ATTACHMENT 2. MODEL TOXICS CONTROL ACT-CONFORMING EXPOSURE POINT CONCENTRATIONS

Attachment 2. Model Toxics Control Act-Conforming Exposure Point Concentrations

This attachment to the Lower Duwamish Waterway (LDW) baseline human health risk assessment (HHRA) presents Model Toxics Control Act (MTCA)-conforming exposure point concentrations (EPCs) and compares them to the EPCs used in this HHRA. EPCs in this HHRA were calculated according to guidance from US Environmental Protection Agency (EPA) statisticians following the most current statistical methods and software (i.e., ProUCL 4.0). This attachment explores the potential differences that could occur if MTCA methods[1] had been used instead. Rather than recalculating all of the EPCs used in the HHRA, a subset of the chemical of potential concern (COPC)-scenario combinations that represent a variety of datasets were selected. A total of 31 seafood consumption scenario EPCs and 23 sediment exposure EPCs were re-analyzed as a part of this exercise; summary statistics for these EPCs are presented in Table 1.

MTCA-conforming EPCs are presented together with the EPCs calculated for the HHRA using ProUCL software in Table 2. Methods for calculating the MTCA-conforming EPCs provided in Table 2 were reviewed by Gregory Glass on behalf of the Washington State Department of Ecology (Ecology). Mr. Glass provided instructions for calculating MTCA-conforming EPCs for several scenarios that were not possible to calculate using MTCAStat statistical analysis software (Ecology 1997). In addition, Mr. Glass suggested that when the distribution of a dataset was determined to be neither lognormal nor normal, the results of several statistical approaches should be shown for comparison purposes (Glass 2007a).

Methods for Determination of Distribution

Goodness of fit to a lognormal or normal distribution was assessed using MTCAStat for all datasets with fewer than 500 values, with non-detected results entered at their reporting limit and coded as non-detected for calculations using a "censored probability plot" approach. For other datasets, the MTCA censored probability plot method was replicated in Microsoft® Excel® as follows:

1. Data values were sorted, with non-detect values equal to one-half the RL, to determine the rank ordering.

[1] As noted in the risk characterization, Section B.5.1.3, the exposures for scenarios that are evaluated under MTCA have not been specifically quantified in this HHRA. MTCA-conforming EPCs are calculated following current statistical guidance (Ecology 1992, 1997).

2. Percentiles were calculated from ranks according to the formula used in MTCA (Equation 1; see Ecology 1992, 1997) along with the normal z-score[2] for each percentile.

$$\text{Percentile} = [(\text{rank} - 3/8)/(n + 1/4)] \qquad \textbf{Equation 1}$$

3. Using only detected values, the coefficient of determination (R^2) was calculated between the z-scores of the detected values and their corresponding arithmetic and log-transformed concentrations.

4. If the R^2 between the z-scores and the log-transformed data was greater than 0.90, the dataset was considered to be lognormal (regardless of whether it was also normal). If the data were not lognormal, but the R^2 between the z-scores and the arithmetic data was greater than 0.90, the data were considered to be normal (Ecology 1992). Some datasets did not meet either criterion and were accordingly evaluated under MTCA as neither normal nor lognormal.

Methods for Calculation of Upper Confidence Limits

Upper confidence limits (UCLs) were calculated using both detect and non-detect data. When possible, UCLs were calculated using MTCAStat according to MTCA guidance (Ecology 1992). Calculations for datasets with more than 500 values were performed following MTCA statistical methods using ProUCL 4.0 or, for larger datasets, using unpublished BTNCTD.EXE software provided by Dr. Charles Land through Ecology's consultant, Gregory Glass (Glass 2007b; Land 1994). The latter software was used for datasets with more than 1,000 values because ProUCL will not calculate an h-statistic for such large datasets. According to the authors of ProUCL, the behavior of the h-statistic with such large datasets has not been adequately evaluated (EPA 2006).

Non-detect results were handled in accordance with MTCA guidance (Ecology 1992) as follows:

1. If 85% or more of the samples were detected, one-half of each RL was used in place of the non-detect results.

2. If ≥ 50% and < 85% of samples were detected, Cohen's method was applied.[3] Because only one reporting limit value can be entered into MTCAStat for calculations using Cohen's method, the maximum RL was generally used when multiple RLs were present. When non-detect reporting limits were greater than detect values, it was sometimes necessary to develop an alternative approach than the maximum RL. In most of these situations, the average RL was

[2] A z-score for each calculated percentile was determined from standard tables for the normal distribution.

[3] Cohen's method was used to calculate a corrected mean and standard deviation for use in determining a UCL (Ecology 2001).

substituted for all non-detect values. In one case, the value of the smallest detected value was substituted for all non-detected values.

3. If the detection frequency was less than 50%, the maximum detected value was used as the UCL.

Either Land's method (h-statistic) for lognormal data or the t-statistic for normal data was selected for calculating a UCL, according to the distribution of the data. If a dataset is neither normal nor lognormal, MTCA statistical guidance discusses several alternatives for UCL calculations (see Ecology (1992), Section 5.2.1 and Supplement S-6, Note 2). EPCs based on both maximum values and z-statistics are reported in this attachment for datasets that are neither normal nor lognormal. A z-statistic UCL can be appropriate when sample size is "sufficiently large" that the distribution of the mean approaches a normal distribution (Central Limit Theorem), but it is not well-supported for smaller sample sizes. The coverage (i.e., inclusion of the true mean with the stated probability) of the maximum value as an EPC depends on sample size and location (distribution percentile) of the true mean value. For comparison purposes, in cases where the R^2 for the lognormal distribution approached but did not quite meet the 0.90 acceptance criterion, the h-statistic was also calculated.

The MTCA statistical methods are more restricted than those available in ProUCL. A comparison of the MTCA-conforming EPCs and ProUCL EPCs as calculated in this HHRA (see Table 2) reveals no consistent pattern; the MTCA-conforming EPCs are for varying datasets less than, equal to, or greater than the ProUCL results. In some cases, different statistical approaches lead to practically identical results. Most datasets evaluated using non-parametric Chebyshev statistics in ProUCL have lower EPCs when calculated according to MTCA methods. The greatest MTCA exceedances of ProUCL results occur for MTCA EPCs calculated using Land's h-statistic together with small sample sizes.

Research has shown that the h-statistic UCL can result in unrealistically high values, even for some datasets that are technically lognormally distributed, especially as skewness increases and sample size decreases. In accordance with MTCA guidance (Ecology 1992), in this attachment, an h-statistic UCL was calculated for all datasets that passed the R^2 criterion for being lognormally distributed. It should be noted that, of the 54 EPCs recalculated, the h-statistic UCL was greater than the maximum detected value in seven cases.[4] All seven cases reflect small datasets, with between 6 and 14 values (Table 1). Because no alternative UCL calculation method is provided in MTCA guidance for these cases (without additional data collection), the maximum detected value is also presented for comparison (Table 2). EPCs calculated using

[4] The COPC-scenario combinations with h-statistic UCLs greater than the maximum detected value included arsenic (clams), arsenic (pelagic fish), carcinogenic polycyclic aromatic hydrocarbons (cPAHs) (beach play area 3), dioxin/furan toxic equivalent (TEQ) (tribal clamming and clamming 7 days per year), and total polychlorinated biphenyls (PCBs) (beach play area 3 and area 4).

ProUCL also infrequently exceed the maximum dataset value and are used in HHRA exposure calculations. The degree of exceedance of a maximum dataset value is occasionally much larger for MTCA EPCs based on an h-statistic than for ProUCL results.

For four of the seven cases discussed above, the h-statistic UCL was greater than the maximum detected value by a factor of 5 or less. For the other three cases, the difference was much larger. The most extreme examples were for cPAHs in beach play – Area 3 and dioxin/furans for the tribal clamming scenario. For cPAHs in beach play – Area 3, the h-statistic UCL was 71 mg/kg dw compared to a maximum detected value of 2.9 mg/kg dw for that exposure area. The maximum cPAH result in surface sediment for the entire LDW was 11 mg/kg dw (n = 793), so the value of 71 mg/kg dw was well outside the bounds of the existing data. Similarly, the h-statistic UCL for dioxin/furan TEQ for the tribal clamming scenario was 0.136 mg/kg dw (n = 11), which was much higher than the maximum detected value anywhere in the LDW of 0.0021 mg/kg dw (n = 43). These cases of high EPCs calculated using the h-statistic primarily reflect the small sample sizes and skewness for specific datasets and exposure areas. The additional LDW-wide data provide a broader context for the interpretation of these EPCs and indicate that they are biased high.

References

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Table 1. Summary statistics for seafood consumption and sediment exposure EPCs selected for re-analysis using MTCA-conforming data evaluation methods

Chemical	Consumption Category or Scenario	Detection Frequency		Concentration (mg/kg)[a]			Number of Different RLs
		Ratio	Percent	Mean Value	Range of Detected Values	RL or Range of RLs	
Seafood consumption scenarios							
Arsenic (inorganic)[b]	benthic fish, fillet	6/8	75	0.004	0.003 – 0.006 J	0.003	1
	benthic fish, whole body	8/8	100	0.056	0.02 – 0.09	na	na
	clams	8/8	100	1.24	0.132 – 3.27	na	na
	crab, edible meat	6/6	100	0.023	0.01 – 0.03	na	na
	crab, whole body	6/6	100	0.075	0.022 JM – 0.123 M	na	na
	pelagic fish, whole body	8/10	80	0.057	0.02 – 0.16	0.01	1
Carcinogenic PAHs[b, c]	benthic fish, fillet	5/8	63	0.00039	0.00037 J – 0.00064 J	0.00045	1
	benthic fish, whole body	21/24	88	0.0014	0.00045 J – 0.0028 J	0.00045	1
	clams	14/14	100	0.015	0.0068 – 0.044	na	na
	crab, edible meat	8/19	42	0.00044	0.00033 – 0.00084 J	0.00065	1
	crab, whole body	19/19	100	0.00075	0.00045 M – 0.0024 JM	na	na
	pelagic fish, whole body	26/26	100	0.00078	0.00037 J – 0.0022	na	na
Copper	benthic fish, whole body	24/24	100	1.73	0.494 – 3.47	na	na
	crab, edible meat	21/21	100	7.5	4.43 – 16	na	na
	crab, whole body	21/21	100	14	6.9 M – 24 M	na	na
Mercury	benthic fish, fillet	23/23	100	0.041	0.013 – 0.083	na	na
	benthic fish, whole body	24/24	100	0.01	0.005 – 0.027	na	na
	crab, edible meat	25/25	100	0.057	0.023 – 0.11	na	na
	crab, whole body	21/21	100	0.046	0.022 M – 0.097 M	na	na
	mussels	21/21	100	0.013	0.0088 – 0.023	na	na
	pelagic fish, whole body	31/31	100	0.033	0.018 – 0.088	na	na

Chemical	Consumption Category or Scenario	Detection Frequency		Concentration (mg/kg)[a]			Number of Different RLs
		Ratio	Percent	Mean Value	Range of Detected Values	RL or Range of RLs	
Total PCBs	benthic fish, fillet	33/33	100	0.7	0.079 – 2.0	na	na
	benthic fish, whole body	45/45	100	2.2	0.45 – 4.7	na	na
	clams	14/14	100	0.14	0.024 – 0.58 J	na	na
	crab, edible meat	26/29	90	0.17	0.060 – 0.39 J	0.020	1
	crab, whole body	25/25	100	0.89	0.25 – 1.9 JM	na	na
	mussels	18/22	82	0.034	0.016 – 0.060	0.013	1
	pelagic fish, whole body	53/53	100	1.7	0.164 – 18.4 J	na	na
Vanadium	clams	14/14	100	1.3	0.68 – 2.65	na	na
	mussels	8/8	100	0.15	0.058 – 0.26	na	na
	pelagic fish, whole body	22/26	85	0.4	0.21 – 1.23	0.2 – 0.25	2
Sediment exposure scenarios							
Arsenic	beach play RME, Area 3	6/9	67	8.5	7.2 – 18	3.1 – 6.6	3
	beach play RME, Area 5	22/22	100	8.1	3.94 – 11.8	na	na
	beach play RME, Area 7	9/9	100	8.9	5.05 J – 14	na	na
	tribal clamming – RME and 183 days per year	254/275	92	20	1.2 – 1,100	3.1 – 31	11
	clamming –7 days per year	100/103	97	8.8	2.7 – 20.7	3.1 – 6.6	3
	netfishing	755/817	92	20	1.2 – 1,100	3 – 31	18
Carcinogenic PAHs	beach play RME, Area 3	7/9	78	0.66	0.038 – 2.9 J	0.035 – 0.036	2
	beach play RME, Area 5	22/22	100	0.21	0.015 J – 1.0 J	na	na
	beach play RME, Area 7	8/9	89	0.077	0.024 J – 0.15	0.0094	1
	beach play RME, Area 8	11/11	100	0.23	0.049 – 0.62	na	na
	tribal clamming – RME and 183 days per year	255/264	97	0.5	0.0097 – 11	0.0091 – 0.11	8
	clamming – 7 days per year	97/103	94	0.27	0.0097 J – 3.0	0.0091 – 0.036	5

Chemical	Consumption Category or Scenario	Detection Frequency		Concentration (mg/kg)[a]			Number of Different RLs
		Ratio	Percent	Mean Value	Range of Detected Values	RL or Range of RLs	
	netfishing	749/793	94	0.5	0.0091 J – 11	0.009 – 0.13	22
Dioxin/furan TEQ	tribal clamming – RME and 183 days per year	11/11	100	0.00034	0.0000017 – 0.0021 J	na	na
	clamming – 7 days per year	6/6	100	0.000075	0.0000017 – 0.000412 J	na	na
	netfishing	43/43	100	0.00010	0.0000011 – 0.0021 J	na	na
Total PCBs	beach play RME, Area 3	11/14	79	0.089	0.0022 – 0.42 J	0.016 – 0.017	2
	beach play RME, Area 4	12/12	100	2.8	0.011 J – 23	na	na
	beach play RME, Area 5	31/32	97	0.1	0.024 – 0.66	0.020	1
	beach play RME, Area 7	10/14	71	0.063	0.0098 – 0.34	0.019 – 0.040	3
	tribal clamming – RME and 183 days per year	415/440	94	2.0	0.0022 – 110	0.016 – 0.040	5
	clamming – 7 days per year	142/161	88	0.43	0.0022 – 23	0.016 – 0.040	5
	netfishing	1205/1291	93	1.0	0.0016 J – 220	0.00056 – 0.05	25

[a] Summary statistics are presented in mg/kg ww for seafood consumption scenarios and in mg/kg dw for sediment exposure scenarios.

[b] No mussel data were available for this chemical. When calculating the CDI and risk values, the proportion of seafood consumption that had been assigned to mussels was divided proportionally among the remaining consumption categories.

[c] cPAH concentrations are given in terms of benzo(a)pyrene equivalents. Data used in the risk characterization section of this document are from only 2004 because of high RLs in historical data. All cPAH data are analyzed in the uncertainty analysis (Section B.6).

dw – dry weight

EPC – exposure point concentration

J – Analyte was positively identified and detected; however, concentration is an estimated value because the result is less than the quantitation limit or QC criteria were not met.

M – value is a weighted mean (described in Table B.2-4).

MTCA – Model Toxics Control Act

na – not applicable; no analytical data for that chemical in that seafood category

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

RL – reporting limit

RME – reasonable maximum exposure

TEQ – toxic equivalent

ww – wet weight

Table 2. Comparison of EPCs used in this HHRA and MTCA-conforming EPCs

Chemical	Consumption Category or Scenario	DF (%)	HHRA ProUCL 4.0 EPCs		Distribution Test		MTCA-Conforming EPCs	
			Statistic Used	EPC (mg/kg)[a]	Lognormal R^2	Normal R^2	Statistic Used	EPC (mg/kg)[a]
Seafood Consumption Scenarios								
Arsenic (inorganic)	benthic fish, fillet	75	95% Chebyshev, pooled one-half RL	0.0062	0.902	0.938	Land's h-statistic (Cohen's method)	0.0053
	benthic fish, whole body	100	Student's-t UCL	0.073	0.911	0.924	Land's h-statistic	0.091
	clams	100	Student's-t UCL	2.0	0.955	0.902	Land's h-statistic [maximum detected value][b]	6.8 [3.3]
	crab, edible meat	100	95% Chebyshev (mean, SD) UCL	0.042	0.663	0.663	z-statistic maximum detected value	0.030 0.030
	crab, whole body	100	Student's-t UCL	0.11	0.884	0.861	z-statistic maximum detected value [Land's h-statistic][c]	0.11 0.12 [0.23]
	pelagic fish, whole body	80	95% KM (t) UCL	0.088	0.930	0.962	Land's h-statistic (Cohen's method) [maximum detected value][b]	0.27 [0.16]
Carcinogenic PAHs	benthic fish, fillet	63	maximum detected value	0.00064	0.982	0.985	Land's h-statistic (Cohen's method)[d]	0.00053
	benthic fish, whole body	88	95% KM (Chebyshev) UCL	0.0023	0.847	0.901	t-statistic (one-half RL substitution)	0.0018
	clams	100	approximate gamma UCL	0.020	0.920	0.733	Land's h-statistic	0.020
	crab, edible meat	42	95% KM (t) UCL	0.00065	0.663	0.738	maximum detected value[e]	0.00084
	crab, whole body	100	95% modified-t UCL	0.00092	0.435	0.319	z-statistic maximum detected value	0.00090 0.0024
	pelagic fish, whole body	100	95% modified-t UCL	0.00095	0.872	0.701	z-statistic maximum detected value [Land's h-statistic][c]	0.00094 0.0022 [0.00093]

Chemical	Consumption Category or Scenario	DF (%)	HHRA ProUCL 4.0 EPCs		Distribution Test		MTCA-Conforming EPCs	
			Statistic Used	EPC (mg/kg)[a]	Lognormal R^2	Normal R^2	Statistic Used	EPC (mg/kg)[a]
Copper	benthic fish, whole body	100	95% Chebyshev (mean, SD) UCL	2.6	0.886	0.879	z-statistic maximum detected value [Land's h-statistic][c]	2.1 3.5 [2.4]
	crab, edible meat	100	Student's-t UCL	8.5	0.884	0.745	z-statistic maximum detected value [Land's h-statistic][c]	8.5 16 [8.5]
	crab, whole body	100	Student's-t UCL	16	0.954	0.926	Land's h-statistic	16
Mercury	benthic fish, fillet	100	95% Chebyshev, pooled RL	0.058	0.921	0.923	Land's h-statistic	0.056
	benthic fish, whole body	100	Student's-t UCL	0.020	0.962	0.939	Land's h-statistic	0.017
	crab, edible meat	100	approximate gamma UCL	0.064	0.951	0.870	Land's h-statistic	0.065
	crab, whole body	100	Student's-t UCL	0.052	0.889	0.757	z-statistic maximum detected value [Land's h-statistic][c]	0.052 0.097 [0.052]
	mussels	100	approximate gamma UCL	0.014	0.929	0.834	Land's h-statistic	0.014
	pelagic fish, whole body	100	Student's-t UCL	0.039	0.876	0.712	z-statistic maximum detected value [Land's h-statistic][c]	0.038 0.088 [0.038]
Total PCBs	benthic fish, fillet	100	95% Chebyshev, pooled RL	1.2	0.962	0.894	Land's h-statistic	1.1
	benthic fish, whole body	100	approximate gamma UCL	2.6	0.962	0.932	Land's h-statistic	2.7
	clams	100	99% Chebyshev (mean, SD) UCL	0.60	0.820	0.728	z-statistic maximum detected value [Land's h-statistic][c]	0.22 0.58 [0.40]
	crab, edible meat	90	95% KM (t) UCL	0.20	0.850	0.950	t-statistic (one-half RL substitution)	0.20
	crab, whole body	100	95% H-UCL	1.1	0.934	0.866	Land's h-statistic	1.1
	mussels	82	95% KM (percentile bootstrap) UCL	0.041	0.870	0.958	t-statistic (Cohen's method)	0.040
	pelagic fish, whole body	100	95% H-UCL	1.9	0.926	0.394	Land's h-statistic	1.9

Chemical	Consumption Category or Scenario	DF (%)	HHRA ProUCL 4.0 EPCs		Distribution Test		MTCA-Conforming EPCs	
			Statistic Used	EPC (mg/kg)[a]	Lognormal R^2	Normal R^2	Statistic Used	EPC (mg/kg)[a]
Vanadium	clams	100	approximate gamma UCL	1.5	0.902	0.787	Land's h-statistic	1.5
	mussels	100	Student's-t UCL	0.19	0.894	0.941	t-statistic	0.19
	pelagic fish, whole body	85	95% KM (Chebyshev) UCL	0.62	0.927	0.827	Land's h-statistic (Cohen's method)[f]	0.48
Sediment Exposure Scenarios								
Arsenic	beach play RME, Area 3	67	95% KM (percentile bootstrap) UCL	13	0.934	0.955	Land's h-statistic (Cohen's method)	14[f] 16[g]
	beach play RME, Area 5	100	95% Students-t UCL	8.9	0.943	0.973	Land's h-statistic	9.1
	beach play RME, Area 7	100	95% Students-t UCL	11	0.949	0.945	Land's h-statistic	12
	tribal clamming – RME and 183 days per year	92	95% KM (BCA) UCL	27	0.941	0.987	Land's h-statistic (one-half RL substitution)[h]	14
	clamming – 7 days per year	97	95% KM (percentile bootstrap) UCL	9.5	0.985	0.958	Land's h-statistic (one-half RL substitution)	9.7
	netfishing	92	95% KM (BCA) UCL	21	0.980	0.985	Land's h-statistic using ProUCL (one-half RL substitution)[h, i]	15
Carcinogenic PAHs	beach play RME, Area 3	78	95% KM (Chebyshev) UCL	2.1	0.914	0.843	Land's h-statistic (Cohen's method)[f] [maximum detected value][b]	71 [2.9]
	beach play RME, Area 5	100	95% Chebyshev (MVUE) UCL	0.41	0.919	0.570	Land's h-statistic	0.37
	beach play RME, Area 7	89	95% KM (t) UCL	0.11	0.854	0.921	t-statistic (one-half RL substitution)	0.11
	beach play RME, Area 8	100	95% Students-t UCL	0.32	0.951	0.842	Land's h-statistic	0.43
	tribal clamming – RME and 183 days per year	97	95% KM (Chebyshev) UCL	0.77	0.993	0.795	Land's h-statistic (one-half RL substitution)	0.55
	clamming – 7 days per year	94	95% KM (Chebyshev) UCL	0.48	0.989	0.552	Land's h-statistic (one-half RL substitution)	0.38
	netfishing	94	95% KM (Chebyshev) UCL	0.57	0.984	0.925	Land's h-statistic using ProUCL (one-half RL substitution)[i]	0.56

Chemical	Consumption Category or Scenario	DF (%)	HHRA ProUCL 4.0 EPCs		Distribution Test		MTCA-Conforming EPCs	
			Statistic Used	EPC (mg/kg)[a]	Lognormal R^2	Normal R^2	Statistic Used	EPC (mg/kg)[a]
Dioxin/furan TEQ	tribal clamming – RME and 183 days per year	100	95% adjusted gamma UCL	0.00142	0.935	0.579	Land's h-statistic [maximum detected value][b]	0.136 [0.00210]
	clamming – 7 days per year	100	99% Chebyshev (MVUE) UCL	0.000365	0.866	na	z-statistic maximum detected value [Land's h-statistic][c]	0.000186 0.000412 [0.0644]
	netfishing	100	99% Chebyshev (mean, SD) UCL	0.000610	0.899[j]	0.290	Land's h-statistic	0.000139
Total PCBs	beach play RME, Area 3	79	95% KM (Chebyshev) UCL	0.24	0.972	0.751	Land's h-statistic (Cohen's method)[f] [maximum detected value][b]	1.8 [0.42]
	beach play RME, Area 4	100	95% adjusted gamma UCL	11	0.986	0.460	Land's h-statistic [maximum detected value][b]	207 [23]
	beach play RME, Area 5	97	95% KM (Chebyshev) UCL	0.19	0.925	0.505	Land's h-statistic (one-half RL substitution)	0.13
	beach play RME, Area 7	71	97.5% KM (Chebyshev) UCL	0.23	0.866	0.555	maximum detected value [Land's h-statistic (Cohen's method)][c, g]	0.34 [0.19]
	tribal clamming – RME and 183 days per year	94	97.5% KM (Chebyshev) UCL	4.0	0.983	0.690	Land's h-statistic (one-half RL substitution)	3.9
	clamming – 7 days per year	88	97.5% KM (Chebyshev) UCL	1.5	0.970	0.152	Land's h-statistic (one-half RL substitution)	0.34
	netfishing	93	97.5% KM (Chebyshev) UCL	2.5	0.993	0.867	Land's h-statistic (one-half RL substitution)[k]	0.98

[a] EPCs are presented in mg/kg ww for seafood consumption scenarios and in mg/kg dw for sediment exposure scenarios.

[b] For some recalculated EPCs, the Land's h-statistic UCL is substantially greater than the maximum detected value. For comparison purposes, the maximum detected value is shown in brackets.

[c] The Land's h-statistic is presented for comparison purposes only, as indicated by the brackets around the UCL. While the lognormal R^2 value is less than the 0.9 cutoff, it approaches this threshold.

[d] To calculate the UCL, the lowest detected value was used in place of the RL for the non-detect values because the mean of the detected data (0.49) was only slightly higher than the RLs (0.45).

[e] Detection frequency less than 50%, so no UCL was calculated.

[f] To calculate the UCL in MTCAStat, the highest RL was used to represent the non-detect data.

[g] To calculate the UCL in MTCAStat, the average RL for the non-detect data was used.

[h] An additional UCL calculation was performed without the two highest RLs, but the EPC remained the same.

[i] Several datasets were evaluated in both MTCAStat and ProUCL to ensure that the same h-statistic was calculated in both programs.

[j] Equal to 0.90 when rounded to two significant figures.

[k] UCL calculated using BTNCTD.EXE program supplied by Gregory Glass (Glass 2007b; Land 1994) because ProUCL will not calculate an h-statistic for datasets with more than 1,000 values.

BCA – bias-corrected accelerated

DF – detection frequency

dw – dry weight

EPC – exposure point concentration

HHRA – human health risk assessment

H-UCL – UCL based on Land's h-statistic

KM – Kaplan-Meier method for calculating a UCL

MTCA – Model Toxics Control Act

MVUE – minimum-variance unbiased eliminator

na – not applicable; no analytical data for that chemical in that seafood category

nd – not detected

PAH – polycyclic aromatic hydrocarbon

PCB – polychlorinated biphenyl

RL – reporting limit

RME – reasonable maximum exposure

SD – standard deviation

t (t-distribution) – statistical method used to estimate the mean for a normally distributed set of samples

TEQ – toxic equivalent

UCL – upper confidence limit on the mean

ww – wet weight