Inlet	Butter clam	23.00		
DSHS	Budd Inlet	Manila clam	20.00		
DSHS	Budd Inlet	Manila clam	20.00		
DSHS	Quartermaster Harbor	Manila clam	23.00		
DSHS	Quartermaster Harbor	Manila clam	20.00		
DSHS	Alki Point	Horseneck clam	20.00		
DSHS	Quartermaster Harbor	Horseneck clam	26.00		
DSHS	Sinclair Inlet	Horseneck clam	27.00		
UBAP/EB	Elliott Bay	English sole	125.00		J
UBAP/EB	Elliott Bay	English sole	13.00		J
UBAP/EB	Elliott Bay	English sole	55.00		J
UBAP/EB	Elliott Bay	English sole	54.00		J
UBAP/EB	Elliott Bay	English sole	74.00		J
UBAP/EB	Elliott Bay	English sole	71.00		J
UBAP/EB	Elliott Bay	English sole	53.00		J
UBAP/EB	Elliott Bay	English sole	99.00		J
UBAP/EB	Elliott Bay	English sole	67.00		J
UBAP/EB	Elliott Bay	English sole	66.00		J
UBAP/EB	Elliott Bay	English sole	21.00		J
UBAP/EB	Elliott Bay	English sole	18.00		J
UBAP/EB	Elliott Bay	English sole	39.00		J
UBAP/EB	Elliott Bay	English sole	48.00		J
UBAP/EB	Elliott Bay	English sole	55.00		J

TABLE B-4. DATA LISTING FOR MERCURY (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Mercury	Det. Limit	Data Qual.
UBAP/EB	Elliott Bay	English sole	70.00		J
UBAP/EB	Elliott Bay	English sole	60.00		J
UBAP/EB	Elliott Bay	English sole	66.00		J
UBAP/EB	Elliott Bay	English sole	97.00		J
UBAP/EB	Elliott Bay	English sole	48.00		J
UBAP/EB	Elliott Bay	English sole	75.00		J
UBAP/EB	Elliott Bay	English sole	100.00		J
UBAP/EB	Elliott Bay	English sole	114.00		J
UBAP/EB	Elliott Bay	English sole	70.00		J
UBAP/EB	Elliott Bay	English sole	61.00		J
UBAP/EB	Elliott Bay	English sole	102.00		J
UBAP/EB	Elliott Bay	English sole	43.00		J
UBAP/EB	Elliott Bay	English sole	78.00		J
UBAP/EB	Elliott Bay	English sole	52.00		J
UBAP/EB	Elliott Bay	English sole	22.00		J
UBAP/EB	Elliott Bay	English sole	101.00		J
UBAP/EB	Elliott Bay	English sole	45.00		J
UBAP/EB	Elliott Bay	English sole	53.00		J
UBAP/EB	Elliott Bay	English sole	69.00		J
UBAP/EB	Elliott Bay	English sole	118.00		J
UBAP/EB	Elliott Bay	English sole	58.00		J
UBAP/EB	Elliott Bay	English sole	99.00		J
UBAP/EB	Elliott Bay	English sole	85.00		J
UBAP/EB	Elliott Bay	English sole	68.00		J
UBAP/EB	Elliott Bay	English sole	61.00		J
UBAP/EB	Elliott Bay	English sole	34.00		J
UBAP/EB	Elliott Bay	English sole	28.00		J
UBAP/EB	Elliott Bay	English sole	11.00		J
UBAP/EB	Elliott Bay	English sole	71.00		J
UBAP/EB	Elliott Bay	English sole	39.00		J
UBAP/EB	Elliott Bay	English sole	23.00		J
UBAP/EB	Elliott Bay	English sole	78.00		J
UBAP/EB	Elliott Bay	English sole	33.00		J
UBAP/EB	Elliott Bay	English sole	99.00		J
UBAP/EB	Elliott Bay	English sole	65.00		J
UBAP/EB	Elliott Bay	English sole	67.00		J
UBAP/EB	Elliott Bay	English sole	134.00		J
UBAP/EB	Elliott Bay	English sole	46.00		J
UBAP/EB	Elliott Bay	English sole	149.00		J
UBAP/EB	Elliott Bay	English sole	29.00		J
UBAP/EB	Point Pulley	English sole	56.00		J
UBAP/EB	Point Pulley	English sole	95.00		J
UBAP/EB	Point Pulley	English sole	86.00		J
UBAP/EB	Point Pulley	English sole	91.00		J
UBAP/EB	Point Pulley	English sole	118.00		J
UBAP/EH	Everett Harbor	English sole	9.00		J
UBAP/EH	Everett Harbor	English sole	3.00		J
UBAP/EH	Everett Harbor	English sole	16.00		J
UBAP/EH	Everett Harbor	English sole	11.00		J
UBAP/EH	Everett Harbor	English sole	9.00		J
UBAP/EH	Everett Harbor	English sole	34.00		J
UBAP/EH	Everett Harbor	English sole	66.00		J
UBAP/EH	Everett Harbor	English sole	46.00		J

TABLE B-4. DATA LISTING FOR MERCURY (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Mercury	Det. Limit	Data Qual.
UBAP/EH	Everett Harbor	English sole	38.00		J
UBAP/EH	Everett Harbor	English sole	19.00		J
UBAP/EH	Everett Harbor	English sole	61.00		J
UBAP/EH	Everett Harbor	English sole	78.00		J
UBAP/EH	Everett Harbor	English sole	65.00		J
UBAP/EH	Everett Harbor	English sole	44.00		J
UBAP/EH	Everett Harbor	English sole	42.00		J
UBAP/EH	Everett Harbor	English sole	70.00		J
UBAP/EH	Everett Harbor	English sole	34.00		J
UBAP/EH	Everett Harbor	English sole	49.00		J
UBAP/EH	Everett Harbor	English sole	61.00		J
UBAP/EH	Everett Harbor	English sole	46.00		J
UBAP/EH	Everett Harbor	English sole	13.00		J
UBAP/EH	Everett Harbor	English sole	23.00		J
UBAP/EH	Everett Harbor	English sole	63.00		J
UBAP/EH	Everett Harbor	English sole	33.00		J
UBAP/EH	Everett Harbor	English sole	60.00		J
UBAP/EH	Everett Harbor	English sole	58.00		J
UBAP/EH	Everett Harbor	English sole	41.00		J
UBAP/EH	Everett Harbor	English sole	42.00		J
UBAP/EH	Everett Harbor	English sole	37.00		J
UBAP/EH	Everett Harbor	English sole	40.00		J
UBAP/EH	Everett Harbor	English sole	47.00		J
UBAP/EH	Everett Harbor	English sole	31.00		J
UBAP/EH	Everett Harbor	English sole	50.00		J
UBAP/EH	Everett Harbor	English sole	40.00		J
UBAP/EH	Everett Harbor	English sole	26.00		J
UBAP/EH	Everett Harbor	English sole	36.00		J
UBAP/EH	Everett Harbor	English sole	15.00		J
UBAP/EH	Everett Harbor	English sole	34.00		J
UBAP/EH	Everett Harbor	English sole	36.00		J
UBAP/EH	Everett Harbor	English sole	71.00		J
UBAP/EH	Everett Harbor	English sole	51.00		J
UBAP/EH	Everett Harbor	English sole	76.00		J
UBAP/EH	Everett Harbor	English sole	39.00		J
UBAP/EH	Everett Harbor	English sole	35.00		J
UBAP/EH	Everett Harbor	English sole	32.00		J
UBAP/EH	Everett Harbor	English sole	28.00		J
UBAP/EH	Everett Harbor	English sole	35.00		J
UBAP/EH	Everett Harbor	English sole	36.00		J
UBAP/EH	Everett Harbor	English sole	114.00		J
UBAP/EH	Port Susan	English sole	52.00		J
UBAP/EH	Port Susan	English sole	68.00		J
UBAP/EH	Port Susan	English sole	53.00		J
UBAP/EH	Port Susan	English sole	100.00		J
UBAP/EH	Port Susan	English sole	62.00		J
UBAP/EH	Everett Harbor	Starry flounder	88.00		J
UBAP/EH	Everett Harbor	Starry flounder	49.00		J
UBAP/EH	Everett Harbor	Starry flounder	139.00		J
UBAP/EH	Everett Harbor	Starry flounder	139.00		J
UBAP/EH	Everett Harbor	Starry flounder	89.00		J
UBAP/EH	Everett Harbor	Dungeness crab	64.00		J
UBAP/EH	Everett Harbor	Dungeness crab	82.00		J

TABLE B-4. DATA LISTING FOR MERCURY (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Mercury	Det. Limit	Data Qual.
UBAP/EH	Everett Harbor	Dungeness crab	57.00		J
UBAP/EH	Everett Harbor	Dungeness crab	132.00		J
UBAP/EH	Everett Harbor	Dungeness crab	74.00		J
UBAP/EH	Everett Harbor	Dungeness crab	89.00		J
UBAP/EH	Everett Harbor	Dungeness crab	38.00		J
UBAP/EH	Everett Harbor	Dungeness crab	67.00		J
UBAP/EH	Everett Harbor	Dungeness crab	33.00		J
UBAP/EH	Everett Harbor	Dungeness crab	41.00		J
UBAP/EH	Everett Harbor	Dungeness crab	41.00		J
UBAP/EH	Everett Harbor	Dungeness crab	53.00		J
UBAP/EH	Port Susan	Dungeness crab	70.00		J
NOAA2	Commencement Bay	Pacific hake	4.00		
NOAA2	Elliott Bay	Pacific hake	3.00		
NOAA2	Elliott Bay	Pacific hake	3.00		
NOAA2	Point Jefferson	Pacific hake	5.00		
NOAA2	Point Jefferson	Pacific hake	3.00		
NOAA2	Point Jefferson	Pacific hake	5.00		
NOAA2	Point Jefferson	Pacific hake	9.00		
NOAA2	Commencement Bay	Rockfish	3.00	U	
NOAA2	Commencement Bay	Rockfish	9.00		
NOAA2	Commencement Bay	Rockfish	2.00	U	
NOAA2	Commencement Bay	Rockfish	79.00		
NOAA2	Elliott Bay	Rockfish	3.00	U	
NOAA2	Elliott Bay	Rockfish	15.00		
NOAA2	Elliott Bay	Rockfish	3.00		
NOAA2	Edmonds	Rockfish	8.00		
NOAA2	Edmonds	Rockfish	28.00		
NOAA2	Edmonds	Rockfish	7.00		
NOAA2	Edmonds	Rockfish	55.00		
NOAA2	Edmonds	Rockfish	5.00		
NOAA2	Agate Pass	Rockfish	3.00	U	
NOAA2	Agate Pass	Rockfish	17.00		
NOAA2	Agate Pass	Rockfish	16.00		
NOAA2	Agate Pass	Rockfish	15.00		
NOAA2	Point Madison	Sablefish	3.00		
NOAA2	Point Madison	Sablefish	22.00		
NOAA2	Point Madison	Pacific cod	13.00		
NOAA2	Manchester	Pacific cod	7.00		
NOAA2	Manchester	Pacific cod	90.00		
NOAA2	Manchester	Pacific cod	3.00		
NOAA2	Manchester	Pacific cod	13.00		
NOAA2	Point Jefferson	Pacific cod	26.00		
NOAA2	Commencement Bay	Walleye pollock	6.00		
NOAA2	Point Madison	Walleye pollock	73.00		
NOAA2	Point Madison	Walleye pollock	8.00		
NOAA2	Point Madison	Walleye pollock	3.00		
NOAA2	Point Madison	Walleye pollock	6.00		
NOAA2	Point Madison	Walleye pollock	1.00	U	
NOAA2	Point Madison	Tomcod	5.00		
NOAA2	Point Madison	Tomcod	3.00		
NOAA2	Point Madison	Tomcod	8.00		
NOAA2	Commencement Bay	Starry flounder	2.00	U	
NOAA2	Commencement Bay	Starry flounder	156.00		

TABLE B-4. DATA LISTING FOR MERCURY (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Mercury	Det. Limit	Data Qual.
NOAA2	Commencement Bay	Starry flounder	2.00	U	
NOAA2	Commencement Bay	Starry flounder	2.00	U	
NOAA2	Sinclair Inlet	Starry flounder	11.00		
NOAA2	Sinclair Inlet	Starry flounder	14.00		
NOAA2	Sinclair Inlet	Starry flounder	17.00		
NOAA2	Sinclair Inlet	Starry flounder	2.00	U	
NOAA2	Elliott Bay	Rock sole	3.00		
NOAA2	Elliott Bay	Rock sole	4.00		
NOAA2	Elliott Bay	Rock sole	9.00		
NOAA2	Elliott Bay	Rock sole	2.00	U	
NOAA2	Edmonds	Rock sole	2.00		
NOAA2	Edmonds	Rock sole	2.00		
NOAA2	Edmonds	Rock sole	3.00		
NOAA2	Edmonds	Rock sole	2.00	U	
NOAA2	Elliott Bay	Market squid	16.00		
NOAA2	Elliott Bay	Market squid	8.00		
NOAA2	Elliott Bay	Market squid	5.00		
NOAA2	Sinclair Inlet	Market squid	22.00		
NOAA2	Edmonds	Market squid	6.00		
NOAA2	Edmonds	Market squid	3.00		
WDOE1	Eagle Harbor	Bivalve spp.	18.00		
WDOE1	Eagle Harbor	Bivalve spp.	31.00		
WDOE1	Eagle Harbor	Bivalve spp.	68.00		
WDOE1	Eagle Harbor	Bivalve spp.	54.00		
WDOE1	Eagle Harbor	Bivalve spp.	22.00		
WDOE1	Eagle Harbor	Bivalve spp.	34.00		
WDOE1	Eagle Harbor	Bivalve spp.	27.00		
WDOE1	Eagle Harbor	Bivalve spp.	10.00		
WDOE1	Point Blakely	Bivalve spp.	12.00		

TABLE B-5. DATA LISTING FOR CARCINOGENIC PAH (UG/KG WET)
IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	B(A)A	Det. Limit	Data Qual.	B(b)F	Det. Limit	Data Qual.	Chrysene	Det. Limit	Data Qual.	B(a)P	Det. Limit	Data Qual.
EPA/DSHS	Dash Point	Bentnose clam	5.00			2.00			2.00	U		2.00	U	
EPA/DSHS	Dash Point	Bentnose clam	20.00			6.00			20.00			4.00	U	
EPA/DSHS	Everett Harbor	Sand clam	2.00	U		0.80			2.00	U		2.00	U	
EPA/DSHS	Alki Point	Littleneck clam	2.00	U		2.00	U		2.00	U		2.00	U	
EPA/DSHS	Birch Bay	Littleneck clam	2.00	U		1.00	U		2.00	U		2.00	U	
EPA/DSHS	Quartermaster Harbor	Littleneck clam	2.00	U		1.00	U		2.00	U		2.00	U	
EPA/DSHS	Dash Point	Littleneck clam	2.00	U		1.00	U		2.00	U		2.00	U	
EPA/DSHS	Everett Harbor	Littleneck clam	2.00	U		2.00			2.00			2.00	U	
EPA/DSHS	Mukilteo	Littleneck clam	2.00	U		1.00	U		2.00	U		2.00	U	
EPA/DSHS	Sinclair Inlet	Littleneck clam	2.00	U		2.00			2.00	U		2.00	U	
EPA/DSHS	Alki Point	Butter clam	2.00	U		1.00	U		2.00	U		2.00	U	
EPA/DSHS	Birch Bay	Butter clam	2.00	U		1.00	U		2.00	U		2.00	U	
EPA/DSHS	Burley Lagoon	Butter clam	2.00	U		1.00	U		2.00	U		2.00	U	
EPA/DSHS	Quartermaster Harbor	Butter clam	2.00	U		1.00		J	3.00			2.00	U	
EPA/DSHS	Everett Harbor	Butter clam	2.00	U		1.00	U		2.00		J	2.00	U	
EPA/DSHS	Mukilteo	Butter clam	2.00	U		10.00		J	2.00	U		2.00	U	
EPA/DSHS	Mukilteo	Butter clam	2.00	U		1.00		J	2.00	U		2.00	U	
EPA/DSHS	Sinclair Inlet	Butter clam	2.00	U		1.00	U		2.00	U		2.00	U	
EPA/DSHS	Quartermaster Harbor	Manila clam	5.00			1.00	U		8.00			2.00	U	
EPA/WDOE	Budd Inlet	Ulva	60.00	U		60.00	U		60.00	U		60.00	U	
EPA/WDOE	Commencement Bay	Ulva	240.00	U		240.00	U		240.00	U		240.00	U	
EPA/WDOE	Elliott Bay	Ulva	150.00	U		150.00	U		150.00	U		150.00	U	
EPA/WDOE	Everett Harbor	Ulva	120.00	U		120.00	U		120.00	U		120.00	U	
EPA/WDOE	Point No Point	Ulva	110.00	U		110.00	U		110.00	U		7.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	70.00	U	J	70.00	U	J	70.00	U	J	70.00	U	J
EPA/WDF	Elliott Bay	Chinook salmon	74.00	U	J	74.00	U	J	74.00	U	J	74.00	U	J
EPA/WDF	Elliott Bay	Chinook salmon	370.00	U	J	370.00	U	J	370.00	U	J	370.00	U	J
EPA/WDF	Everett Harbor	Chinook salmon	190.00	U	J	190.00	U	J	190.00	U	J	190.00	U	J
WDOE1	Rolling Bay	Rock crab	2.00	U	M	4.00	U	M	4.00	U	M	6.00	U	M
WDOE1	Eagle Harbor	Rock crab	12.00			53.00			14.00			18.00		
WDOE1	Eagle Harbor	Rock crab	10.00			4.00	U		6.60			18.00	U	
WDOE1	Eagle Harbor	Rock crab	14.00			26.00			14.00			6.40		
WDOE1	Eagle Harbor	Rock crab	5.40			2.60			5.40			6.00	U	M
WDOE1	Eagle Harbor	Bivalve spp.	210.00			120.00			360.00			58.00		
WDOE1	Eagle Harbor	Bivalve spp.	2.00	U		2.00	U		2.00	U		6.00	U	
WDOE1	Eagle Harbor	Bivalve spp.	22.00			24.00			28.00			6.00	U	
WDOE1	Eagle Harbor	Bivalve spp.	35.00			54.00			120.00			14.00		
WDOE1	Eagle Harbor	Bivalve spp.	28.00			33.00			44.00			6.00	U	
WDOE1	Eagle Harbor	Bivalve spp.	46.00			48.00			46.00			15.00		
WDOE1	Eagle Harbor	Bivalve spp.	32.00			26.00			39.00			6.00	U	
WDOE1	Eagle Harbor	Bivalve spp.	2.00	U		2.00	U		2.00	U		6.00	U	
WDOE1	Point Blakely	Bivalve spp.	10.00			14.00			15.00			3.20		
WDOE2	Budd Inlet	Softshell clam	77.00			91.00			110.00			10.00	U	
WDOE2	Budd Inlet	Littleneck clam	10.00	U		10.00	U		10.00	U		10.00	U	
WDOE2	Budd Inlet	Littleneck clam	10.00	U		10.00	U		10.00	U		10.00	U	
WDOE2	Budd Inlet	Bivalve spp.	50.00	U		10.00	U		50.00	U		10.00	U	

TABLE B-6. DATA LISTING FOR PCBs (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	PCB1254	Det. Limit	Data Qual.	PCB1260	Det. Limit	Data Qual.	Total PCBs	Det. Limit	Data Qual.
EPA/DSHS	Dash Point	Bentnose clam	2.70			1.00	U		.	.	.
EPA/DSHS	Dash Point	Bentnose clam	6.00			7.00			.	.	.
EPA/DSHS	Everett Harbor	Sand clam	8.60			3.10			.	.	.
EPA/DSHS	Alki Point	Littleneck clam	2.00			1.00	U		.	.	.
EPA/DSHS	Birch Bay	Littleneck clam	1.00	U		1.00	U		.	.	.
EPA/DSHS	Quartermaster Harbor	Littleneck clam	2.70			2.10			.	.	.
EPA/DSHS	Dash Point	Littleneck clam	1.00	U		3.40			.	.	.
EPA/DSHS	Everett Harbor	Littleneck clam	4.00			3.20			.	.	.
EPA/DSHS	Mukilteo	Littleneck clam	3.40			3.00			.	.	.
EPA/DSHS	Sinclair Inlet	Littleneck clam	8.60			11.00			.	.	.
EPA/DSHS	Alki Point	Butter clam	3.90			2.20			.	.	.
EPA/DSHS	Birch Bay	Butter clam	1.00	U		1.00	U		.	.	.
EPA/DSHS	Burley Lagoon	Butter clam	3.80			3.40			.	.	.
EPA/DSHS	Quartermaster Harbor	Butter clam	4.10			2.40			.	.	.
EPA/DSHS	Everett Harbor	Butter clam	3.50			2.70			.	.	.
EPA/DSHS	Mukilteo	Butter clam	1.70			2.00			.	.	.
EPA/DSHS	Mukilteo	Butter clam	2.90			2.80			.	.	.
EPA/DSHS	Sinclair Inlet	Butter clam	10.00			13.00			.	.	.
EPA/DSHS	Quartermaster Harbor	Manila clam	4.00			2.90			.	.	.
EPA/WDOE	Commencement Bay	Laminaria	10.00	U		10.00	U		.	.	.
EPA/WDOE	Commencement Bay	Laminaria	10.00	U		10.00	U		.	.	.
EPA/WDOE	Commencement Bay	Laminaria	10.00	U		10.00	U		.	.	.
EPA/WDOE	Commencement Bay	Laminaria	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Laminaria	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Laminaria	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Laminaria	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Laminaria	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Laminaria	10.00	U		10.00	U		.	.	.
EPA/WDOE	Commencement Bay	Nereocystis	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Nereocystis	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Nereocystis	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Nereocystis	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Nereocystis	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Nereocystis	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Nereocystis	10.00	U		10.00	U		.	.	.
EPA/WDOE	Budd Inlet	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Budd Inlet	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Budd Inlet	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Budd Inlet	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Commencement Bay	Ulva	30.00	U		30.00	U		.	.	.
EPA/WDOE	Commencement Bay	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Commencement Bay	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Commencement Bay	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Everett Harbor	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Everett Harbor	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Everett Harbor	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Ulva	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Nori	10.00	U		10.00	U		.	.	.

TABLE B-6. DATA LISTING FOR PCBs (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	PCB1254	Det. Limit	Data Qual.	PCB1260	Det. Limit	Data Qual.	Total PCBs	Det. Limit	Data Qual.
EPA/WDOE	Elliott Bay	Nori	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Nori	10.00	U		10.00	U		.	.	.
EPA/WDOE	Elliott Bay	Nori	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Nori	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Nori	10.00	U		10.00	U		.	.	.
EPA/WDOE	Point No Point	Nori	10.00	U		10.00	U		.	.	.
EPA/WDF	Anacortes	Chinook salmon	24.00			10.00	U		.	.	.
EPA/WDF	Anacortes	Chinook salmon	16.00			10.00	U		.	.	.
EPA/WDF	Commencement Bay	Chinook salmon	57.00			10.00	U		.	.	.
EPA/WDF	Commencement Bay	Chinook salmon	210.00			10.00	U		.	.	.
EPA/WDF	Commencement Bay	Chinook salmon	140.00			10.00	U		.	.	.
EPA/WDF	Commencement Bay	Chinook salmon	160.00			10.00	U		.	.	.
EPA/WDF	Commencement Bay	Chinook salmon	61.00			10.00	U		.	.	.
EPA/WDF	Elliott Bay	Chinook salmon	96.00			10.00	U		.	.	.
EPA/WDF	Elliott Bay	Chinook salmon	35.00			10.00	U		.	.	.
EPA/WDF	Elliott Bay	Chinook salmon	170.00			10.00	U		.	.	.
EPA/WDF	Elliott Bay	Chinook salmon	120.00			10.00	U		.	.	.
EPA/WDF	Elliott Bay	Chinook salmon	29.00			10.00	U		.	.	.
EPA/WDF	Elliott Bay	Chinook salmon	54.00			10.00	U		.	.	.
EPA/WDF	Elliott Bay	Chinook salmon	39.00			10.00	U		.	.	.
EPA/WDF	Elliott Bay	Chinook salmon	41.00			10.00	U		.	.	.
EPA/WDF	Elliott Bay	Chinook salmon	45.00			10.00	U		.	.	.
EPA/WDF	Everett Harbor	Chinook salmon	99.00			10.00	U		.	.	.
EPA/WDF	Point No Point	Chinook salmon	47.00			10.00	U		.	.	.
EPA/WDF	Point No Point	Chinook salmon	16.00			10.00	U		.	.	.
EPA/WDF	Point No Point	Chinook salmon	48.00			10.00	U		.	.	.
EPA/WDF	Point No Point	Chinook salmon	140.00			10.00	U		.	.	.
EPA/WDF	Point No Point	Chinook salmon	38.00			10.00	U		.	.	.
EPA/WDF	Point No Point	Chinook salmon	16.00			10.00	U		.	.	.
EPA/WDF	Point No Point	Chinook salmon	16.00			10.00	U		.	.	.
EPA/WDF	Commencement Bay	Coho salmon	69.00			10.00	U		.	.	.
EPA/WDF	Commencement Bay	Coho salmon	93.00			10.00	U		.	.	.
DSHS	Alki Point	Bivalve spp.	2.10		JQ	.	.	.	.	.	.
DSHS	Birch Bay	Bivalve spp.	1.70		JQ	.	.	.	.	.	.
DSHS	Budd Inlet	Bivalve spp.	11.30		JQ	.	.	.	.	.	.
DSHS	Burley Lagoon	Bivalve spp.	11.90		JQ	.	.	.	.	.	.
DSHS	Quartermaster Harbor	Bivalve spp.	1.10		JQ	.	.	.	.	.	.
DSHS	Dash Point	Bivalve spp.	12.20		JQ	.	.	.	.	.	.
DSHS	Mukilteo	Bivalve spp.	9.50		JQ	.	.	.	.	.	.
DSHS	Sinclair Inlet	Bivalve spp.	17.00		JQ	.	.	.	.	.	.
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	1.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	4.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	2.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	1.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	10.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	280.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	430.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	280.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	450.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	630.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	250.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	230.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	2,060.00		

TABLE B-6. DATA LISTING FOR PCBs (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	PCB1254	Det. Limit	Data Qual.	PCB1260	Det. Limit	Data Qual.	Total PCBs	Det. Limit	Data Qual.
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	650.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	310.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	556.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	190.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	730.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	410.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	330.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	13.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	30.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	1,490.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	37.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	45.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	640.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	200.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	690.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	150.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	390.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	480.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	53.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	29.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	47.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	12.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	420.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	280.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	150.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	79.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	160.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	42.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	330.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	670.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	490.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	53.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	200.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	440.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	530.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	430.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	53.00		J
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	680.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	1,030.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	830.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	100.00		
UBAP/EB	Elliott Bay	English sole	.	.	.	.	.	.	350.00		J
UBAP/EB	Point Pulley	English sole	.	.	.	.	.	.	8.00		J
UBAP/EB	Point Pulley	English sole	.	.	.	.	.	.	5.00		J
UBAP/EB	Point Pulley	English sole	.	.	.	.	.	.	3.00		J
UBAP/EB	Point Pulley	English sole	.	.	.	.	.	.	19.00		J
UBAP/EB	Point Pulley	English sole	.	.	.	.	.	.	2.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	42.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	25.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	16.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	13.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	18.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	31.00		

TABLE B-6. DATA LISTING FOR PCBs (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	PCB1254	Det. Limit	Data Qual.	PCB1260	Det. Limit	Data Qual.	Total PCBs	Det. Limit	Data Qual.
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	63.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	20.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	20.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	19.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	64.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	30.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	36.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	25.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	47.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	91.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	37.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	27.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	12.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	37.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	21.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	21.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	10.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	9.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	15.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	20.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	7.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	11.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	12.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	5.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	21.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	31.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	11.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	48.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	30.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	11.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	19.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	34.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	10.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	27.00		
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	5.00		J
UBAP/EH	Everett Harbor	English sole	.	.	.	.	.	.	12.00		

TABLE B-7. DATA LISTING FOR ALPHA-HCH (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Alpha-HCH	Det. Limit	Data Qual.
EPA/DSHS	Dash Point	Bentnose clam	0.10	U	
EPA/DSHS	Dash Point	Bentnose clam	0.20	U	
EPA/DSHS	Everett Harbor	Sand clam	0.10	U	
EPA/DSHS	Alki Point	Littleneck clam	0.10	U	
EPA/DSHS	Birch Bay	Littleneck clam	0.10	U	
EPA/DSHS	Quartermaster Harbor	Littleneck clam	0.10	U	
EPA/DSHS	Dash Point	Littleneck clam	0.10	U	
EPA/DSHS	Everett Harbor	Littleneck clam	0.10	U	
EPA/DSHS	Mukilteo	Littleneck clam	0.10	U	
EPA/DSHS	Sinclair Inlet	Littleneck clam	0.10	U	
EPA/DSHS	Alki Point	Butter clam	0.10	U	
EPA/DSHS	Birch Bay	Butter clam	0.10	U	
EPA/DSHS	Burley Lagoon	Butter clam	0.10	U	
EPA/DSHS	Quartermaster Harbor	Butter clam	0.10	U	
EPA/DSHS	Everett Harbor	Butter clam	0.10	U	
EPA/DSHS	Mukilteo	Butter clam	0.10	U	
EPA/DSHS	Mukilteo	Butter clam	0.10	U	
EPA/DSHS	Sinclair Inlet	Butter clam	0.10	U	
EPA/DSHS	Quartermaster Harbor	Manila clam	0.10	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U	
EPA/WDOE	Elliott Bay	Laminaria	1.00	U	
EPA/WDOE	Elliott Bay	Laminaria	1.00	U	
EPA/WDOE	Point No Point	Laminaria	1.00	U	
EPA/WDOE	Point No Point	Laminaria	1.00	U	
EPA/WDOE	Point No Point	Laminaria	1.00	U	
EPA/WDOE	Commencement Bay	Nereocystis	1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U	
EPA/WDOE	Point No Point	Nereocystis	1.00	U	
EPA/WDOE	Point No Point	Nereocystis	1.00	U	
EPA/WDOE	Budd Inlet	Ulva	1.00	U	
EPA/WDOE	Budd Inlet	Ulva	1.00	U	
EPA/WDOE	Budd Inlet	Ulva	1.00	U	
EPA/WDOE	Budd Inlet	Ulva	1.00	U	
EPA/WDOE	Commencement Bay	Ulva	3.00	U	
EPA/WDOE	Commencement Bay	Ulva	1.00	U	
EPA/WDOE	Commencement Bay	Ulva	1.00	U	
EPA/WDOE	Commencement Bay	Ulva	1.00	U	
EPA/WDOE	Elliott Bay	Ulva	1.00	U	
EPA/WDOE	Elliott Bay	Ulva	1.00	U	
EPA/WDOE	Elliott Bay	Ulva	1.00	U	
EPA/WDOE	Everett Harbor	Ulva	1.00	U	
EPA/WDOE	Everett Harbor	Ulva	1.00	U	
EPA/WDOE	Everett Harbor	Ulva	1.00	U	
EPA/WDOE	Point No Point	Ulva	1.00	U	
EPA/WDOE	Point No Point	Ulva	1.00	U	
EPA/WDOE	Point No Point	Ulva	1.00	U	
EPA/WDOE	Elliott Bay	Nori	1.00	U	

TABLE B-7. DATA LISTING FOR ALPHA-HCH (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Alpha-HCH	Det. Limit	Data Qual.
EPA/WDOE	Elliott Bay	Nori	1.00	U	
EPA/WDOE	Elliott Bay	Nori	1.00	U	
EPA/WDOE	Elliott Bay	Nori	1.00	U	
EPA/WDOE	Point No Point	Nori	1.00	U	
EPA/WDOE	Point No Point	Nori	1.00	U	
EPA/WDOE	Point No Point	Nori	1.00	U	
EPA/WDF	Anacortes	Chinook salmon	1.00	U	
EPA/WDF	Anacortes	Chinook salmon	1.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	1.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	1.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	1.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	2.00		
EPA/WDF	Commencement Bay	Chinook salmon	1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	6.00		
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U	
EPA/WDF	Everett Harbor	Chinook salmon	1.00	U	
EPA/WDF	Point No Point	Chinook salmon	5.00		
EPA/WDF	Point No Point	Chinook salmon	1.00	U	
EPA/WDF	Point No Point	Chinook salmon	1.00	U	
EPA/WDF	Point No Point	Chinook salmon	1.00	U	
EPA/WDF	Point No Point	Chinook salmon	2.00		
EPA/WDF	Point No Point	Chinook salmon	1.00	U	
EPA/WDF	Point No Point	Chinook salmon	1.00	U	
EPA/WDF	Commencement Bay	Coho salmon	1.00	U	
EPA/WDF	Commencement Bay	Coho salmon	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	10.00	U	
UBAP/EB	Elliott Bay	English sole	10.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	

TABLE B-7. DATA LISTING FOR ALPHA-HCH (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Alpha-HCH	Det. Limit	Data Qual.
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	4.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	4.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	4.00	U	
UBAP/EB	Elliott Bay	English sole	10.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	10.00	U	
UBAP/EB	Elliott Bay	English sole	10.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Elliott Bay	English sole	1.00	U	
UBAP/EB	Point Pulley	English sole	1.00	U	
UBAP/EB	Point Pulley	English sole	1.00	U	
UBAP/EB	Point Pulley	English sole	1.00	U	
UBAP/EB	Point Pulley	English sole	1.00	U	
UBAP/EB	Point Pulley	English sole	1.00	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	

TABLE B-7. DATA LISTING FOR ALPHA-HCH (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Alpha-HCH	Det. Limit	Data Qual.
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.20		J
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.30		J
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Everett Harbor	English sole	0.10	U	
UBAP/EH	Port Susan	English sole	0.10	U	
UBAP/EH	Port Susan	English sole	0.10	U	
UBAP/EH	Port Susan	English sole	0.10	U	
UBAP/EH	Port Susan	English sole	0.10	U	
UBAP/EH	Port Susan	English sole	0.10	U	
UBAP/EH	Everett Harbor	Starry flounder	0.10	U	
UBAP/EH	Everett Harbor	Starry flounder	0.10	U	
UBAP/EH	Everett Harbor	Starry flounder	0.10	U	
UBAP/EH	Everett Harbor	Starry flounder	0.10	U	
UBAP/EH	Everett Harbor	Starry flounder	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	

TABLE B-7. DATA LISTING FOR ALPHA-HCH (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	Alpha-HCH	Det. Limit	Data Qual.
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.10	U	
UBAP/EH	Port Susan	Dungeness crab	0.10	U	

TABLE B-8. DATA LISTING FOR DDD, DDE, AND DDT (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	DDD	Det. Limit	Data Qual.	DDE	Det. Limit	Data Qual.	DDT	Det. Limit	Data Qual.
EPA/DSHS	Dash Point	Bentnose clam	0.10	U		0.16			0.10	U	
EPA/DSHS	Dash Point	Bentnose clam	0.20	U		0.65			0.20	U	
EPA/DSHS	Everett Harbor	Sand clam	0.10	U	M	0.10	U	M	0.10	U	
EPA/DSHS	Alki Point	Littleneck clam	0.10	U		0.10	U		0.10	U	
EPA/DSHS	Birch Bay	Littleneck clam	0.10	U		0.19			0.10	U	
EPA/DSHS	Quartermaster Harbor	Littleneck clam	0.10	U		0.10	U	M	0.10	U	M
EPA/DSHS	Dash Point	Littleneck clam	0.10	U		0.10	U		0.10	U	
EPA/DSHS	Everett Harbor	Littleneck clam	0.10	U		0.40			0.10	U	
EPA/DSHS	Mukilteo	Littleneck clam	0.10	U		0.10	U	M	0.10	U	
EPA/DSHS	Sinclair Inlet	Littleneck clam	0.57			0.54			0.10	U	
EPA/DSHS	Alki Point	Butter clam	0.10	U		0.57			0.30		
EPA/DSHS	Birch Bay	Butter clam	0.10	U		0.10	U		0.10	U	
EPA/DSHS	Burley Lagoon	Butter clam	0.10	U		0.22			0.10	U	
EPA/DSHS	Quartermaster Harbor	Butter clam	0.10	U		0.35			0.16		
EPA/DSHS	Everett Harbor	Butter clam	0.10	U		0.15			0.10	U	
EPA/DSHS	Mukilteo	Butter clam	0.10	U		0.10	U	M	0.10	U	
EPA/DSHS	Mukilteo	Butter clam	0.10	U		0.10	U		0.10	U	
EPA/DSHS	Sinclair Inlet	Butter clam	0.10	U		0.68			0.89		
EPA/DSHS	Quartermaster Harbor	Manila clam	0.10	U		0.35			0.10	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U		3.00			1.00	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U		3.00			1.00	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U		3.00			1.00	U	
EPA/WDOE	Commencement Bay	Laminaria	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Laminaria	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Laminaria	1.00	U		3.00			1.00	U	
EPA/WDOE	Point No Point	Laminaria	1.00	U		3.00			1.00	U	
EPA/WDOE	Point No Point	Laminaria	1.00	U		3.00			1.00	U	
EPA/WDOE	Point No Point	Laminaria	1.00	U		3.00			1.00	U	
EPA/WDOE	Commencement Bay	Nereocystis	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U		2.00			1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Nereocystis	1.00	U		3.00			1.00	U	
EPA/WDOE	Point No Point	Nereocystis	1.00	U		3.00			1.00	U	
EPA/WDOE	Point No Point	Nereocystis	1.00	U		2.00			1.00	U	
EPA/WDOE	Budd Inlet	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Budd Inlet	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Budd Inlet	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Budd Inlet	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Commencement Bay	Ulva	3.00	U		4.00			3.00	U	
EPA/WDOE	Commencement Bay	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Commencement Bay	Ulva	1.00	U		2.00			1.00	U	
EPA/WDOE	Commencement Bay	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Everett Harbor	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Everett Harbor	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Everett Harbor	Ulva	1.00	U		4.00			1.00	U	
EPA/WDOE	Point No Point	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Point No Point	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Point No Point	Ulva	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Nori	1.00	U		3.00			1.00	U	

TABLE B-8. DATA LISTING FOR DDD, DDE, AND DDT (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	DDD	Det. Limit	Data Qual.	DDE	Det. Limit	Data Qual.	DDT	Det. Limit	Data Qual.
EPA/WDOE	Elliott Bay	Nori	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Nori	1.00	U		3.00			1.00	U	
EPA/WDOE	Elliott Bay	Nori	1.00	U		2.00			1.00	U	
EPA/WDOE	Point No Point	Nori	1.00	U		3.00			1.00	U	
EPA/WDOE	Point No Point	Nori	1.00	U		3.00			1.00	U	
EPA/WDOE	Point No Point	Nori	1.00	U		3.00			1.00	U	
EPA/WDF	Anacortes	Chinook salmon	1.00	U		9.00			1.00	U	
EPA/WDF	Anacortes	Chinook salmon	1.00	U		4.00			1.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	1.00	U		11.00			1.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	9.00			51.00			5.00		
EPA/WDF	Commencement Bay	Chinook salmon	1.00	U		.	.	.	1.00	U	
EPA/WDF	Commencement Bay	Chinook salmon	23.00			35.00			11.00		
EPA/WDF	Commencement Bay	Chinook salmon	16.00			7.00			22.00		
EPA/WDF	Elliott Bay	Chinook salmon	27.00			18.00			18.00		
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U		7.00			1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	31.00			34.00			3.00		
EPA/WDF	Elliott Bay	Chinook salmon	5.00			27.00			6.00		
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U		8.00			1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	10.00			11.00			5.00		
EPA/WDF	Elliott Bay	Chinook salmon	1.00	U		7.00			3.00		
EPA/WDF	Elliott Bay	Chinook salmon	9.00			1.00			1.00	U	
EPA/WDF	Elliott Bay	Chinook salmon	4.00			6.00			2.00		
EPA/WDF	Everett Harbor	Chinook salmon	8.00			17.00			5.00		
EPA/WDF	Point No Point	Chinook salmon	12.00			36.00			10.00	U	
EPA/WDF	Point No Point	Chinook salmon	1.00	U		3.00			1.00	U	
EPA/WDF	Point No Point	Chinook salmon	9.00			20.00			5.00		
EPA/WDF	Point No Point	Chinook salmon	10.00	U		42.00			10.00	U	
EPA/WDF	Point No Point	Chinook salmon	6.00			35.00			1.00	U	
EPA/WDF	Point No Point	Chinook salmon	1.00	U		5.00			1.00	U	
EPA/WDF	Point No Point	Chinook salmon	1.00	U		7.00			1.00	U	
EPA/WDF	Commencement Bay	Coho salmon	3.00			9.00			4.00		
EPA/WDF	Commencement Bay	Coho salmon	22.00			29.00			28.00		
DSHS	Alki Point	Bivalve spp.	.	.	.	0.10		JG	0.10		JG
DSHS	Birch Bay	Bivalve spp.	.	.	.	0.20		JG	0.10		JG
DSHS	Budd Inlet	Bivalve spp.	.	.	.	0.20		JG	0.10		JG
DSHS	Burley Lagoon	Bivalve spp.	.	.	.	0.10		JG	2.00	U	JG
DSHS	Quartermaster Harbor	Bivalve spp.	.	.	.	0.10		JG	2.00	U	JG
DSHS	Dash Point	Bivalve spp.	.	.	.	0.10		JG	0.10		JG
DSHS	Mukilteo	Bivalve spp.	.	.	.	0.10		JG	0.10		JG
DSHS	Sinclair Inlet	Bivalve spp.	.	.	.	0.10		JG	0.10		JG
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	50.00	U		20.00	U		50.00	U	

TABLE B-8. DATA LISTING FOR DDD, DDE, AND DDT (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	DDD	Det. Limit	Data Qual.	DDE	Det. Limit	Data Qual.	DDT	Det. Limit	Data Qual.
UBAP/EB	Elliott Bay	English sole	50.00	U		20.00	U		50.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	20.00	U		8.00	U		20.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	20.00	U		8.00	U		20.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	20.00	U		8.00	U		20.00	U	
UBAP/EB	Elliott Bay	English sole	50.00	U		20.00	U		50.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	50.00	U		20.00	U		50.00	U	
UBAP/EB	Elliott Bay	English sole	50.00	U		20.00	U		50.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Elliott Bay	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Point Pulley	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Point Pulley	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Point Pulley	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Point Pulley	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EB	Point Pulley	English sole	5.00	U		2.00	U		5.00	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	

TABLE B-8. DATA LISTING FOR DDD, DDE, AND DDT (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	DDD	Det. Limit	Data Qual.	DDE	Det. Limit	Data Qual.	DDT	Det. Limit	Data Qual.
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Port Susan	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Port Susan	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Port Susan	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Port Susan	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Port Susan	English sole	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Starry flounder	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Starry flounder	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Starry flounder	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Starry flounder	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Starry flounder	0.60	U		0.40	U		0.70	U	

TABLE B-8. DATA LISTING FOR DDD, DDE, AND DDT (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	DDD	Det. Limit	Data Qual.	DDE	Det. Limit	Data Qual.	DDT	Det. Limit	Data Qual.
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Everett Harbor	Dungeness crab	0.60	U		0.40	U		0.70	U	
UBAP/EH	Port Susan	Dungeness crab	0.60	U		0.40	U		0.70	U	
NOAA2	Commencement Bay	Pacific hake	1.83			5.06			7.47		
NOAA2	Elliott Bay	Pacific hake	1.99			3.69			3.45		
NOAA2	Elliott Bay	Pacific hake	3.40			3.54			1.86		
NOAA2	Edmonds	Pacific hake	2.64			0.50	U		0.80	U	
NOAA2	Point Jefferson	Pacific hake	1.78			2.31			0.80	U	
NOAA2	Point Jefferson	Pacific hake	1.81			1.02			1.91		
NOAA2	Point Jefferson	Pacific hake	1.87			1.03			0.80	U	
NOAA2	Point Jefferson	Pacific hake	1.00	U		2.76			0.80	U	
NOAA2	Commencement Bay	Rockfish	1.00	U		2.22			0.80	U	
NOAA2	Commencement Bay	Rockfish	1.00	U		0.50	U		1.97		
NOAA2	Commencement Bay	Rockfish	1.00	U		2.25			0.80	U	
NOAA2	Commencement Bay	Rockfish	1.85			1.21			0.80	U	
NOAA2	Elliott Bay	Rockfish	1.00	U		0.50	U		0.80	U	
NOAA2	Elliott Bay	Rockfish	1.00	U		0.50	U		0.80	U	
NOAA2	Elliott Bay	Rockfish	1.00	U		2.15			0.80	U	
NOAA2	Edmonds	Rockfish	1.00	U		3.49			0.80	U	
NOAA2	Edmonds	Rockfish	1.00	U		3.87			1.86		
NOAA2	Edmonds	Rockfish	1.00	U		2.31			0.80	U	
NOAA2	Edmonds	Rockfish	1.00	U		2.50			0.80	U	
NOAA2	Edmonds	Rockfish	1.00	U		2.35			0.80	U	
NOAA2	Agate Pass	Rockfish	1.00	U		0.50	U		0.80	U	
NOAA2	Agate Pass	Rockfish	1.85			4.91			2.02		
NOAA2	Agate Pass	Rockfish	2.17			3.32			0.80	U	
NOAA2	Manchester	Rockfish	3.27			3.27			0.80	U	
NOAA2	Point Madison	Sablefish	1.97			8.04			3.14		
NOAA2	Point Madison	Sablefish	1.87			9.71			3.46		
NOAA2	Agate Pass	Pacific cod	3.96			8.56			3.89		
NOAA2	Manchester	Pacific cod	1.00	U		10.60			0.80	U	
NOAA2	Manchester	Pacific cod	1.94			6.03			1.83		
NOAA2	Manchester	Pacific cod	7.80			4.90			0.80	U	
NOAA2	Manchester	Pacific cod	2.52			6.12			0.80	U	
NOAA2	Point Jefferson	Pacific cod	4.70			8.32			4.42		
NOAA2	Commencement Bay	Walleye pollock	1.00	U		0.50	U		0.80	U	
NOAA2	Commencement Bay	Walleye pollock	1.00	U		2.37			0.80	U	
NOAA2	Point Madison	Walleye pollock	1.91			2.41			0.80	U	
NOAA2	Point Madison	Walleye pollock	1.00	U		0.94			0.80	U	
NOAA2	Point Madison	Walleye pollock	1.85			3.32			0.80	U	
NOAA2	Point Madison	Walleye pollock	1.88			1.07			0.80	U	
NOAA2	Point Madison	Walleye pollock	1.00	U		0.93			0.80	U	
NOAA2	Commencement Bay	Tomcod	1.00	U		0.50	U		0.80	U	

TABLE B-8. DATA LISTING FOR DDD, DDE, AND DDT (UG/KG WET) IN PUGET SOUND FISH, SHELLFISH, AND MACROALGAE

Project	Area	Species	DDD	Det. Limit	Data Qual.	DDE	Det. Limit	Data Qual.	DDT	Det. Limit	Data Qual.
NOAA2	Point Madison	Tomcod	3.52			2.54			0.80	U	
NOAA2	Point Madison	Tomcod	1.00	U		1.06			0.80	U	
NOAA2	Point Madison	Tomcod	4.18			3.88			3.17		
NOAA2	Commencement Bay	Starry flounder	1.00	U		2.67			0.80	U	
NOAA2	Commencement Bay	Starry flounder	1.78			3.21			0.80	U	
NOAA2	Commencement Bay	Starry flounder	1.00	U		1.10			0.80	U	
NOAA2	Commencement Bay	Starry flounder	1.00	U		6.42			2.21		
NOAA2	Sinclair Inlet	Starry flounder	3.76			8.00			2.05		
NOAA2	Sinclair Inlet	Starry flounder	1.00	U		2.81			0.80	U	
NOAA2	Sinclair Inlet	Starry flounder	3.53			6.23			2.06		
NOAA2	Sinclair Inlet	Starry flounder	1.00	U		15.60			2.05		
NOAA2	Sinclair Inlet	Starry flounder	1.72			2.36			0.80	U	
NOAA2	Elliott Bay	Rock sole	5.36			5.38			0.80	U	
NOAA2	Elliott Bay	Rock sole	1.00	U		1.04			0.80	U	
NOAA2	Elliott Bay	Rock sole	1.00	U		2.88			0.80	U	
NOAA2	Elliott Bay	Rock sole	1.00	U		2.99			0.80	U	
NOAA2	Edmonds	Rock sole	1.00	U		2.40			0.80	U	
NOAA2	Edmonds	Rock sole	1.00	U		1.07			0.80	U	
NOAA2	Edmonds	Rock sole	1.00	U		2.64			0.80	U	
NOAA2	Edmonds	Rock sole	3.14			0.50	U		0.80	U	
NOAA2	Elliott Bay	Market squid	1.89			1.22			0.80	U	
NOAA2	Elliott Bay	Market squid	1.00	U		1.10			0.80	U	
NOAA2	Elliott Bay	Market squid	7.44			3.49			0.80	U	
NOAA2	Sinclair Inlet	Market squid	1.90			2.81			0.80	U	
NOAA2	Sinclair Inlet	Market squid	1.91			0.94			0.80	U	
NOAA2	Edmonds	Market squid	1.77			2.31			0.80	U	
NOAA2	Edmonds	Market squid	1.83			1.02			0.80		

APPENDIX C

SUMMARIES OF CONTAMINANT CONCENTRATIONS AND ASSOCIATED HEALTH RISKS FOR VARIOUS SEAFOOD CATEGORIES AND LOCATIONS IN PUGET SOUND

TABLES

Number		Page
C-1	Summary of carcinogenic contaminant concentrations and associated health risks for various seafood categories and locations in Puget Sound	C-1
C-2	Summary of noncarcinogenic contaminant concentrations and associated health risks for various seafood categories and locations in Puget Sound	C-4

TABLE C-1. SUMMARY OF CARCINOGENIC CONTAMINANT CONCENTRATIONS AND ASSOCIATED HEALTH RISKS FOR VARIOUS SEAFOOD CATEGORIES AND LOCATIONS IN PUGET SOUND

ical	Area	Seafood Category	No. Samples	Percent Detected	Summary Data (ug/kg wet wt) Mean	SE	Minimum	Maximum	Carcinogenic Risk Average Case	High Case
nic	Alki Point	Shellfish	12	100	2,658	249	1,530	4,500	$6x10^{-7}$	$1x10^{-5}$
	Anacortes	Fish	2	100	515	125	390	640	$1x10^{-6}$	$4x10^{-5}$
	Birch Bay	Shellfish	10	100	2,287	213	1,200	3,330	$5x10^{-7}$	$1x10^{-5}$
	Budd Inlet	Shellfish	10	100	2,540	257	1,330	4,060	$6x10^{-7}$	$1x10^{-5}$
	Budd Inlet	Kelp/Ulva	4	100	485	54	340	590	$2x10^{-9}$	$2x10^{-6}$
	Burley Lagoon	Shellfish	6	100	2,780	164	2,400	3,490	$7x10^{-7}$	$1x10^{-5}$
	Quartermaster Harbor	Shellfish	13	100	3,454	285	1,550	5,220	$8x10^{-7}$	$2x10^{-5}$
	Commencement Bay	Fish	27	100	6,367	1,413	500	20,700	$2x10^{-5}$	$2x10^{-4}$
	Commencement Bay	Shellfish	2	100	6,650	250	6,400	6,900	$2x10^{-6}$	$5x10^{-5}$
	Commencement Bay	Kelp/Ulva	9	100	3,467	907	940	9,200	$2x10^{-8}$	$2x10^{-5}$
	Dash Point	Shellfish	12	100	2,733	311	1,400	4,980	$6x10^{-7}$	$2x10^{-5}$
	Elliott Bay	Fish	40	100	2,142	230	340	6,500	$6x10^{-6}$	$5x10^{-5}$
	Elliott Bay	Shellfish	3	100	9,667	4,348	1,300	15,900	$2x10^{-6}$	$1x10^{-4}$
	Elliott Bay	Kelp/Ulva	9	100	2,563	460	730	4,250	$1x10^{-8}$	$1x10^{-5}$
	Elliott Bay	Nori	4	100	3,223	241	2,730	3,880	$4x10^{-9}$	$4x10^{-6}$
	Everett Harbor	Fish	1	100	930	-	930	930	$2x10^{-6}$	-
	Everett Harbor	Shellfish	3	100	2,067	338	1,400	2,500	$5x10^{-7}$	$2x10^{-5}$
	Everett Harbor	Kelp/Ulva	3	100	507	87	410	680	$2x10^{-9}$	$3x10^{-6}$
	Mukilteo	Shellfish	12	100	1,820	104	1,260	2,400	$4x10^{-7}$	$9x10^{-6}$
	Point No Point	Fish	7	100	474	94	190	880	$1x10^{-6}$	$1x10^{-5}$
	Point No Point	Kelp/Ulva	8	100	3,340	799	820	7,500	$2x10^{-8}$	$2x10^{-5}$
	Point No Point	Nori	3	100	1,020	491	470	2,000	$1x10^{-9}$	$3x10^{-6}$
	Sinclair Inlet	Fish	19	100	6,602	1,150	1,200	19,600	$2x10^{-5}$	$2x10^{-4}$
	Sinclair Inlet	Shellfish	12	100	3,074	340	1,300	4,900	$7x10^{-7}$	$2x10^{-5}$
	Edmonds	Fish	27	100	2,137	207	400	4,050	$6x10^{-6}$	$5x10^{-5}$
	Edmonds	Shellfish	6	100	8,133	2,886	3,600	22,100	$2x10^{-6}$	$7x10^{-5}$
	Agate Pass	Fish	4	100	2,125	379	1,100	2,900	$6x10^{-6}$	$7x10^{-5}$
	Point Madison	Fish	11	100	1,882	361	500	4,400	$5x10^{-6}$	$5x10^{-5}$
	Manchester	Fish	4	100	4,875	1,802	700	9,400	$1x10^{-5}$	$2x10^{-4}$
	Point Jefferson	Fish	5	100	2,220	518	1,000	3,500	$6x10^{-6}$	$7x10^{-5}$
	Eagle Harbor	Shellfish	8	100	2,938	322	1,500	4,400	$7x10^{-7}$	$2x10^{-5}$
	Point Blakely	Shellfish	1	100	3,700	-	3,700	3,700	$9x10^{-7}$	-
	All Puget Sound	Fish	147	100	3,441	354	190	20,700	$9x10^{-6}$	$8x10^{-5}$
	All Puget Sound	Shellfish	110	100	3,252	254	1,200	22,100	$8x10^{-7}$	$2x10^{-5}$
	All Puget Sound	Kelp/Ulva	33	100	2,559	380	340	9,200	$1x10^{-8}$	$1x10^{-5}$
	All Puget Sound	Nori	7	100	2,279	499	470	3,880	$3x10^{-9}$	$3x10^{-6}$
	Alki Point	Shellfish	2	50	0.54	0.39	0.15	0.92	$3x10^{-9}$	$6x10^{-7}$
	Anacortes	Fish	2	100	7.50	2.50	5.00	10.00	$4x10^{-7}$	$2x10^{-5}$
	Birch Bay	Shellfish	2	50	0.22	0.07	0.15	0.29	$1x10^{-9}$	$1x10^{-7}$
	Budd Inlet	Kelp/Ulva	4	100	4.00	0.00	4.00	4.00	$4x10^{-10}$	$3x10^{-7}$
	Burley Lagoon	Shellfish	1	100	0.32	-	0.32	0.32	$2x10^{-9}$	-
	Quartermaster Harbor	Shellfish	3	67	0.39	0.12	0.15	0.56	$2x10^{-9}$	$1x10^{-7}$
	Commencement Bay	Fish	19	84	17.87	5.92	1.00	79.00	$1x10^{-6}$	$1x10^{-5}$
	Commencement Bay	Kelp/Ulva	9	100	4.22	0.36	3.00	7.00	$5x10^{-10}$	$4x10^{-7}$
	Dash Point	Shellfish	3	67	0.42	0.22	0.15	0.85	$2x10^{-9}$	$1x10^{-7}$
	Elliott Bay	Fish	73	23	18.52	5.85	1.15	415.00	$1x10^{-6}$	$1x10^{-5}$
	Elliott Bay	Shellfish	3	100	5.61	2.89	2.00	11.33	$3x10^{-8}$	$2x10^{-6}$
	Elliott Bay	Kelp/Ulva	9	100	3.89	0.11	3.00	4.00	$4x10^{-10}$	$3x10^{-7}$
	Elliott Bay	Nori	4	100	3.75	0.25	3.00	4.00	$1x10^{-10}$	$9x10^{-8}$
	Everett Harbor	Fish	55	2	1.38	0.53	0.85	30.00	$8x10^{-8}$	$1x10^{-6}$
	Everett Harbor	Shellfish	3	67	0.30	0.10	0.15	0.50	$2x10^{-9}$	$8x10^{-8}$
	Everett Harbor	Kelp/Ulva	3	100	4.33	0.33	4.00	5.00	$5x10^{-10}$	$5x10^{-7}$
	Mukilteo	Shellfish	3	-	0.15	0.00	0.15	0.15	$8x10^{-10}$	$2x10^{-8}$
	Point No Point	Fish	7	100	28.36	8.28	4.00	53.00	$2x10^{-6}$	$2x10^{-5}$
	Point No Point	Kelp/Ulva	8	100	3.88	0.13	3.00	4.00	$4x10^{-10}$	$3x10^{-7}$
	Point No Point	Nori	3	100	4.00	0.00	4.00	4.00	$1x10^{-10}$	$8x10^{-8}$
	Sinclair Inlet	Fish	5	100	10.39	2.77	3.71	18.15	$6x10^{-7}$	$8x10^{-6}$
	Sinclair Inlet	Shellfish	4	100	2.79	0.90	1.16	5.11	$1x10^{-8}$	$6x10^{-7}$
	Point Pulley	Fish	5	-	6.00	0.00	6.00	6.00	$4x10^{-7}$	$3x10^{-6}$

TABLE C-1. (Continued)

Chemical	Area	Seafood Category	No. Samples	Percent Detected	Summary Data (ug/kg wet wt) Mean	SE	Minimum	Maximum	Carcinogenic Risk Average Case	High Case
	Port Susan	Fish	5	-	0.85	0.00	0.85	0.85	$5x10^{-8}$	$4x10^{-7}$
	Edmonds	Fish	10	100	3.64	0.35	1.97	6.23	$2x10^{-7}$	$2x10^{-6}$
	Edmonds	Shellfish	2	100	4.07	0.42	3.65	4.48	$2x10^{-8}$	$1x10^{-6}$
	Agate Pass	Fish	4	75	8.06	3.20	1.15	16.41	$5x10^{-7}$	$8x10^{-6}$
	Point Madison	Fish	10	100	6.52	1.55	1.83	15.04	$4x10^{-7}$	$5x10^{-6}$
	Manchester	Fish	5	100	10.08	1.05	6.94	13.10	$6x10^{-7}$	$6x10^{-6}$
	Point Jefferson	Fish	5	100	6.73	2.69	3.30	17.44	$4x10^{-7}$	$7x10^{-6}$
	All Puget Sound	Fish	205	40	11.15	2.24	0.85	415.00	$7x10^{-7}$	$7x10^{-6}$
	All Puget Sound	Shellfish	26	69	1.60	0.49	0.15	11.33	$9x10^{-9}$	$3x10^{-7}$
	All Puget Sound	Kelp/Ulva	33	100	4.03	0.11	3.00	7.00	$5x10^{-10}$	$3x10^{-7}$
	All Puget Sound	Nori	7	100	3.86	0.14	3.00	4.00	$1x10^{-10}$	$8x10^{-8}$
HCH	Alki Point	Shellfish	2	-	0.05	0.00	0.05	0.05	$9x10^{-9}$	$2x10^{-7}$
	Anacortes	Fish	2	-	0.50	0.00	0.50	0.50	$1x10^{-6}$	$8x10^{-6}$
	Birch Bay	Shellfish	2	-	0.05	0.00	0.05	0.05	$9x10^{-9}$	$2x10^{-7}$
	Budd Inlet	Kelp/Ulva	4	-	0.50	0.00	0.50	0.50	$2x10^{-9}$	$1x10^{-6}$
	Burley Lagoon	Shellfish	1	-	0.05	-	0.05	0.05	$9x10^{-9}$	-
	Quartermaster Harbor	Shellfish	3	-	0.05	0.00	0.05	0.05	$9x10^{-9}$	$2x10^{-7}$
	Commencement Bay	Fish	7	14	0.71	0.21	0.50	2.00	$1x10^{-6}$	$2x10^{-5}$
	Commencement Bay	Kelp/Ulva	9	-	0.61	0.11	0.50	1.50	$2x10^{-9}$	$2x10^{-6}$
	Dash Point	Shellfish	3	-	0.07	0.02	0.05	0.10	$1x10^{-8}$	$5x10^{-7}$
	Elliott Bay	Fish	64	2	1.01	0.17	0.50	6.00	$2x10^{-6}$	$2x10^{-5}$
	Elliott Bay	Kelp/Ulva	9	-	0.50	0.00	0.50	0.50	$2x10^{-9}$	$1x10^{-6}$
	Elliott Bay	Nori	4	-	0.50	0.00	0.50	0.50	$5x10^{-10}$	$3x10^{-7}$
	Everett Harbor	Fish	53	-	0.06	0.01	0.05	0.50	$1x10^{-7}$	$1x10^{-6}$
	Everett Harbor	Shellfish	3	-	0.05	0.00	0.05	0.05	$9x10^{-9}$	$2x10^{-7}$
	Everett Harbor	Kelp/Ulva	3	-	0.50	0.00	0.50	0.50	$2x10^{-9}$	$1x10^{-6}$
	Mukilteo	Shellfish	3	-	0.05	0.00	0.05	0.05	$9x10^{-9}$	$2x10^{-7}$
	Point No Point	Fish	7	29	1.36	0.64	0.50	5.00	$3x10^{-6}$	$4x10^{-5}$
	Point No Point	Kelp/Ulva	8	-	0.50	0.00	0.50	0.50	$2x10^{-9}$	$1x10^{-6}$
	Point No Point	Nori	3	-	0.50	0.00	0.50	0.50	$5x10^{-10}$	$3x10^{-7}$
	Sinclair Inlet	Shellfish	2	-	0.05	0.00	0.05	0.05	$9x10^{-9}$	$2x10^{-7}$
	Point Pulley	Fish	5	-	0.50	0.00	0.50	0.50	$1x10^{-6}$	$8x10^{-6}$
	Port Susan	Fish	5	-	0.05	0.00	0.05	0.05	$1x10^{-7}$	$8x10^{-7}$
	All Puget Sound	Fish	143	3	0.60	0.09	0.05	6.00	$1x10^{-6}$	$1x10^{-5}$
	All Puget Sound	Shellfish	19	-	0.05	0.00	0.05	0.10	$9x10^{-9}$	$2x10^{-7}$
	All Puget Sound	Kelp/Ulva	33	-	0.53	0.03	0.50	1.50	$2x10^{-9}$	$2x10^{-6}$
	All Puget Sound	Nori	7	-	0.50	0.00	0.50	0.50	$5x10^{-10}$	$3x10^{-7}$
PAH	Alki Point	Shellfish	2	-	3.8	0.3	3.5	4.0	$7x10^{-7}$	$2x10^{-5}$
	Birch Bay	Shellfish	2	-	3.5	0.0	3.5	3.5	$6x10^{-7}$	$1x10^{-5}$
	Budd Inlet	Shellfish	4	25	95.8	63.1	20.0	283.0	$2x10^{-5}$	$1x10^{-3}$
	Budd Inlet	Kelp/Ulva	1	-	120.0	-	120.0	120.0	$5x10^{-7}$	-
	Burley Lagoon	Shellfish	1	-	3.5	-	3.5	3.5	$6x10^{-7}$	-
	Quartermaster Harbor	Shellfish	3	67	7.7	3.4	3.5	14.5	$1x10^{-6}$	$8x10^{-5}$
	Commencement Bay	Kelp/Ulva	1	-	480.0	-	480.0	480.0	$2x10^{-6}$	-
	Dash Point	Shellfish	3	67	20.2	14.0	3.5	48.0	$4x10^{-6}$	$3x10^{-4}$
	Elliott Bay	Kelp/Ulva	1	-	300.0	-	300.0	300.0	$1x10^{-6}$	-
	Everett Harbor	Shellfish	3	67	4.1	1.0	2.5	6.0	$7x10^{-7}$	$3x10^{-5}$
	Everett Harbor	Kelp/Ulva	1	-	240.0	-	240.0	240.0	$9x10^{-7}$	-
	Mukilteo	Shellfish	3	-	3.2	0.2	3.0	3.5	$6x10^{-7}$	$1x10^{-5}$
	Point No Point	Kelp/Ulva	1	-	168.5	-	168.5	168.5	$6x10^{-7}$	-
	Sinclair Inlet	Shellfish	2	50	4.3	0.8	3.5	5.0	$8x10^{-7}$	$5x10^{-5}$
	Eagle Harbor	Shellfish	8	75	177.9	85.3	6.0	748.0	$3x10^{-5}$	$1x10^{-3}$
	Point Blakely	Shellfish	1	100	42.2	-	42.2	42.2	$8x10^{-6}$	-
	All Puget Sound	Shellfish	32	47	61.9	25.2	2.5	748.0	$1x10^{-5}$	$4x10^{-4}$
	All Puget Sound	Kelp/Ulva	5	-	261.7	62.6	120.0	480.0	$1x10^{-6}$	$1x10^{-3}$
PCB	Alki Point	Shellfish	2	100	4.3	1.8	2.5	6.1	$5x10^{-7}$	$6x10^{-5}$
	Anacortes	Fish	2	100	25.0	4.0	21.0	29.0	$3x10^{-5}$	$8x10^{-4}$
	Birch Bay	Shellfish	2	-	1.0	0.0	1.0	1.0	$1x10^{-7}$	$2x10^{-6}$
	Budd Inlet	Kelp/Ulva	4	-	10.0	0.0	10.0	10.0	$3x10^{-8}$	$2x10^{-5}$

ble C-1. (Continued)

ical	Area	Seafood Category	No. Samples	Percent Detected	Summary Data (ug/kg wet wt) Mean	SE	Minimum	Maximum	Carcinogenic Risk Average Case	High Case
	Burley Lagoon	Shellfish	1	100	7.2	-	7.2	7.2	$9x10^{-7}$	-
	Quartermaster Harbor	Shellfish	3	100	6.1	0.6	4.8	6.9	$7x10^{-7}$	$2x10^{-5}$
	Commencement Bay	Fish	23	100	108.0	12.7	19.0	263.0	$1x10^{-4}$	$1x10^{-3}$
	Commencement Bay	Shellfish	1	100	177.0	-	177.0	177.0	$2x10^{-5}$	-
	Commencement Bay	Kelp/Ulva	9	-	12.2	2.2	10.0	30.0	$3x10^{-8}$	$3x10^{-5}$
	Dash Point	Shellfish	3	100	6.7	3.2	3.2	13.0	$8x10^{-7}$	$5x10^{-5}$
	Elliott Bay	Fish	59	100	250.0	48.6	20.0	2,060.0	$3x10^{-4}$	$4x10^{-3}$
	Elliott Bay	Shellfish	3	100	121.0	54.6	61.0	230.0	$1x10^{-5}$	$8x10^{-4}$
	Elliott Bay	Kelp/Ulva	9	-	10.0	0.0	10.0	10.0	$3x10^{-8}$	$2x10^{-5}$
	Elliott Bay	Nori	4	-	10.0	0.0	10.0	10.0	$7x10^{-9}$	$5x10^{-6}$
	Everett Harbor	Fish	40	98	27.9	3.4	1.8	104.0	$4x10^{-5}$	$4x10^{-4}$
	Everett Harbor	Shellfish	3	100	8.4	1.7	6.2	11.7	$1x10^{-6}$	$4x10^{-5}$
	Everett Harbor	Kelp/Ulva	3	-	10.0	0.0	10.0	10.0	$3x10^{-8}$	$2x10^{-5}$
	Mukilteo	Shellfish	3	100	5.3	0.8	3.7	6.4	$6x10^{-7}$	$2x10^{-5}$
	Point No Point	Fish	7	100	50.9	16.6	21.0	145.0	$7x10^{-5}$	$1x10^{-3}$
	Point No Point	Kelp/Ulva	8	-	10.0	0.0	10.0	10.0	$3x10^{-8}$	$2x10^{-5}$
	Point No Point	Nori	3	-	10.0	0.0	10.0	10.0	$7x10^{-9}$	$5x10^{-6}$
	Sinclair Inlet	Fish	12	100	168.8	44.1	30.0	518.0	$2x10^{-4}$	$3x10^{-3}$
	Sinclair Inlet	Shellfish	4	100	54.4	19.3	19.6	93.0	$7x10^{-6}$	$3x10^{-4}$
	Port Susan	Fish	1	-	1.8	-	1.8	1.8	$2x10^{-6}$	-
	Edmonds	Fish	17	100	92.6	29.7	21.0	548.0	$1x10^{-4}$	$2x10^{-3}$
	Edmonds	Shellfish	7	100	124.9	28.1	24.0	215.0	$2x10^{-5}$	$5x10^{-4}$
	Agate Pass	Fish	4	100	90.3	13.3	68.0	129.0	$1x10^{-4}$	$1x10^{-3}$
	Point Madison	Fish	11	100	88.7	22.3	24.0	245.0	$1x10^{-4}$	$1x10^{-3}$
	Manchester	Fish	4	100	320.3	128.5	112.0	684.0	$4x10^{-4}$	$8x10^{-3}$
	Point Jefferson	Fish	5	100	119.2	41.7	62.0	283.0	$2x10^{-4}$	$2x10^{-3}$
	Eagle Harbor	Shellfish	8	50	12.6	3.2	5.0	28.0	$2x10^{-6}$	$5x10^{-5}$
	Point Blakely	Shellfish	1	-	5.0	-	5.0	5.0	$6x10^{-7}$	-
	All Puget Sound	Fish	185	99	138.2	17.6	1.8	2,060.0	$2x10^{-4}$	$2x10^{-3}$
	All Puget Sound	Shellfish	41	83	44.7	10.2	1.0	230.0	$5x10^{-6}$	$2x10^{-4}$
	All Puget Sound	Kelp/Ulva	33	-	10.6	0.6**	10.0	30.0	$3x10^{-8}$	$2x10^{-5}$
	All Puget Sound	Nori	7	-	10.0	0.0	10.0	10.0	$7x10^{-9}$	$5x10^{-6}$

TABLE C-2. SUMMARY OF NONCARCINOGENIC CONTAMINANT CONCENTRATIONS AND ASSOCIATED HEALTH RISKS FOR VARIOUS SEAFOOD CATEGORIES AND LOCATIONS IN PUGET SOUND

Chemical	Area	Seafood Category	No. Samples	Percent Detected	Summary Data (ug/kg wet wt) Mean	SE	Minimum	Maximum	Noncarcinogenic Risk Index Average Case	High Case
Cadmium	Alki Point	Shellfish	13	100	232.3	41.2	40.0	470.0	$1x10^{-2}$	$3x10^{-1}$
	Anacortes	Fish	2	-	1.0	0.0	1.0	1.0	$6x10^{-4}$	$5x10^{-3}$
	Birch Bay	Shellfish	11	100	236.7	23.9	140.0	364.0	$1x10^{-2}$	$3x10^{-1}$
	Budd Inlet	Shellfish	11	100	376.8	53.0	120.0	770.0	$2x10^{-2}$	$5x10^{-1}$
	Budd Inlet	Kelp/Ulva	4	100	134.8	10.9	102.0	147.0	$1x10^{-4}$	$1x10^{-1}$
	Burley Lagoon	Shellfish	7	100	140.4	36.3	80.0	350.0	$7x10^{-3}$	$2x10^{-1}$
	Quartermaster Harbor	Shellfish	14	100	283.6	43.7	17.0	560.0	$1x10^{-2}$	$4x10^{-1}$
	Commencement Bay	Fish	27	93	3.9	0.5	0.5	10.0	$2x10^{-3}$	$2x10^{-2}$
	Commencement Bay	Shellfish	2	100	33.5	29.5	4.0	63.0	$2x10^{-3}$	$4x10^{-1}$
	Commencement Bay	Kelp/Ulva	9	100	158.7	19.9	85.0	280.0	$2x10^{-4}$	$2x10^{-1}$
	Dash Point	Shellfish	12	100	296.3	97.8	40.0	1,280.0	$2x10^{-2}$	$5x10^{-1}$
	Elliott Bay	Fish	38	79	6.4	1.8	0.5	66.0	$4x10^{-3}$	$5x10^{-2}$
	Elliott Bay	Shellfish	3	100	37.3	2.7	32.0	41.0	$2x10^{-3}$	$5x10^{-2}$
	Elliott Bay	Kelp/Ulva	9	100	221.8	50.7	46.0	437.0	$2x10^{-4}$	$3x10^{-1}$
	Elliott Bay	Nori	4	100	167.3	69.5	62.0	367.0	$5x10^{-5}$	$8x10^{-2}$
	Everett Harbor	Fish	1	100	4.0	-	4.0	4.0	$2x10^{-3}$	-
	Everett Harbor	Shellfish	3	100	223.3	119.2	80.0	460.0	$1x10^{-2}$	$8x10^{-1}$
	Everett Harbor	Kelp/Ulva	3	100	53.0	2.9	48.0	58.0	$6x10^{-5}$	$5x10^{-2}$
	Mukilteo	Shellfish	13	100	215.2	27.0	100.0	447.0	$1x10^{-2}$	$3x10^{-1}$
	Point No Point	Fish	7	100	8.0	1.7	3.0	14.0	$5x10^{-3}$	$6x10^{-2}$
	Point No Point	Kelp/Ulva	8	100	199.1	43.0	67.0	365.0	$2x10^{-4}$	$2x10^{-1}$
	Point No Point	Nori	3	100	274.3	60.0	207.0	394.0	$8x10^{-5}$	$1x10^{-1}$
	Sinclair Inlet	Fish	18	28	1.8	0.6	0.5	10.0	$1x10^{-3}$	$1x10^{-2}$
	Sinclair Inlet	Shellfish	13	100	162.8	29.7	17.0	350.0	$9x10^{-3}$	$2x10^{-1}$
	Edmonds	Fish	25	64	4.8	1.2	0.5	20.0	$3x10^{-3}$	$3x10^{-2}$
	Edmonds	Shellfish	7	100	62.0	35.1	2.0	250.0	$3x10^{-3}$	$2x10^{-1}$
	Agate Pass	Fish	4	100	10.0	3.5	4.0	20.0	$6x10^{-3}$	$1x10^{-1}$
	Point Madison	Fish	11	100	6.8	2.1	1.0	23.0	$4x10^{-3}$	$5x10^{-2}$
	Manchester	Fish	4	100	9.5	2.1	5.0	15.0	$6x10^{-3}$	$7x10^{-2}$
	Point Jefferson	Fish	5	100	9.2	3.5	2.0	20.0	$5x10^{-3}$	$9x10^{-2}$
	Eagle Harbor	Shellfish	8	100	158.8	29.7	80.0	290.0	$8x10^{-3}$	$2x10^{-1}$
	Point Blakely	Shellfish	1	100	110.0	-	110.0	110.0	$6x10^{-3}$	-
	All Puget Sound	Fish	142	76	5.4	0.6	0.5	66.0	$3x10^{-3}$	$3x10^{-2}$
	All Puget Sound	Shellfish	118	100	219.1	16.2	2.0	1,280.0	$1x10^{-2}$	$3x10^{-1}$
	All Puget Sound	Kelp/Ulva	33	100	173.2	19.4	46.0	437.0	$2x10^{-4}$	$2x10^{-1}$
	All Puget Sound	Nori	7	100	213.1	48.6	62.0	394.0	$6x10^{-5}$	$6x10^{-2}$
Lead	Alki Point	Shellfish	9	89	108.3	28.7	5.0	260.0	$1x10^{-3}$	$4x10^{-2}$
	Anacortes	Fish	2	-	5.0	0.0	5.0	5.0	$6x10^{-4}$	$5x10^{-3}$
	Birch Bay	Shellfish	9	78	57.8	27.0	5.0	270.0	$6x10^{-4}$	$3x10^{-2}$
	Budd Inlet	Shellfish	8	100	107.5	25.8	40.0	270.0	$1x10^{-3}$	$4x10^{-2}$
	Budd Inlet	Kelp/Ulva	4	100	113.8	42.4	5.0	195.0	$3x10^{-5}$	$4x10^{-2}$
	Burley Lagoon	Shellfish	5	100	96.0	16.9	40.0	140.0	$1x10^{-3}$	$3x10^{-2}$
	Quartermaster Harbor	Shellfish	12	83	195.0	52.3	5.0	570.0	$2x10^{-3}$	$7x10^{-2}$
	Commencement Bay	Fish	27	63	15.3	4.2	0.5	100.0	$2x10^{-3}$	$2x10^{-2}$
	Commencement Bay	Shellfish	2	-	5.0	0.0	5.0	5.0	$6x10^{-5}$	$1x10^{-3}$
	Commencement Bay	Kelp/Ulva	9	89	786.4	464.9	2.5	4,460.0	$2x10^{-4}$	$3x10^{-1}$
	Dash Point	Shellfish	8	100	448.8	199.4	90.0	1,630.0	$5x10^{-3}$	$2x10^{-1}$
	Elliott Bay	Fish	37	51	26.3	7.7	1.0	200.0	$3x10^{-3}$	$4x10^{-2}$
	Elliott Bay	Shellfish	3	33	1.3	0.3	1.0	2.0	$1x10^{-5}$	$6x10^{-4}$
	Elliott Bay	Kelp/Ulva	9	89	279.2	120.7	2.5	1,160.0	$7x10^{-5}$	$9x10^{-2}$
	Elliott Bay	Nori	4	100	132.5	48.3	5.0	240.0	$8x10^{-6}$	$1x10^{-2}$
	Everett Harbor	Fish	1	-	5.0	-	5.0	5.0	$6x10^{-4}$	-
	Everett Harbor	Shellfish	3	67	201.7	111.2	5.0	390.0	$2x10^{-3}$	$1x10^{-1}$
	Everett Harbor	Kelp/Ulva	3	100	185.0	92.6	85.0	370.0	$4x10^{-5}$	$1x10^{-1}$
	Mukilteo	Shellfish	11	91	81.4	20.6	5.0	260.0	$9x10^{-4}$	$3x10^{-2}$
	Point No Point	Fish	7	-	5.0	0.0	5.0	5.0	$6x10^{-4}$	$5x10^{-3}$
	Point No Point	Kelp/Ulva	8	63	69.1	32.5	2.5	250.0	$2x10^{-5}$	$2x10^{-2}$
	Point No Point	Nori	3	-	2.5	0.0	2.5	2.5	$2x10^{-7}$	$1x10^{-4}$
	Sinclair Inlet	Fish	18	44	12.2	4.7	2.0	83.0	$2x10^{-3}$	$2x10^{-2}$

C-2. (Continued)

Area	Seafood Category	No. Samples	Percent Detected	Summary Data (ug/kg wet wt) Mean	SE	Minimum	Maximum	Noncarcinogenic Risk Index Average Case	High Case
Sinclair Inlet	Shellfish	10	80	172.2	34.6	1.0	290.0	$2x10^{-3}$	$5x10^{-2}$
Edmonds	Fish	25	48	23.3	10.3	0.5	200.0	$3x10^{-3}$	$4x10^{-2}$
Edmonds	Shellfish	7	29	4.6	0.9	1.0	8.0	$5x10^{-5}$	$1x10^{-3}$
Agate Pass	Fish	4	75	4.0	1.2	1.0	7.0	$5x10^{-4}$	$8x10^{-3}$
Point Madison	Fish	11	18	0.8	0.2	0.5	3.0	$1x10^{-4}$	$1x10^{-3}$
Manchester	Fish	4	100	2.5	0.9	1.0	5.0	$3x10^{-4}$	$5x10^{-3}$
Point Jefferson	Fish	5	100	3.6	0.4	3.0	5.0	$5x10^{-4}$	$5x10^{-3}$
Eagle Harbor	Shellfish	8	100	840.0	200.0	430.0	1,980.0	$9x10^{-3}$	$3x10^{-1}$
Point Blakely	Shellfish	1	100	380.0	-	380.0	380.0	$4x10^{-3}$	-
All Puget Sound	Fish	141	50	16.3	3.0	0.5	200.0	$2x10^{-3}$	$2x10^{-2}$
All Puget Sound	Shellfish	96	81	199.3	33.1	1.0	1,980.0	$2x10^{-3}$	$6x10^{-2}$
All Puget Sound	Kelp/Ulva	33	85	338.0	135.7	2.5	4,460.0	$8x10^{-5}$	$1x10^{-1}$
All Puget Sound	Nori	7	57	76.8	36.8	2.5	240.0	$5x10^{-6}$	$7x10^{-3}$
Alki Point	Shellfish	11	100	18.7	1.6	8.0	26.0	$1x10^{-3}$	$2x10^{-2}$
Anacortes	Fish	2	100	151.5	108.5	43.0	260.0	$9x10^{-2}$	7.e+00
Birch Bay	Shellfish	8	100	16.0	2.9	1.0	22.0	$8x10^{-4}$	$2x10^{-2}$
Budd Inlet	Shellfish	9	100	24.1	4.1	20.0	57.0	$1x10^{-3}$	$3x10^{-2}$
Budd Inlet	Kelp/Ulva	4	75	1.4	0.6	0.5	3.0	$2x10^{-6}$	$2x10^{-3}$
Burley Lagoon	Shellfish	5	100	16.8	3.2	4.0	20.0	$9x10^{-4}$	$3x10^{-2}$
Quartermaster Harbor	Shellfish	12	100	20.3	1.2	14.0	27.0	$1x10^{-3}$	$2x10^{-2}$
Commencement Bay	Fish	17	71	35.1	9.8	1.0	156.0	$2x10^{-2}$	$3x10^{-1}$
Commencement Bay	Kelp/Ulva	9	44	2.7	1.6	0.5	15.0	$3x10^{-6}$	$5x10^{-3}$
Dash Point	Shellfish	10	100	40.3	9.5	7.0	103.0	$2x10^{-3}$	$6x10^{-2}$
Elliott Bay	Fish	18	89	27.9	6.4	1.0	76.0	$2x10^{-2}$	$2x10^{-1}$
Elliott Bay	Shellfish	3	100	9.7	3.3	5.0	16.0	$5x10^{-4}$	$2x10^{-2}$
Elliott Bay	Kelp/Ulva	9	33	1.3	0.4	0.5	4.0	$1x10^{-6}$	$2x10^{-3}$
Elliott Bay	Nori	4	50	1.3	0.6	0.5	3.0	$4x10^{-7}$	$6x10^{-4}$
Everett Harbor	Fish	1	100	35.0	-	35.0	35.0	$2x10^{-2}$	-
Everett Harbor	Shellfish	3	100	17.3	6.4	10.0	30.0	$9x10^{-4}$	$5x10^{-2}$
Everett Harbor	Kelp/Ulva	3	67	1.2	0.4	0.5	2.0	$1x10^{-6}$	$2x10^{-3}$
Mukilteo	Shellfish	11	100	15.3	2.4	1.0	20.0	$8x10^{-4}$	$2x10^{-2}$
Point No Point	Fish	7	100	33.9	3.6	22.0	49.0	$2x10^{-2}$	$2x10^{-1}$
Point No Point	Kelp/Ulva	8	50	1.3	0.4	0.5	4.0	$1x10^{-6}$	$2x10^{-3}$
Point No Point	Nori	3	33	0.7	0.2	0.5	1.0	$2x10^{-7}$	$3x10^{-4}$
Sinclair Inlet	Fish	4	75	10.8	3.5	1.0	17.0	$6x10^{-3}$	$1x10^{-1}$
Sinclair Inlet	Shellfish	10	100	27.3	2.4	15.0	41.0	$1x10^{-3}$	$3x10^{-2}$
Edmonds	Fish	9	89	12.3	6.0	1.0	55.0	$7x10^{-3}$	$1x10^{-1}$
Edmonds	Shellfish	2	100	4.5	1.5	3.0	6.0	$2x10^{-4}$	$2x10^{-2}$
Agate Pass	Fish	4	75	12.4	3.6	1.5	17.0	$7x10^{-3}$	$1x10^{-1}$
Point Madison	Fish	11	91	13.1	6.3	0.5	73.0	$8x10^{-3}$	$1x10^{-1}$
Manchester	Fish	4	100	28.3	20.7	3.0	90.0	$2x10^{-2}$	$4x10^{-1}$
Point Jefferson	Fish	5	100	9.6	4.2	3.0	26.0	$6x10^{-3}$	$1x10^{-1}$
Eagle Harbor	Shellfish	8	100	33.0	6.8	10.0	68.0	$2x10^{-3}$	$5x10^{-2}$
Point Blakely	Shellfish	1	100	12.0	-	12.0	12.0	$6x10^{-4}$	-
All Puget Sound	Fish	82	87	26.6	4.2	0.5	260.0	$2x10^{-2}$	$2x10^{-1}$
All Puget Sound	Shellfish	93	100	22.5	1.6	1.0	103.0	$1x10^{-3}$	$3x10^{-2}$
All Puget Sound	Kelp/Ulva	33	48	1.7	0.5	0.5	15.0	$2x10^{-6}$	$2x10^{-3}$
All Puget Sound	Nori	7	43	1.0	0.3	0.5	3.0	$3x10^{-7}$	$4x10^{-4}$

APPENDIX D

SUMMARIES OF CONTAMINANT CONCENTRATIONS FOR INDIVIDUAL SPECIES AND LOCATIONS IN PUGET SOUND

TABLES

Number		Page
D-1	Summary of arsenic data by sample area and species	D-1
D-2	Summary of cadmium data by sample area and species	D-8
D-3	Summary of lead data by sample area and species	D-15
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D-5	Summary of carcinogenic PAH by sample area and species	D-28
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TABLE D-1. SUMMARY OF ARSENIC DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Alki Point	Littleneck clam	7	100	7	2526	623	1850	3500
	Butter clam	4	100	4	3170	1070	1900	4500
	Horseneck clam	1	100	1	1530	.	1530	1530
	All Species	12	100	12	2658	864	1530	4500
Anacortes	Species							
	Chinook salmon	2	100	2	515	177	390	640
	All Species	2	100	2	515	177	390	640
Birch Bay	Species							
	M. inquinata	1	100	1	1720	.	1720	1720
	Littleneck clam	6	100	6	2333	679	1200	3170
	Butter clam	3	100	3	2383	846	1700	3330
	All Species	10	100	10	2287	675	1200	3330
Budd Inlet	Species							
	M. inquinata	1	100	1	2070	.	2070	2070
	Softshell clam	1	100	1	1330	.	1330	1330
	Littleneck clam	5	100	5	2990	755	2130	4060
	Butter clam	1	100	1	1950	.	1950	1950
	Manila clam	2	100	2	2550	792	1990	3110
	Ulva	4	100	4	485	108	340	590
	All Species	14	100	14	1953	1178	340	4060
Burley Lagoon	Species							
	Butter clam	6	100	6	2780	401	2400	3490
	All Species	6	100	6	2780	401	2400	3490

(CONTINUED)

TABLE D-1. SUMMARY OF ARSENIC DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Quartermaster Harbor	Littleneck clam	6	100	6	3373	525	2700	4030
	Butter clam	3	100	3	4663	516	4200	5220
	Manila clam	3	100	3	3040	1051	1960	4060
	Horseneck clam	1	100	1	1550	.	1550	1550
	All Species	13	100	13	3454	1028	1550	5220
Commencement Bay	Species							
	Chinook salmon	5	100	5	1302	563	710	1900
	Coho salmon	2	100	2	2500	566	2100	2900
	Pacific hake	1	100	1	3200	.	3200	3200
	Rockfish	3	100	3	1833	1002	800	2800
	Walleye pollock	2	100	2	10400	1414	9400	11400
	Tomcod	2	100	2	2420	2263	820	4020
	English sole	4	100	4	17793	3088	14030	20400
	Starry flounder	4	100	4	1225	939	500	2600
	Pacific sanddab	1	100	1	20700	.	20700	20700
	Rock sole	2	100	2	14150	9122	7700	20600
	Buffalo sculpin	1	100	1	1000	.	1000	1000
	Market squid	2	100	2	6650	354	6400	6900
	Laminaria	4	100	4	5875	2262	4200	9200
	Nereocystis	1	100	1	1550	.	1550	1550
	Ulva	4	100	4	1538	839	940	2780
	All Species	38	100	38	5695	6410	500	20700

(CONTINUED)

TABLE D-1. SUMMARY OF ARSENIC DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Dash Point	Heart cockle	1	100	1	1400	.	1400	1400
	M. inquinata	1	100	1	3760	.	3760	3760
	Bentnose clam	4	100	4	3135	1468	1500	4980
	Littleneck clam	4	100	4	2415	847	1900	3680
	Butter clam	2	100	2	2715	516	2350	3080
	All Species	12	100	12	2733	1078	1400	4980
Elliott Bay	Species							
	Chinook salmon	9	100	9	1339	871	340	3200
	Pacific hake	2	100	2	1500	1414	500	2500
	Rockfish	4	100	4	1425	386	1200	2000
	Sablefish	13	100	13	1831	1494	500	5300
	Pacific cod	1	100	1	2000	.	2000	2000
	English sole	6	100	6	3787	1563	1800	6500
	Rock sole	5	100	5	3280	709	2400	4300
	Market squid	3	100	3	9667	7530	1300	15900
	Laminaria	2	100	2	3475	1096	2700	4250
	Nereocystis	4	100	4	3383	582	2600	3980
	Ulva	3	100	3	863	119	730	960
	Nori	4	100	4	3223	482	2730	3880
	All Species	56	100	56	2690	2597	340	15900
Everett Harbor	Species							
	Chinook salmon	1	100	1	930	.	930	930
	Sand clam	1	100	1	1400	.	1400	1400

(CONTINUED)

TABLE D-1. SUMMARY OF ARSENIC DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Everett Harbor	Littleneck clam	1	100	1	2500	.	2500	2500
	Butter clam	1	100	1	2300	.	2300	2300
	Ulva	3	100	3	507	150	410	680
	All Species	7	100	7	1236	865	410	2500
Mukilteo	Species							
	Littleneck clam	6	100	6	1712	420	1260	2400
	Butter clam	6	100	6	1928	281	1600	2240
	All Species	12	100	12	1820	359	1260	2400
Point No Point	Species							
	Chinook salmon	7	100	7	474	248	190	880
	Laminaria	3	100	3	5210	2098	3380	7500
	Nereocystis	2	100	2	3900	778	3350	4450
	Ulva	3	100	3	1097	275	820	1370
	Nori	3	100	3	1020	851	470	2000
	All Species	18	100	18	1839	2039	190	7500
Sinclair Inlet	Species							
	Pacific cod	4	100	4	6850	3951	3600	12600
	English sole	5	100	5	6380	3233	2100	11100
	Starry flounder	4	100	4	1725	411	1200	2200
	Rock sole	6	100	6	9873	6371	5000	19600
	Littleneck clam	5	100	5	2440	656	2000	3600
	Butter clam	4	100	4	4078	903	3140	4900
	Horseneck clam	1	100	1	2680	.	2680	2680

(CONTINUED)

TABLE D-1. SUMMARY OF ARSENIC DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Sinclair Inlet	Market squid	2	100	2	2850	2192	1300	4400
	All Species	31	100	31	5236	4316	1200	19600
Edmonds	Species							
	Pacific hake	1	100	1	4050	.	4050	4050
	Striped perch	2	100	2	500	141	400	600
	Rockfish	9	100	9	1727	539	800	2400
	Pacific cod	2	100	2	2800	1131	2000	3600
	English sole	6	100	6	1883	1042	1000	3900
	Rock sole	7	100	7	2886	932	1200	3800
	Market squid	6	100	6	8133	7069	3600	22100
	All Species	33	100	33	3227	3776	400	22100
Agate Pass	Species							
	Rockfish	4	100	4	2125	759	1100	2900
	All Species	4	100	4	2125	759	1100	2900
Point Madison	Species							
	Sablefish	2	100	2	1250	636	800	1700
	Pacific cod	1	100	1	3500	.	3500	3500
	Walleye pollock	5	100	5	2340	1293	1100	4400
	Tomcod	3	100	3	1000	458	500	1400
	All Species	11	100	11	1882	1197	500	4400
Manchester	Species							
	Pacific cod	4	100	4	4875	3603	700	9400
	All Species	4	100	4	4875	3603	700	9400

(CONTINUED)

TABLE D-1. SUMMARY OF ARSENIC DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Point Jefferson	Pacific hake	4	100	4	1925	1100	1000	3500
	Pacific cod	1	100	1	3400	.	3400	3400
	All Species	5	100	5	2220	1158	1000	3500
Eagle Harbor	Species							
	Bivalve spp.	8	100	8	2938	912	1500	4400
	All Species	8	100	8	2938	912	1500	4400
Point Blakely	Species							
	Bivalve spp.	1	100	1	3700	.	3700	3700
	All Species	1	100	1	3700	.	3700	3700
All Puget Sound Areas	Species							
	Chinook salmon	24	100	24	993	711	190	3200
	Coho salmon	2	100	2	2500	566	2100	2900
	Pacific hake	8	100	8	2244	1272	500	4050
	Striped perch	2	100	2	500	141	400	600
	Rockfish	20	100	20	1762	629	800	2900
	Sablefish	15	100	15	1753	1409	500	5300
	Pacific cod	13	100	13	4723	3206	700	12600
	Walleye pollock	7	100	7	4643	4113	1100	11400
	Tomcod	5	100	5	1568	1411	500	4020
	English sole	21	100	21	6528	6206	1000	20400
	Starry flounder	8	100	8	1475	723	500	2600
	Pacific sanddab	1	100	1	20700	.	20700	20700
	Rock sole	20	100	20	6207	5714	1200	20600

(CONTINUED)

TABLE D-1. SUMMARY OF ARSENIC DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
All Puget Sound Areas	Species							
	Buffalo sculpin	1	100	1	1000	.	1000	1000
	Heart cockle	1	100	1	1400	.	1400	1400
	M. inquinata	3	100	3	2517	1091	1720	3760
	Bentnose clam	4	100	4	3135	1468	1500	4980
	Sand clam	1	100	1	1400	.	1400	1400
	Softshell clam	1	100	1	1330	.	1330	1330
	Littleneck clam	40	100	40	2538	763	1200	4060
	Butter clam	30	100	30	2935	1056	1600	5220
	Manila clam	5	100	5	2844	884	1960	4060
	Horseneck clam	3	100	3	1920	658	1530	2680
	Bivalve spp.	9	100	9	3022	890	1500	4400
	Market squid	13	100	13	7446	5981	1300	22100
	Laminaria	9	100	9	5120	2033	2700	9200
	Nereocystis	7	100	7	3269	951	1550	4450
	Ulva	17	100	17	911	574	340	2780
	Nori	7	100	7	2279	1320	470	3880
	All Species	297	100	297	3246	3517	190	22100

TABLE D-2. SUMMARY OF CADMIUM DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Alki Point	Littleneck clam	8	100	8	280	138	70	470
	Butter clam	4	100	4	142	164	40	387
	Horseneck clam	1	100	1	210	.	210	210
	All Species	13	100	13	232	149	40	470
Anacortes	Species							
	Chinook salmon	0	.	2	1	0	1	1
	All Species	0	.	2	1	0	1	1
Birch Bay	Species							
	M. inquinata	1	100	1	140	.	140	140
	Littleneck clam	7	100	7	281	63	180	364
	Butter clam	3	100	3	167	25	140	190
	All Species	11	100	11	237	79	140	364
Budd Inlet	Species							
	M. inquinata	1	100	1	551	.	551	551
	Softshell clam	1	100	1	770	.	770	770
	Littleneck clam	6	100	6	336	96	180	435
	Butter clam	1	100	1	120	.	120	120
	Manila clam	2	100	2	344	23	327	360
	Ulva	4	100	4	135	22	102	147
	All Species	15	100	15	312	186	102	770
Burley Lagoon	Species							
	Littleneck clam	1	100	1	350	.	350	350
	Butter clam	6	100	6	106	29	80	157

(CONTINUED)

TABLE D-2. SUMMARY OF CADMIUM DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	All Species							
Burley Lagoon		7	100	7	140	96	80	350
Quartermaster Harbor	Species							
	Littleneck clam	7	100	7	403	106	274	560
	Butter clam	3	100	3	94	12	80	104
	Manila clam	3	100	3	202	161	17	300
	Horseneck clam	1	100	1	260	.	260	260
	All Species	14	100	14	284	164	17	560
Commencement Bay	Species							
	Chinook salmon	5	100	5	7	3	3	9
	Coho salmon	1	50	2	3	3	1	5
	Pacific hake	1	100	1	3	.	3	3
	Rockfish	4	100	4	5	3	2	10
	Walleye pollock	2	100	2	5	1	4	5
	Tomcod	2	100	2	5	1	4	5
	English sole	3	100	3	2	1	1	3
	Starry flounder	4	100	4	3	1	2	5
	Pacific sanddab	1	100	1	2	.	2	2
	Rock sole	1	50	2	1	0	1	1
	Buffalo sculpin	1	100	1	2	.	2	2
	Market squid	2	100	2	34	42	4	63
	Laminaria	4	100	4	203	57	152	280
	Nereocystis	1	100	1	171	.	171	171
	Ulva	4	100	4	112	27	85	148

(CONTINUED)

TABLE D-2. SUMMARY OF CADMIUM DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	All Species							
Commencement Bay		36	95	38	42	72	1	280
Dash Point	Species							
	Heart cockle	1	100	1	180	.	180	180
	M. inquinata	1	100	1	1280	.	1280	1280
	Bentnose clam	4	100	4	93	55	40	170
	Littleneck clam	4	100	4	380	37	340	420
	Butter clam	2	100	2	103	18	90	116
	All Species	12	100	12	296	339	40	1280
Elliott Bay	Species							
	Chinook salmon	8	89	9	7	4	1	13
	Pacific hake	2	100	2	16	6	11	20
	Rockfish	4	100	4	7	4	3	12
	Sablefish	9	75	12	2	2	1	8
	Pacific cod	1	100	1	66	.	66	66
	English sole	2	40	5	1	1	1	2
	Rock sole	4	80	5	6	8	1	20
	Market squid	3	100	3	37	5	32	41
	Laminaria	2	100	2	138	48	104	172
	Nereocystis	4	100	4	370	78	272	437
	Ulva	3	100	3	81	38	46	122
	Nori	4	100	4	167	139	62	367
	All Species	46	85	54	56	110	1	437

(CONTINUED)

TABLE D-2. SUMMARY OF CADMIUM DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Everett Harbor	Chinook salmon	1	100	1	4	.	4	4
	Sand clam	1	100	1	80	.	80	80
	Littleneck clam	1	100	1	460	.	460	460
	Butter clam	1	100	1	130	.	130	130
	Ulva	3	100	3	53	5	48	58
	All Species	7	100	7	119	155	4	460
Mukilteo	Species							
	Littleneck clam	7	100	7	281	82	200	447
	Butter clam	6	100	6	138	40	100	196
	All Species	13	100	13	215	97	100	447
Point No Point	Species							
	Chinook salmon	7	100	7	8	5	3	14
	Laminaria	3	100	3	108	36	67	130
	Nereocystis	2	100	2	364	1	363	365
	Ulva	3	100	3	180	101	118	297
	Nori	3	100	3	274	104	207	394
	All Species	18	100	18	137	139	3	394
Sinclair Inlet	Species							
	Pacific cod	1	25	4	1	1	1	2
	English sole	0	.	5	1	0	1	1
	Starry flounder	4	100	4	6	3	3	10
	Rock sole	0	.	5	1	0	1	1
	Littleneck clam	6	100	6	233	67	150	350

(CONTINUED)

TABLE D-2. SUMMARY OF CADMIUM DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Sinclair Inlet	Butter clam	4	100	4	91	35	60	140
	Horseneck clam	1	100	1	310	.	310	310
	Market squid	2	100	2	22	6	17	26
	All Species	18	58	31	69	105	1	350
Edmonds	Species							
	Pacific hake	1	100	1	1	.	1	1
	Striped perch	2	100	2	4	4	1	6
	Rockfish	7	88	8	10	7	1	20
	Pacific cod	0	.	2	1	0	1	1
	English sole	1	20	5	1	1	1	2
	Rock sole	5	71	7	3	4	1	11
	Market squid	7	100	7	62	93	2	250
	All Species	23	72	32	17	48	1	250
Agate Pass	Species							
	Rockfish	4	100	4	10	7	4	20
	All Species	4	100	4	10	7	4	20
Point Madison	Species							
	Sablefish	2	100	2	19	6	15	23
	Pacific cod	1	100	1	1	.	1	1
	Walleye pollock	5	100	5	4	2	2	6
	Tomcod	3	100	3	6	5	2	12
	All Species	11	100	11	7	7	1	23

(CONTINUED)

TABLE D-2. SUMMARY OF CADMIUM DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Manchester	Pacific cod	4	100	4	10	4	5	15
	All Species	4	100	4	10	4	5	15
Point Jefferson	Species							
	Pacific hake	4	100	4	11	8	4	20
	Pacific cod	1	100	1	2	.	2	2
	All Species	5	100	5	9	8	2	20
Eagle Harbor	Species							
	Bivalve spp.	8	100	8	159	84	80	290
	All Species	8	100	8	159	84	80	290
Point Blakely	Species							
	Bivalve spp.	1	100	1	110	.	110	110
	All Species	1	100	1	110	.	110	110
All Puget Sound Areas	Species							
	Chinook salmon	21	88	24	6	4	1	14
	Coho salmon	1	50	2	3	3	1	5
	Pacific hake	8	100	8	10	8	1	20
	Striped perch	2	100	2	4	4	1	6
	Rockfish	19	95	20	9	6	1	20
	Sablefish	11	79	14	4	7	1	23
	Pacific cod	8	62	13	9	18	1	66
	Walleye pollock	7	100	7	4	1	2	6
	Tomcod	5	100	5	5	4	2	12
	English sole	6	33	18	1	1	1	3

(CONTINUED)

TABLE D-2. SUMMARY OF CADMIUM DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
All Puget Sound Areas	Species							
	Starry flounder	8	100	8	5	3	2	10
	Pacific sanddab	1	100	1	2	.	2	2
	Rock sole	10	53	19	3	5	1	20
	Buffalo sculpin	1	100	1	2	.	2	2
	Heart cockle	1	100	1	180	.	180	180
	M. inquinata	3	100	3	657	577	140	1280
	Bentnose clam	4	100	4	93	55	40	170
	Sand clam	1	100	1	80	.	80	80
	Softshell clam	1	100	1	770	.	770	770
	Littleneck clam	47	100	47	314	104	70	560
	Butter clam	30	100	30	121	63	40	387
	Manila clam	5	100	5	259	138	17	360
	Horseneck clam	3	100	3	260	50	210	310
	Bivalve spp.	9	100	9	153	80	80	290
	Market squid	14	100	14	47	66	2	250
	Laminaria	9	100	9	157	62	67	280
	Nereocystis	7	100	7	340	93	171	437
	Ulva	17	100	17	113	59	46	297
	Nori	7	100	7	213	129	62	394
	All Species	266	89	300	113	156	1	1280

TABLE D-3. SUMMARY OF LEAD DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Alki Point	Littleneck clam	4	80	5	61	45	5	120
	Butter clam	4	100	4	168	93	40	260
	All Species	8	89	9	108	86	5	260
Anacortes	Species							
	Chinook salmon	0	.	2	5	0	5	5
	All Species	0	.	2	5	0	5	5
Birch Bay	Species							
	M. inquinata	1	100	1	270	.	270	270
	Littleneck clam	4	80	5	33	16	5	40
	Butter clam	2	67	3	28	20	5	40
	All Species	7	78	9	58	81	5	270
Budd Inlet	Species							
	Softshell clam	1	100	1	270	.	270	270
	Littleneck clam	4	100	4	63	26	40	100
	Butter clam	1	100	1	130	.	130	130
	Manila clam	2	100	2	105	7	100	110
	Ulva	4	100	4	114	85	5	195
	All Species	12	100	12	110	73	5	270
Burley Lagoon	Species							
	Butter clam	5	100	5	96	38	40	140
	All Species	5	100	5	96	38	40	140
Quartermaster Harbor	Species							
	Littleneck clam	4	80	5	81	60	5	140

(CONTINUED)

TABLE D-3. SUMMARY OF LEAD DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Quartermaster Harbor	Butter clam	3	100	3	457	100	380	570
	Manila clam	2	67	3	88	75	5	150
	Horseneck clam	1	100	1	300	.	300	300
	All Species	10	83	12	195	181	5	570
Commencement Bay	Species							
	Chinook salmon	0	.	5	5	0	5	5
	Coho salmon	0	.	2	5	0	5	5
	Pacific hake	1	100	1	2	.	2	2
	Rockfish	4	100	4	6	4	3	10
	Walleye pollock	2	100	2	8	6	4	12
	Tomcod	2	100	2	29	1	28	30
	English sole	3	100	3	36	13	22	48
	Starry flounder	2	50	4	1	1	1	2
	Pacific sanddab	1	100	1	47	.	47	47
	Rock sole	1	50	2	52	69	3	100
	Buffalo sculpin	1	100	1	18	.	18	18
	Market squid	0	.	2	5	0	5	5
	Laminaria	4	100	4	264	157	85	440
	Nereocystis	0	.	1	3	.	3	3
	Ulva	4	100	4	1505	1976	370	4460
	All Species	25	66	38	197	729	1	4460
Dash Point	Species							
	Heart cockle	1	100	1	230	.	230	230

(CONTINUED)

TABLE D-3. SUMMARY OF LEAD DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Dash Point	Bentnose clam	2	100	2	1310	453	990	1630
	Littleneck clam	3	100	3	97	6	90	100
	Butter clam	2	100	2	225	134	130	320
	All Species	8	100	8	449	564	90	1630
Elliott Bay	Species							
	Chinook salmon	5	56	9	81	71	5	200
	Pacific hake	2	100	2	5	1	4	6
	Rockfish	2	50	4	9	10	1	23
	Sablefish	4	33	12	8	5	4	20
	Pacific cod	1	100	1	15	.	15	15
	English sole	2	50	4	17	19	5	45
	Rock sole	3	60	5	3	2	1	6
	Market squid	1	33	3	1	1	1	2
	Laminaria	1	50	2	51	69	3	100
	Nereocystis	4	100	4	138	26	100	160
	Ulva	3	100	3	620	505	160	1160
	Nori	4	100	4	133	97	5	240
	All Species	32	60	53	76	178	1	1160
Everett Harbor	Species							
	Chinook salmon	0	.	1	5	.	5	5
	Sand clam	1	100	1	390	.	390	390
	Littleneck clam	0	.	1	5	.	5	5
	Butter clam	1	100	1	210	.	210	210

(CONTINUED)

TABLE D-3. SUMMARY OF LEAD DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Everett Harbor	Ulva	3	100	3	185	160	85	370
	All Species	5	71	7	166	161	5	390
Mukilteo	Species							
	Littleneck clam	4	80	5	35	17	5	50
	Butter clam	6	100	6	120	72	60	260
	All Species	10	91	11	81	68	5	260
Point No Point	Species							
	Chinook salmon	0	.	7	5	0	5	5
	Laminaria	2	67	3	41	52	3	100
	Nereocystis	1	50	2	79	108	3	155
	Ulva	2	67	3	91	138	3	250
	Nori	0	.	3	3	0	3	3
	All Species	5	28	18	33	68	3	250
Sinclair Inlet	Species							
	Pacific cod	0	.	4	5	0	4	5
	English sole	3	60	5	18	13	5	32
	Starry flounder	4	100	4	2	0	2	2
	Rock sole	1	20	5	20	35	3	83
	Littleneck clam	4	100	4	173	71	120	270
	Butter clam	4	100	4	258	40	200	290
	Market squid	0	.	2	1	0	1	1
	All Species	16	57	28	69	102	1	290

(CONTINUED)

TABLE D-3. SUMMARY OF LEAD DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Edmonds	Pacific hake	1	100	1	13	.	13	13
	Striped perch	1	50	2	93	124	5	180
	Rockfish	5	63	8	8	10	1	30
	Pacific cod	1	50	2	103	138	5	200
	English sole	0	.	5	4	1	3	5
	Rock sole	4	57	7	14	20	1	58
	Market squid	2	29	7	5	2	1	8
	All Species	14	44	32	19	46	1	200
Agate Pass	Species							
	Rockfish	3	75	4	4	2	1	7
	All Species	3	75	4	4	2	1	7
Point Madison	Species							
	Sablefish	0	.	2	1	0	1	1
	Pacific cod	1	100	1	1	.	1	1
	Walleye pollock	1	20	5	1	1	1	3
	Tomcod	0	.	3	1	0	1	1
	All Species	2	18	11	1	1	1	3
Manchester	Species							
	Pacific cod	4	100	4	3	2	1	5
	All Species	4	100	4	3	2	1	5
Point Jefferson	Species							
	Pacific hake	4	100	4	4	1	3	5
	Pacific cod	1	100	1	3	.	3	3

(CONTINUED)

TABLE D-3. SUMMARY OF LEAD DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	All Species							
Point Jefferson		5	100	5	4	1	3	5
Eagle Harbor	Species							
	Bivalve spp.	8	100	8	840	566	430	1980
	All Species	8	100	8	840	566	430	1980
Point Blakely	Species							
	Bivalve spp.	1	100	1	380	.	380	380
	All Species	1	100	1	380	.	380	380
All Puget Sound Areas	Species							
	Chinook salmon	5	21	24	34	56	5	200
	Coho salmon	0	.	2	5	0	5	5
	Pacific hake	8	100	8	5	3	2	13
	Striped perch	1	50	2	93	124	5	180
	Rockfish	14	70	20	7	8	1	30
	Sablefish	4	29	14	7	6	1	20
	Pacific cod	8	62	13	19	54	1	200
	Walleye pollock	3	43	7	3	4	1	12
	Tomcod	2	40	5	12	16	1	30
	English sole	8	47	17	17	16	3	48
	Starry flounder	6	75	8	2	1	1	2
	Pacific sanddab	1	100	1	47	.	47	47
	Rock sole	9	47	19	17	29	1	100
	Buffalo sculpin	1	100	1	18	.	18	18
	Heart cockle	1	100	1	230	.	230	230

(CONTINUED)

TABLE D-3. SUMMARY OF LEAD DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
All Puget Sound Areas	Species							
	M. inquinata	1	100	1	270	.	270	270
	Bentnose clam	2	100	2	1310	453	990	1630
	Sand clam	1	100	1	390	.	390	390
	Softshell clam	1	100	1	270	.	270	270
	Littleneck clam	27	84	32	71	58	5	270
	Butter clam	28	97	29	177	132	5	570
	Manila clam	4	80	5	95	54	5	150
	Horseneck clam	1	100	1	300	.	300	300
	Bivalve spp.	9	100	9	789	551	380	1980
	Market squid	3	21	14	3	2	1	8
	Laminaria	7	78	9	142	154	3	440
	Nereocystis	5	71	7	101	70	3	160
	Ulva	16	94	17	539	1054	3	4460
	Nori	4	57	7	77	97	3	240
	All Species	180	65	277	120	348	1	4460

TABLE D-4. SUMMARY OF MERCURY DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Alki Point	Littleneck clam	6	100	6	19.7	5.28	10.0	26.0
	Butter clam	4	100	4	17.0	6.00	8.0	20.0
	Horseneck clam	1	100	1	20.0	.	20.0	20.0
	All Species	11	100	11	18.7	5.16	8.0	26.0
Anacortes	Species							
	Chinook salmon	2	100	2	151.5	153.44	43.0	260.0
	All Species	2	100	2	151.5	153.44	43.0	260.0
Birch Bay	Species							
	M. inquinata	1	100	1	22.0	.	22.0	22.0
	Littleneck clam	4	100	4	16.3	7.50	5.0	20.0
	Butter clam	3	100	3	13.7	10.97	1.0	20.0
	All Species	8	100	8	16.0	8.12	1.0	22.0
Budd Inlet	Species							
	M. inquinata	1	100	1	57.0	.	57.0	57.0
	Softshell clam	1	100	1	20.0	.	20.0	20.0
	Littleneck clam	4	100	4	20.0	0.00	20.0	20.0
	Butter clam	1	100	1	20.0	.	20.0	20.0
	Manila clam	2	100	2	20.0	0.00	20.0	20.0
	Ulva	3	75	4	1.4	1.11	0.5	3.0
	All Species	12	92	13	17.1	14.87	0.5	57.0
Burley Lagoon	Species							
	Littleneck clam	1	100	1	20.0	.	20.0	20.0
	Butter clam	4	100	4	16.0	8.00	4.0	20.0

(CONTINUED)

TABLE D-4. SUMMARY OF MERCURY DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	All Species							
Burley Lagoon		5	100	5	16.8	7.16	4.0	20.0
Quartermaster Harbor	Species							
	Littleneck clam	5	100	5	20.8	4.76	14.0	27.0
	Butter clam	3	100	3	18.7	2.31	16.0	20.0
	Manila clam	3	100	3	19.0	4.58	14.0	23.0
	Horseneck clam	1	100	1	26.0	.	26.0	26.0
	All Species	12	100	12	20.3	4.16	14.0	27.0
Commencement Bay	Species							
	Chinook salmon	5	100	5	47.6	6.66	39.0	54.0
	Coho salmon	2	100	2	50.0	12.73	41.0	59.0
	Pacific hake	1	100	1	4.0	.	4.0	4.0
	Rockfish	2	50	4	22.6	37.76	1.0	79.0
	Walleye pollock	1	100	1	6.0	.	6.0	6.0
	Starry flounder	1	25	4	39.8	77.50	1.0	156.0
	Laminaria	0	.	4	0.5	0.00	0.5	0.5
	Nereocystis	0	.	1	0.5	.	0.5	0.5
	Ulva	4	100	4	5.5	6.35	2.0	15.0
	All Species	16	62	26	23.9	36.19	0.5	156.0
Dash Point	Species							
	Heart cockle	1	100	1	20.0	.	20.0	20.0
	M. inquinata	1	100	1	103.0	.	103.0	103.0
	Bentnose clam	4	100	4	53.3	16.38	31.0	69.0
	Littleneck clam	3	100	3	15.7	7.51	7.0	20.0

(CONTINUED)

TABLE D-4. SUMMARY OF MERCURY DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Dash Point	Butter clam	1	100	1	20.0	.	20.0	20.0
	All Species	10	100	10	40.3	30.12	7.0	103.0
Elliott Bay	Species							
	Chinook salmon	9	100	9	51.0	18.34	20.0	76.0
	Pacific hake	2	100	2	3.0	0.00	3.0	3.0
	Rockfish	2	67	3	6.5	7.40	1.5	15.0
	Rock sole	3	75	4	4.3	3.40	1.0	9.0
	Market squid	3	100	3	9.7	5.69	5.0	16.0
	Laminaria	0	.	2	0.5	0.00	0.5	0.5
	Nereocystis	0	.	4	0.5	0.00	0.5	0.5
	Ulva	3	100	3	3.0	1.00	2.0	4.0
	Nori	2	50	4	1.3	1.19	0.5	3.0
	All Species	24	71	34	16.1	23.37	0.5	76.0
Everett Harbor	Species							
	Chinook salmon	1	100	1	35.0	.	35.0	35.0
	Sand clam	1	100	1	30.0	.	30.0	30.0
	Littleneck clam	1	100	1	12.0	.	12.0	12.0
	Butter clam	1	100	1	10.0	.	10.0	10.0
	Ulva	2	67	3	1.2	0.76	0.5	2.0
	All Species	6	86	7	12.9	14.17	0.5	35.0
Mukilteo	Species							
	Littleneck clam	5	100	5	16.6	7.60	3.0	20.0
	Butter clam	6	100	6	14.2	9.09	1.0	20.0

(CONTINUED)

TABLE D-4. SUMMARY OF MERCURY DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	All Species							
Mukilteo		11	100	11	15.3	8.13	1.0	20.0
Point No Point	Species							
	Chinook salmon	7	100	7	33.9	9.60	22.0	49.0
	Laminaria	1	33	3	0.7	0.29	0.5	1.0
	Nereocystis	0	.	2	0.5	0.00	0.5	0.5
	Ulva	3	100	3	2.3	1.53	1.0	4.0
	Nori	1	33	3	0.7	0.29	0.5	1.0
	All Species	12	67	18	13.8	17.42	0.5	49.0
Sinclair Inlet	Species							
	Starry flounder	3	75	4	10.8	6.95	1.0	17.0
	Littleneck clam	4	100	4	27.8	8.66	15.0	34.0
	Butter clam	4	100	4	28.3	9.00	21.0	41.0
	Horseneck clam	1	100	1	27.0	.	27.0	27.0
	Market squid	1	100	1	22.0	.	22.0	22.0
	All Species	13	93	14	22.6	10.48	1.0	41.0
Edmonds	Species							
	Rockfish	5	100	5	20.6	21.36	5.0	55.0
	Rock sole	3	75	4	2.0	0.82	1.0	3.0
	Market squid	2	100	2	4.5	2.12	3.0	6.0
	All Species	10	91	11	10.9	16.43	1.0	55.0
Agate Pass	Species							
	Rockfish	3	75	4	12.4	7.30	1.5	17.0
	All Species	3	75	4	12.4	7.30	1.5	17.0

(CONTINUED)

TABLE D-4. SUMMARY OF MERCURY DATA BY SAMPLE AREA AND SPECIES

Area	Species	Detection Frequency NO. DET.	Detection Frequency % DET.	Summary Data (ug/kg wet wt) N	MEAN	STD	MIN	MAX
Point Madison	Sablefish	2	100	2	12.5	13.44	3.0	22.0
	Pacific cod	1	100	1	13.0	.	13.0	13.0
	Walleye pollock	4	80	5	18.1	30.82	0.5	73.0
	Tomcod	3	100	3	5.3	2.52	3.0	8.0
	All Species	10	91	11	13.1	20.74	0.5	73.0
Manchester	Species							
	Pacific cod	4	100	4	28.3	41.37	3.0	90.0
	All Species	4	100	4	28.3	41.37	3.0	90.0
Point Jefferson	Species							
	Pacific hake	4	100	4	5.5	2.52	3.0	9.0
	Pacific cod	1	100	1	26.0	.	26.0	26.0
	All Species	5	100	5	9.6	9.42	3.0	26.0
Eagle Harbor	Species							
	Bivalve spp.	8	100	8	33.0	19.21	10.0	68.0
	All Species	8	100	8	33.0	19.21	10.0	68.0
Point Blakely	Species							
	Bivalve spp.	1	100	1	12.0	.	12.0	12.0
	All Species	1	100	1	12.0	.	12.0	12.0
All Puget Sound Areas	Species							
	Chinook salmon	24	100	24	53.0	46.36	20.0	260.0
	Coho salmon	2	100	2	50.0	12.73	41.0	59.0
	Pacific hake	7	100	7	4.6	2.15	3.0	9.0
	Rockfish	12	75	16	16.4	21.56	1.0	79.0

(CONTINUED)

TABLE D-4. SUMMARY OF MERCURY DATA BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
All Puget Sound Areas	Species							
	Sablefish	2	100	2	12.5	13.44	3.0	22.0
	Pacific cod	6	100	6	25.3	32.62	3.0	90.0
	Walleye pollock	5	83	6	16.1	28.01	0.5	73.0
	Tomcod	3	100	3	5.3	2.52	3.0	8.0
	Starry flounder	4	50	8	25.3	53.25	1.0	156.0
	Rock sole	6	75	8	3.1	2.59	1.0	9.0
	Heart cockle	1	100	1	20.0	.	20.0	20.0
	M. inquinata	3	100	3	60.7	40.62	22.0	103.0
	Bentnose clam	4	100	4	53.3	16.38	31.0	69.0
	Sand clam	1	100	1	30.0	.	30.0	30.0
	Softshell clam	1	100	1	20.0	.	20.0	20.0
	Littleneck clam	33	100	33	19.4	6.69	3.0	34.0
	Butter clam	27	100	27	17.7	8.46	1.0	41.0
	Manila clam	5	100	5	19.4	3.29	14.0	23.0
	Horseneck clam	3	100	3	24.3	3.79	20.0	27.0
	Bivalve spp.	9	100	9	30.7	19.28	10.0	68.0
	Market squid	6	100	6	10.0	7.40	3.0	22.0
	Laminaria	1	11	9	0.6	0.17	0.5	1.0
	Nereocystis	0	.	7	0.5	0.00	0.5	0.5
	Ulva	15	88	17	2.8	3.34	0.5	15.0
	Nori	3	43	7	1.0	0.91	0.5	3.0
	All Species	183	85	215	20.2	26.92	0.5	260.0

TABLE D-5. SUMMARY OF CARCINOGENIC PAH BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Alki Point	Littleneck clam	0	.	1	4	.	4	4
	Butter clam	0	.	1	4	.	4	4
	All Species	0	.	2	4	0	4	4
Birch Bay	Species							
	Littleneck clam	0	.	1	4	.	4	4
	Butter clam	0	.	1	4	.	4	4
	All Species	0	.	2	4	0	4	4
Budd Inlet	Species							
	Softshell clam	1	100	1	283	.	283	283
	Littleneck clam	0	.	2	20	0	20	20
	Bivalve spp.	0	.	1	60	.	60	60
	Ulva	0	.	1	120	.	120	120
	All Species	1	20	5	101	110	20	283
Burley Lagoon	Species							
	Butter clam	0	.	1	4	.	4	4
	All Species	0	.	1	4	.	4	4
Quartermaster Harbor	Species							
	Littleneck clam	0	.	1	4	.	4	4
	Butter clam	1	100	1	5	.	5	5
	Manila clam	1	100	1	15	.	15	15
	All Species	2	67	3	8	6	4	15
Commencement Bay	Species							
	Ulva	0	.	1	480	.	480	480

(CONTINUED)

TABLE D-5. SUMMARY OF CARCINOGENIC PAH BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	All Species							
Commencement Bay		0	.	1	480	.	480	480
Dash Point	Species							
	Bentnose clam	2	100	2	29	28	9	48
	Littleneck clam	0	.	1	4	.	4	4
	All Species	2	67	3	20	24	4	48
Elliott Bay	Species							
	Ulva	0	.	1	300	.	300	300
	All Species	0	.	1	300	.	300	300
Everett Harbor	Species							
	Sand clam	1	100	1	4	.	4	4
	Littleneck clam	1	100	1	6	.	6	6
	Butter clam	0	.	1	3	.	3	3
	Ulva	0	.	1	240	.	240	240
	All Species	2	50	4	63	118	3	240
Mukilteo	Species							
	Littleneck clam	0	.	1	4	.	4	4
	Butter clam	0	.	2	3	0	3	3
	All Species	0	.	3	3	0	3	4
Point No Point	Species							
	Ulva	0	.	1	169	.	169	169
	All Species	0	.	1	169	.	169	169
Sinclair Inlet	Species							
	Littleneck clam	1	100	1	5	.	5	5

(CONTINUED)

TABLE D-5. SUMMARY OF CARCINOGENIC PAH BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Sinclair Inlet	Butter clam	0	.	1	4	.	4	4
	All Species	1	50	2	4	1	4	5
Rolling Bay	Species							
	Rock crab	0	.	1	8	.	8	8
	All Species	0	.	1	8	.	8	8
Eagle Harbor	Species							
	Rock crab	4	100	4	50	36	16	97
	Bivalve spp.	6	75	8	178	241	6	748
	All Species	10	83	12	135	203	6	748
Point Blakely	Species							
	Bivalve spp.	1	100	1	42	.	42	42
	All Species	1	100	1	42	.	42	42
All Puget Sound Areas	Species							
	Rock crab	4	80	5	42	37	8	97
	Bentnose clam	2	100	2	29	28	9	48
	Sand clam	1	100	1	4	.	4	4
	Softshell clam	1	100	1	283	.	283	283
	Littleneck clam	2	22	9	8	7	4	20
	Butter clam	1	13	8	3	1	3	5
	Manila clam	1	100	1	15	.	15	15
	Bivalve spp.	7	70	10	153	220	6	748
	Ulva	0	.	5	262	140	120	480
	All Species	19	45	42	83	148	3	748

TABLE D-6. SUMMARY OF TOTAL PCBS BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Alki Point	Littleneck clam	1	100	1	2.50	.	2.50	2.50
	Butter clam	1	100	1	6.10	.	6.10	6.10
	All Species	2	100	2	4.30	2.55	2.50	6.10
Anacortes	Species							
	Chinook salmon	2	100	2	25.00	5.66	21.00	29.00
	All Species	2	100	2	25.00	5.66	21.00	29.00
Birch Bay	Species							
	Littleneck clam	0	.	1	1.00	.	1.00	1.00
	Butter clam	0	.	1	1.00	.	1.00	1.00
	All Species	0	.	2	1.00	0.00	1.00	1.00
Budd Inlet	Species							
	Ulva	0	.	4	10.00	0.00	10.00	10.00
	All Species	0	.	4	10.00	0.00	10.00	10.00
Burley Lagoon	Species							
	Butter clam	1	100	1	7.20	.	7.20	7.20
	All Species	1	100	1	7.20	.	7.20	7.20
Quartermaster Harbor	Species							
	Littleneck clam	1	100	1	4.80	.	4.80	4.80
	Butter clam	1	100	1	6.50	.	6.50	6.50
	Manila clam	1	100	1	6.90	.	6.90	6.90
	All Species	3	100	3	6.07	1.12	4.80	6.90
Commencement Bay	Species							
	Chinook salmon	5	100	5	130.60	65.94	62.00	215.00

(CONTINUED)

TABLE D-6. SUMMARY OF TOTAL PCBS BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Commencement Bay	Coho salmon	2	100	2	86.00	16.97	74.00	98.00
	Pacific hake	1	100	1	143.00	.	143.00	143.00
	Rockfish	4	100	4	86.25	16.80	73.00	108.00
	Walleye pollock	2	100	2	32.50	19.09	19.00	46.00
	Tomcod	1	100	1	54.00	.	54.00	54.00
	English sole	4	100	4	119.75	51.07	68.00	190.00
	Starry flounder	4	100	4	143.00	97.15	35.00	263.00
	Market squid	1	100	1	177.00	.	177.00	177.00
	Laminaria	0	.	4	10.00	0.00	10.00	10.00
	Nereocystis	0	.	1	10.00	.	10.00	10.00
	Ulva	0	.	4	15.00	10.00	10.00	30.00
	All Species	24	73	33	63.94	68.47	10.00	263.00
Dash Point	Species							
	Bentnose clam	2	100	2	8.10	6.93	3.20	13.00
	Littleneck clam	1	100	1	3.90	.	3.90	3.90
	All Species	3	100	3	6.70	5.47	3.20	13.00
Elliott Bay	Species							
	Chinook salmon	9	100	9	74.89	48.43	34.00	175.00
	Pacific hake	2	100	2	157.50	31.82	135.00	180.00
	Rockfish	3	100	3	116.00	73.53	59.00	199.00
	Sablefish	12	100	12	66.08	94.26	23.00	360.00
	Pacific cod	1	100	1	271.00	.	271.00	271.00
	English sole	28	100	28	418.79	484.91	20.00	2060.00

(CONTINUED)

TABLE D-6. SUMMARY OF TOTAL PCBS BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Elliott Bay	Rock sole	4	100	4	155.50	90.19	49.00	249.00
	Market squid	3	100	3	121.00	94.56	61.00	230.00
	Laminaria	0	.	2	10.00	0.00	10.00	10.00
	Nereocystis	0	.	4	10.00	0.00	10.00	10.00
	Ulva	0	.	3	10.00	0.00	10.00	10.00
	Nori	0	.	4	10.00	0.00	10.00	10.00
	All Species	62	83	75	203.23	343.68	10.00	2060.00
Everett Harbor	Species							
	Chinook salmon	1	100	1	104.00	.	104.00	104.00
	English sole	33	97	34	26.43	18.91	1.75	99.00
	Starry flounder	5	100	5	22.80	6.76	16.00	33.00
	Dungeness crab	5	83	6	11.13	8.12	1.75	24.00
	Sand clam	1	100	1	11.70	.	11.70	11.70
	Littleneck clam	1	100	1	7.20	.	7.20	7.20
	Butter clam	1	100	1	6.20	.	6.20	6.20
	Ulva	0	.	3	10.00	0.00	10.00	10.00
	All Species	47	90	52	23.82	20.41	1.75	104.00
Mukilteo	Species							
	Littleneck clam	1	100	1	6.40	.	6.40	6.40
	Butter clam	2	100	2	4.70	1.41	3.70	5.70
	All Species	3	100	3	5.27	1.40	3.70	6.40
Point No Point	Species							
	Chinook salmon	7	100	7	50.86	43.98	21.00	145.00

(CONTINUED)

TABLE D-6. SUMMARY OF TOTAL PCBS BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Point No Point	Laminaria	0	.	3	10.00	0.00	10.00	10.00
	Nereocystis	0	.	2	10.00	0.00	10.00	10.00
	Ulva	0	.	3	10.00	0.00	10.00	10.00
	Nori	0	.	3	10.00	0.00	10.00	10.00
	All Species	7	39	18	25.89	33.21	10.00	145.00
Sinclair Inlet	Species							
	Pacific cod	3	100	3	56.33	31.34	30.00	91.00
	English sole	4	100	4	111.25	102.15	39.00	259.00
	Starry flounder	5	100	5	282.20	164.49	96.00	518.00
	Littleneck clam	1	100	1	19.60	.	19.60	19.60
	Butter clam	1	100	1	23.00	.	23.00	23.00
	Market squid	2	100	2	87.50	7.78	82.00	93.00
	All Species	16	100	16	140.16	141.58	19.60	518.00
Port Susan	Species							
	English sole	0	.	1	1.75	.	1.75	1.75
	All Species	0	.	1	1.75	.	1.75	1.75
Edmonds	Species							
	Pacific hake	1	100	1	111.00	.	111.00	111.00
	Rockfish	5	100	5	85.40	44.24	38.00	142.00
	Pacific cod	2	100	2	289.00	366.28	30.00	548.00
	English sole	5	100	5	42.20	23.81	21.00	81.00
	Rock sole	4	100	4	61.75	26.87	33.00	88.00
	Market squid	7	100	7	124.86	74.31	24.00	215.00

(CONTINUED)

TABLE D-6. SUMMARY OF TOTAL PCBS BY SAMPLE AREA AND SPECIES

		Detection Frequency			Summary Data (ug/kg wet wt)			
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	All Species							
Edmonds		24	100	24	102.00	110.13	21.00	548.00
Agate Pass	Species							
	Rockfish	4	100	4	90.25	26.68	68.00	129.00
	All Species	4	100	4	90.25	26.68	68.00	129.00
Point Madison	Species							
	Sablefish	2	100	2	153.50	37.48	127.00	180.00
	Pacific cod	1	100	1	245.00	.	245.00	245.00
	Walleye pollock	5	100	5	31.40	10.31	24.00	49.00
	Tomcod	3	100	3	89.00	41.58	49.00	132.00
	All Species	11	100	11	88.73	73.85	24.00	245.00
Manchester	Species							
	Pacific cod	4	100	4	320.25	256.90	112.00	684.00
	All Species	4	100	4	320.25	256.90	112.00	684.00
Point Jefferson	Species							
	Pacific hake	4	100	4	78.25	20.53	62.00	108.00
	Pacific cod	1	100	1	283.00	.	283.00	283.00
	All Species	5	100	5	119.20	93.28	62.00	283.00
Eagle Harbor	Species							
	Bivalve spp.	4	50	8	12.63	8.96	5.00	28.00
	All Species	4	50	8	12.63	8.96	5.00	28.00
Point Blakely	Species							
	Bivalve spp.	0	.	1	5.00	.	5.00	5.00
	All Species	0	.	1	5.00	.	5.00	5.00

(CONTINUED)

TABLE D-6. SUMMARY OF TOTAL PCBS BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
All Puget Sound Areas	Species							
	Chinook salmon	24	100	24	76.54	56.38	21.00	215.00
	Coho salmon	2	100	2	86.00	16.97	74.00	98.00
	Pacific hake	8	100	8	110.25	41.25	62.00	180.00
	Rockfish	16	100	16	92.56	39.76	38.00	199.00
	Sablefish	14	100	14	78.57	92.92	23.00	360.00
	Pacific cod	12	100	12	235.58	206.37	30.00	684.00
	Walleye pollock	7	100	7	31.71	11.48	19.00	49.00
	Tomcod	4	100	4	80.25	38.20	49.00	132.00
	English sole	74	97	76	181.07	345.65	1.75	2060.00
	Starry flounder	14	100	14	149.79	153.22	16.00	518.00
	Rock sole	8	100	8	108.63	79.41	33.00	249.00
	Dungeness crab	5	83	6	11.13	8.12	1.75	24.00
	Bentnose clam	2	100	2	8.10	6.93	3.20	13.00
	Sand clam	1	100	1	11.70	.	11.70	11.70
	Littleneck clam	6	86	7	6.49	6.16	1.00	19.60
	Butter clam	7	88	8	7.43	6.60	1.00	23.00
	Manila clam	1	100	1	6.90	.	6.90	6.90
	Bivalve spp.	4	44	9	11.78	8.76	5.00	28.00
	Market squid	13	100	13	122.23	68.64	24.00	230.00
	Laminaria	0	.	9	10.00	0.00	10.00	10.00
	Nereocystis	0	.	7	10.00	0.00	10.00	10.00
	Ulva	0	.	17	11.18	4.85	10.00	30.00
	Nori	0	.	7	10.00	0.00	10.00	10.00

(CONTINUED)

TABLE D-6. SUMMARY OF TOTAL PCBS BY SAMPLE AREA AND SPECIES

		Detection Frequency			Summary Data (ug/kg wet wt)			
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
All Puget Sound Areas	All Species	222	82	272	102.54	205.82	1.00	2060.00

TABLE D-7. SUMMARY OF ALPHA-HCH BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Alki Point	Littleneck clam	0	.	1	0.05	.	0.05	0.05
	Butter clam	0	.	1	0.05	.	0.05	0.05
	All Species	0	.	2	0.05	0.00	0.05	0.05
Anacortes	Species							
	Chinook salmon	0	.	2	0.50	0.00	0.50	0.50
	All Species	0	.	2	0.50	0.00	0.50	0.50
Birch Bay	Species							
	Littleneck clam	0	.	1	0.05	.	0.05	0.05
	Butter clam	0	.	1	0.05	.	0.05	0.05
	All Species	0	.	2	0.05	0.00	0.05	0.05
Budd Inlet	Species							
	Ulva	0	.	4	0.50	0.00	0.50	0.50
	All Species	0	.	4	0.50	0.00	0.50	0.50
Burley Lagoon	Species							
	Butter clam	0	.	1	0.05	.	0.05	0.05
	All Species	0	.	1	0.05	.	0.05	0.05
Quartermaster Harbor	Species							
	Littleneck clam	0	.	1	0.05	.	0.05	0.05
	Butter clam	0	.	1	0.05	.	0.05	0.05
	Manila clam	0	.	1	0.05	.	0.05	0.05
	All Species	0	.	3	0.05	0.00	0.05	0.05
Commencement Bay	Species							
	Chinook salmon	1	20	5	0.80	0.67	0.50	2.00

(CONTINUED)

TABLE D-7. SUMMARY OF ALPHA-HCH BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Commencement Bay	Coho salmon	0	.	2	0.50	0.00	0.50	0.50
	Laminaria	0	.	4	0.50	0.00	0.50	0.50
	Nereocystis	0	.	1	0.50	.	0.50	0.50
	Ulva	0	.	4	0.75	0.50	0.50	1.50
	All Species	1	6	16	0.66	0.44	0.50	2.00
Dash Point	Species							
	Bentnose clam	0	.	2	0.08	0.04	0.05	0.10
	Littleneck clam	0	.	1	0.05	.	0.05	0.05
	All Species	0	.	3	0.07	0.03	0.05	0.10
Elliott Bay	Species							
	Chinook salmon	1	11	9	1.11	1.83	0.50	6.00
	English sole	0	.	55	0.99	1.32	0.50	5.00
	Laminaria	0	.	2	0.50	0.00	0.50	0.50
	Nereocystis	0	.	4	0.50	0.00	0.50	0.50
	Ulva	0	.	3	0.50	0.00	0.50	0.50
	Nori	0	.	4	0.50	0.00	0.50	0.50
	All Species	1	1	77	0.92	1.28	0.50	6.00
Everett Harbor	Species							
	Chinook salmon	0	.	1	0.50	.	0.50	0.50
	English sole	0	.	47	0.05	0.00	0.05	0.05
	Starry flounder	0	.	5	0.05	0.00	0.05	0.05
	Dungeness crab	0	.	12	0.05	0.00	0.05	0.05
	Sand clam	0	.	1	0.05	.	0.05	0.05

(CONTINUED)

TABLE D-7. SUMMARY OF ALPHA-HCH BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Everett Harbor	Littleneck clam	0	.	1	0.05	.	0.05	0.05
	Butter clam	0	.	1	0.05	.	0.05	0.05
	Ulva	0	.	3	0.50	0.00	0.50	0.50
	All Species	0	.	71	0.08	0.10	0.05	0.50
Mukilteo	Species							
	Littleneck clam	0	.	1	0.05	.	0.05	0.05
	Butter clam	0	.	2	0.05	0.00	0.05	0.05
	All Species	0	.	3	0.05	0.00	0.05	0.05
Point No Point	Species							
	Chinook salmon	2	29	7	1.36	1.70	0.50	5.00
	Laminaria	0	.	3	0.50	0.00	0.50	0.50
	Nereocystis	0	.	2	0.50	0.00	0.50	0.50
	Ulva	0	.	3	0.50	0.00	0.50	0.50
	Nori	0	.	3	0.50	0.00	0.50	0.50
	All Species	2	11	18	0.83	1.10	0.50	5.00
Sinclair Inlet	Species							
	Littleneck clam	0	.	1	0.05	.	0.05	0.05
	Butter clam	0	.	1	0.05	.	0.05	0.05
	All Species	0	.	2	0.05	0.00	0.05	0.05
Point Pulley	Species							
	English sole	0	.	5	0.50	0.00	0.50	0.50
	All Species	0	.	5	0.50	0.00	0.50	0.50

(CONTINUED)

TABLE D-7. SUMMARY OF ALPHA-HCH BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Port Susan	English sole	0	.	5	0.05	0.00	0.05	0.05
	Dungeness crab	0	.	1	0.05	.	0.05	0.05
	All Species	0	.	6	0.05	0.00	0.05	0.05
All Puget Sound Areas	Species							
	Chinook salmon	4	17	24	1.04	1.44	0.50	6.00
	Coho salmon	0	.	2	0.50	0.00	0.50	0.50
	English sole	0	.	112	0.53	1.03	0.05	5.00
	Starry flounder	0	.	5	0.05	0.00	0.05	0.05
	Dungeness crab	0	.	13	0.05	0.00	0.05	0.05
	Bentnose clam	0	.	2	0.08	0.04	0.05	0.10
	Sand clam	0	.	1	0.05	.	0.05	0.05
	Littleneck clam	0	.	7	0.05	0.00	0.05	0.05
	Butter clam	0	.	8	0.05	0.00	0.05	0.05
	Manila clam	0	.	1	0.05	.	0.05	0.05
	Laminaria	0	.	9	0.50	0.00	0.50	0.50
	Nereocystis	0	.	7	0.50	0.00	0.50	0.50
	Ulva	0	.	17	0.56	0.24	0.50	1.50
	Nori	0	.	7	0.50	0.00	0.50	0.50
	All Species	4	2	215	0.50	0.92	0.05	6.00

TABLE D-8. SUMMARY OF TOTAL DDT BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Alki Point	Littleneck clam	0	.	1	0.15	.	0.15	0.15
	Butter clam	1	100	1	0.92	.	0.92	0.92
	All Species	1	50	2	0.54	0.54	0.15	0.92
Anacortes	Species							
	Chinook salmon	2	100	2	7.50	3.54	5.00	10.00
	All Species	2	100	2	7.50	3.54	5.00	10.00
Birch Bay	Species							
	Littleneck clam	1	100	1	0.29	.	0.29	0.29
	Butter clam	0	.	1	0.15	.	0.15	0.15
	All Species	1	50	2	0.22	0.10	0.15	0.29
Budd Inlet	Species							
	Ulva	4	100	4	4.00	0.00	4.00	4.00
	All Species	4	100	4	4.00	0.00	4.00	4.00
Burley Lagoon	Species							
	Butter clam	1	100	1	0.32	.	0.32	0.32
	All Species	1	100	1	0.32	.	0.32	0.32
Quartermaster Harbor	Species							
	Littleneck clam	0	.	1	0.15	.	0.15	0.15
	Butter clam	1	100	1	0.56	.	0.56	0.56
	Manila clam	1	100	1	0.45	.	0.45	0.45
	All Species	2	67	3	0.39	0.21	0.15	0.56
Commencement Bay	Species							
	Chinook salmon	4	80	5	38.40	30.75	1.00	69.00

(CONTINUED)

TABLE D-8. SUMMARY OF TOTAL DDT BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Commencement Bay	Coho salmon	2	100	2	47.50	44.55	16.00	79.00
	Pacific hake	1	100	1	14.36	.	14.36	14.36
	Rockfish	4	100	4	3.11	0.30	2.72	3.46
	Walleye pollock	1	50	2	2.21	1.50	1.15	3.27
	Tomcod	0	.	1	1.15	.	1.15	1.15
	Starry flounder	4	100	4	5.02	3.07	2.00	9.13
	Laminaria	4	100	4	4.00	0.00	4.00	4.00
	Nereocystis	1	100	1	4.00	.	4.00	4.00
	Ulva	4	100	4	4.50	1.73	3.00	7.00
	All Species	25	89	28	13.48	22.05	1.00	79.00
Dash Point	Species							
	Bentnose clam	2	100	2	0.56	0.42	0.26	0.85
	Littleneck clam	0	.	1	0.15	.	0.15	0.15
	All Species	2	67	3	0.42	0.38	0.15	0.85
Elliott Bay	Species							
	Chinook salmon	9	100	9	27.22	23.86	8.00	68.00
	Pacific hake	2	100	2	8.97	0.23	8.80	9.13
	Rockfish	1	33	3	1.78	1.10	1.15	3.05
	English sole	1	2	55	19.33	56.61	6.00	415.00
	Rock sole	4	100	4	5.19	4.07	1.94	11.14
	Market squid	3	100	3	5.61	5.01	2.00	11.33
	Laminaria	2	100	2	4.00	0.00	4.00	4.00
	Nereocystis	4	100	4	3.75	0.50	3.00	4.00

(CONTINUED)

TABLE D-8. SUMMARY OF TOTAL DDT BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	Species							
Elliott Bay	Ulva	3	100	3	4.00	0.00	4.00	4.00
	Nori	4	100	4	3.75	0.50	3.00	4.00
	All Species	33	37	89	15.94	45.59	1.15	415.00
Everett Harbor	Species							
	Chinook salmon	1	100	1	30.00	.	30.00	30.00
	English sole	0	.	49	0.85	0.00	0.85	0.85
	Starry flounder	0	.	5	0.85	0.00	0.85	0.85
	Dungeness crab	0	.	12	0.85	0.00	0.85	0.85
	Sand clam	0	.	1	0.15	.	0.15	0.15
	Littleneck clam	1	100	1	0.50	.	0.50	0.50
	Butter clam	1	100	1	0.25	.	0.25	0.25
	Ulva	3	100	3	4.33	0.58	4.00	5.00
	All Species	6	8	73	1.37	3.47	0.15	30.00
Mukilteo	Species							
	Littleneck clam	0	.	1	0.15	.	0.15	0.15
	Butter clam	0	.	2	0.15	0.00	0.15	0.15
	All Species	0	.	3	0.15	0.00	0.15	0.15
Point No Point	Species							
	Chinook salmon	7	100	7	28.36	21.90	4.00	53.00
	Laminaria	3	100	3	4.00	0.00	4.00	4.00
	Nereocystis	2	100	2	3.50	0.71	3.00	4.00
	Ulva	3	100	3	4.00	0.00	4.00	4.00
	Nori	3	100	3	4.00	0.00	4.00	4.00

(CONTINUED)

TABLE D-8. SUMMARY OF TOTAL DDT BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	All Species							
Point No Point		18	100	18	13.42	17.88	3.00	53.00
Sinclair Inlet	Species							
	Starry flounder	5	100	5	10.39	6.19	3.71	18.15
	Littleneck clam	1	100	1	1.16	.	1.16	1.16
	Butter clam	1	100	1	1.62	.	1.62	1.62
	Market squid	2	100	2	4.18	1.32	3.25	5.11
	All Species	9	100	9	7.01	6.04	1.16	18.15
Point Pulley	Species							
	English sole	0	.	5	6.00	0.00	6.00	6.00
	All Species	0	.	5	6.00	0.00	6.00	6.00
Port Susan	Species							
	English sole	0	.	5	0.85	0.00	0.85	0.85
	Dungeness crab	0	.	1	0.85	.	0.85	0.85
	All Species	0	.	6	0.85	0.00	0.85	0.85
Edmonds	Species							
	Pacific hake	1	100	1	3.29	.	3.29	3.29
	Rockfish	5	100	5	4.10	1.29	3.21	6.23
	Rock sole	4	100	4	3.15	0.81	1.97	3.79
	Market squid	2	100	2	4.06	0.59	3.65	4.48
	All Species	12	100	12	3.71	1.02	1.97	6.23
Agate Pass	Species							
	Rockfish	2	67	3	5.27	3.85	1.15	8.78
	Pacific cod	1	100	1	16.41	.	16.41	16.41

(CONTINUED)

TABLE D-8. SUMMARY OF TOTAL DDT BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
Area	All Species							
Agate Pass		3	75	4	8.06	6.40	1.15	16.41
Point Madison	Species							
	Sablefish	2	100	2	14.10	1.34	13.15	15.04
	Walleye pollock	5	100	5	3.46	1.68	1.83	5.57
	Tomcod	3	100	3	6.55	4.64	1.96	11.23
	All Species	10	100	10	6.52	4.92	1.83	15.04
Manchester	Species							
	Rockfish	1	100	1	6.94	.	6.94	6.94
	Pacific cod	4	100	4	10.86	1.81	9.04	13.10
	All Species	5	100	5	10.08	2.35	6.94	13.10
Point Jefferson	Species							
	Pacific hake	4	100	4	4.05	0.68	3.30	4.74
	Pacific cod	1	100	1	17.44	.	17.44	17.44
	All Species	5	100	5	6.73	6.02	3.30	17.44
All Puget Sound Areas	Species							
	Chinook salmon	23	96	24	28.35	23.42	1.00	69.00
	Coho salmon	2	100	2	47.50	44.55	16.00	79.00
	Pacific hake	8	100	8	6.47	3.96	3.29	14.36
	Rockfish	13	81	16	3.82	2.16	1.15	8.78
	Sablefish	2	100	2	14.10	1.34	13.15	15.04
	Pacific cod	6	100	6	12.88	3.45	9.04	17.44
	Walleye pollock	6	86	7	3.10	1.62	1.15	5.57
	Tomcod	3	75	4	5.20	4.65	1.15	11.23

(CONTINUED)

TABLE D-8. SUMMARY OF TOTAL DDT BY SAMPLE AREA AND SPECIES

		Detection Frequency		Summary Data (ug/kg wet wt)				
		NO. DET.	% DET.	N	MEAN	STD	MIN	MAX
All Puget Sound Areas	Species							
	English sole	1	1	114	9.99	40.18	0.85	415.00
	Starry flounder	9	64	14	5.45	5.62	0.85	18.15
	Rock sole	8	100	8	4.17	2.93	1.94	11.14
	Dungeness crab	0	.	13	0.85	0.00	0.85	0.85
	Bentnose clam	2	100	2	0.56	0.42	0.26	0.85
	Sand clam	0	.	1	0.15	.	0.15	0.15
	Littleneck clam	3	43	7	0.36	0.37	0.15	1.16
	Butter clam	5	63	8	0.52	0.52	0.15	1.62
	Manila clam	1	100	1	0.45	.	0.45	0.45
	Market squid	7	100	7	4.76	3.06	2.00	11.33
	Laminaria	9	100	9	4.00	0.00	4.00	4.00
	Nereocystis	7	100	7	3.71	0.49	3.00	4.00
	Ulva	17	100	17	4.18	0.81	3.00	7.00
	Nori	7	100	7	3.86	0.38	3.00	4.00
	All Species	139	49	284	8.79	27.54	0.15	415.00

APPENDIX E

CONCENTRATIONS OF CHEMICALS OF CONCERN IN FISH AND SHELLFISH FROM LOCATIONS OUTSIDE OF PUGET SOUND

TABLE E-1. BIOACCUMULATION DATA FOR CARCINOGENIC CHEMICALS OF CONCERN IN TARGET SPECIES FROM LOCATIONS OUTSIDE OF PUGET SOUND

Chemical	Seafood Category	Species	Common Name	Region	Location	Mean (ug/kg wet)
Arsenic	Shellfish	Arctica islandica	Ocean quahog	Mid-Atlantic coast		2,995.0
		Cancer irroratus	Rock Crab	Delaware	Dumpsite	1,900.0
		Mytilus californianus	California mussel	California	Bodega Head	1,573.0
		Mytilus californianus	California mussel	California	Crescent City	2,850.0
		Mytilus californianus	California mussel	California	Oceanside	1,100.0
		Mytilus californianus	California mussel	California	Royal Palms	1,700.0
		Mytilus californianus	California mussel	California	Tomales Bay	1,400.0
		Mytilus californianus	California mussel	California	Trinidad Head	1,700.0
		Mytilus edulis	Edible mussel	California	Pt. Loma	1,400.0
		Spisula solidissima	Surf clam	Mid-Atlantic coast		2,098.0
Carcino-genic PAH	Fish	Pseudopleuronectes americanus	Winter flounder	New York	Raritan Bay	2.8[a,b]
		Pseudopleuronectes americanus	Winter flounder	New York Bight		1.9[a,b]
	Shellfish	Arctica islandica	Ocean quahog	Massachusetts	Buzzards Bay	0.5[c]
		Arctica islandica	Ocean quahog	Massachusetts	Georges Bank	0.5[c]
		Arctica islandica	Ocean quahog	New Jersey	Shelf	0.7[c]
		Arctica islandica	Ocean quahog	New York	Long Island shelf	1.6[c]
		Arctica islandica	Ocean quahog	Nova Scotia	Shelf	1.0[c]
		Arctica islandica	Ocean quahog	Rhode Island	Shelf	0.5[c]
		Arctica islandica	Ocean quahog	Rhode Island-Massachusetts	Shelf	1.2[c]
		Cancer irroratus	Rock crab	New York Bight	Ambrose area	3.0[a,b]
		Cancer irroratus	Rock crab	New York Bight		3.6[a,b]
		Homarus americanus	American lobster	Mid-Atlantic Bight	Wilmington Canyon	2.5[a,b]
		Homarus americanus	American lobster	New York	Raritan Bay	2.1[a,b]
		Homarus americanus	American lobster	New York Bight	Ambrose area	4.2[a,b]
		Homarus americanus	American lobster	New York Bight	Shelf break	6.4[a,b]
		Homarus americanus	American lobster	New York Bight	Tom's Canyon	2.2[a,b]
		Mercenaria mercenaria	Hardshell clam	Rhode Island	Narragansett Bay	0.2[d]
		Mya arenaria	Softshell clam	Oregon	Coos Bay	45.8
		Mytilus californianus	California mussel	Washington	Freshwater Bay	12.8[a]
		Mytilus edulis	Edible mussel	Oregon	Yaquina Bay	156.3
		Spisula solidissima	Surf clam	Maryland	Ocean City	8.4[a,b]
		Spisula solidissima	Surf clam	New Jersey	Barnegat	3.6[a,b]
		Spisula solidissima	Surf clam	New Jersey	Shark River Inlet	2.5[a,b]
		Spisula solidissima	Surf clam	New York	Atlantic Beach	4.9[a,b]
		Spisula solidissima	Surf clam	New York	Rockaway Beach	3.7[a]
		Spisula solidissima	Surf clam	New York Bight		3.4[a,b]
		Spisula solidissima	Surf clam	Virginia	Chincoteague	3.2[a,b]

TABLE E-1. (Continued)

Chemical	Seafood Category	Species	Common Name	Region	Location	Mean (ug/kg wet)
PCB	Fish	Leiostomus xanthurus	Spot	New Jersey	Cape May	30.0
		Leiostomus xanthurus	Spot	New Jersey	Sandy Hook	240.0
		Microstomus pacificus	Dover sole	California	Dana Point	19.6
		Microstomus pacificus	Dover sole	California	Newport Beach	650.0
		Microstomus pacificus	Dover sole	California	Palos Verdes Shelf	1150.0
		Microstomus pacificus	Dover sole	California	Point Hueneme	80.0
		Microstomus pacificus	Dover sole	California	Point Loma	200.0
		Microstomus pacificus	Dover sole	California	Santa Catalina Island	45.0
		Microstomus pacificus	Dover sole	California	Santa Monica Bay	1750.0
		Platichthys stellatus	Starry flounder	Washington	McCalister Creek	30.8
		Pseudopleuronectes americanus	Winter flounder	New Jersey	Great Bay	48.9
		Pseudopleuronectes americanus	Winter flounder	New Jersey	Sandy Hook	70.0
		Pseudopleuronectes americanus	Winter flounder	New York	Apex dump	108.0
		Pseudopleuronectes americanus	Winter flounder	New York	Raritan Bay	99.3
		Pseudopleuronectes americanus	Winter flounder	New York Bight		75.0
	Shellfish	Arctica islandica	Ocean quahog	Massachusetts	Buzzards Bay	20.1
		Arctica islandica	Ocean quahog	New Jersey	Shelf	9.6
		Arctica islandica	Ocean quahog	New York	Long Island shelf	15.6
		Arctica islandica	Ocean quahog	Nova Scotia	Shelf	3.1
		Arctica islandica	Ocean quahog	Rhode Island	Shelf	13.3
		Arctica islandica	Ocean quahog	Rhode Island - Massachusetts	Shelf	10.2
		Cancer anthonyi	Yellow crab	California	Palos Verdes shelf	190.0
		Cancer irroratus	Rock crab	New York Bight	Ambrose	50.0
		Cancer irroratus	Rock crab	New York Bight		37.2
		Homarus americanus	American lobster	Maine	Casco Bay	36.7
		Homarus americanus	American lobster	Mid-Atlantic Bight	Wilmington Canyon	20.0
		Homarus americanus	American lobster	New York	Long Island Sound	78.4
		Homarus americanus	American lobster	New York	New York Harbor	233.0
		Homarus americanus	American lobster	New York	Raritan Bay	220.0
		Homarus americanus	American lobster	New York Bight	Ambrose	40.0
		Homarus americanus	American lobster	New York Bight	Dredge disposal site	15.6
		Homarus americanus	American lobster	New York Bight	New Jersey coast	147.7
		Homarus americanus	American lobster	New York Bight	Shelf break	33.3
		Homarus americanus	American lobster	New York Bight	Tom's Canyon	10.5
		Mytilus californianus	California mussel	California	Ano Neuvo	62.0
		Mytilus californianus	California mussel	California	Avila Beach	52.0
		Mytilus californianus	California mussel	California	Bodega Head	0.9[b]
		Mytilus californianus	California mussel	California	Crescent City	3.6
		Mytilus californianus	California mussel	California	Diablo Point	9.4
		Mytilus californianus	California mussel	California	Glass Beach	9.1
		Mytilus californianus	California mussel	California	Intake Cove	14.0
		Mytilus californianus	California mussel	California	JP Burns	0.9[b]

TABLE E-1. (Continued)

Chemical	Seafood Category	Species	Common Name	Region	Location	Mean (ug/kg wet)
		Mytilus californianus	California mussel	California	Los Angeles	50.0
		Mytilus californianus	California mussel	California	Montana de Oro	0.9[b]
		Mytilus californianus	California mussel	California	Oceanside	13.5
		Mytilus californianus	California mussel	California	Pacific Grove	0.9[b]
		Mytilus californianus	California mussel	California	Pecho Rock	50.0
		Mytilus californianus	California mussel	California	Point Loma	19.4
		Mytilus californianus	California mussel	California	Pudding Creek	3.6
		Mytilus californianus	California mussel	California	Pygmy Beach	0.9
		Mytilus californianus	California mussel	California	Royal Palms	26.0[b]
		Mytilus californianus	California mussel	California	Shell Beach	16.0
		Mytilus californianus	California mussel	California	Soberanes Point	0.9[b]
		Mytilus californianus	California mussel	California	Trinidad Head	0.9[b]
		Mytilus edulis	Edible mussel	California	Alameda Bay	122.5
		Mytilus edulis	Edible mussel	California	Anaheim	126.0
		Mytilus edulis	Edible mussel	California	Channel Islands	38.0
		Mytilus edulis	Edible mussel	California	Elkhorn	55.0
		Mytilus edulis	Edible mussel	California	Elkhorn Slough	16.0
		Mytilus edulis	Edible mussel	California	Los Angeles	149.7
		Mytilus edulis	Edible mussel	California	Marine del Rey	172.0
		Mytilus edulis	Edible mussel	California	Newport Bay Island	189.5
		Mytilus edulis	Edible mussel	California	Newport Beach	100.0
		Mytilus edulis	Edible mussel	California	Newport Harbor	886.0
		Mytilus edulis	Edible mussel	California	Port Hueneme	240.0
		Mytilus edulis	Edible mussel	California	Royal Palms Beach	120.0
		Mytilus edulis	Edible mussel	California	San Diego Harbor	440.0
		Mytilus edulis	Edible mussel	California	Tomales Bay	0.9[b]
		Spisula solidissima	Surf clam	Maryland	Ocean City	10.0
		Spisula solidissima	Surf clam	New Jersey	Barnegat	10.0
		Spisula solidissima	Surf clam	New Jersey	Shark River Inlet	70.0
		Spisula solidissima	Surf clam	New York	Atlantic Beach	30.0
		Spisula solidissima	Surf clam	New York	Rockaway Beach	30.0
		Spisula solidissima	Surf clam	New York Bight		15.0
		Spisula solidissima	Surf clam	Virginia	Chincoteague	50.0
DDT	Fish	Microstomus pacificus	Dover sole	California	Dana Point	55.4
		Microstomus pacificus	Dover sole	California	Newport Beach	2,200.0
		Microstomus pacificus	Dover sole	California	Palos Verdes Shelf	14,846.0
		Microstomus pacificus	Dover sole	California	Point Hueneme	700.0
		Microstomus pacificus	Dover sole	California	Point Loma	50.0
		Microstomus pacificus	Dover sole	California	Santa Catalina Island	100.0
		Microstomus pacificus	Dover sole	California	Santa Monica Bay	1,450.0
		Platichthys stellatus	Starry flounder	Washington	McCalister Creek	34.7
		Pseudopleuronectes americanus	Winter flounder	New Jersey	Great Bay	5.8
		Pseudopleuronectes americanus	Winter Flounder	New York	Raritan Bay	29.2
		Pseudopleuronectes americanus	Winter flounder	New York Bight	Apex dump	11.7
		Pseudopleuronectes americanus	Winter Flounder	New York Bight		7.1

TABLE E-1. (Continued)

Chemical	Seafood Category	Species	Common Name	Region	Location	Mean (ug/kg wet)
	Shellfish	Cancer irroratus	Rock crab	New York Bight	Ambrose	4.0
		Cancer irroratus	Rock crab	New York Bight		8.0
		Homarus americanus	American lobster	Mid-Atlantic Bight	Wilmington Canyon	5.0
		Homarus americanus	American lobster	New York	Long Island Sound	25.0[b]
		Homarus americanus	American lobster	New York	New York Harbor	25.0[b]
		Homarus americanus	American lobster	New York	Raritan Bay	10.9
		Homarus americanus	American lobster	New York Bight	Ambrose	0.3
		Homarus americanus	American lobster	New York Bight	Dredge disposal site	25.0[b]
		Homarus americanus	American lobster	New York Bight	New Jersey site	25.0[b]
		Homarus americanus	American lobster	New York Bight	Shelf break	12.4
		Homarus americanus	American lobster	New York Bight	Tom's Canyon	2.4
		Mytilus californianus	California mussel	California	Ano Nuevo	92.0
		Mytilus californianus	California mussel	California	Avila Beach	9.4
		Mytilus californianus	California mussel	California	Bodega Head	4.1
		Mytilus californianus	California mussel	California	Crescent City	3.9
		Mytilus californianus	California mussel	California	Diablo Point	6.0
		Mytilus californianus	California mussel	California	Intake Cove	6.3
		Mytilus californianus	California mussel	California	JP Burns	4.5
		Mytilus californianus	California mussel	California	Los Angeles	233.4
		Mytilus californianus	California mussel	California	Montana de Oro	6.1
		Mytilus californianus	California mussel	California	Oceanside	49.6
		Mytilus californianus	California mussel	California	Pacific Grove	8.0
		Mytilus californianus	California mussel	California	Pecho Rock	11.5
		Mytilus californianus	California mussel	California	Point Loma	21.5
		Mytilus californianus	California mussel	California	Royal Palms	272.2
		Mytilus californianus	California mussel	California	Soberanes Point	5.1
		Mytilus californianus	California mussel	California	Trinidad Head	1.8
		Mytilus edulis	Edible mussel	California	Alameda Bay	163.2
		Mytilus edulis	Edible mussel	California	Anaheim	315.0
		Mytilus edulis	Edible mussel	California	Channel Islands	81.0
		Mytilus edulis	Edible mussel	California	Elkhorn	888.0
		Mytilus edulis	Edible mussel	California	Elkhorn Slough	179.0
		Mytilus edulis	Edible mussel	California	Los Angeles	202.9
		Mytilus edulis	Edible mussel	California	Marina del Rey	104.0
		Mytilus edulis	Edible mussel	California	Newport Bay Island	887.2
		Mytilus edulis	Edible mussel	California	Port Hueneme	128.0
		Mytilus edulis	Edible mussel	California	Tomales Bay	5.4
		Spisula solidissima	Surf clam	Maryland	Ocean City	4.1
		Spisula solidissima	Surf clam	New Jersey	Barnegat	6.0
		Spisula solidissima	Surf clam	New Jersey	Shark River Inlet	2.5
		Spisula solidissima	Surf clam	New York	Atlantic Beach	3.0
		Spisula solidissima	Surf clam	New York	Rockaway Beach	2.7
		Spisula solidissima	Surf clam	New York Bight		0.5
		Spisula solidissima	Surf clam	Virginia	Chincoteague	0.2

TABLE E-1. (Continued)

Chemical	Seafood Category	Species	Common Name	Region	Location	Mean (ug/kg wet)
alpha-HCH	Shellfish	Mytilus californianus	California mussel	California	Bodega Head	1.5
		Mytilus californianus	California mussel	California	Oceanside	1.3
		Mytilus californianus	California mussel	California	Point Loma	1.0
		Mytilus californianus	California mussel	California	Royal Palms	0.4
		Mytilus californianus	California mussel	California	Trinidad Head	8.2
		Mytilus edulis	Edible mussel	California	Alameda Bay	0.6
		Mytilus edulis	Edible mussel	California	Anaheim	0.5
		Mytilus edulis	Edible mussel	California	Channel Islands	0.3
		Mytilus edulis	Edible mussel	California	Elkhorn	0.5
		Mytilus edulis	Edible mussel	California	Elkhorn Slough	0.5
		Mytilus edulis	Edible mussel	California	Marina del Rey	0.5
		Mytilus edulis	Edible mussel	California	Port Hueneme	0.7
		Mytilus edulis	Edible mussel	California	Tomales Bay	0.6

[a] Benzo(a)anthracene + benzo(a)pyrene + chrysene.

[b] Not detected in samples for this species and location.

[c] Benzo(a)pyrene only.

[d] Benzo(a)anthracene only.

Reference: Adapted from Tetra Tech (1987).