South Puget Sound Verification of 303(d) Listings for Chemical Contaminants in Fish and Shellfish

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by
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July 2006

Waterbody Numbers

Waterbody Name	New Waterbody ID	Old Waterbody ID
Budd Inlet (Inner)	47122A8F9	WA-13-0030
Squaxin, Peale, and Pickering Passages	47122B9F0	WA-14-0010
Squaxin, Peale, and Pickering Passages	47122C8J7	WA-14-0010
Case Inlet and Dana Passage	47122D8D0	WA-PS-0090
Case Inlet and Dana Passage	47122B7J9	WA-PS-0090
Puget Sound (South)	47122B6G6	WA-PS-0300
Puget Sound (South)	47122C5E6	WA-PS-0300
Carr Inlet	47122C6B2	WA-15-0060
Hale Passage (South)	47122C6G0	WA-15-0130
Commencement Bay (Outer)	47122C4I2	WA-10-0010
Tacoma Narrows	47122D5C6	WA-PS-0070
Dalco Passage/Poverty Bay	47122D4C7	WA-PS-0280
Dalco Passage/Poverty Bay	47122D4A5	WA-PS-0280

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Abstract

Twelve open-water sites in south Puget Sound and one intertidal area in inner Budd Inlet are on the federal Clean Water Act Section 303(d) List for violations of water quality standards. Listings include total polychlorinated biphenyls (PCBs) and bis(2-ethylhexyl)-phthalate (BEHP) in sole and rockfish. Listings also include polynuclear aromatic hydrocarbons (PAHs) in clams from the former Cascade Pole cleanup site in inner Budd Inlet. Sole and mussels were collected from these sites and analyzed by the Department of Ecology to assess the appropriateness of the 303(d) listings.

Concentrations of PCBs in Puget Sound sole were low but exceeded the National Toxics Rule (NTR) criteria at all but one site. BEHP was not detected and therefore did not exceed the NTR criteria. It was recommended to continue listing PCBs but to change BEHP from Category 5 (*On the 303[d] List)* to Category 1 (*Meets Tested Standards*).

Concentrations of PAHs in mussel tissue from the Cascade Pole cleanup site were significantly lower than previous results but still exceeded NTR criteria. Four currently 303(d)-listed PAH chemicals – benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene – were found to exceed the NTR criterion of 0.93 ug/Kg ww. Two others – benzo(a)pyrene and indeno(1,2,3-cd)pyrene – also exceeded NTR criteria. It is recommended that all six of these chemicals be included in Category 5 of the 303(d) List.

Pentachlorophenol, dioxins, and furans from the Cascade Pole site were also analyzed, even though there were no previous 303(d) listings for these chemicals at the site. Pentachlorophenol was not detected. The dioxin congener 2,3,7,8-TCDD was found to exceed NTR criteria and was recommended for Category 5.

Acknowledgements

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Introduction

The Washington State Department of Ecology (Ecology) Water Quality Program requested that 12 open-water sites in south Puget Sound and one intertidal area in inner Budd Inlet be re-assessed for violations of water quality standards. These sites are on the federal Clean Water Act Section 303(d) List for exceeding the National Toxics Rule (NTR) human health criteria for chemical contaminants in bottom fish or clam tissue.

The 2002/2004 303(d) listings are based on data older than nine years. As a result, the data may no longer be indicative of current contaminant levels in bottom fish and clam tissue. The data collected in this study were used in conjunction with existing information to evaluate current contaminant levels in tissue from 303(d)-listed grids (sampling sites) in south Puget Sound. Recommendations are provided on the appropriate listing category for these grids. These data will also be useful in prioritizing areas on which to focus future efforts in reducing contaminant levels. The present verification study was conducted by Ecology's Environmental Assessment Program, Toxics Studies Unit.

Background

South Puget Sound

The 303(d) listings for south Puget Sound were made by Ecology based on their analysis of data generated by a long-term fish tissue monitoring program conducted by the Washington Department of Fish and Wildlife (WDFW) as part of the Puget Sound Assessment Monitoring Program (PSAMP) (West et al., 2001). There are a total of 12 grid sites scattered throughout southern Puget Sound (see Figure 1 and Table 1). Individual listing decisions for each of these sites are provided in Appendix A.

These sites are listed for either total polychlorinated biphenyls (PCBs) or bis(2-ethylhexyl)-phthalate (BEHP), or both chemicals, in English sole (*Pleuronectes vetulus*), copper rockfish (*Sebastes caurinus*), and quillback rockfish (*Sebastes maliger)* muscle tissue. These species were collected multiple times by WDFW between 1992 – 1996, and the data were pooled in the WDFW report. Table 1 compares the historic contaminant concentrations to the NTR human health criteria and shows the exceedances of the NTR criteria.

WDFW is currently working on a conservation plan for copper rockfish and quillback rockfish (Sandie O'Neill, WDFW, personal communication). These populations have been over-fished and, as a consequence, are dwindling in the Puget Sound. Ecology therefore did not re-sample the four grids (9-12) listed for contaminants in rockfish tissue (see Figure 1).

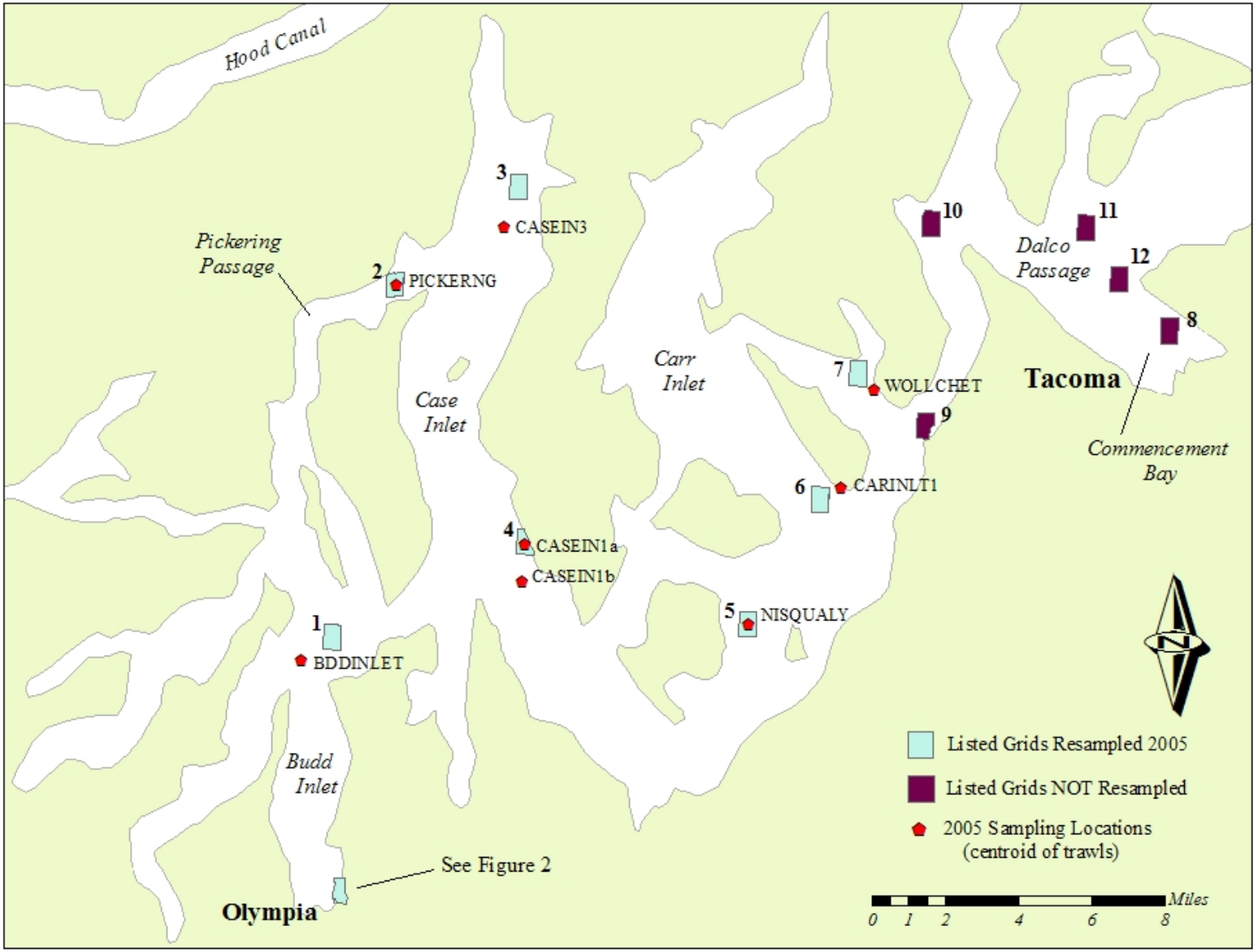

Figure 1. South Puget Sound Grids Listed for Toxics in Fish and Shellfish Tissue.

Table 1. Historic (1992-1996) Concentrations of 303(d)-listed Chemicals for South Puget Sound Bottom Fish.

Site No.[1]	303(d) Waterbody Name	303(d) Listing ID	Historic PSAMP* Station Name	Waterbody ID	Species	303(d)-listed Parameter	Contaminant Concentrations (ug/kg ww)**			NTR Human Health Criteria (ug/Kg ww)
							mean	min	max	
1	Squaxin, Peale, and Pickering Passages	35941	BDDINLET	47122B9F0	English Sole	Total PCB aroclors	**8.7**	4.3	**17.5**	5.3
2	Squaxin, Peale, and Pickering Passages	36025	PICKERNG	47122C8J7	English Sole	Total PCB aroclors	**8.8**	4	**13.4**	5.3
2	Squaxin, Peale, and Pickering Passages	35987	PICKERNG	47122C8J7	English Sole	Bis(2-ethylhexylphthalate)	727.7	100	**1983**	767
3	Case Inlet and Dana Passage	35988	CASEIN3	47122D8D0	English Sole	Bis(2-ethylhexylphthalate)	427.7	100	**1083**	767
4	Case Inlet and Dana Passage	36342	CASEIN1	47122B7J9	English Sole	Total PCB aroclors	**15.3**	**9.5**	**21.9**	5.3
4	Case Inlet and Dana Passage	36237	CASEIN1	47122B7J9	English Sole	Bis(2-ethylhexylphthalate)	622	100	**1383**	767
5	Puget Sound (South)	36340	NISQUALY	47122B6G6	English Sole	Total PCB aroclors	**20.92**	**9.01**	**44.5**	5.3
5	Puget Sound (South)	36340	NISQUALY	47122B6G6	English Sole	Total PCBs congeners	**5.8**	2.7	**9.5**	5.3
5	Puget Sound (South)	36235	NISQUALY	47122B6G6	English Sole	Bis(2-ethylhexylphthalate)	627.7	100	**1683**	767
6	Carr Inlet	36343	CARINLT1	47122C6B2	English Sole	Total PCB aroclors	**13.6**	**7.1**	**19.3**	5.3
7	Hale Passage (South)	36344	WOLLCHET	47122C6G0	English Sole	Total PCB aroclors	**25.4**	**14.4**	**43.8**	5.3
8	Commencement Bay (Outer)	35739	OUTRCOMM	47122C4I2	English Sole	Total PCB aroclors	**41.2**	**6**	**81.2**	5.3
8	Commencement Bay (Outer)	35739	OUTRCOMM	47122C4I2	English Sole	Total PCB congeners	**33.4**	**21.7**	**49.9**	5.3
8	Commencement Bay (Outer)	35655	OUTRCOMM	47122C4I2	English Sole	Bis(2-ethylhexylphthalate)	**1422**	100	**3683**	767
9	Puget Sound (South)	35829	DAYISLND	47122C5E6	Copper rockfish	Total PCB aroclors	**6.2**	3.9	**12**	5.3
10	Tacoma Narrows	36346	GIGHARBR	47122D5C6	Quillback rockfish	Total PCB aroclors	**77.1**	**46.4**	**140.4**	5.3
11	Dalco Passage/Poverty Bay	36345	DALCOPAS	47122D4C7	Quillback rockfish	Total PCB aroclors	**64.2**	4	**124.4**	5.3
12	Dalco Passage/Poverty Bay	35743	BNSPNT	47122D4A5	Quillback rockfish	Total PCB aroclors	**74.7**	**68**	**81.3**	5.3
12	Dalco Passage/Poverty Bay	35743	BNSPNT	47122D4A5	Quillback rockfish	Total PCB congeners	3.5	2.6	4.3	5.3

[1] Site Numbers correspond with Figure 1.
* Puget Sound Ambient Monitoring Program
** Contaminant concentrations were pooled in the report (West, et. al., 2001)
Bolded values exceed NTR human health criteria

PCBs were historically used as insulating fluids, plasticizers, pesticide extenders, in inks and carbonless paper, and as heat transfer and hydraulic fluids. PCBs were phased out of use and manufacture by EPA between 1977 and 1985 (EPA, 1992). EPA has classified PCBs as probable human carcinogens. PCBs are commonly elevated in urban waterways and ports. Many areas of Puget Sound are influenced by cities and by urban stormwater runoff.

PCBs in the environment are typically analyzed for in two forms: congeners and aroclors. PCB congeners are individual PCB compounds. There are 209 PCB congeners. Aroclors are commercial mixtures of PCB congeners that were once sold in the United States. Approximately 150 of the 209 PCB congeners have been detected in the various aroclor formations.

BEHP is a manufactured chemical commonly added to plastics, principally PVC products, to make them flexible. It is ubiquitous in the environment because of its use in plastics. There is a likelihood that the BEHP data from the PSAMP study reflect laboratory contamination and not environmental contamination (Jim West, WDFW, personal communication).

Inner Budd Inlet

The 303(d)-listed grid in inner Budd Inlet is shown in Figure 2. The listings came from a 1985 investigation by Ecology of the intertidal area surrounding the Cascade Pole Company wood treatment facility (Norton, 1986), where high concentrations of polynuclear aromatic hydrocarbons (PAHs) were found in soft shell clam (*Mya arenaria*) tissue. Table 2 compares the PAH levels that were found during the investigation to the NTR human health criteria. Concentrations of chrysene, benzo(a)anthracene, benzo(b)fluoranthene, and benzo(k)-fluoranthene were two to three orders of magnitude higher than the NTR human health criteria.

Table 2. 303(d)-listed PAHs in Soft Shell Clams from Inner Budd Inlet near Cascade Pole in 1985.

303(d)-Listed Parameter	Concentration (ug/Kg ww)	NTR Human Health Criteria (ug/Kg ww)
Chrysene	110	0.93
Benzo(a)anthracene	77	0.93
Benzo(b)fluoranthene + Benzo(k)fluoranthene	91	0.93

From 1957 until 1986, the Cascade Pole Company operated a wood-treating facility on property leased from the Port of Olympia. Other wood-treating businesses also operated at the site prior to 1957. During numerous investigations of the site, many toxic chemicals related to wood preserving substances such as creosote were found at elevated concentrations in soils, groundwater, surface water, intertidal sediments, and marine organisms adjacent to the site. Toxic chemicals included PAHs, pentachlorophenol (PCP), volatile hydrocarbons, and dioxins. Many of these chemicals are known human carcinogens (Duerr, 2004).

During 2001 and 2002, after years of public debate, court settlements, and other cleanup actions at the site, 42,000 cubic yards of contaminated intertidal sediment were removed from Budd Inlet (Figure 2) and stored in an on-site upland containment area (Mohsen Kourehdar, Ecology, personal communication). Clean sediment was then brought in to replace the removed contaminated sediment in the intertidal area.

In accordance with Ecology's Toxics Cleanup Program, the Port of Olympia has agreed to conduct ongoing monitoring of the site. This includes groundwater monitoring every six months, eventual construction of a new groundwater treatment system, and sediment sampling every five years. There are no plans within the ongoing monitoring agreement to address the 303(d) listings for clam tissue at the Cascade Pole site.

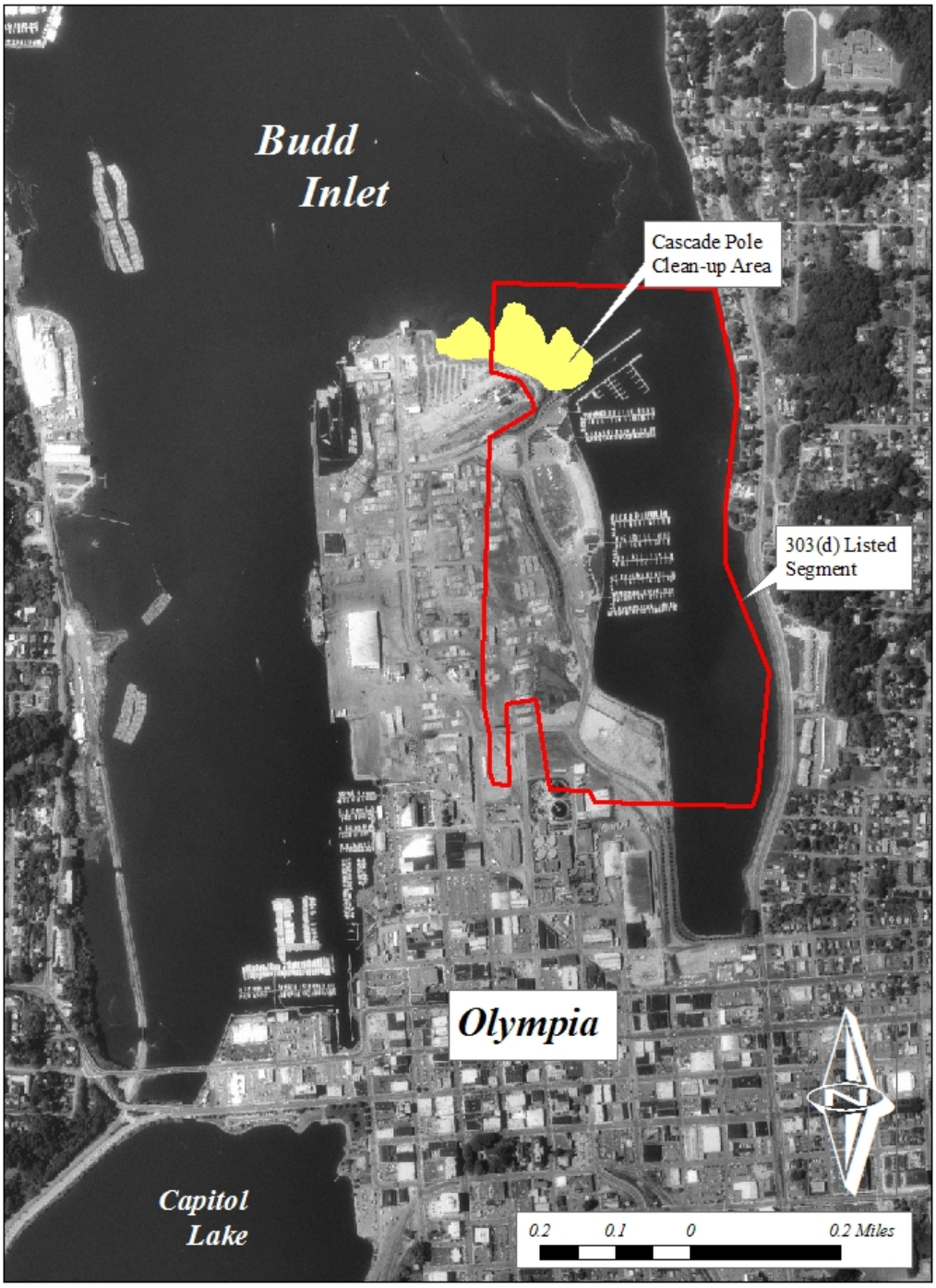

Figure 2. Budd Inlet Showing the Cascade Pole Sampling Area

Methods

Project Description

Decision Criteria

In order to make recommendations on whether waterbodies should be removed or retained on the 303(d) list, data must meet the listing criteria of Ecology's Water Quality 303(d) Listing Policy (Ecology, 2002). Listing recommendations for this study are based on the following:

A waterbody (grid) will be placed on the 303(d) list (Category 5) due to toxic pollutants in fin fish muscle or whole shellfish when either the average of three single-fish samples with the highest concentration of a given chemical or one composite sample made up of at least five fish exceeds the criteria for human health impacts based on EPA's bio-concentration factors and water column criteria established under the National Toxics Rule.

More on the National Toxics Rule (NTR)

The fish tissue criteria used by Ecology for determination of 303(d) listings are derived from the human-health-based NTR criteria for water and EPA's bioconcentration factors. This is primarily done for contaminants that are difficult to measure in the water column because criteria are set at levels below easily available laboratory detection levels. In these cases fish tissue is a good indicator of criteria exceedance because fish tissue is frequently the most direct route of exposure to contaminants. Both fish tissue and water sample results for various contaminants listed in the NTR have been used by Ecology in 303(d) listings and to determine exceedances of human-health-based water quality criteria.

South Puget Sound

One to three composite samples of edible muscle tissue from English sole and rock sole were collected from seven 303(d)-listed grids in south Puget Sound. Tissue was analyzed for 303(d) contaminants: total PCBs and BEHP. Both PCB aroclors and a subset of samples for PCB congeners were analyzed. Four grids listed for rockfish were not sampled due to conservation concerns, and one additional site (OUTRCOMM) for English sole in Commencement Bay was not sampled because the location was too deep (Figure 1).

Ecology was able to use fish collected by the Washington Department of Fish and Wildlife (WDFW) from three of the seven grid sites. Samples from WDFW included English sole from Pickering Passage (PICKERNG) and Case Inlet (CASEIN3) that were collected as part of an abundance and distribution survey of groundfishes in Puget Sound conducted in May 2005. Ecology also used archive English sole tissue from a 2005 WDFW PSAMP monitoring site (NISQUALY). The other four sites were sampled by Ecology.

All seven of the 303(d)-listed grids sampled for this study were based on historical data from English sole tissue. For the four sites sampled by Ecology, only rock sole was available during the fall 2005 collection. Rock sole tend to occur in shallow water, and English sole migrate to deeper water by winter. Though their life histories vary somewhat, rock sole and English sole have similar diets consisting of mollusc siphons, clams, marine worms, small shrimp and crabs, and brittle stars (Hart, 1980). Rock sole and English sole should, therefore, be reasonably comparable in tissue chemical concentrations.

Inner Budd Inlet

Three composite samples of bay mussels (*Mytilus trossulus*) were collected from the Cascade Pole intertidal cleanup/excavation site and analyzed for 303(d)-listed contaminants: benzo(a)anthracene, chrysene, benzo(b)fluoranthene, and benzo(k)fluoranthene. At the request of Ecology's Toxics Cleanup Program, additional PAHs, pentachlorophenol (PCP), and dioxin/furans were also analyzed.

The original 303(d) listings from the Cascade Pole site were based on soft shell clam tissue. A reconnaissance visit to the site revealed that soft shell clams and other organisms were just starting to recolonize the site after the 2001-2002 excavation and addition of new intertidal sediments. There was not enough clam tissue biomass at the site for analysis. Bay mussels, which were abundant at the site, were used in place of soft shell clams.

During the 2001-2002 cleanup and excavation of the Cascade Pole intertidal area, sections of sediment were removed at different depths depending on contamination levels. Depths of sediment removal included one, two, three, and five feet. For the present study, the three sampling sites were spaced 200 – 300 feet apart and at varying distances from shore in order to represent these different areas of contamination.

Field Sampling Procedures

Sole

Sole were collected by trawling from Ecology's 26' research vessel "Skookum". Ten individuals were targeted at each site. An Otter trawl (4-seam semi-balloon, 16' head rope, 19' footrope with loop style chain, ¾" square measure net mesh, with codend mesh of 5/8") was used by Ecology. Each trawl was towed along the bottom for about ten minutes before retrieval. Between one to six tows were made at each site. See Appendix B, Table B-1, for sampling location information.

Selected fish were humanely killed then weighed and measured, rinsed with site water, individually wrapped in aluminum foil, placed in waterproof plastic bags, and stored on ice in coolers for transport to Ecology headquarters, where samples were frozen pending preparation of tissue samples. Data on fish weight, length, sex, and age are included in Appendix B, Table B-2.

Mussels

Bay mussels from the Cascade Pole excavation/cleanup site were collected by hand picking off the beach at low tide. Mussels were placed in laboratory-cleaned, one-gallon glass jars after collection and placed on ice in coolers for transport to Ecology headquarters, where samples were also frozen pending preparation of tissue samples.

Sampling locations are shown in Figure 3. More detailed information can be found in Appendix B, Table B-3. The number of individuals per composite sample and size range are shown in Table 3.

Table 3. Biological Information for Mussels.

Station Name	Number of Individuals per Composite	Total Composite Weight (g)	Range of Individual Lengths (mm)	Average Length (mm)
1-Out	75	310	25 - 74	42
2-Close	75	380	35 - 70	44
3-Close	186	375	25 - 47	35

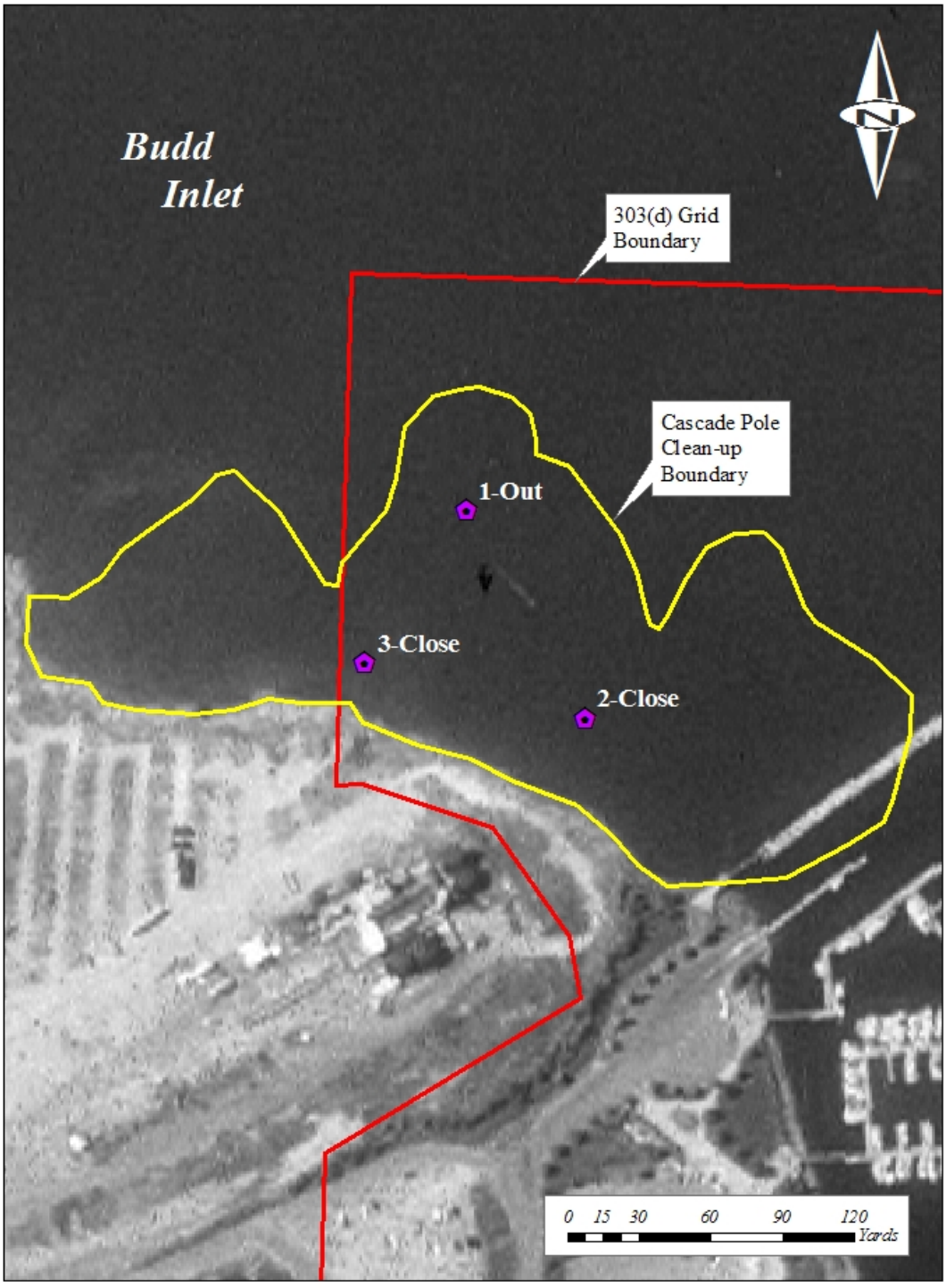

Figure 3. Mussel Sampling Locations at the Cascade Pole Clean-up Site.

Preparation of Tissue Samples

Preparation of tissue samples followed EPA (2000) guidance and took place at Ecology's headquarters in Lacey. Precautions were taken to minimize contamination during sample processing. Persons preparing samples wore non-talc nitrile gloves and aprons. Work surfaces were covered with heavy grade aluminum foil. Gloves, aluminum foil, and dissection tools were changed between composite samples.

All resecting instruments were washed thoroughly with Liquinox detergent, followed by sequential rinses of hot tap water, deionized water, pesticide-grade acetone, and pesticide-grade hexane. This decontamination procedure was repeated between each composite sample.

Sole

Samples were prepared by partially thawing the entire fish, removing the foil wrapper and rinsing with deionized water to remove adhering debris. Skin was removed to be consistent with PSAMP protocols. The entire muscle fillet from one or both sides of each fish were then removed with stainless steel scalpels and homogenized by several passes through a Kitchen-Aid food processor.

To avoid contamination with tissue samples for BEHP analysis, plastics were avoided. For these samples, a stainless steel homogenizer was used.

Composite samples consisted of equal-weight aliquots from each of five fish. Samples were homogenized to uniform color and consistency and placed in jars, specifically-cleaned for low-level organics analyses, and sent to the laboratories. Excess sample was archived in freezers in the Chain of Custody room at the Ecology headquarters building.

The sex of each fish was determined during processing. Otoliths were removed and sent to WDFW in Olympia, Washington for aging analysis.

Mussels

Mussels were rinsed with tap water followed by deionized water to remove any adhering debris. The entire soft parts were then removed and homogenized to uniform color and consistency with several passes through a Kitchen-Aid food processor. Excess sample was archived in freezers in the Chain of Custody room at Ecology headquarters.

Laboratory Analysis

Analytical methods for this study are shown in Table 4. Analyses were conducted by the Ecology Manchester Environmental Laboratory, located in Manchester, Washington, and by Pacific Rim Laboratories Inc., located in Surrey, British Columbia.

Table 4. Analytical Methods for the 303(d) Verification Study.

Parameter	Sample Preparation Method	Analytical Method	Laboratory
Percent lipids	Extraction	EPA 608.5	MEL
Sole tissue			
PCB aroclors	EPA 3540/3620/3665	EPA 8082	MEL
BEHP	EPA 3540/3620	EPA 1625 & 8270	MEL
PCB congeners	Soxhlet extraction	EPA 1668a	Pacific Rim
Mussel tissue			
PAHs	EPA 3640	EPA 8270	MEL
PCP	EPA 3540/3620	EPA 1625 & 8270	MEL
Dioxin/Furans	Soxhlet extraction	EPA 1613	Pacific Rim

MEL – Manchester Environmental Laboratory

Data Quality

Overall, relatively few problems were encountered in the analysis for this project, and the data are useable as qualified by Manchester Laboratory. Laboratory quality control samples met both laboratory established quality control limits and the analytical measurement quality objectives (MQOs) established by the Quality Assurance Project Plan (Era-Miller, 2005) for the study (Table 5), with few exceptions. A summary of the data quality follows. More detailed explanations can be found in the case narratives from Manchester Laboratory (Appendix C).

Table 5. Analytical Measurement Quality Objectives for the South Puget Sound Verification Study.[1]

Parameter	Laboratory Control Samples	Laboratory Control Duplicates	Matrix Spike Samples	Matrix Spike Duplicates	Surrogate Standards
	% recovery limits	RPD	% recovery limits	RPD	% recovery limits
Percent lipids	n/a	≤ 20	n/a	n/a	n/a
PCB aroclors	50-150	≤ 50	50-150	≤ 50	10-140
BEHP	50-150	≤ 50	50-150	≤ 40	50-150
PCB congeners	30-150	≤ 50	50-150	≤ 50	25-150
PAHs	50-150	≤ 50	50-150	≤ 40	50-150
PCP	50-150	≤ 50	50-150	≤ 40	50-150
Dioxin/Furans	15-190	≤ 50	50-150	≤ 50	20-180

[1]Quality Control (QC) limits from EPA methods and personal communication with Manchester Laboratory.
RPD = Relative Percent Difference

The percent recoveries of the laboratory control samples (LCS), matrix spikes, and surrogate standards provide an indication of bias in the analytical system due to calibration or matrix effects. Surrogate standards are added to every sample prior to extraction, while matrix spikes are added to only one sample within a sample batch. The relative percent differences (RPD) of laboratory duplicates and matrix spike duplicates give a measure of analytical precision.

All samples for all analyses met study MQOs for LCS, matrix spikes, and surrogate recoveries with the exception of a few LCS and surrogate recoveries for PCB congeners. Five of 70 LCS results exceeded the MQO values of 30 – 150% for PCB congeners. These five results (PCB-005/008, -040, -041/071/072, -044, and -074) should be considered biased high. Their bias does not significantly affect the sum result for total PCB congeners. Only 6 of 232 surrogate recovery results fell outside of the MQO range (25 – 150%) for PCB congeners. These six results were for PCB-001 and -003, congeners which were not detected in any of the samples. Their bias does not affect the sum result for total PCB congeners.

The precision of laboratory duplicate samples and matrix spike duplicate samples are shown in Appendix D, Tables D-1 and D-2. Precision for all the analyses met the study MQOs of 0 – 50 % RPD, ranging from 0 – 46 % RPD.

A standard reference material (SRM) was analyzed for determining accuracy of the PCB congener and PAH analyses. The laboratories analyzed National Institute of Standards & Technology (NIST) SRM 1974b: Organics in Mussel Tissue (*Mytilus edulis*). Appendix D, Tables D-3 and D-4, give a comparison between study results and SRM values. The majority of study results for PCB congeners appear to be biased slightly low, indicating that true concentrations in the environment may be somewhat higher than study concentrations show. Most of the study results for PAHs appear to be biased slightly high, indicating that actual environmental concentrations may be somewhat lower than study concentrations show.

Results and Discussion

South Puget Sound

Results for the south Puget Sound sole tissue samples are shown in Table 6.

Bis(2-ethylhexyl)phthalate (BEHP) was not detected at any of the four sampling sites where it was analyzed for: PICKERING, CASEIN3, CASEIN1, and NISQUALY. As mentioned previously, it was suspected that these older BEHP 303(d) listings were due to laboratory contamination. The four sites listed for BEHP should be moved from Category 5 (*On the 303(d) List)* to Category 1 (*Meets Tested Standards*).

PCBs were either not detected or had relatively low concentrations at all seven grid sampling sites. Only PCB aroclors 1254 and 1260 were detected. With the exception of two English sole samples, from CASEIN1 (13.2 ug/Kg ww) and NISQUALY (19.5 ug/Kg ww), total PCB concentrations were at or below 8.3 ug/Kg ww, close to the NTR human health criterion of 5.3 ug/Kg ww.

Although total PCB concentrations were relatively low, six of the seven sampling sites slightly exceeded NTR human health criteria. Therefore, sites CARINLT1, CASEIN1, WOLLCHET, PICKERING, and NISQUALY should all remain in Category 5 of the 303(d) List. CASEIN3 was not originally listed for PCBs, but should now be added as a new Category 5 listing for PCBs. BDDINLET could be moved from Category 5 to Category 1.

The more sensitive congener analysis detected PCBs in all seven subset samples, whereas aroclors were detected in only two of these samples. The sum of detected PCB congeners is shown in Table 6. All the results for PCB congeners are shown in Appendix E, Table E-1.

PCB Levels in Context

In general, average PCB concentrations for English and rock sole in south Puget Sound are very low, even though they slightly exceed the NTR human health criteria. It is likely that these levels represent background conditions for Puget Sound (Jim West, WDFW, personal communication).

PCB concentrations are slightly lower in the current study compared to the historical data from the PSAMP study (1992 – 1996); however, a temporal trend comparison can not be made due to differences in species (English sole vs. rock sole) and season of fish collection.

The PSAMP study found no temporal trends in PCB concentrations at six baseline stations in the greater Puget Sound studied between 1991 and 1996 (West et al., 2001). PSAMP researchers are currently assessing temporal trends in PCB data between 1991 and 2005 (Jim West, WDFW, personal communication).

Table 6. PCB and BEHP Concentrations for Puget Sound Sole, Collected May - October 2005 (ug/Kg, part per billion, wet weight).

Sample ID	BDDINLET	CARINLT1		CASEIN1a	CASEIN1b	CASEIN1b	CASEIN3	NTR Human Health Criteria (ug/Kg ww)
Sample Lab No.	06028103	06028104	06028105	06028106	06028107	06028108	06028109	
Station No.	1	6	6	4	4	4	3	
Species	Rock Sole	Rock Sole	Rock Sole	Rock Sole	English Sole	English Sole	English Sole	
Mean fish age (yrs)	6	8.6	6.8	8.2	4	4	6.8	--
Lipids (%)	0.55	0.48	0.41	0.41	0.52	0.28	0.32	--
Bis(2-ethylhexylphthalate)	NA	NA	NA	40 U	NA	39 U	39 U	767
PCB Aroclors								
PCB-1016	5.4 U	5.5 U	5.5 U	5.5 U	5.6 U	5.4 U	5.1 U	--
PCB-1221	5.4 U	5.5 U	5.5 U	5.5 U	5.6 U	5.4 U	5.1 U	--
PCB-1232	5.4 U	5.5 U	5.5 U	5.5 U	5.6 U	5.4 U	5.1 U	--
PCB-1242	5.4 U	5.5 U	5.5 U	5.5 U	5.6 U	5.4 U	5.1 U	--
PCB-1248	5.4 U	5.5 U	5.5 U	5.5 U	5.6 U	5.4 U	5.1 U	--
PCB-1254	5.4 U	5.5 U	5.5 U	5.5 U	**7.3 J**	5.4 U	5.1 U	--
PCB-1260	5.4 U	5.5 U	5.5 U	5.5 U	**5.9 J**	**5.6 J**	**6.6 J**	--
PCB-1262	5.4 U	5.5 U	5.5 U	5.5 U	5.6 U	5.4 U	5.1 U	--
PCB-1268	5.4 U	5.5 U	5.5 U	5.5 U	5.6 U	5.4 U	5.1 U	--
Total PCB aroclors	5.4 U	5.5 U	5.5 U	5.5 U	**13.2 J**	**5.6 J**	**6.6 J**	5.3
Total PCB congeners	**4.3 J**	**8.3 J**	NA	**5.0 J**	**9.8 J**	NA	NA	5.3

Bold = Detected chemicals
NA = Not analyzed for
□ = Boxed values exceed National Toxics Rule (NTR) human health criteria for edible fish tissue
-- = NTR criteria have not been established for this analyte
U = The analyte was not detected at or above the reported result.
J = The analyte was positively identified. The associated numerical result is an estimate.

Table 6 (cont.). PCB and BEHP Concentrations for Puget Sound Sole, Collected May - October 2005 (ug/Kg, part per billion, wet weight).

Sample ID	WOLLCHET		PICKERNG		NISQUALY			NTR Human Health Criteria (ug/Kg ww)
Sample Lab No.	06028110	06028111	06028112	06028113	06028114	06028115	06028116	
Station No.	7	7	2	2	5	5	5	
Species	Rock Sole	Rock Sole	English Sole	English Sole	English Sole	English Sole	English Sole	
Mean fish age (yrs)	8.8	8.6	3.8	3.2	5.1	4.2	4.5	--
Lipids (%)	0.36	0.55	0.64	0.55	0.07	0.06	0.19	--
Bis(2-ethylhexylphthalate)	NA	NA	NA	38 U	NA	NA	44 U	767
PCB Aroclors								
PCB-1016	5.5 U	5.1 U	5.5 U	5.6 U	5.5 U	5.5 U	NA	--
PCB-1221	5.5 U	5.1 U	5.5 U	5.6 U	5.5 U	5.5 U	NA	--
PCB-1232	5.5 U	5.1 U	5.5 U	5.6 U	5.5 U	5.5 U	NA	--
PCB-1242	5.5 U	5.1 U	5.5 U	5.6 U	5.5 U	5.5 U	NA	--
PCB-1248	5.5 U	5.1 U	5.5 U	5.6 U	5.5 U	5.5 U	NA	--
PCB-1254	5.5 U	5.1 U	5.5 U	5.6 U	5.5 U	5.5 U	NA	--
PCB-1260	5.5 U	5.1 U	5.5 U	5.6 U	**6.8 J**	**6.1 J**	NA	--
PCB-1262	5.5 U	5.1 U	5.5 U	5.6 U	5.5 U	5.5 U	NA	--
PCB-1268	5.5 U	5.1 U	5.5 U	5.6 U	5.5 U	5.5 U	NA	--
Total PCB aroclors	5.5 U	5.1 U	5.5 U	5.6 U	**6.8 J**	**6.1 J**	NA	5.3
Total PCB congeners	**7.0 J**	NA	**6.1 J**	NA	**19.5 J**	NA	NA	5.3

Bold = Detected chemicals
NA = Not analyzed for
□ = Boxed values exceed National Toxics Rule (NTR) human health criteria for edible fish tissue
-- = NTR criteria have not been established for this analyte
U = The analyte was not detected at or above the reported result.
J = The analyte was positively identified. The associated numerical result is an estimate.

Inner Budd Inlet

PAH and PCP results from bay mussel tissue samples from the Cascade Pole cleanup area in inner Budd Inlet are shown in Table 7.

Table 7. PCP and PAH Concentrations in Mussels from the Cascade Pole Cleanup Site, Collected November 2005 (ug/Kg, part per billion, wet weight).

Sample ID:	1-Out	2-Close	3-Close	NTR Human Health Criteria (ug/Kg ww)
Sample Lab No:	06028117	06028101	06028102	
Lipids (%)	0.51	0.47	0.63	--
Pentachlorophenol	42 U	44 U	41 U	90.2
PAHs				
1-Methylnaphthalene	0.69	0.50 U	0.84	--
2-Methylnaphthalene	0.73	0.79	1.2	--
Acenaphthene	0.93	1.1	1.3	--
Acenaphthylene	0.49 U	0.50 U	0.64	--
Anthracene	0.94	0.79	1.1	3,300,000
Benzo(a)anthracene	1.9	1.7	3.8	0.93
Benzo(a)pyrene	1.8	0.86	2.6	0.93
Benzo(b)fluoranthene	0.49 U	1.4	2.5	0.93
Benzo(ghi)perylene	0.49 U	0.77	1.5	--
Benzo(k)fluoranthene	0.49 U	4.3	6.5	0.93
Chrysene	3.7	3.8	8.7	0.93
Dibenzo(a,h)anthracene	0.49 U	0.50 U	0.49 U	0.93
Dibenzofuran	0.74	0.87	1.0	--
Fluoranthene	5.6	8.1	15	425,500
Fluorene	1.1	1.1	1.4	420,000
Indeno(1,2,3-cd)pyrene	0.49 U	0.65	1.3	0.93
Naphthalene	1.2	0.84	0.78	--
Phenanthrene	4.8	6.2	11	--
Pyrene	4.5	6.5	9.7	330,000

Bolded parameters are the 303(d)-listed chemicals
□ = Boxed values exceed National Toxics Rule (NTR) human health criteria for edible fish tissue
-- = NTR criteria have not been established for this analyte
U = The analyte was not detected at or above the reported result.

Eighteen of the 19 PAH chemicals analyzed were detected in the mussel tissue samples. Dibenzo(a,h)anthracene was not detected. The four 303(d)-listed chemicals – benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene and chrysene – were all found to exceed the NTR criteria of 0.93 ug/Kg ww. Benzo(a)pyrene and indeno(1,2,3-cd)pyrene also

exceeded NTR criteria. Inner Budd Inlet should therefore be listed on Category 5 of the 303(d) List for these six chemicals.

Table 8 compares current concentrations of the four 303(d)-listed PAHs for bay mussel tissue to the 1985 concentrations found in soft shell clam tissue. This table shows that concentrations have decreased significantly from between one to two orders of magnitude. While bay mussels and soft shell clams are both filter feeders, they may have different chemical exposure pathways. Mussels for this current study were found on the surface of the intertidal sediment. Soft shell clams are typically found 20 cm down in sediments, and they extend their siphons to the sediment surface to filter water.

Table 8. Comparison Between 303(d)-listed PAH Chemical Concentrations in Clams and Current Concentrations in Mussels from the Cascade Pole Cleanup Site (ug/Kg, part per billion, wet weight).

Location:	1-Out	2-Close	3-Close	
Tissue Type:	Bay Mussel			Soft Shell Clam
Year:	2005			1985
Lipids (%)	0.51	0.47	0.63	0.84
Benzo(a)anthracene	2	2	4	77
Benzo(b)fluoranthene	nd	1	3	91*
Benzo(k)fluoranthene	nd	4	7	91*
Chrysene	4	4	9	110

nd = not detected

* = Benzo(b)fluoranthene + Benzo(k)fluoranthene

Pentachlorophenol (PCP) was not detected in any of the samples.

In addition to PCP, dioxins and furan congeners were also analyzed, although inner Budd Inlet was not previously 303(d) listed for these chemicals in clam or mussel tissue. Results for the dioxins/furan analysis are shown in Table 9.

The majority of the 17 dioxin/furans congeners were detected; however, NTR human health criteria have only been developed for the 2,3,7,8-TCDD congener (0.07 ng/Kg, parts per trillion). The NTR criterion was exceeded for only one of the three samples (3-Close).

TEQs (toxic equivalents) were calculated for each sample and exceeded the NTR criteria for each sample. TEQs are calculated by multiplying each congener result by its congener-specific toxicity equivalent factor (TEF) and then summing to obtain the overall TEQ. The 1998 World Health Organization TEFs were used in this report because they are internationally accepted and preferred by EPA (2002). These TEFs are described by Van den Berg et. al. (1998).

Based on the 2,3,7,8-TCDD exceedance of the NTR criteria for sample 3-Close and the TEQ values for all three samples, inner Budd Inlet should be placed on Category 5 of the 303(d) List for 2,3,7,8-TCDD in mussel tissue.

Table 9. Dioxin/Furan Concentrations in Mussels from the Cascade Pole Cleanup Site, Collected November 2005 (ng/Kg, part per trillion, wet weight).

Sample ID: / Sample Lab No:	TEF	1-Out 06028100		2-Close 06028101		3-Close 06028102		NTR Human Health Criteria (ng/Kg ww)
Lipids (%)		0.7		0.7		2.3		--
2,3,7,8-TCDD	1	0.065	J	0.03	UJ	0.095		0.07
1,2,3,7,8-PeCDD	1	0.229	J	0.121	J	0.136	J	--
1,2,3,4,7,8-HxCDD	0.1	0.10	UJ	0.10	UJ	0.10	UJ	--
1,2,3,6,7,8-HxCDD	0.1	0.286	J	0.125	J	0.705		--
1,2,3,7,8,9-HxCDD	0.1	0.05	UJ	0.05	UJ	0.129	J	--
1,2,3,4,6,7,8-HpCDD	0.01	3.34		2.85		10.1		--
OCDD	0.0001	14.2		12.5		57.1		--
2,3,7,8-TCDF	0.1	0.245		0.211		0.376		--
1,2,3,7,8-PeCDF	0.05	1.69		1.49		2.39		--
2,3,4,7,8-PeCDF	0.5	0.071	J	0.084	J	0.142	J	--
1,2,3,4,7,8-HxCDF	0.1	0.051	J	0.078	J	0.168	J	--
1,2,3,6,7,8-HxCDF	0.1	0.05	UJ	0.05	UJ	0.085	J	--
2,3,4,6,7,8-HxCDF	0.1	0.093	J	0.090	J	0.209	J	--
1,2,3,7,8,9-HxCDF	0.1	0.06	UJ	0.06	UJ	0.060	UJ	--
1,2,3,4,6,7,8-HpCDF	0.01	0.264	J	0.339	J	1.00		--
1,2,3,4,7,8,9-HpCDF	0.01	0.05	UJ	0.05	UJ	0.05	UJ	--
OCDF	0.0001	0.368	J	0.597	J	1.86		--
TEQ		**0.55**		**0.38**		**0.72**		0.07

TEF = Toxicity equivalency factor (Van den Berg et al., 1998)

TEQ = 2,3,7,8-TCDD toxicity equivalent; the detection limit for non-detected chemicals was used in the calculation of TEQs.

□ = Boxed values exceed National Toxics Rule (NTR) human health criteria for edible fish tissue

-- = NTR criteria have not been established for this analyte

UJ = The analyte was not detected at or above the reported estimated result.

J = The analyte was positively identified. The associated numerical result is an estimate.

PAH and Dioxin Levels in Context

Although PAH and dioxin/furan levels at Cascade Pole exceed NTR human health criteria they are relatively low when compared to other places in Washington State. Figure 4 compares total PAH concentrations in the Cascade Pole mussel samples to concentrations in samples from the National Mussel Watch Project for stations in Washington State. PAH concentrations at the Mussel Watch station for Budd Inlet are higher than levels at Cascade Pole (Figure 4). The Budd Inlet Mussel Watch station is located several miles north of the Cascade Pole site. The station is on east side of the bay at the abandoned Washington State Department of Natural Resources (DNR) Marine Research and Development Center Laboratory.

Dioxin/furan TEQ values for mussels from the Cascade Pole site were compared to mollusc data collected by the Dredged Material Management Program (DMMP) in 2005 (Figure 5). TEQ values for the Cascade Pole site (0.38-0.72 ng/Kg ww) are slightly higher than those observed in clam tissues from a location in south Puget Sound (0.05-0.53 ng/Kg ww). The DMMP data are from monitoring of tissues collected at and around a dredged material disposal site located in the Nisqually Reach, between Anderson and Ketron islands. Sediment dioxin/furan TEQ concentrations on and in the vicinity of the site range from 2 – 7.3 ng/Kg dw and are considered to represent un-impacted conditions relative to dioxin/furan inputs. Very little dredged material has been deposited at the site since it was established in 1989 (Erika Hoffman, EPA, personal communication).

Molluscs at the disposal site were collected in 100 – 130 meters of water and include *Yoldia seminuda*, *Compsomyax subdiaphana*, and *Macoma spp*. *Yoldia* and *Macoma* are facultative suspension feeders while *Compsomyax* is an obligate suspension feeder. All three species are infaunal, unlike mussels which are water column filter feeders. Considering differences in their chemical exposure pathways, use of these clams as comparison to mussels is not ideal, but it does indicate that dioxin/furan concentrations in mussels at the Cascade Pole site are relatively similar to infaunal tissue concentrations associated with background levels of dioxin/furan exposure.

Dioxin/furan levels at the Cascade Pole site likely indicate residual contamination from the former wood treating facility at the site. PAH levels could be residual from the Cascade Pole cleanup site, but could also be indicative of urban impacts.

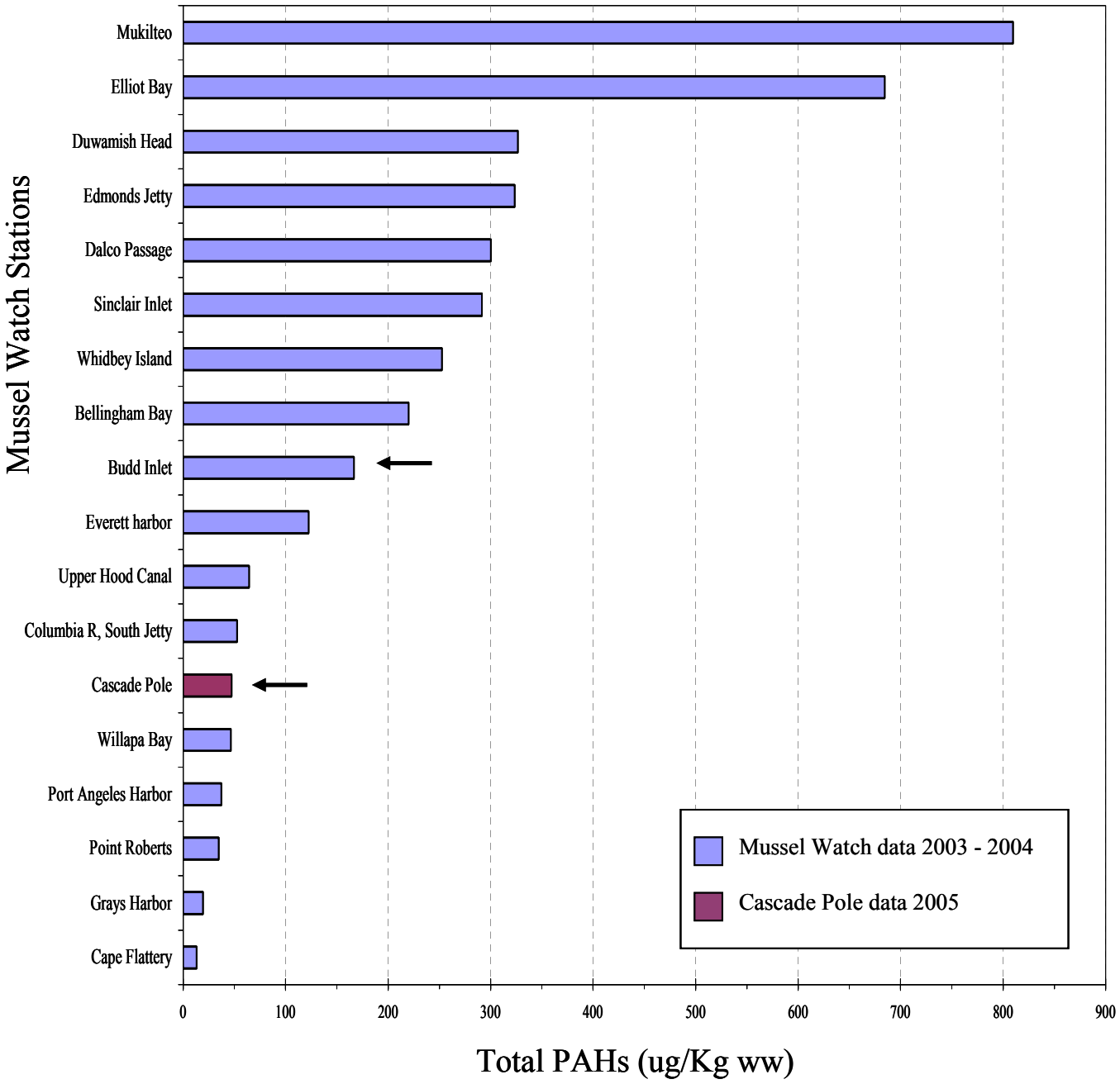

Figure 4. Comparison of Total PAHs for the Cascade Pole Sampling Site vs. Mussel Watch Stations[1] in Washington State.

[1] Mussel Watch data courtesy of Alan J. Mearns, Senior Staff Scientist, Hazardous Materials Response Division, Office of Response and Restoration, National Oceanic and Atmospheric Administration, Seattle. Data computed from data provided by the NOAA National Status and Trends Program, Silver Spring, MD.

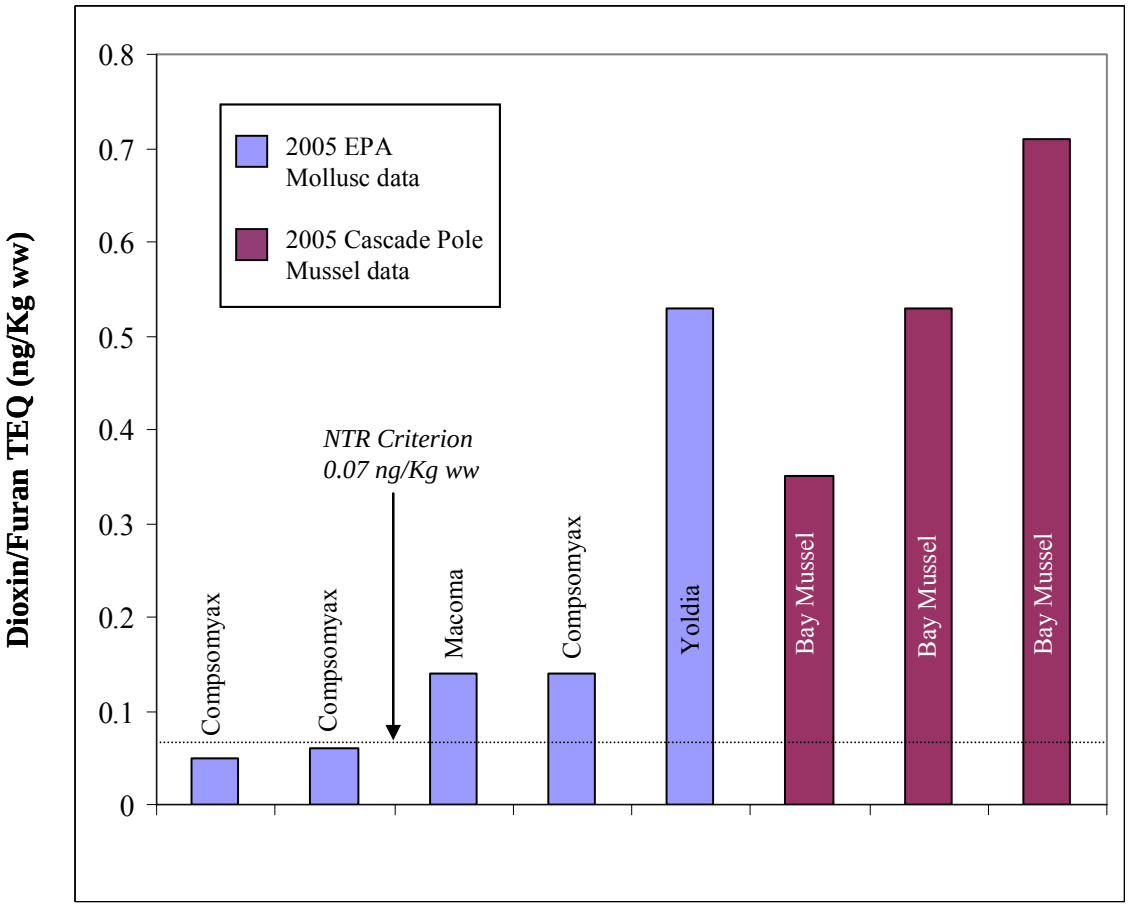

Figure 5. Comparison of Dioxin/Furan TEQ Values for Mussels from the Cascade Pole Sampling Site and from Puget Sound.

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Conclusions and Recommendations

South Puget Sound

Total PCB concentrations were found to be relatively low at all seven sampling sites. Six of the seven sites slightly exceeded the National Toxics Rule (NTR) human health criteria. Therefore, CARINLT1, CASEIN1, WOLLCHET, PICKERING, and NISQUALY should all remain in Category 5 of the 303(d) list. The sixth site, CASEIN3, was not originally listed for PCBs but should be added as a new Category 5 (*On the 303[d] List)* listing for PCBs. Since PCB concentrations were below the NTR human health criteria at BDDINLET, this site could be moved from Category 5 to Category 1 (*Meets Tested Standards*) of the 303(d) List.

Bis(2-ethylhexyl)phthalate (BEHP) was not detected at any of the four sampling sites where it was analyzed: PICKERING, CASEIN3, CASEIN1, and NISQUALY. These sites listed for BEHP should be moved from Category 5 to Category 1.

Listing recommendations for south Puget Sound are given in Table 10.

Recommendation

Because PCB concentrations for south Puget Sound are low compared to the rest of Puget Sound and appear to be decreasing over time, natural attenuation is likely to bring PCB levels into compliance with National Toxics Rule (NTR). Sole should be monitored again in five years to assess PCB levels.

Table 10. Recommended Listing Status for 303(d) Listings of Fish from South Puget Sound.

Waterbody Name	Historic PSAMP Station Name[1]	Waterbody ID	Listing ID No.	303(d)-Listed Parameter	Matrix	Current List Category	Proposed List Category
Squaxin, Peale, and Pickering Passages	BDDINLET	47122B9F0	35941	Total PCBs	English Sole	5	1
	PICKERING	47122C8J7	36025	Total PCBs	"	5	5
			35987	Bis(2-ethylhexylphthalate)	"	5	1
Case Inlet and Dana Passage	CASEIN3	47122D8D0	35988	Bis(2-ethylhexylphthalate)	"	5	1
			NL	Total PCBs	"	*NL*	5*
	CASEIN1	47122B7J9	36342	Total PCBs	"	5	5
			36237	Bis(2-ethylhexylphthalate)	"	5	1
Puget Sound (South)	NISQUALY	47122B6G6	36340	Total PCBs	"	5	5
			36235	Bis(2-ethylhexylphthalate)	"	5	1
Carr Inlet	CARINLT1	47122C6B2	36343	Total PCBs	"	5	5
Hale Passage (South)	WOLLCHET	47122C6G0	36344	Total PCBs	"	5	5
Commencement Bay (Outer)	OUTRCOMM	47122C4I2	35739	Total PCBs	"	5	5†
			35655	Bis(2-ethylhexylphthalate)	"	5	5†
Puget Sound (South)	DAYISLND	47122C5E6	35829	Total PCBs	Copper Rockfish	5	5†
Tacoma Narrows	GIGHARBR	47122D5C6	36346	Total PCBs	Quillback Rockfish	5	5†
Dalco Passage/ Poverty Bay	DALCOPAS	47122D4C7	36345	Total PCBs	"	5	5†
	BNSPNT	47122D4A5	35743	Total PCBs	"	5	5†

[1] Puget Sound Ambient Monitoring Program
*New listing recommendation
NL = not currently 303(d) listed
† = Listings were not verified for the current study, therefore are not recommended for a change in listing status.

Inner Budd Inlet

Four currently 303(d)-listed PAH chemicals – benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene – were found to exceed the NTR criterion of 0.93 ug/Kg ww. Two others – benzo(a)pyrene and indeno(1,2,3-cd)pyrene – also exceeded NTR criteria. All six of these chemicals should be included in Category 5 of the 303(d) List.

Although not previously analyzed for, dioxin congener 2,3,7,8-TCDD was found to exceed the NTR criterion of 0.07 ng/Kg, parts per trillion. TEQ values for dioxins and furans were also found to exceed the NTR criterion for 2,3,7,8-TCDD. Inner Budd Inlet should therefore be placed in Category 5 of the 303(d) List for 2,3,7,8-TCDD in mussel tissue.

Listing recommendations for mussels from the Cascade Pole cleanup area in inner Budd Inlet are shown in Table 11.

Table 11. Recommended Status for 303(d) Listings of Mussels from Budd Inlet.

Waterbody Name	Waterbody ID	Listing ID No.	303(d)-Listed Parameter	Current List Category	Proposed List Category
Budd Inlet (Inner)	47122A89	8685	Benzo(b)fluoranthene	5	5
		8686	Benzo(k)fluoranthene	5	5
		8688	Benzo(a)anthracene	5	5
		8689	Chrysene	5	5
		NL	Benzo(a)pyrene	*NL*	5*
		NL	Indeno(1,2,3-cd)pyrene	*NL*	5*
		NL	2,3,7,8-TCDD	*NL*	5*

*New listing recommendation
NL = not currently 303(d) listed

Recommendations

1. Molluscs (mussels and/or clams) should be monitored again in five years to determine if PAHs and dioxin/furans will continue to decrease through natural attenuation. In five years, soft shell clams may be re-colonized in the mud flats of the Cascade Pole cleanup area.

2. As part of the continued monitoring of the Cascade Pole cleanup area, intertidal sediments will be analyzed for PAHs and dioxin/furans in 2007 (Mohsen Kourehdar, personal communication). Information from this monitoring will aid Ecology in assessing environmental impacts at the site.

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Appendices

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Appendix A.

Descriptions of 303(d) Listings

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Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	SQUAXIN, PEALE, AND PICKERING PASSAGES	Listing ID #:	35941
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.155
Listed96?:	N	Longitude:	122.905

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1992-1993 from English sole (Pleuronectes vetulus) samples from station BDDINLET.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	SQUAXIN, PEALE, AND PICKERING PASSAGES	Listing ID #:	35987
Parameter:	Bis(2-ethylhexyl)phthalate	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.295
Listed96?:	N	Longitude:	122.875

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1993 from English sole (Pleuronectes vetulus) samples from station PICKERNG.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	SQUAXIN, PEALE, AND PICKERING PASSAGES	Listing ID #:	36025
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.295
Listed96?:	N	Longitude:	122.875

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1993 and 1996 from English sol (Pleuronectes vetulus) samples from station PICKERNG.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	CASE INLET AND DANA PASSAGE	Listing ID #:	35988
Parameter:	Bis(2-ethylhexyl)phthalate	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.335
Listed96?:	N	Longitude:	122.805

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1993 from English sole (Pleuronectes vetulus) samples from station CASEIN3.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	CASE INLET AND DANA PASSAGE	Listing ID #:	36342
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.195
Listed96?:	N	Longitude:	122.795

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue samples collected in 1993 and 1996 from English sole (Pleuronectes vetulus) samples from station CASEIN1.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	CASE INLET AND DANA PASSAGE	Listing ID #:	36237
Parameter:	Bis(2-ethylhexyl)phthalate	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.195
Listed96?:	N	Longitude:	122.795

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue samples collected in 1993 from English sole (Pleuronectes vetulus) samples fro station CASEIN1.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	PUGET SOUND (SOUTH)	Listing ID #:	36340
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.165
Listed96?:	N	Longitude:	122.665

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue tissue samples collected in 1993-1997 from English sole (Pleuronectes vetulus) samples from station NISQUALY. Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue tissue samples collected in 1997-1999 from English sole (Pleuronectes vetulus) samples from station NISQUALY.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	PUGET SOUND (SOUTH)	Listing ID #:	36235
Parameter:	Bis(2-ethylhexyl)phthalate	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.165
Listed96?:	N	Longitude:	122.665

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1993 from English sole (Pleuronectes vetulus) samples from station NISQUALY.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	CARR INLET	Listing ID #:	36343
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.215
Listed96?:	N	Longitude:	122.625

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1993 and 1996 from English sol (Pleuronectes vetulus) samples from station CARINLT1.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	HALE PASSAGE (SOUTH)	Listing ID #:	36344
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.265
Listed96?:	N	Longitude:	122.605

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1993 and 1996 from English sol (Pleuronectes vetulus) samples from station WOLLCHET.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	COMMENCEMENT BAY (OUTER)	Listing ID #:	35739
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.285
Listed96?:	N	Longitude:	122.425

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1993 and 1995 from English sol (Pleuronectes vetulus) samples from station OUTRCOMM.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	COMMENCEMENT BAY (OUTER)	Listing ID #:	35655
Parameter:	Bis(2-ethylhexyl)phthalate	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.285
Listed96?:	N	Longitude:	122.425

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1993 from English sole (Pleuronectes vetulus) samples from station OUTRCOMM.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	PUGET SOUND (SOUTH)	Listing ID #:	35829
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.245
Listed96?:	N	Longitude:	122.565

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1992-1993 from copper rockfish (Sebastes caurinus) samples from station DAYISLND.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	TACOMA NARROWS	Listing ID #:	36346
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.325
Listed96?:	Y	Longitude:	122.565

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1996 from quillback rockfish (Sebastes maliger) samples from station GIGHARBR.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	DALCO PASSAGE/POVERTY BAY	Listing ID #:	36345
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.325
Listed96?:	N	Longitude:	122.475

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1996 from quillback rockfish (Sebastes maliger) samples from station DALCOPAS.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	DALCO PASSAGE/POVERTY BAY	Listing ID #:	35743
Parameter:	Total PCBs	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	N	Latitude:	47.305
Listed96?:	N	Longitude:	122.455

Basis

Washington Department of Fish and Wildlife PSAMP database show the National Toxic Rule Criterion was exceeded in a composite of more than 5 muscle tissue tissue tissue tissue tissue samples collected in 1992-1995 from quillback rockfish (Sebastes maliger) samples from station BNSPNT.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	BUDD INLET (INNER)	Listing ID #:	8685
Parameter:	Benzo(b)fluorene	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	Y	Latitude:	47.055
Listed96?:	Y	Longitude:	122.895

Basis

Norton, 1986. , excursions beyond the criterion in edible shellfish tissue.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	BUDD INLET (INNER)	Listing ID #:	8686
Parameter:	Benzo(k)fluorene	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	Y	Latitude:	47.055
Listed96?:	Y	Longitude:	122.895

Basis

Norton, 1986. , excursions beyond the criterion in edible shellfish tissue.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	BUDD INLET (INNER)	Listing ID #:	8688
Parameter:	BENZO(A)ANTHRACENE	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	Y	Latitude:	47.055
Listed96?:	Y	Longitude:	122.895

Basis

Norton, 1986. , excursions beyond the criterion in edible shellfish tissue.

Remarks

Water Quality Assessment for Washington

2002/2004 Candidate List

Water Body Name:	BUDD INLET (INNER)	Listing ID #:	8689
Parameter:	Chrysene	Township:	
Medium:	Tissue	Range:	
Category:	5	Section:	
Listed 98?:	Y	Latitude:	47.055
Listed96?:	Y	Longitude:	122.895

Basis

Norton, 1986. , excursions beyond the criterion in edible shellfish tissue.

Remarks

Appendix B.

Sampling Site Locations and Fish Sample Information

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Table B-1. Site Locations for Bottom Fish Sampling in South Puget Sound.

Site Name	Trawl No.	Date	Time	Tide	Water Depth (m)	Wire Out (m)	Latitude North	Longitude West	Datum	Collection Agency
BDDINLET										
Start Trawl	1	10/27/05	11:31	7.2	16		47° 08.5692'	122° 55.4728'	WGS84	Ecology
End Trawl	1	"	11:41		12.6	70	47° 08.9033'	122° 55.3056'	"	"
Start Trawl	2	"	12:05	8.5	20.2		47° 08.5811'	122° 55.4466'	"	"
End Trawl	2	"	12:17		26.5	100	47° 08.9956'	122° 55.1823'	"	"
Start Trawl	5	"	13:49	12.2	25.3		47° 08.5022'	122° 55.4288'	"	"
End Trawl	5	"	13:59		13.8	75	47° 08.8639'	122° 55.3125'	"	"
Start Trawl	6	"	14:12	13	19.9		47° 08.6583'	122° 55.3888'	"	"
End Trawl	6	"	14:22		22	75	47° 08.3384'	122° 55.4188'	"	"
Centroid	--	--	--	--	--	--	**47° 8.74'**	**122° 55.42'**	NAD83	"
PICKERING										
Start Trawl	1	5/26/05	9:14	10.6	22		47° 17.6580'	122° 52.7268'	WGS84	WDFW
End Trawl	1	"	9:23		22	73	47° 17.8302'	122° 52.3128'	"	"
Centroid	--	--	--	--	--	--	**47° 17.70'**	**122° 52.50'**	NAD83	"
CASEIN3										
Start Trawl	1	5/27/05	9:56	9.9	27		47° 19.0020'	122° 48.9828'	WGS84	WDFW
End Trawl	1	"	10:06		27	64	47° 19.2588'	122° 48.6480'	"	"
Centroid	--	--	--	--	--	--	**47° 19.1304'**	**122° 48.8154'**	"	"
CASEIN1-a										
Start Trawl	1	10/26/05	9:33	4.3	15		47° 11.8816'	122° 47.9005'	WGS84	Ecology
End Trawl	1	"	9:43		13.2	65	47° 11.6033'	122° 47.6872'	"	"
Start Trawl	2	"	10:08	5.3	19.8		47° 11.8164'	122° 47.8738'	"	"
End Trawl	2	"	10:18		21.3	100	47° 11.4506'	122° 47.6235'	"	"
Start Trawl	3	"	10:46	7.8	12.2		47° 11.8858'	122° 47.8842'	"	"
End Trawl	3	"	10:57		8.7	60	47° 11.6107'	122° 47.6714'	"	"
Start Trawl	4	"	11:20	9	13.3		47° 11.9060'	122° 47.9066'	"	"
End Trawl	4	"	11:34		17	100	47° 11.4207'	122° 47.5855'	"	"

Site Name	Trawl No.	Date	Time	Tide	Water Depth (m)	Wire Out (m)	Latitude North	Longitude West	Datum	Collection Agency
Start Trawl	5	10/27/05	15:01	13.6	16.2		47° 11.7812'	122° 47.8348'	"	"
End Trawl	5	"	15:15		15.9	60	47° 11.2854'	122° 47.4811'	"	"
Start Trawl	6	"	15:25	13.7	11		47° 11.3247'	122° 47.4833'	"	"
End Trawl	6	"	15:35		14.9	50	47° 11.6610'	122° 47.7261'	"	"
Centroid	--	--	--	--	--	--	**47° 11.64'**	**122° 47.74'**	NAD83	"
CASEIN1-b										
Start Trawl	1	5/23/05	11:03	-1.6	90		47° 10.6482'	122° 47.6298'	WGS84	WDFW
End Trawl	1	"	11:14		90	183	47° 10.8768'	122° 47.9802'	"	"
Centroid	--	--	--	--	--	--	**47° 10.7628'**	**122° 47.8050'**	"	"
NISQUALY										
Centroid	1	5/5/05	21 min.	--	132	322	**47° 9.6805'**	**122° 40.0885'**	NAD83	WDFW/PSAMP
CARINLT1										
Start Trawl	1	10/27/05	10:10	4.1	12.8		47° 13.2695'	122° 36.9481'	WGS84	Ecology
End Trawl	1	"	10:20		18.0	70	47° 03.0106'	122° 36.5857'	"	"
Centroid	--	--	--	--	--	--	**47° 13.18'**	**122° 36.82'**	NAD83	"
WOLLCHET										
Start Trawl	1	10/27/05	9:16	3.4	18.9		47° 15.6578'	122° 35.8983'	WGS84	Ecology
End Trawl	1	"	9:26		14.0	75	47° 15.3948'	122° 35.5120'	"	"
Centroid	--	--	--	--	--	--	**47° 15.53'**	**122° 35.75'**	NAD83	"

Bolded centroid coordinates were used for study locations in Ecology's Environmental Information Management (EIM) database
Centroid = Approximate center location for one or more trawls
WDFW = Washington Department of Fish and Wildlife
PSAMP = Puget Sound Ambient Monitoring Program

Table B-2. Fish Sample Biological Information.

Station ID	Sample ID	Sample No.	Collection Date	Species of Sole	Total Length (mm)	Weight (g)	Sex	Age (yrs)
BDDINLET	BUD-1	06028103	10/27/05	Rock	269	250	M	6
			10/27/05	"	290	310	F	5
			10/27/05	"	297	360	F	4
			10/27/05	"	304	291	M	11
			10/27/05	"	324	432	F	4
				Mean	**297**	**329**	**n/a**	**6**
CARINLT1	CAR1-1	06028104	10/27/05	Rock	332	451	F	7
			10/27/05	"	323	401	F	11
			10/27/05	"	291	305	M	10
			10/27/05	"	306	348	F	7
			10/27/05	"	299	298	M	8
				Mean	**310**	**361**	**n/a**	**8.6**
CARINLT1	CAR1-2	06028105	10/27/05	Rock	315	369	F	11
			10/27/05	"	311	363	F	7
			10/27/05	"	298	333	F	6
			10/27/05	"	326	399	F	5
			10/27/05	"	312	340	F	5
				Mean	**312**	**361**	**n/a**	**6.8**
CASEIN1	CASE1-1	06028106	10/27/05	Rock	279	230	M	13
			10/26/05	"	328	445	F	6
			10/26/05	"	330	430	F	11
			10/26/05	"	314	401	F	6
			10/26/05	"	291	297	F	5
				Mean	**308**	**361**	**n/a**	**8.2**
CASEIN1	CASE1-3	06028107	5/23/05	English	280	201	F	5
			5/23/05	"	250	135	F	2
			5/23/05	"	267	175	F	5
			5/23/05	"	262	191	F	5
			5/23/05	"	275	204	F	3
				Mean	**267**	**181.2**	**n/a**	**4**
CASEIN1	CASE1-4	06028108	5/23/05	English	277	184	F	5
			5/23/05	"	236	115	F	2
			5/23/05	"	285	203	U	4
			5/23/05	"	269	167	F	3
			5/23/05	"	328	332	F	6
				Mean	**279**	**200**	**n/a**	**4**
CASEIN3	CASE3-1	06028109	5/27/05	English	222	93	F	2
			5/27/05	"	213	84	F	2
			5/27/05	"	242	126	F	2
			5/27/05	"	295	201	M	21
				Mean	**243**	**126**	**n/a**	**6.8**

Station ID	Sample ID	Sample No.	Collection Date	Species of Sole	Total Length (mm)	Weight (g)	Sex	Age (yrs)
WOLLCHET	WCHT-1	06028110	10/27/05	Rock	322	361	F	9
			10/27/05	"	338	461	F	6
			10/27/05	"	376	624	F	11
			10/27/05	"	339	428	F	12
			10/27/05	"	318	389	F	6
				Mean	**339**	**453**	**n/a**	**8.8**
WOLLCHET	WCHT-2	06028111	10/27/05	Rock	293	321	F	5
			10/27/05	"	329	433	F	11
			10/27/05	"	341	501	F	9
			10/27/05	"	321	375	F	7
			10/27/05	"	316	430	F	11
				Mean	**320**	**412**	**n/a**	**8.6**
PICKERING	PICK-1	06028112	10/26/05	English	269	158	M	7
			10/26/05	"	292	208	F	2
			10/26/05	"	248	139	F	3
			10/26/05	"	250	155	M	5
			10/26/05	"	240	131	F	2
				Mean	**260**	**158**	**n/a**	**3.8**
PICKERING	PICK-2	06028113	10/26/05	English	254	150	F	2
			10/26/05	"	271	186	F	3
			10/26/05	"	245	146	F	2
			10/26/05	"	320	293	F	5
			10/26/05	"	279	189	F	4
				Mean	**274**	**193**	**n/a**	**3.2**
NISQUALY	05NQ-ESM01	06028114	5/5/05	English	242	n/a	F	3
			5/5/05	"	258	"	F	4
			5/5/05	"	312	"	F	5
			5/5/05	"	252	"	F	5
			5/5/05	"	337	"	F	11
			5/5/05	"	371	"	F	10
			5/5/05	"	275	"	F	4
			5/5/05	"	230	"	M	3
			5/5/05	"	480	"	F	7
			5/5/05	"	275	"	F	4
			5/5/05	"	264	"	F	5
			5/5/05	"	265	"	F	5
			5/5/05	"	280	"	M	7
			5/5/05	"	240	"	F	3
			5/5/05	"	250	"	F	4
			5/5/05	"	234	"	F	3
			5/5/05	"	245	"	M	7
			5/5/05	"	233	"	F	3
			5/5/05	"	250	"	F	5
			5/5/05	"	303	"	F	4
				Mean	**280**	**n/a**	**n/a**	**5.1**

Station ID	Sample ID	Sample No.	Collection Date	Species of Sole	Total Length (mm)	Weight (g)	Sex	Age (yrs)
NISQUALY	05NQ-ESM02	06028115	5/5/05	English	290	n/a	M	7
			5/5/05	"	280	"	F	4
			5/5/05	"	237	"	M	5
			5/5/05	"	320	"	F	3
			5/5/05	"	246	"	F	3
			5/5/05	"	324	"	F	4
			5/5/05	"	260	"	F	4
			5/5/05	"	285	"	F	4
			5/5/05	"	311	"	F	4
			5/5/05	"	265	"	F	5
			5/5/05	"	277	"	F	4
			5/5/05	"	287	"	F	5
			5/5/05	"	325	"	F	5
			5/5/05	"	255	"	F	4
			5/5/05	"	273	"	F	3
			5/5/05	"	258	"	F	3
			5/5/05	"	284	"	F	4
			5/5/05	"	235	"	F	3
			5/5/05	"	296	"	F	5
			5/5/05	"	310	"	F	5
				Mean	**281**	**n/a**	**n/a**	**4.2**
NISQUALY	05NQ-ESM03	06028116	5/5/05	English	370	n/a	F	6
			5/5/05	"	264	"	F	4
			5/5/05	"	258	"	F	4
			5/5/05	"	290	"	M	6
			5/5/05	"	315	"	F	5
			5/5/05	"	275	"	M	5
			5/5/05	"	230	"	F	3
			5/5/05	"	306	"	F	6
			5/5/05	"	260	"	F	6
			5/5/05	"	320	"	F	5
			5/5/05	"	284	"	F	5
			5/5/05	"	250	"	F	4
			5/5/05	"	275	"	F	4
			5/5/05	"	278	"	F	4
			5/5/05	"	240	"	F	3
			5/5/05	"	350	"	F	4
			5/5/05	"	285	"	F	4
			5/5/05	"	273	"	F	4
			5/5/05	"	246	"	F	3
			5/5/05	"	275	"	F	4
				Mean	**282**	**n/a**	**n/a**	**4.5**

U = Sex not determined

Table B-3. Site Locations for Mussel Sampling at the Cascade Pole Site.

Site Name	Date	Time	Tide	Latitude North	Longitude West	Location Description
1-out	11/10/05	6:45	1.5	47° 03.552'	122° 53.963'	Out from shore – middle of the site
2-close	"	7:15	2.0	47° 03.510'	122° 53.925'	Close to shore – east side of the site
3-close	"	7:45	2.7	47° 03.520'	122° 53.992'	Close to shore – west side of the site

Coordinates were used for study locations in Ecology's Environmental Information Management (EIM) database

Appendix C.

Case Narratives from Manchester Environmental Laboratory

Data Qualifier Codes

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N - The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".

NJ - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

UJ - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

REJ - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

NC - Not Calculated

bold - The analyte was present in the sample. (Visual Aid to locate detected compounds on report sheet.)

Manchester Environmental Laboratory
7411 Beach Drive East, Port Orchard, Washington 98366

April 19, 2006

Subject:	SPS Fish
Samples:	06-028100 through 028102
LIMS Project ID:	1045-06
Laboratory:	Pacific Rim Laboratories
Project Officer:	Brandee Era-Miller
By:	Karin Feddersen

Data Review for Polychlorodibenzo-p-dioxin and furan

(2,3,7,8 substituted tetra through octa PCDD/PCDF)

Summary

Data from these analyses were reviewed for qualitative and quantitative accuracy following the National Functional Guidelines for Organic Data Review adapted for high resolution dioxin analysis and using the EPA Region 10 SOP for the Validation of PCDD/PCDF.

Samples were prepared and analyzed according to EPA method 1613.

Results have been reported in nanograms per Kilogram (ng/Kg); parts per trillion wet weight.

A number of congeners were qualified with a "J" because the concentration detected was below the lowest calibration standard; results derived from responses outside the calibration range are considered estimates.

Holding times

EPA method 1613 states: "if stored in the dark at <-10°C, solid, semi-solid, multi-phase, and tissue samples may be stored for up to one year." Samples were kept below -10°C until extraction, and were analyzed within the one-year holding time.

Calibration

The calibration standards were within 20% relative standard deviations (RSD) for all target analytes and 30% for all the labeled reference compounds (Internal Standards), with a few exceptions. Since the corresponding sample internal standards and the LCS recoveries were within limits, the outliers were deemed to not affect the results.

All ion abundance ratios were within +/- 15% of the theoretical value.

Internal Standard Recoveries

Internal standard recoveries for each congener in these samples were within control limits of 25% – 150%.

Ion abundance ratios

Each dioxin and furan isomer reported as detected met the isotopic abundance ratio and retention time criteria for positive identification.

Method Blank

No target analytes were detected in the method blank.

Laboratory Control Sample (LCS)

Recoveries for all target analytes in the laboratory control samples were within quality control limits of 80% to 120%.

Duplicate

A duplicate was analyzed for sample 028101. RPDs between the results were within quality control limits of ± 30%.

Manchester Environmental Laboratory
7411 Beach Drive E, Port Orchard Washington 98366

Case Narrative

March 29, 2006

Project: SPS Fish & Shellfish Verification

Sample(s): 06028101, 06028102, 06028117

Case no. 1045-06

Officer(s): Brandee Era-Miller

By: Jeff Westerlund
Organics Analysis Unit

PAH Analysis

Analytical Method(S)

These tissue samples were extracted following Manchester Laboratory's standard operating procedure for the extraction of PAHs. The samples were extracted with methylene chloride/hexane by SW846 method 3540 and solvent exchanged to hexane. The extracts were then cleaned by eluting through a silica gel column to remove polar interferences and concentrated to 1.0 ml. These extracts were analyzed by capillary gas chromatography with mass spectral detection (GC/MS - SIM) following EPA SW-846 Method 8270. If a target analyte is detected and its identification is unambiguously confirmed at a concentration below its PQL, the reported concentration is qualified as an estimate using the 'J' qualifier.

Calibrations

The initial calibration was acceptable. The initial 7 point calibration utilized quadratic fits having a correlation coefficient (r^2) of greater than 0.99. No initial calibration data points varied from their true values by more than +/- 20% (+/- 50% on the low point).

All compounds in the continuing calibration verification sample (CCVs) were within the established QC limits of +/- 20% of the true value.

All internal standard areas were within the internal standard QC acceptance limit of 50% - 200%.

No DFTPP was analyzed, as there are no DFTPP tuning criteria for SIM analysis. The 12 hour instrument window starts with the analysis of the CCV.

Holding Times

All samples were extracted and analyzed within the method specified holding times.

Surrogate(S)

All of the surrogate recoveries are within the QAPP specified control limits, unless noted below. Sample 06028102, 08028102 LMX1 and 06028102 LMX2 had high recoveries of Chrysene-d12. Matrix interference was shown by having all three analyses of this sample having high Chrysene-d12 recoveries. No data was qualified as the remaining two surrogate recoveries in each sample were within QAPP specified limits.

The LCS sample OL06038T1 had high recovery of chrysene-d12. No data was qualified as the remaining two surrogate recoveries were within QAPP specified limits and all analyte recoveries were within QAPP specified control limits.

Control limits for PAH surrogate recoveries were specified as follows:

Naphthalene-d8	50%-150%
Phenanthrene-d10	50%-150%
Chrysene-d12	50%-150%

Method Blanks

Phenanthrene was detected in all of the method blanks associated with this set of data. No corrective action was taken as the phenanthrene concentration in the samples was greater than 5 times the amount found in the method blanks

Matrix Spikes

Matrix spikes were performed on the sample 06028102. All recoveries were within specified limits with no exceptions.

Current matrix spike recovery limits have been set at 50%-150%.

Laboratory Control Spikes

LCS samples OL06037T1 and OL06038T1 were analyzed with this set of data.

All recoveries in LCS OL06037T1 were acceptable.

All recoveries in LCS OL06038T1 were acceptable.

Current LCS spike recovery limits have been set at 50%-150%.

Comments

The sample 06028100 was lost during the initial extraction process on 2/6/06. A duplicate sample was extracted successfully on 2/6/06. This sample was re-extracted as sample 06028117 on 2/7/06. The original duplicate sample was analyzed with the re-extracted sample and reported as 06028117 LDP1.

Manchester Environmental Laboratory
7411 Beach Dr E, Port Orchard, Washington 98366

Case Narrative

March 13, 2006

Subject: SPS Fish and Shellfish Verification

Samples: 06028103 - 06028115

Officer: Brandee Era-Miller

By: M.Mandjikov

Polychlorinated Biphenyl (PCB) Analysis

Analytical Method(s)

The fish tissue samples were extracted into methylene chloride and hexane (50/50 v/v) using a Soxhlet apparatus. Following the extraction, each extract was solvent exchanged into hexane. 10% of each extract was removed for lipids analysis.

The extracts were then eluted through 2 gram micro Florisil® columns with a 6% v/v preserved diethyl ether/hexane solution. After Florisil treatment, each extract was solvent exchanged into iso-octane and concentrated to 1 mL. At this point, visual inspection of extract revealed that approximately 90% of the extract was emulsified with lipid material. 1 mL of iso-octane was added to each sample. Each extract was then treated with concentrated sulfuric acid, vortexed and centrifuged prior to analysis.

All the extracts were analyzed using dual column GC-ECD. These methods are modifications of EPA SW- 846 methods 3540, 3620, 3665, and 8082.

Holding Times

All samples were prepared and analyzed within the method holding times.

Calibration

All relative standard deviations (RSD) between the calibration factors are less than 20%.

All initial calibration verification (ICV) standards are acceptable and within 15% of the theoretical value with the exceptions of Aroclor 1254 and DCB. New Aroclor 1254 and DCB standards were prepared and analyzed. A new calibration curve was prepared and the samples were re-analyzed. The ICV for Aroclor 1254 is in control for the second calibration. Due to an oversight, no DCB independent ICV was analyzed with this project. However, both DCB

standards used for calibration for this project have been checked against valid independent standards prior to this analysis and have been documented as in control.

The continuing calibration verification standards are stable and within the 85% - 115% control limits for TMX, Aroclor 1016 and Aroclor 1260. Both the surrogate DCB and Aroclor 1254 increased in sensitivity during the sample analysis to a maximum of 133%. Aroclor 1254 results reported above the reporting limits should be considered to be biased high and are qualified as estimates, "J".

Blanks

There is no evidence of any target analyte detected in any of the blanks.

Surrogates

Per the QAPP, the acceptable surrogate recoveries are 10% - 140%.

All the samples and QC samples were spiked with 100 ng of the surrogate compounds, Tetrachloro-m-xylene (TMX) and Decachlorobiphenyl (DCB). All the surrogate recoveries are acceptable and within the established QC limits, with the exception of sample 06028103 at 144%. No analytes are detected above the reporting limits in this sample and therefore no action has been taken.

Duplicates

Samples 06028110 and 06028111 were prepared in duplicate to evaluate the precision of this method. Because no analytes are detected above the reporting limits, the relative percent difference between the sample concentrations is not calculated.

Matrix Spiked Samples

Sample 06028105 was prepared in triplicate. Two replicates were spiked with 500 ng of Aroclors 1016 and 1260. All spike recoveries are within the control limits of 50% - 150% established by the QAPP.

Laboratory Control Sample

Ten grams of analytically clean Ottawa sand was spiked with 500 ng of Aroclors 1016 and 1260 to provide a laboratory control sample (LCS) for this extraction batch. This sample was processed and analyzed identically to the rest of the project. All the LCS recoveries are within the acceptable limits of 50% - 150% established by the QAPP.

Standard Reference Material

The Standard Reference Material (SRM), NIST 1974b, Organics in Mussel Tissue was prepared, extracted and analyzed with each batch of samples. The results for the PCB Aroclors are reported. However, there are no Aroclor reference values assigned to this SRM.

Comments

The Aroclor 1254 ICV results from the first calibration is low, recovering at approximately 80% - 82%. Review of the analytical data from this calibration suggests that the Aroclor 1254 results may be biased low. A new set of Aroclor 1254 standards with DCB were prepared, a new calibration established and the samples re-analyzed. Although the Aroclor ICV for this second calibration is within the control limits, the CCVs increased in sensitivity as the analysis progressed to approximately 130% of the reference value. Review of the analytical data from this calibration suggests that the Aroclor 1254 results may be biased high. The Aroclor 1254 reporting limits are not qualified since they are verified by the second calibration. All detected Aroclor 1254 results are reported from the second analysis, qualified as estimates, "J" and should be considered to be biased high.

All detected Aroclor 1260 results should be considered to be biased high due to the problems with the high DCB and Aroclor 1254 results.

Interference from other Aroclors present in the tissue and metabolism of the Aroclor congeners, degrade the congeners so that the congener ratios in the environmental samples do not match the ratios in the analytical standards. Congeners representative of each Aroclor with the least amount of interference from other Aroclors are averaged to estimate the concentration of the Aroclor present. All Aroclor results reported below 10 ug/Kg are considered estimates and are qualified, "J" due to a poor pattern match with the analytical standard.

The surrogate, DCB recovered above the control limits in the first calibration. A new stock was prepared and added to the new Aroclor 1254 standard. Although, a calibration curve was prepared with the new standards, DCB was reported from the first calibration to be consistent with the majority of the analytical results.

When the concentration of one or more Aroclors was high enough to obscure the evidence of other Aroclors, the reporting limit is raised to a level above the interference and qualified, "UJ", as an estimated reporting limit.

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Manchester Environmental Laboratory
7411 Beach Drive East, Port Orchard Washington 98366

April 18, 2006

Subject:	**SPS Fish**
Samples:	06-028103, 028104, 028106, 028107, 028110, 028112, 028114
Project ID:	1045-06
Laboratory:	Pacific Rim Laboratories Inc.
Project Officer:	Brandee Era-Miller
By:	Karin Feddersen

Data Review for PCB Congener and PCB Equivalent Analysis

Summary

See contract lab narrative for more details.

Data from these analyses were reviewed for qualitative and quantitative precision and bias following EPA method 1668A.

Samples were prepared and analyzed according to EPA method 1668A. Results have been reported in micrograms per liter (µg/Kg).

Sample results reported below the Estimated Quantitation Limit (EQL) were qualified as estimates "J" for detects and "UJ" for non-detects.

Several groups of congeners coelute. These coelutions are indicated next to the IUPAC #s on the report. This reported value is a sum total of all the coeluting congeners.

An Aroclor 1260 standard was analyzed with the samples and relevant congeners in the samples were compared to those in the standard.

Holding Times

EPA method 1668A allows storage of samples for one year from the date of collection. Extraction and analysis took place within this time frame.

Blanks

Low levels of certain target compounds were detected in the laboratory blanks. These congeners were also detected in some of the corresponding samples. If the concentration of a congener in a sample was less than ten times that of the corresponding method blank (prepared on the same date), the result was flagged by the laboratory with a "B". To be consistent with Manchester Laboratory's reporting protocols for organic analyses, the B flags were changed to "UJ;" not

detected at or above the estimated reporting limit, and a "J" added for each corresponding total homolog.

Calibration

The calibration standards were within 20% relative standard deviations (RSD) for all target analytes and 35% for all the labeled reference compounds (Internal Standards).

All calibration verification standard recoveries were within QC limits of 70% to 130% for target analytes and 50% to 150% for the labeled reference compounds.

All the ion abundance ratios and relative retention times were within QC criteria.

The 209 standard is from a different source than the initial calibration standards.

Internal Standard (Surrogate) Recoveries

Internal standard recoveries for these samples were all within the method specified QC limits of 25% to 150% with several exceptions. Affected analyte results have been qualified as estimates.

Ion abundance ratios

Each congener reported as detected met the isotopic abundance ratio and retention time criteria for positive identification with several exceptions, which have been qualified "N".

On-going Precision and Recovery (OPR)

Recoveries were within quality control limits of 50% to 150% with several exceptions. PCB-18 recovery was low, indicating a possible low bias for this analyte in the samples. All PCB-18 results have been qualified as estimates. Recoveries for PCB-40 and PCB-74 were high, indicating a possible high bias for these analytes in the samples. Detected results for these analytes have been qualified as estimates. Non-detected results are unaffected.

Standard Reference Material (SRM)

NIST SRM 1974b was extracted and analyzed with these samples upon the request of the project officer. The results for most analytes are fairly close to the certified values. Two were outside 50% to 150% of the certified values; PCB-74: 223% and PCB-82/120: 172%. Detected results for these analytes have been qualified as estimates in the samples.

Appendix D.

Data Quality Information

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Table D-1. Precision of Laboratory Duplicate Results (ug/Kg wet weight) and Percent Matrix Spike Recoveries for Sole Tissue Chemistry.

Sample ID:	WCHT-1					WCHT-2					Matrix Spike/ MS Duplicate Recovery (%)		
Sample Lab No:	06028110					06028111							
Parameter	Result		Duplicate		RPD	Result		Duplicate		RPD	Spike	Duplicate	RPD
Lipids	0.36		0.46		24%	0.55		0.46		18%	--	--	nc
PCB Aroclors													
PCB-1016	5.5	U	5.6	U	nc	5.1	U	5.2	U	nc	71	70	1%
PCB-1221	5.5	U	5.6	U	nc	5.1	U	5.2	U	nc	--	--	nc
PCB-1232	5.5	U	5.6	U	nc	5.1	U	5.2	U	nc	--	--	nc
PCB-1242	5.5	U	5.6	U	nc	5.1	U	5.2	U	nc	--	--	nc
PCB-1248	5.5	U	5.6	U	nc	5.1	U	5.2	U	nc	--	--	nc
PCB-1254	5.5	U	5.6	U	nc	5.1	U	5.2	U	nc	--	--	nc
PCB-1260	5.5	U	5.6	U	nc	5.1	U	5.2	U	nc	90	87	3%
PCB-1262	5.5	U	5.6	U	nc	5.1	U	5.2	U	nc	--	--	nc
PCB-1268	5.5	U	5.6	U	nc	5.1	U	5.2	U	nc	--	--	nc
Sample ID:	05NQ-ESM01					2-Close*					Matrix Spike/ MS Duplicate Recovery (%)		
Sample Lab No:	06028114					06028101							
Parameter	Result		Duplicate		RPD	Result		Duplicate		RPD	Spike	Duplicate	RPD
BEHP	--	--	--	--	--	44	U	42	U	nc	116	133	14%
PCB congeners													
PCB-017	0.004		0.005		22%	--	--	--	--	--			
PCB-044	0.044		0.038		15%	--	--	--	--	--			
PCB-092	0.138		0.133		4%	--	--	--	--	--			
PCB-153/168	2.51		2.35		7%	--	--	--	--	--			
PCB-209	0.178		0.181		2%	--	--	--	--	--			
Monochlorobiphenyls	0.004	U	0.005	UJ	nc	--	--	--	--	--			
Dichlorobiphenyls	0.035	U	0.035	U	nc	--	--	--	--	--			
Trichlorobiphenyls	0.104		0.097		7%	--	--	--	--	--			
Tetrachlorobiphenyls	0.862		0.751		14%	--	--	--	--	--			
Pentachlorobiphenyls	3.24		3.15		3%	--	--	--	--	--			
Hexachlorobiphenyls	7.01		6.53		7%	--	--	--	--	--			
Heptachlorobiphenyls	5.01		4.32		15%	--	--	--	--	--			
Octachlorobiphenyls	2.64		2.14		21%	--	--	--	--	--			
Nonachlorobiphenyls	0.478		0.477		0%	--	--	--	--	--			
Total PCBs	19.5		17.7		10%	--	--	--	--	--			

Only one matrix spike recovery sample was analyzed for PCB Congeners.

* = The laboratory duplicate for BEHP analysis was performed on a mussel tissue sample.
U = The analyte was not detected at or above the reported result.
UJ = The analyte was not detected at or above the reported estimated result.
nc = not calculated due to non-detections
RPD = relative percent difference

Table D-2. Precision of Laboratory Duplicate Results (ug/Kg wet weight) and Percent Matrix Spike Recoveries for Mussel Tissue Chemistry.

Sample ID: / Sample Lab No:	1-Out 06028100					Matrix Spike/ MS Duplicate Recovery (%)		
Parameter	Result		Duplicate		RPD	Spike	Duplicate	RPD
PAHs								
1-Methylnaphthalene	0.69		0.67		3%	54	54	0%
2-Methylnaphthalene	0.73		0.86		16%	56	53	6%
Acenaphthene	0.93		1.1		17%	64	60	6%
Acenaphthylene	0.49	U	0.49	U	nc	61	61	0%
Anthracene	0.94		0.99		5%	67	70	4%
Benzo(a)anthracene	1.9		1.5		24%	83	84	1%
Benzo(a)pyrene	1.8		0.49	U	nc	79	81	3%
Benzo(b)fluoranthene	0.49	U	0.49	U	nc	105	112	6%
Benzo(ghi)perylene	0.49	U	0.49	U	nc	82	88	7%
Benzo(k)fluoranthene	0.49	U	0.49	U	nc	72	68	6%
Chrysene	3.7		3.3		11%	62	65	5%
Dibenzo(a,h)anthracene	0.49	U	0.49	U	0%	89	87	2%
Dibenzofuran	0.74		0.90		20%	64	64	0%
Fluoranthene	5.6		8.9		46%	69	63	9%
Fluorene	1.1		1.2		9%	67	66	2%
Indeno(1,2,3-cd)pyrene	0.49	U	0.49	U	nc	90	87	3%
Naphthalene	1.2		1.1		9%	71	62	14%
Phenanthrene	4.8		7.7		46%	72	66	9%
Pyrene	4.5		5.5		20%	72	71	1%

U = The analyte was not detected at or above the reported result.
UJ = The analyte was not detected at or above the reported estimated result.
J = The analyte was positively identified. The associated numerical result is an estimate.
nc = not calculated due to non-detections
RPD = relative percent difference

Table D-2 (cont.). Precision of Laboratory Duplicate Results (ug/Kg wet weight) and Percent Matrix Spike Recoveries for Mussel Tissue Chemistry.

Sample ID: / Sample Lab No:	2-Close 06028101					Matrix Spike/ MS Duplicate Recovery (%)		
Parameter	Result		Duplicate		RPD	Spike	Duplicate	RPD
Lipids	0.47		0.56		17%	--	--	nc
Pentachlorophenol	44	U	42	U	nc	70	99	34%
Dioxins/furans								
2,3,7,8-TCDD	0.03	UJ	0.041	J	nc	Only one matrix spike recovery sample was analyzed for dioxins/furans.		
1,2,3,7,8-PeCDD	0.121	J	0.163	J	30%			
1,2,3,4,7,8-HxCDD	0.10	UJ	0.119	J	nc			
1,2,3,6,7,8-HxCDD	0.125	J	0.129	J	3%			
1,2,3,7,8,9-HxCDD	0.05	UJ	0.05	UJ	nc			
1,2,3,4,6,7,8-HpCDD	2.85		3.27		14%			
OCDD	12.5		12.8		2%			
2,3,7,8-TCDF	0.211		0.245		15%			
1,2,3,7,8-PeCDF	1.49		1.78		18%			
2,3,4,7,8-PeCDF	0.084	J	0.09	J	7%			
1,2,3,4,7,8-HxCDF	0.078	J	0.109	J	33%			
1,2,3,6,7,8-HxCDF	0.05	UJ	0.087	J	nc			
2,3,4,6,7,8-HxCDF	0.090	J	0.084	J	7%			
1,2,3,7,8,9-HxCDF	0.06	UJ	0.06	UJ	nc			
1,2,3,4,6,7,8-HpCDF	0.339	J	0.362	J	7%			
1,2,3,4,7,8,9-HpCDF	0.05	UJ	0.05	J	nc			
OCDF	0.597	J	0.65	J	9%			

U = The analyte was not detected at or above the reported result.
UJ = The analyte was not detected at or above the reported estimated result.
J = The analyte was positively identified. The associated numerical result is an estimate.
nc = not calculated due to non-detections
RPD = relative percent difference

Table D-3. Percent Difference of Standard Reference Material and Study Concentrations for PCB Congeners (ug/Kg wet weight).

Parameter	Study Value	Mean SRM Value*	% Difference
PCB-018	0.78	0.84 ± 0.13	- 7%
PCB-044	5.13	3.85 ± 0.20	+ 29%
PCB-049	3.28	5.66 ± 0.23	- 53%
PCB-052	3.65	6.26 ± 0.37	- 53%
PCB-070	4.56	6.01 ± 0.22	- 27%
PCB-074	7.93	3.55 ± 0.23	+ 76%
PCB-099	5.5	5.92 ± 0.27	- 7%
PCB-105	3.43	4.00 ± 0.18	- 15%
PCB-107	1.04	1.03 ± 0.12	+ 1%
PCB-110	9.86	10.00 ± 0.7	- 1%
PCB-118	9.18	10.3 ± 0.4	- 11%
PCB-128	1.73	1.79 ± 0.12	- 3%
PCB-132	2.29	2.43 ± 0.25	- 6%
PCB-151	1.52	1.86 ± 0.16	- 20%
PCB-156	0.528	0.718 ± 0.080	- 30%
PCB-158	0.807	0.999 ± 0.096	- 21%
PCB-183	1.18	1.25 ± 0.03	- 6%

SRM = Standard Reference Material 1974b - Organics in Mussel Tissue (Mytilus edulis).
* = The certified value is the weighted mean of the results of three to eight analytical methods;
The ± values quantify the uncertainty about the mean as 95% confidence intervals.

Table D-4. Percent Difference of Standard Reference Material and Study Concentrations for PAHs (ug/Kg wet weight).

Parameter	Study Value		Mean SRM Value*		% Difference
1-Methylnaphthalene	0.80	U	0.614	± 0.05	n/a
2-Methylnaphthalene	0.74	U	1.25	± 0.09	n/a
Acenaphthene	1.0	U	0.274	± 0.054	n/a
Acenaphthylene	1.0	U	0.48	± 0.12	n/a
Anthracene	1.0	U	0.527	± 0.071	n/a
Benzo(a)anthracene	4.9		4.74	± 0.53	+ 3%
Benzo(a)pyrene	2.2		2.8	± 0.38	- 24%
Benzo(b)fluoranthene	3.4		6.46	± 0.59	- 62%
Benzo(ghi)perylene	3.8		3.12	± 0.33	+ 20%
Benzo(k)fluoranthene	6.0		3.16	± 0.18	+ 62%
Chrysene	11		6.3	± 1.0	+ 54%
Dibenzo(a,h)anthracene	1.0	U	0.327	± 0.031	n/a
Fluoranthene	18		17.1	± 0.7	+ 5%
Fluorene	1.5		0.494	± 0.036	+ 101%
Indeno(1,2,3-cd)pyrene	2.3		2.14	± 0.011	+ 7%
Naphthalene	0.92		2.43	± 0.12	- 90%
Phenanthrene	11		2.58	± 0.11	+ 124%
Pyrene	15		18.04	± 0.6	- 18%

SRM = Standard Reference Material 1974b - Organics in Mussel Tissue (Mytilus edulis).

* = The certified value is the weighted mean of the results of three to seven analytical methods; The SRM values for 1-Methylnaphthalene, 2-Methylnaphthalene, acenaphthene, and acenaphthylene are non-certified and should be considered reference values only; The ± values quantify the uncertainty about the mean as 95% confidence intervals.

n/a = Comparison not applicable because of non-detections

U = The analyte was not detected at or above the reported result.

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Appendix E.

Individual PCB Congener Data

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Table E-1. PCB Congener Concentrations (ug/Kg wet weight) for Puget Sound Sole Muscle Fillets, Collected May - October 2005.

Sample ID:	BUDINLET	CARINLT1	CASEIN1a	CASEIN1b	WOLLCHET	PICKERING	NISQUALY
Sample Lab No:	06028103	06028104	06028106	06028107	06028110	06028112	06028114
Species:	Rock Sole	Rock Sole	Rock Sole	English Sole	Rock Sole	English Sole	English Sole
PCB-001	0.003 UJ	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-002	0.005 UJ	0.005 UJ	0.005 UJ	0.005 UJ	0.005 UJ	0.003 U	0.004 UJ
PCB-003	0.003 UJ	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-004/010	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
PCB-005/008	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
PCB-006	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
PCB-007/009	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
PCB-011	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
PCB-012/013	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
PCB-014	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
PCB-015	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
PCB-016/032	0.004 U	0.004 U	0.004 U	0.011	0.004 U	0.005	0.011
PCB-017	0.004 U	0.004 U	0.004 U	0.005	0.004 U	0.004 U	0.004
PCB-018	0.004 UJ	0.004 UJ	0.004 UJ	0.008 J	0.004 J	0.006 J	0.01 J
PCB-019	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-020/021/033	0.004 U	0.004 U	0.004 U	0.008	0.004 U	0.004 U	0.012
PCB-022	0.004 U	0.004 U	0.004 U	0.007	0.004 U	0.004 U	0.007
PCB-023/034	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-024/027	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-025	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-026	0.004 U	0.004 U	0.004 U	0.005	0.005	0.004 U	0.006
PCB-028/031	0.030	0.034	0.034	0.058	0.035	0.035	0.046
PCB-029	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-030	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-035	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-036	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-037	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-038	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-039	0.004 U	0.005	0.004 U	0.006	0.005	0.005	0.008
PCB-040	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.008 J	0.015 J
PCB-041/071/072	0.02	0.029	0.017	0.05	0.032	0.045	0.077
PCB-042	0.003 U	0.003 U	0.003 U	0.016	0.003 U	0.012	0.017
PCB-043	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-044	0.017	0.016	0.011	0.036	0.018	0.036	0.044
PCB-045	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-046	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-047/048/075	0.046	0.062	0.037	0.08	0.06	0.061	0.1
PCB-049	0.027	0.033	0.022	0.059	0.03	0.054	0.079
PCB-050	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-051	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.005
PCB-052	0.053	0.068	0.037	0.091	0.069	0.071	0.105
PCB-053	0.004 U	0.004 U	0.004 U	0.006	0.004 U	0.004	0.006
PCB-054	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
PCB-055	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-056	0.006	0.007	0.003	0.008	0.009	0.005	0.014

Table E-1 (cont.). PCB Congener Concentrations (ug/Kg wet weight) for Puget Sound Sole Muscle Fillets, Collected May - October 2005.

Sample ID:	BUDINLET		CARINLT1		CASEIN1a		CASEIN1b		WOLLCHET		PICKERING		NISQUALY	
Sample Lab No:	06028103		06028104		06028106		06028107		06028110		06028112		06028114	
Species:	Rock Sole		Rock Sole		Rock Sole		English Sole		Rock Sole		English Sole		English Sole	
PCB-057	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-058	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-059	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.004	
PCB-060	0.006		0.01		0.005		0.009		0.008		0.009		0.012	
PCB-061	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-062	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-063	0.003	U	0.006		0.003	U	0.013		0.006		0.011		0.021	
PCB-064/068	0.003	U	0.003	U	0.003		0.003	U	0.003	U	0.003	U	0.003	U
PCB-065	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-066/080	0.047		0.07		0.034		0.076		0.067		0.059		0.106	
PCB-067	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-069/073	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-070	0.034		0.052		0.026		0.064		0.055		0.059		0.106	
PCB-074	0.075	J	0.107	J	0.044	J	0.088	J	0.1	J	0.079	J	0.151	J
PCB-076	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-077	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-078	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-079	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-081	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-082/120	0.043	J	0.093	J	0.062		0.076	J	0.069	J	0.049	J	0.097	J
PCB-083/109	0.003	U	0.003	U	0.003	U	0.01		0.003	U	0.007		0.014	
PCB-084	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-085	0.009		0.003	U	0.009		0.003	U	0.012		0.017		0.044	
PCB-086/097/125	0.014		0.021		0.013		0.088		0.02		0.058		0.137	
PCB-087/115	0.029		0.065		0.033		0.086		0.047		0.053		0.132	
PCB-088	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-089/101/113	0.156		0.3		0.2		0.585		0.252		0.321		0.583	
PCB-090	0.005		0.003	U	0.003	U	0.028		0.003	U	0.022		0.036	
PCB-091	0.006		0.01		0.007		0.041		0.007		0.027		0.056	
PCB-092	0.055		0.101		0.047		0.100		0.075		0.064		0.138	
PCB-093/095/121	0.026		0.038		0.028		0.139		0.038		0.09		0.177	
PCB-094	0.003	U	0.004		0.003	U	0.004		0.003		0.003	U	0.005	
PCB-096	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-098/102	0.003	U	0.003	U	0.003	U	0.011		0.003	U	0.003	U	0.013	
PCB-099	0.183		0.362		0.175		0.313		0.258		0.197		0.471	
PCB-100	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-103	0.003	U	0.006		0.003	U	0.008		0.005		0.006		0.014	
PCB-104	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-105	0.055		0.088		0.048		0.083		0.084		0.069		0.147	
PCB-106	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-107	0.023		0.034		0.018		0.059		0.031		0.039		0.103	
PCB-108	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-110	0.081		0.163		0.085		0.279		0.153		0.181		0.436	
PCB-111/116/117	0.004		0.011		0.005		0.017		0.008		0.012		0.022	
PCB-112	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U

Table E-1 (cont.). PCB Congener Concentrations (ug/Kg wet weight) for Puget Sound Sole Muscle Fillets, Collected May - October 2005.

Sample ID:	BUDINLET		CARINLT1		CASEIN1a		CASEIN1b		WOLLCHET		PICKERING		NISQUALY	
Sample Lab No:	06028103		06028104		06028106		06028107		06028110		06028112		06028114	
Species:	Rock Sole		Rock Sole		Rock Sole		English Sole		Rock Sole		English Sole		English Sole	
PCB-114	0.003	U	0.005		0.003	U	0.003		0.003		0.003	U	0.007	
PCB-118	0.202		0.378		0.165		0.329		0.301		0.234		0.557	
PCB-119	0.01		0.017		0.009		0.021		0.015		0.012		0.033	
PCB-122	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-123	0.003	U	0.003	U	0.003	U	0.003	U	0.003		0.003	U	0.003	
PCB-124	0.005		0.008		0.004		0.003	U	0.01		0.005		0.018	
PCB-126	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-127	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-128	0.088		0.149		0.101		0.113		0.124		0.081		0.211	
PCB-129	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-130	0.016		0.017		0.011		0.058		0.021		0.037		0.116	
PCB-131/142/165	0.003	U	0.003		0.003	U	0.007		0.004		0.004		0.013	
PCB-132	0.003	U	0.029		0.003	U	0.106		0.026		0.003	U	0.184	
PCB-133	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-134	0.003	U	0.035		0.015		0.03		0.031		0.016		0.039	
PCB-135	0.012		0.015		0.008		0.051		0.021		0.039		0.088	
PCB-136	0.012		0.018		0.01		0.046		0.018		0.035		0.086	
PCB-137	0.016		0.024		0.015		0.024		0.025		0.013		0.053	
PCB-138/160	0.502		0.87		0.531		0.696		0.677		0.451		1.32	
PCB-139/149	0.07		0.117		0.054		0.401		0.127		0.301		0.807	
PCB-140	0.003	U	0.009		0.003	U	0.006		0.006		0.006		0.013	
PCB-141	0.03		0.061		0.031		0.064		0.051		0.041		0.117	
PCB-143	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-144	0.006		0.015		0.006		0.019		0.011		0.016		0.043	
PCB-145	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-146/161	0.105		0.16		0.087		0.229		0.153		0.141		0.417	
PCB-147	0.005		0.007		0.003		0.021		0.006		0.015		0.043	
PCB-148	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.004	
PCB-150	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-151	0.076		0.143		0.068		0.142		0.118		0.109		0.257	
PCB-152	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-153/168	0.844		1.33		0.795		1.39		1.25		0.905		2.51	
PCB-154	0.02		0.037		0.021		0.026		0.031		0.02		0.055	
PCB-155	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-156	0.023		0.046		0.028		0.039		0.036		0.025		0.073	
PCB-157	0.005		0.009		0.006		0.011		0.008		0.006		0.016	
PCB-158	0.003	U	0.003	U	0.026		0.003	U	0.043		0.003	U	0.003	U
PCB-159	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-162	0.003	U	0.004		0.003	U	0.004		0.003	U	0.003	U	0.008	
PCB-163/164	0.003	U	0.149		0.072		0.276		0.142		0.177		0.497	
PCB-166	0.003	U	0.003	U	0.012		0.003	U	0.003	U	0.003	U	0.003	U
PCB-167	0.016		0.029		0.014		0.029		0.026		0.015		0.041	
PCB-169	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U	0.003	U
PCB-170/190	0.088		0.193		0.163		0.153		0.138		0.003	U	0.482	
PCB-171	0.038		0.09		0.061		0.054		0.065		0.04		0.149	

Table E-1 (cont.). PCB Congener Concentrations (ug/Kg wet weight) for Puget Sound Sole Muscle Fillets, Collected May - October 2005.

Sample ID:	BUDINLET	CARINLT1	CASEIN1a	CASEIN1b	WOLLCHET	PICKERING	NISQUALY
Sample Lab No:	06028103	06028104	06028106	06028107	06028110	06028112	06028114
Species:	Rock Sole	Rock Sole	Rock Sole	English Sole	Rock Sole	English Sole	English Sole
PCB-172/192	0.013	0.026	0.022	0.027	0.022	0.013	0.079
PCB-173	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-174	0.017	0.035	0.017	0.115	0.036	0.077	0.305
PCB-175	0.007	0.013	0.007	0.013	0.011	0.008	0.042
PCB-176	0.004	0.006	0.003 U	0.023	0.006	0.013	0.062
PCB-177	0.025	0.047	0.024	0.156	0.04	0.098	0.425
PCB-178	0.064	0.106	0.07	0.105	0.099	0.07	0.248
PCB-179	0.035	0.066	0.033	0.092	0.051	0.069	0.215
PCB-180/193	0.185	0.434	0.383	0.385	0.349	0.222	1
PCB-181	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-182/187	0.207	0.362	0.215	0.57	0.299	0.387	1.5
PCB-183	0.098	0.226	0.113	0.163	0.186	0.106	0.451
PCB-184	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-185	0.006	0.012	0.01	0.003 U	0.009	0.003 U	0.036
PCB-186	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-188	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.007
PCB-189	0.003 U	0.006	0.005	0.006	0.005	0.003 U	0.01
PCB-191	0.003 U	0.01	0.003 U	0.007	0.005	0.004	0.003 U
PCB-194	0.023 N	0.104	0.121	0.116	0.027	0.003 U	0.234
PCB-195	0.003 U	0.003 U	0.054	0.065	0.003 U	0.003 U	0.003 U
PCB-196/203	0.109	0.345	0.17	0.246	0.272	0.155	0.866
PCB-197	0.008	0.016	0.014	0.012	0.01	0.007	0.032
PCB-198	0.004	0.016	0.007	0.012	0.003 U	0.003 U	0.054
PCB-199	0.108	0.306	0.142	0.308	0.242	0.182	1.06
PCB-200	0.005	0.01	0.003 U	0.016	0.007	0.012	0.049
PCB-201	0.019	0.043	0.024	0.045	0.038	0.029	0.143
PCB-202	0.032	0.076	0.041	0.089	0.065	0.045	0.183
PCB-204	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
PCB-205	0.003 U	0.003 U	0.003 U	0.007	0.003 U	0.003 U	0.016
PCB-206	0.031	0.12	0.098	0.003 U	0.099	0.003 U	0.312
PCB-207	0.005	0.016	0.013	0.021	0.012	0.008	0.031
PCB-208	0.017	0.041	0.022	0.075	0.03	0.032	0.135
PCB-209	0.025	0.08	0.07	0.118	0.003 U	0.056	0.178
Monochlorobiphenyls	0.005 UJ	0.005 UJ	0.005 UJ	0.005 UJ	0.005 UJ	0.003 U	0.004 U
Dichlorobiphenyls	0.035 U	0.035 U	0.035 U	0.035 U	0.035 U	0.035 U	0.035 U
Trichlorobiphenyls	0.030	0.039	0.034	0.108	0.045	0.051	0.104
Tetrachlorobiphenyls	0.331	0.46	0.239	0.596	0.454	0.513	0.862
Pentachlorobiphenyls	0.906	1.70	0.908	2.28	1.39	1.46	3.24
Hexachlorobiphenyls	1.85	3.28	1.91	3.79	2.96	2.45	7.01
Heptachlorobiphenyls	0.787	1.63	1.12	1.87	1.32	1.11	5.01
Octachlorobiphenyls	0.308	0.916	0.573	0.916	0.661	0.430	2.64
Nonachlorobiphenyls	0.053	0.177	0.133	0.096	0.141	0.040	0.478

U = The analyte was not detected at or above the reported result.

UJ = The analyte was not detected at or above the reported estimated result.

N = The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".

J = The analyte was positively identified. The associated numerical result is an estimate.