N00247_000789
NTC SAN DIEGO
SSIC NO. 5090.3.A

Alternative Cleanup Levels Technical Memorandum, Boat Channel Sediments, Former Naval Training Center San Diego

Prepared for

Department of the Navy
Base Realignment and Closure (BRAC)
Program Management Office (PMO) West
San Diego, California

November 6, 2014

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Prepared under
BRAC PMO West
Contract Number No.: N62473-13-D-4803
Document Control Number: TRVT-4803-0005-0005

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Alternative Cleanup Levels for the Boat Channel Sediments, Former Naval Training Center San Diego

1. Introduction

This report was prepared to evaluate methods to develop alternative cleanup levels (ACLs) and to present appropriate ACLs for copper, lead, zinc, Total Chlordane, and Total Dichlorodiphenyltrichloroethane (DDT) for the Boat Channel sediments, Installation Restoration (IR) Program Site 12, at former Naval Training Center (NTC) San Diego, California. The ACLs presented in this report follow the initial ACLs presented in the Draft Feasibility Study (FS) Report (Trevet 2012) and the ACLs proposed in the Water Board letter dated January 9, 2013.

An ACL may be established for chemicals of concern if it is technologically or economically infeasible to achieve the background values and if the chemicals will not pose a substantial present or potential hazard to human health or the environment as long as ACL is not exceeded (California Code of Regulations, Title 22, § 66264.94). The Draft FS Report, Appendix C, documented that it is technologically or economically infeasible to achieve background sediment values.

The intent of an ACL is to provide a technologically and economically feasible chemical-specific concentration that represents the threshold between chemical concentrations that do not cause a substantial present or potential hazard to human health or the environment and the chemical concentrations that do.

2. ACLs Used at Other Sites in San Diego Bay

ACLs have been developed for sediment sites in San Diego Bay since approximately 1995 (Table 1). ACLs are developed on a site-specific basis; therefore, the ACLs for other San Diego Bay sites are presented here for reference and perspective.

Table 1. ACLs Used for Other Sites within San Diego Bay

Chemical	Units [1]	SWM/NASSCO Shipyards (2012) [2]	Campbell Shipyards (2004) [3]	SWM Shipyards (1999) [4]	NASSCO Shipyards (1999) [4]
Copper	mg/kg	159	264	810	810
Lead	mg/kg	NA	88	231	231
Zinc	mg/kg	NA	410	820	820
Total Chlordane	µg/kg	NA	NA	NA	NA
Total DDT	µg/kg	NA	NA	NA	NA

mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram

[1] Results for all chemicals are on a dry-weight basis

[2] Water Board (San Diego Regional Water Quality Control Board). 2012. Cleanup and Abatement Order R9-2012-0024 for the Shipyard Sediment Site. March 14, 2012. SWM = Southwest Marine; NASSCO = National Steel and Shipbuilding Company

[3] Water Board (San Diego Regional Water Quality Control Board). 2004. Order No. R9-2004-0295 Tentative Waste Discharge Requirements for the Port of San Diego Campbell Shipyards Site. October 13, 2004.

[4] Water Board (San Diego Regional Water Quality Control Board). 1999. Cleanup and Abatement Order R9-0099-0012 for the Southwest Marine Shipyard Sediment Site and Cleanup and Abatement Order R9-0099-0020 for the National Steel and Shipbuilding Company Shipyard Sediment Site. March 10, 1999. SWM = Southwest Marine

3. ACLs Proposed in the Draft FS Report

The ACLs presented in the Draft FS Report were based on the apparent effects threshold (AET) analysis, a chemical concentration threshold set at an expected incidence of toxicity of 100 percent. The definition of the AET is that all samples with concentrations greater than the threshold are toxic based on the available data for biological effects. The lowest AET from the multiple biological effects that were tested was used to represent the chemical-specific AETs. The lowest AETs for the Boat Channel data were presented in the Draft FS Report and are listed in Table 2. For the Boat Channel data set, the lowest AET for each chemical of concern was the amphipod survival AET. The incidence of toxicity was less than 100 percent for the sea urchin fertilization and benthic community structure data; therefore, specific chemical AET values could not be calculated for those biological measurements.

Table 2. ACLs Proposed in the 2012 Draft FS Report

Chemical	Units [1]	Threshold	Sensitivity	Efficiency	Reliability
Copper	mg/kg	185	14%	100%	77%
Lead	mg/kg	190	14%	100%	77%
Zinc	mg/kg	346	14%	100%	77%
Total Chlordane	µg/kg	15	29%	100%	81%
Total DDT	µg/kg	274	0%	100%	73%

[1] *Results for all chemicals are on a dry-weight basis*

The AETs were reported in the Draft FS Report and are based on the results of the Boat Channel sediment quality data reported in the Remedial Investigation (RI) Report. The lowest AETs (amphipod survival) are listed below along with results of the sensitivity, efficiency, and reliability analysis. The uncertainty associated with effects-based thresholds such as the AET can be assessed by sensitivity, efficiency, and reliability analysis (U.S. Environmental Protection Agency [U.S. EPA] 1992, Barrick et al. 1988). Sensitivity is calculated as the number of stations correctly predicted by the threshold to exhibit biological effects divided by the number of stations with known biological effects. Efficiency is calculated as the number of stations correctly predicted by the threshold to exhibit biological effects divided by the total number of stations predicted by the threshold to exhibit biological effects. Reliability is a balance of sensitivity and efficiency and is calculated as the number of stations correctly predicted by the threshold to exhibit biological effects plus the number of stations correctly predicted by the threshold to exhibit no biological effects divided by the total number of stations assessed.

The efficiency and reliability of the amphipod survival AET are good; however, the sensitivity is relatively low indicating an increase in false-negative errors. A false-negative error occurs when a station is predicted by the threshold to be unimpacted when it is actually impacted. Due to the definition of an AET—the concentration above which adverse biological effects were always present—the AET efficiency is always 100 percent.

Water Board Letter. The January 9, 2013, Water Board letter proposed ACLs based on the minimum of two thresholds: one based on a greater than 50 percent incidence of amphipod toxicity, and one based on the 95-percent upper confidence limit (UCL) of the mean.

The first threshold based on an incidence of amphipod toxicity of greater than 50 percent may be appropriate as a threshold because it incorporates site-specific sediment chemistry and toxicity data for a sensitive receptor. It also incorporates both the range of concentrations associated with effects as well as the range of concentrations associated with no effects. However, the threshold does not

include consideration of other site-specific data, such as the sea urchin fertilization and benthic community structure. The thresholds for incidence of amphipod toxicity greater than 50 percent are calculated in Appendix A of this report and presented in the next section. The incidence of toxicity values calculated in Appendix A follow the approach described in the Water Board letter ("the apparent level where the majority of stations with concentrations above which exhibit moderate or high amphipod toxicity"); however, the values presented in the Water Board letter could not be repeated. The Water Board letter did not explain why the presented thresholds are not consistent with the calculated incidence of toxicity.

The second threshold, based on the 95-percent UCL, is a central tendency estimate and is not an appropriate threshold. A central tendency estimate, such as the mean, median or the 95-percent UCL, would be useful if an estimate were required of the average exposure across a large area or if average concentrations were to be compared between sites, as opposed to a point by point comparison which is more appropriate for benthic evaluation at individual locations. In addition, the central tendency estimate of the concentrations associated with unimpacted conditions would not be appropriate as a threshold because it would, by definition, indicate that one half of the unimpacted stations exceeded the threshold. Similarly, a central tendency estimate of the impacted distribution would not be appropriate because it would, by definition, indicate that one half of the impacted stations did not exceed the threshold.

Since the intent of an ACL is to provide a chemical-specific concentration that represents the threshold between unimpacted and impacted conditions, statistical estimates of the limits of these two data distributions are necessary and are presented below.

4. Evaluation of Potential Threshold Values

The data available to develop ACLs for the Boat Channel sediments were reported in the RI Report (Bechtel Environmental, Inc. 2003) and the Draft FS Report. Development of the ACLs is based on the evaluation of multiple types of data presented in Appendix A3 of the Draft FS Report as the multiple lines of evidence Station Assessment evaluation. The data set includes the following: concentrations of copper, lead, zinc, Total Chlordane and Total DDT; toxicity data for amphipod survival and sea urchin fertilization; and benthic community structure for 26 stations located within the Boat Channel.

Based on the Station Assessment procedures presented in the Draft FS Report, the toxicity data were categorized either as nontoxic or as low, moderate, or high toxicity. Similarly, the benthic community structure data were categorized as either reference or as low, moderate, or high disturbance. The final Station Assessment, which integrated the multiple lines of evidence (chemistry, toxicity, benthic community), categorized 18 of the Boat Channel stations as either Unimpacted or Likely Unimpacted, six of the stations as Possibly Impacted, and two of the stations as Likely Impacted.

Development of threshold levels based on the data obtained from Boat Channel sediments provides for highly site-specific values.

Effects-based thresholds can be developed from the relationship between chemical concentrations and biological effects. For the Boat Channel, data sets are available for sediment chemistry and biological effects including amphipod survival, sea urchin fertilization, and benthic community structure. A data set is also available for sediment chemistry and the Station Assessment category which integrates multiple lines of evidence of sediment quality. An effects-based threshold can be developed for each chemical of concern for each biological effect line of evidence (LOE). An effects-based threshold can also be developed for each chemical of concern for the Station Assessment

category. The Station Assessment category is valuable because it integrates the multiple LOE to the maximum extent possible.

Examples of effects-based thresholds include AETs and a greater than 50-percent incidence of amphipod toxicity. AETs based on amphipod toxicity and the Station Assessment results are presented here. However, AETs based on the sea urchin fertilization and benthic community structure results are not presented because the stations with the highest reported concentrations exhibited no biological effects for these tests. This suggests that sea urchin fertilization and benthic community structure are not sensitive to the concentrations of chemicals of concern reported for the Boat Channel sediments.

4.1 Incidence of Amphipod Toxicity

This threshold represents a concentration above which greater than 50 percent of the stations exhibited amphipod toxicity. The Incidence of Amphipod Toxicity thresholds are presented in Table 3 and Appendix A. The selection of the greater than 50-percent toxicity level is an appropriate balance of potential uncertainties. A toxicity level of 50 percent or less would indicate remedial action for stations, at least half of which had not exhibited any amphipod toxicity. The greater than 50-percent amphipod toxicity values are listed below with results of the sensitivity, efficiency, and reliability analysis. The efficiency and reliability of the amphipod toxicity threshold are good. However, the sensitivity of the threshold is somewhat low, indicating an increase in false-negative errors.

Table 3. Incidence of Amphipod Toxicity Greater than 50 Percent, Boat Channel Sediments

Chemical	Units [1]	Threshold	Sensitivity	Efficiency	Reliability
Copper	mg/kg	126	43%	60%	77%
Lead	mg/kg	153	43%	60%	77%
Zinc	mg/kg	273	43%	60%	77%
Total Chlordane	µg/kg	13	29%	67%	77%
Total DDT	µg/kg	151	29%	67%	77%

[1] Results for all chemicals are on a dry-weight basis

4.2 Sensitive-AETs for the Station Assessment Results

The Station Assessment results were reported in the Draft FS Report. The Sensitive-AETs for the Station Assessment results were developed here using stations categorized as Unimpacted, Likely Unimpacted, and Likely Impacted in a manner similar to the traditional AETs. However, the threshold was set at the maximum concentration associated with unimpacted conditions (Unimpacted or Likely Unimpacted stations) that was below the minimum concentration associated with impacted conditions (Likely Impacted stations). This modification to the traditional AET sets the sensitivity at 100 percent. Efficiency then depends on the number of false-positive errors. A false-positive occurs when a station is predicted by the threshold to be impacted when it is actually unimpacted. These Sensitive-AETs are considered appropriate for use with the Station Assessment results because the Station Assessment evaluation integrates multiple measures of biological effect.

The Sensitive-AETs for the Station Assessment results are listed in Table 4 with results of the sensitivity, efficiency, and reliability analysis. The development of the Sensitive-AETs is presented in Appendix B. The sensitivity, efficiency, and reliability of the Station Assessment AET are good.

Table 4. Sensitive-AETs for Station Assessment Results, Boat Channel Sediments					
Chemical	Units [1]	Threshold	Sensitivity	Efficiency	Reliability
Copper	mg/kg	126	100%	50%	90%
Lead	mg/kg	165	100%	67%	95%
Zinc	mg/kg	333	100%	67%	95%
Total Chlordane	µg/kg	15	100%	100%	100%
Total DDT	µg/kg	94	100%	67%	95%

[1] *Results for all chemicals are on a dry-weight basis*

4.3 Ninety-five Percent Upper Predictive Limits for Concentrations from Unimpacted and Likely Unimpacted Stations

This section presents the upper limit estimates of chemical concentration that are associated with the Unimpacted and Likely Unimpacted stations from the Station Assessment. Upper limit estimates of the data distribution are appropriate for developing the alternative cleanup levels. Upper limit values such as the 95-percent upper predictive limit (UPL) are appropriate for estimating the threshold of a data distribution that will be used for point-by-point comparisons (U.S. EPA 2013). The 95-percent UPL has previously been used for the Boat Channel sediments site to represent an upper limit estimate of reference concentrations. More data are available than the recommended minimum 10 data values for the development of upper limit values such as the upper predictive limit (U.S. EPA 2013).

The available Boat Channel data can be grouped into three categories based on the evaluation presented in the Station Assessment: the 18 unimpacted stations with Station Assessment categories of Unimpacted or Likely Unimpacted; the two impacted stations with Station Assessment categories of Likely Impacted; and the six stations with Station Assessment category of Possibly Impacted. The Possibly Impacted category was assigned to stations where the potential impacts were small or uncertain and the chemistry, toxicity, and benthic community lines of evidence were in disagreement. There are a sufficient number of unimpacted stations to calculate a 95-percent UPL. However, there are too few impacted stations with which to develop statistical estimates.

The 95-percent UPLs were calculated with data from the Boat Channel Unimpacted and Likely Unimpacted stations using the U.S. EPA statistics program ProUCL. The ProUCL program evaluates the data for consistency with various distributions and then makes a recommendation as to which distribution to use as the basis of the calculated upper limit values. The ProUCL program recommended that copper and zinc be represented by the normal distribution, lead and Total Chlordane by the lognormal distribution, and Total DDT by the gamma distribution. The ProUCL program results are included in Appendix C. The results of the calculations are summarized in Table 5. For comparison, the sensitivity, efficiency, and reliability estimates for Station Assessment categories are also listed. The sensitivity and reliability estimates are good. However, the efficiency of the threshold is lower for copper indicating an increase in false-positive errors.

Table 5. 95-Percent UPLs for Concentrations Associated with Unimpacted and Likely Unimpacted Stations, Boat Channel Sediments

Chemical	Units [1]	Threshold	Station Assessment		
			Sensitivity	Efficiency	Reliability
Copper	mg/kg	166	50%	33%	85%
Lead	mg/kg	183	100%	67%	95%
Zinc	mg/kg	329	100%	50%	90%
Total Chlordane	µg/kg	16	100%	100%	100%
Total DDT	µg/kg	139	100%	67%	95%

[1] *Results for all chemicals are on a dry-weight basis*

5. Background Concentrations

ACL concentrations must be greater than the background concentrations. Background sediment concentrations have been developed for the Boat Channel following two methods known as the distance-from-shore method and the expanded reference data set. Both methods were developed from sediment data collected from the San Diego Bay and were presented in the Draft FS Report.

The distance-from-shore method selected representative data using a screening value based on station distance from shore and iron-normalized concentrations. The background value was represented by the 95-percent UPL of selected data (Appendix A1 of the Draft FS Report).

The expanded reference data set selected representative data from Boat Channel sediment investigations and two regional sediment investigations (Sediment Assessments for Chollas and Paleta Creeks [SCCWRP and U.S. Navy 2005] and Bay Protection and Toxics Cleanup Program [Fairey et al. 1996]). The background value was represented by the 95-percent UPL of selected data (Appendix A2 of the Draft FS Report). During the TEF evaluation, it was determined that cleanup to background is technically and economically infeasible. In accordance with Navy policy, cleanup levels must never be below background. Therefore, the selected ACL must be above the background concentration.

Table 6. Background Concentrations, Boat Channel Sediments

Chemical	Units [1]	Distance-from-Shore Background	Expanded Reference Background	Final Background Value [2]
Copper	mg/kg	126	163	126
Lead	mg/kg	64	56.3	56.3
Zinc	mg/kg	282	257	257
Total Chlordane	µg/kg	2	2.38	2
Total DDT	µg/kg	4	6.6	4

[1] *Results for all chemicals are on a dry-weight basis*

[2] *Lower of the two background values*

6. Conclusions

The recommended ACLs are based on the 95-percent UPLs for concentrations from Unimpacted and Likely Unimpacted stations as presented in Table 5 and summarized below in Table 7. The 95-percent UPL threshold was selected because:

- it is based on sediment concentrations associated with unimpacted conditions, which integrates multiple site-specific LOE;
- it is not biased by the use of only a single biological measurement;
- it is a population upper-limit estimate intended for comparison to single samples such as single stations;
- it represents the threshold between chemical concentrations that are not associated with impacted sediment quality and the chemical concentrations that are;
- it is calculated using a U.S. EPA statistical program;
- the ACLs are within the range of other threshold values calculated for the site, such as the lowest AET, Sensitive-AET for Station Assessment results, and greater than 50-percent incidence of amphipod toxicity;
- the ACLs meet the requirements for background analysis with respect to Navy Policy; and
- the 95-percent UPL statistic has previously been used for the Boat Channel sediments site to identify threshold limit values.

Table 7. Recommended ACLs

Chemical	Units [1]	Recommended ACLs/ 95-Percent UPLs for Unimpacted and Likely Unimpacted Stations
Copper	mg/kg	166
Lead	mg/kg	183
Zinc	mg/kg	329
Total Chlordane	µg/kg	16
Total DDT	µg/kg	139

[1] *Results for all chemicals are on a dry-weight basis*

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Appendix A: Incidence of Amphipod Toxicity

Table A-1. Sediment Copper Concentrations and Amphipod Survival, Former Naval Training Center San Diego [1]					
Boat Channel Station	Copper (mg/kg)	Amphipod Survival Toxicity LOE	Number of Concentrations with Toxicity Above the Listed Concentration [2]	Total Number of Concentrations Above the Listed Concentration	Incidence of Toxicity Above the Listed Concentration [3]
S1S4	281	High	NA	NA	NA
S1S7	185	Nontoxic	1	1	100%
S1S8	174	Nontoxic	1	2	50%
S1S6	156	High	1	3	33%
S1S1	154	High	2	4	50%
S1S9	**126**	**Nontoxic**	**3**	**5**	**60%**
S1S10	122	Nontoxic	3	6	50%
S2S12	112	High	3	7	43%
S2S2	110	Nontoxic	4	8	50%
S2S4	107	Nontoxic	4	9	44%
S1S2	106	Nontoxic	4	10	40%
S2S13	104	Nontoxic	4	11	36%
S2S14	104	Nontoxic	4	12	33%
S2S15	100	Nontoxic	4	13	31%
S2S10	99.7	Moderate	4	14	29%
S2S6	93	Nontoxic	5	15	33%
S1S5	91.6	Nontoxic	5	16	31%
S2S3	84.2	Nontoxic	5	17	29%
S2S8	84.1	Nontoxic	5	18	28%
S2S16	80.8	Nontoxic	5	19	26%
S2S1	75.4	Nontoxic	5	20	25%
S2S11	74.6	Nontoxic	5	21	24%
S2S9	70	Moderate	5	22	23%
S2S7	57	Nontoxic	6	23	26%
S2S5	53.8	Nontoxic	6	24	25%
S1S3	40.1	Moderate	6	25	24%

[1] *The sediment chemistry and amphipod survival toxicity data were presented in the Draft Feasibility Study Report, Appendix A-3 Station Assessment (Trevet 2012).*

[2] *Toxicity is defined as a High or Moderate score for the amphipod survival toxicity line of evidence (LOE), above the listed concentration.*

[3] *The incidence of toxicity above a given concentration is calculated here iteratively for each concentration in the data set. The incidence of toxicity above a given concentration (i.e. the concentration listed on the row) is equal to the number of concentrations above the given concentration that are associated with toxicity divided by the total number of concentrations above the given concentration. Example for copper of 126 mg/kg: there are five copper concentrations above 126 mg/kg and three of those had either moderate or high toxicity; therefore, the incidence of toxicity above 126 mg/kg of Copper is 3/5 or 60 percent. The incidence of toxicity above the maximum concentration in the data set cannot be assessed, by definition (there are no concentrations in the data set greater than the maximum concentration). The selected threshold value (bold) is the lowest concentration above which the incidence of toxicity is greater than 50 percent.*

Table A-2. Sediment Lead Concentrations and Amphipod Survival, Former Naval Training Center San Diego [1]					
Boat Channel Station	Lead (mg/kg)	Amphipod Survival Toxicity LOE	Number of Concentrations with Toxicity Above the Listed Concentration [2]	Total Number of Concentrations Above the Listed Concentration	Incidence of Toxicity Above the Listed Concentration [3]
S1S4	391	High	NA	NA	NA
S1S6	190	High	1	1	100%
S1S8	190	Nontoxic	2	2	100%
S1S1	172	High	2	3	67%
S1S7	165	Nontoxic	3	4	75%
S1S2	**153**	**Nontoxic**	**3**	**5**	**60%**
S1S9	148	Nontoxic	3	6	50%
S1S5	129	Nontoxic	3	7	43%
S1S10	122	Nontoxic	3	8	38%
S2S4	99.4	Nontoxic	3	9	33%
S2S3	91.7	Nontoxic	3	10	30%
S2S6	77.5	Nontoxic	3	11	27%
S2S2	68	Nontoxic	3	12	25%
S2S12	67.2	High	3	13	23%
S2S8	65.7	Nontoxic	4	14	29%
S2S10	62.8	Moderate	4	15	27%
S2S13	58.2	Nontoxic	5	16	31%
S2S15	54.8	Nontoxic	5	17	29%
S2S14	54.7	Nontoxic	5	18	28%
S1S3	49.8	Moderate	5	19	26%
S2S9	47.6	Moderate	6	20	30%
S2S11	47.3	Nontoxic	7	21	33%
S2S5	42.8	Nontoxic	7	22	32%
S2S7	42.8	Nontoxic	7	23	30%
S2S16	42.7	Nontoxic	7	24	29%
S2S1	38.8	Nontoxic	7	25	28%

[1] *The sediment chemistry and amphipod survival toxicity data were presented in the Draft Feasibility Study Report, Appendix A-3 Station Assessment (Trevet 2012).*

[2] *Toxicity is defined as a High or Moderate score for the amphipod survival toxicity line of evidence (LOE), above the listed concentration.*

[3] *The incidence of toxicity above a given concentration is calculated here iteratively for each concentration in the data set. The incidence of toxicity above a given concentration (i.e. the concentration listed on the row) is equal to the number of concentrations above the given concentration that are associated with toxicity divided by the total number of concentrations above the given concentration. Example for lead of 153 mg/kg: there are five lead concentrations above 153 mg/kg and three of those had either moderate or high toxicity; therefore, the incidence of toxicity above 153 mg/kg of lead is 3/5 or 60 percent. The incidence of toxicity above the maximum concentration in the data set cannot be assessed, by definition (there are no concentrations in the data set greater than the maximum concentration). The selected threshold value (bold) is the lowest concentration above which the incidence of toxicity is greater than 50 percent.*

Table A-3. Sediment Zinc Concentrations and Amphipod Survival, Former Naval Training Center San Diego [1]					
Boat Channel Station	Zinc (mg/kg)	Amphipod Survival Toxicity LOE	Number of Concentrations with Toxicity Above the Listed Concentration [2]	Total Number of Concentrations Above the Listed Concentration	Incidence of Toxicity Above the Listed Concentration [3]
S1S4	530	High	NA	NA	NA
S1S8	346	Nontoxic	1	1	100%
S1S6	335	High	1	2	50%
S1S7	333	Nontoxic	2	3	67%
S1S1	330	High	2	4	50%
S1S9	**273**	**Nontoxic**	**3**	**5**	**60%**
S1S10	269	Nontoxic	3	6	50%
S1S2	261	Nontoxic	3	7	43%
S1S5	233	Nontoxic	3	8	38%
S2S4	230	Nontoxic	3	9	33%
S2S12	222	High	3	10	30%
S2S2	220	Nontoxic	4	11	36%
S2S14	207	Nontoxic	4	12	33%
S2S10	205	Moderate	4	13	31%
S2S6	202	Nontoxic	5	14	36%
S2S13	201	Nontoxic	5	15	33%
S2S15	188	Nontoxic	5	16	31%
S2S3	185	Nontoxic	5	17	29%
S2S8	182	Nontoxic	5	18	28%
S2S11	172	Nontoxic	5	19	26%
S2S16	157	Nontoxic	5	20	25%
S2S1	150	Nontoxic	5	21	24%
S2S9	150	Moderate	5	22	23%
S2S7	126	Nontoxic	6	23	26%
S2S5	120	Nontoxic	6	24	25%
S1S3	98	Moderate	6	25	24%

[1] *The sediment chemistry and amphipod survival toxicity data were presented in the Draft Feasibility Study Report, Appendix A-3 Station Assessment (Trevet 2012).*

[2] *Toxicity is defined as a High or Moderate score for the amphipod survival toxicity line of evidence (LOE), above the listed concentration.*

[3] *The incidence of toxicity above a given concentration is calculated here iteratively for each concentration in the data set. The incidence of toxicity above a given concentration (i.e. the concentration listed on the row) is equal to the number of concentrations above the given concentration that are associated with toxicity divided by the total number of concentrations above the given concentration. Example for zinc of 273 mg/kg: there are five zinc concentrations above 273 mg/kg and three of those had either moderate or high toxicity; therefore, the incidence of toxicity above 273 mg/kg of zinc is 3/5 or 60 percent. The incidence of toxicity above the maximum concentration in the data set cannot be assessed, by definition (there are no concentrations in the data set greater than the maximum concentration). The selected threshold value (bold) is the lowest concentration above which the incidence of toxicity is greater than 50 percent.*

Table A-4. Sediment Total Chlordane Concentrations and Amphipod Survival, Former Naval Training Center San Diego [1]					
Boat Channel Station	Total Chlordane (ug/kg)	Amphipod Survival Toxicity LOE	Number of Concentrations with Toxicity Above the Listed Concentration [2]	Total Number of Concentrations Above the Listed Concentration	Incidence of Toxicity Above the Listed Concentration [3]
S1S6	26	High	NA	NA	NA
S1S4	21.2	High	1	1	100%
S1S10	15	Nontoxic	2	2	100%
S1S9	**13**	**Nontoxic**	**2**	**3**	**67%**
S1S7	11	Nontoxic	2	4	50%
S1S5	9	Nontoxic	2	5	40%
S1S8	8	Nontoxic	2	6	33%
S2S4	8	Nontoxic	2	7	29%
S1S1	7	High	2	8	25%
S2S7	7	Nontoxic	3	9	33%
S1S2	6	Nontoxic	3	10	30%
S2S8	3	Nontoxic	3	11	27%
S2S6	2.9	Nontoxic	3	12	25%
S2S12	2.8	High	3	13	23%
S1S3	1.9	Moderate	4	14	29%
S2S2	1.7	Nontoxic	5	15	33%
S2S5	1.7	Nontoxic	5	16	31%
S2S15	1.7	Nontoxic	5	17	29%
S2S9	1.3	Moderate	5	18	28%
S2S11	1.3	Nontoxic	6	19	32%
S2S10	1.2	Moderate	6	20	30%
S2S13	1.2	Nontoxic	7	21	33%
S2S14	1.2	Nontoxic	7	22	32%
S2S16	1	Nontoxic	7	23	30%
S2S3	0.9	Nontoxic	7	24	29%
S2S1	0.7	Nontoxic	7	25	28%

[1] *The sediment chemistry and amphipod survival toxicity data were presented in the Draft Feasibility Study Report, Appendix A-3 Station Assessment (Trevet 2012).*

[2] *Toxicity is defined as a High or Moderate score for the amphipod survival toxicity line of evidence (LOE), above the listed concentration.*

[3] *The incidence of toxicity above a given concentration is calculated here iteratively for each concentration in the data set. The incidence of toxicity above a given concentration (i.e. the concentration listed on the row) is equal to the number of concentrations above the given concentration that are associated with toxicity divided by the total number of concentrations above the given concentration. Example for Total Chlordane of 13 ug/kg: there are three Total Chlordane concentrations above 13 ug/kg and two of those had either moderate or high toxicity; therefore, the incidence of toxicity above 13 ug/kg of Total Chlordane is 2/3 or 67 percent. The incidence of toxicity above the maximum concentration in the data set cannot be assessed, by definition (there are no concentrations in the data set greater than the maximum concentration). The selected threshold value (bold) is the lowest concentration above which the incidence of toxicity is greater than 50 percent.*

Table A-5. Sediment Total DDT Concentrations and Amphipod Survival, Former Naval Training Center San Diego [1]					
Boat Channel Station	Total DDT (ug/kg)	Amphipod Survival Toxicity LOE	Number of Concentrations with Toxicity Above the Listed Concentration [2]	Total Number of Concentrations Above the Listed Concentration	Incidence of Toxicity Above the Listed Concentration [3]
S1S10	274	Nontoxic	NA	NA	NA
S1S4	166	High	0	1	0%
S1S6	159	High	1	2	50%
S1S5	**151**	**Nontoxic**	**2**	**3**	**67%**
S1S7	94	Nontoxic	2	4	50%
S2S4	88	Nontoxic	2	5	40%
S1S9	81	Nontoxic	2	6	33%
S1S1	65	High	2	7	29%
S2S10	51	Moderate	3	8	38%
S1S8	46	Nontoxic	4	9	44%
S2S7	44	Nontoxic	4	10	40%
S1S2	42	Nontoxic	4	11	36%
S2S1	31	Nontoxic	4	12	33%
S1S3	23	Moderate	4	13	31%
S2S6	21	Nontoxic	5	14	36%
S2S13	19	Nontoxic	5	15	33%
S2S8	16	Nontoxic	5	16	31%
S2S2	15	Nontoxic	5	17	29%
S2S5	15	Nontoxic	5	18	28%
S2S12	15	High	5	19	26%
S2S14	14	Nontoxic	6	20	30%
S2S15	11	Nontoxic	6	21	29%
S2S16	9	Nontoxic	6	22	27%
S2S9	7	Moderate	6	23	26%
S2S3	6	Nontoxic	7	24	29%
S2S11	6	Nontoxic	7	25	28%

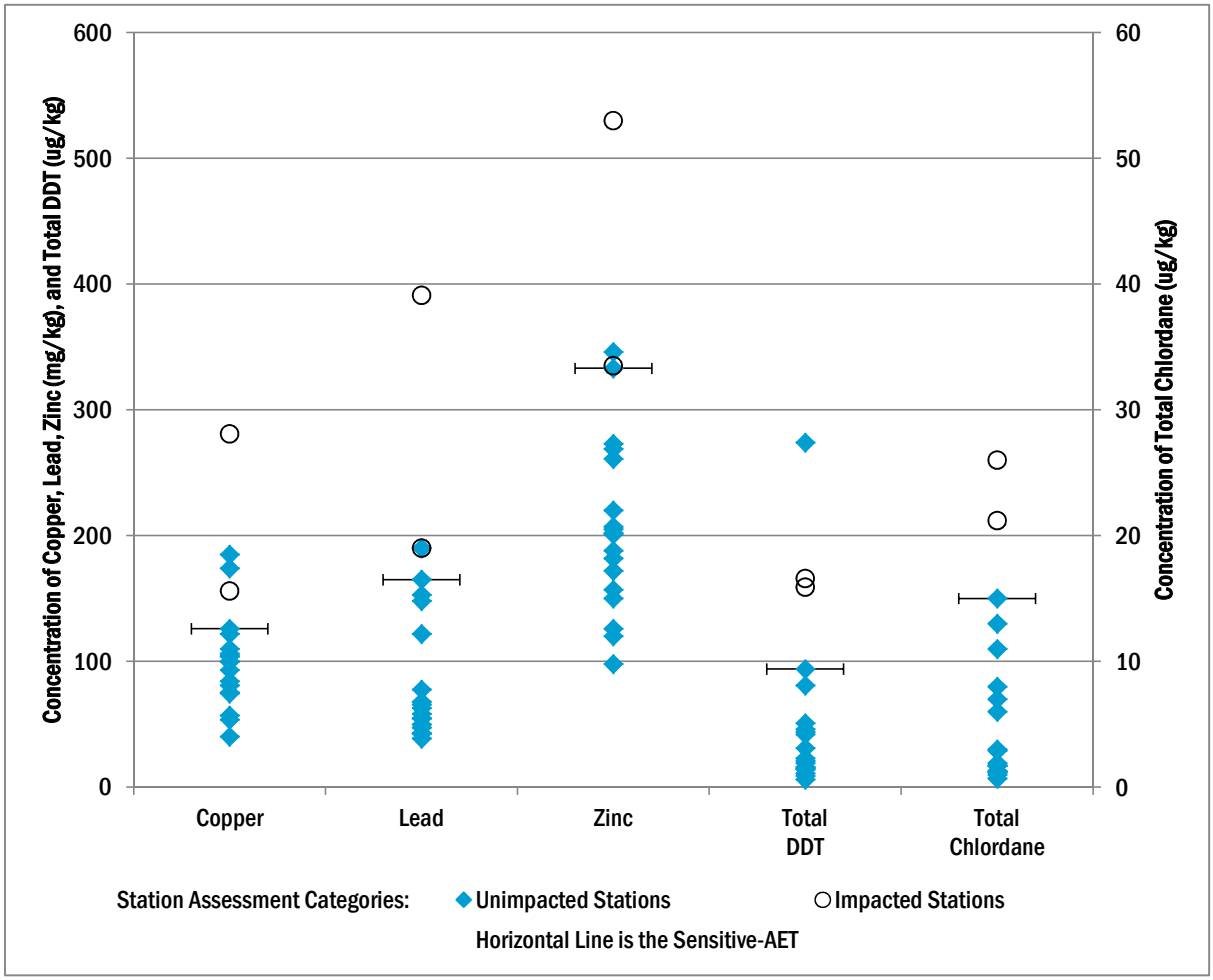
[1] *The sediment chemistry and amphipod survival toxicity data were presented in the Draft Feasibility Study Report, Appendix A-3 Station Assessment (Trevet 2012).*

[2] *Toxicity is defined as a High or Moderate score for the amphipod survival toxicity line of evidence (LOE), above the listed concentration.*

[3] *The incidence of toxicity above a given concentration is calculated here iteratively for each concentration in the data set. The incidence of toxicity above a given concentration (i.e. the concentration listed on the row) is equal to the number of concentrations above the given concentration that are associated with toxicity divided by the total number of concentrations above the given concentration. Example for Total DDT of 151 ug/kg: there are three Total DDT concentrations above 151 ug/kg and two of those had either moderate or high toxicity; therefore, the incidence of toxicity above 151 ug/kg of Total DDT is 2/3 or 67 percent. The incidence of toxicity above the maximum concentration in the data set cannot be assessed, by definition (there are no concentrations in the data set greater than the maximum concentration). The selected threshold value (bold) is the lowest concentration above which the incidence of toxicity is greater than 50 percent.*

Appendix B: Sensitive-AETs for Station Assessment Results

Figure B-1. Sensitive-AETs for Station Assessment Results, Boat Channel Sediment, Former NTC San Diego.



Appendix C: ProUCL Statistical Summaries for the 95-Percent UPLs for Concentrations Associated with Unimpacted and Likely Unimpacted Stations

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Copper, mg/kg

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Minimum	40.1	First Quartile	76.75
Second Largest	174	Median	99.85
Maximum	185	Third Quartile	109
Mean	99.42	SD	37.19
Coefficient of Variation	0.374	Skewness	0.842
Mean of logged Data	4.533	SD of logged Data	0.382

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.453	d2max (for USL)	2.504

Normal GOF Test

Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.166	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.209	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	190.6	90% Percentile (z)	147.1
95% UPL (t)	165.9	95% Percentile (z)	160.6
95% USL	192.5	99% Percentile (z)	185.9

Gamma GOF Test

A-D Test Statistic	0.316	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.121	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.204	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.683	k star (bias corrected MLE)	6.44
Theta hat (MLE)	12.94	Theta star (bias corrected MLE)	15.44
nu hat (MLE)	276.6	nu star (bias corrected)	231.8
MLE Mean (bias corrected)	99.42	MLE Sd (bias corrected)	39.18

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	174.6	90% Percentile	151.8
95% Hawkins Wixley (HW) Approx. Gamma UPL	176.5	95% Percentile	171.4
95% WH Approx. Gamma UTL with 95% Coverage	212.9	99% Percentile	212.4
95% HW Approx. Gamma UTL with 95% Coverage	217.7		
95% WH USL	216	95% HW USL	221.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.128	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Copper, mg/kg

Background Statistics assuming Lognormal Distribution

95% UTL with	95% Coverage	237.5	90% Percentile (z)	151.8
	95% UPL (t)	184.1	95% Percentile (z)	174.4
	95% USL	242.1	99% Percentile (z)	226.2

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r		18	95% UTL with 95% Coverage	185
Approximate f		0.947	Confidence Coefficient (CC) achieved by UTL	0.603
95% Percentile Bootstrap UTL with	95% Coverage	185	95% BCA Bootstrap UTL with 95% Coverage	185
	95% UPL	185	90% Percentile	140.4
	90% Chebyshev UPL	214.1	95% Percentile	175.7
	95% Chebyshev UPL	266	99% Percentile	183.1
	95% USL	185		

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Lead, mg/kg

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Minimum	38.8	First Quartile	47.93
Second Largest	165	Median	60.5
Maximum	190	Third Quartile	110.9
Mean	82.44	SD	49.21
Coefficient of Variation	0.597	Skewness	1.156
Mean of logged Data	4.269	SD of logged Data	0.528

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.453	d2max (for USL)	2.504

Normal GOF Test

Shapiro Wilk Test Statistic	0.787	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.282	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.209	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	203.2	90% Percentile (z)	145.5
95% UPL (t)	170.4	95% Percentile (z)	163.4
95% USL	205.7	99% Percentile (z)	196.9

Gamma GOF Test

A-D Test Statistic	1.264	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.237	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.205	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.65	k star (bias corrected MLE)	3.078
Theta hat (MLE)	22.59	Theta star (bias corrected MLE)	26.78
nu hat (MLE)	131.4	nu star (bias corrected)	110.8
MLE Mean (bias corrected)	82.44	MLE Sd (bias corrected)	46.99

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	176.7	90% Percentile	145.4
95% Hawkins Wixley (HW) Approx. Gamma UPL	178.1	95% Percentile	171.7
95% WH Approx. Gamma UTL with 95% Coverage	230.6	99% Percentile	228.7
95% HW Approx. Gamma UTL with 95% Coverage	236.5		
95% WH USL	235.2	95% HW USL	241.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.866	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.204	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Lead, mg/kg

Background Statistics assuming Lognormal Distribution

95% UTL with	95% Coverage	260.7	90% Percentile (z)	140.5
	95% UPL (t)	183.4	95% Percentile (z)	170.2
	95% USL	267.8	99% Percentile (z)	243.8

Nonparametric Distribution Free Background Statistics

Data appear Approximate Lognormal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r		18	95% UTL with	95% Coverage	190
Approximate f		0.947	Confidence Coefficient (CC) achieved by UTL		0.603
95% Percentile Bootstrap UTL with	95% Coverage	190	95% BCA Bootstrap UTL with	95% Coverage	190
	95% UPL	190		90% Percentile	156.6
	90% Chebyshev UPL	234.1		95% Percentile	168.8
	95% Chebyshev UPL	302.8		99% Percentile	185.8
	95% USL	190			

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Zinc, mg/kg

General Statistics

Total Number of Observations	18	Number of Distinct Observations	18
Minimum	98	First Quartile	160.8
Second Largest	333	Median	201.5
Maximum	346	Third Quartile	250.8
Mean	206.1	SD	68.82
Coefficient of Variation	0.334	Skewness	0.553
Mean of logged Data	5.275	SD of logged Data	0.341

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.453	d2max (for USL)	2.504

Normal GOF Test

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.209	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	374.9	90% Percentile (z)	294.3
95% UPL (t)	329.1	95% Percentile (z)	319.3
95% USL	378.4	99% Percentile (z)	366.2

Gamma GOF Test

A-D Test Statistic	0.204	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.118	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.204	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.503	k star (bias corrected MLE)	7.956
Theta hat (MLE)	21.69	Theta star (bias corrected MLE)	25.91
nu hat (MLE)	342.1	nu star (bias corrected)	286.4
MLE Mean (bias corrected)	206.1	MLE Sd (bias corrected)	73.07

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	344.9	90% Percentile	303.5
95% Hawkins Wixley (HW) Approx. Gamma UPL	347.9	95% Percentile	339.1
95% WH Approx. Gamma UTL with 95% Coverage	413.6	99% Percentile	412.9
95% HW Approx. Gamma UTL with 95% Coverage	421.2		
95% WH USL	419.2	95% HW USL	427.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0993	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Zinc, mg/kg

Background Statistics assuming Lognormal Distribution

95% UTL with	95% Coverage	451	90% Percentile (z)	302.5
	95% UPL (t)	359.4	95% Percentile (z)	342.3
	95% USL	458.9	99% Percentile (z)	431.9

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

	Order of Statistic, r	18	95% UTL with	95% Coverage	346
	Approximate f	0.947	Confidence Coefficient (CC) achieved by UTL		0.603
95% Percentile Bootstrap UTL with	95% Coverage	346	95% BCA Bootstrap UTL with	95% Coverage	346
	95% UPL	346		90% Percentile	291
	90% Chebyshev UPL	418.2		95% Percentile	335
	95% Chebyshev UPL	514.3		99% Percentile	343.8
	95% USL	346			

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Total Chlordane, ug/kg

General Statistics

Total Number of Observations	18	Number of Distinct Observations	14
Minimum	0.7	First Quartile	1.225
Second Largest	13	Median	1.8
Maximum	15	Third Quartile	6.75
Mean	4.417	SD	4.538
Coefficient of Variation	1.027	Skewness	1.322
Mean of logged Data	1.019	SD of logged Data	0.976

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.453	d2max (for USL)	2.504

Normal GOF Test

Shapiro Wilk Test Statistic	0.771	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.289	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.209	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	15.55	90% Percentile (z)	10.23
95% UPL (t)	12.53	95% Percentile (z)	11.88
95% USL	15.78	99% Percentile (z)	14.97

Gamma GOF Test

A-D Test Statistic	1.084	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.762	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.244	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.209	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.211	k star (bias corrected MLE)	1.046
Theta hat (MLE)	3.647	Theta star (bias corrected MLE)	4.222
nu hat (MLE)	43.6	nu star (bias corrected)	37.66
MLE Mean (bias corrected)	4.417	MLE Sd (bias corrected)	4.318

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	13.66	90% Percentile	10.06
95% Hawkins Wixley (HW) Approx. Gamma UPL	14.02	95% Percentile	13.02
95% WH Approx. Gamma UTL with 95% Coverage	20.35	99% Percentile	19.88
95% HW Approx. Gamma UTL with 95% Coverage	21.82		
95% WH USL	20.93	95% HW USL	22.52

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Total Chlordane, ug/kg

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	30.35		90% Percentile (z)	9.675
95% UPL (t)	15.85		95% Percentile (z)	13.79
95% USL	31.9		99% Percentile (z)	26.83

Nonparametric Distribution Free Background Statistics

Data appear Lognormal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	18		95% UTL with 95% Coverage	15
Approximate f	0.947		Confidence Coefficient (CC) achieved by UTL	0.603
95% Percentile Bootstrap UTL with 95% Coverage	15		95% BCA Bootstrap UTL with 95% Coverage	15
95% UPL	15		90% Percentile	11.6
90% Chebyshev UPL	18.4		95% Percentile	13.3
95% Chebyshev UPL	24.74		99% Percentile	14.66
95% USL	15			

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Total DDT, ug/kg

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Minimum	6	First Quartile	15
Second Largest	94	Median	22
Maximum	274	Third Quartile	45.5
Mean	45.11	SD	62.16
Coefficient of Variation	1.378	Skewness	3.266
Mean of logged Data	3.311	SD of logged Data	0.944

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.453	d2max (for USL)	2.504

Normal GOF Test

Shapiro Wilk Test Statistic	0.58	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.296	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.209	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	197.6	90% Percentile (z)	124.8
95% UPL (t)	156.2	95% Percentile (z)	147.4
95% USL	200.8	99% Percentile (z)	189.7

Gamma GOF Test

A-D Test Statistic	0.822	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.764	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.181	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.209	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.143	k star (bias corrected MLE)	0.989
Theta hat (MLE)	39.48	Theta star (bias corrected MLE)	45.61
nu hat (MLE)	41.13	nu star (bias corrected)	35.61
MLE Mean (bias corrected)	45.11	MLE Sd (bias corrected)	45.36

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	138.6	90% Percentile	104.2
95% Hawkins Wixley (HW) Approx. Gamma UPL	139	95% Percentile	135.7
95% WH Approx. Gamma UTL with 95% Coverage	207.8	99% Percentile	208.9
95% HW Approx. Gamma UTL with 95% Coverage	216.6		
95% WH USL	213.8	95% HW USL	223.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.961	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.129	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Appendix C. ProUCL v5.0 Statistics Results
General Background Statistics for Full Data Sets

Total DDT, ug/kg

Background Statistics assuming Lognormal Distribution

95% UTL with	95% Coverage	277.9	90% Percentile (z)	91.97
	95% UPL (t)	148.2	95% Percentile (z)	129.6
	95% USL	291.7	99% Percentile (z)	246.6

Nonparametric Distribution Free Background Statistics

Data appear Approximate Gamma Distribution at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

	Order of Statistic, r	18	95% UTL with	95% Coverage	274
	Approximate f	0.947	Confidence Coefficient (CC) achieved by UTL		0.603
95% Percentile Bootstrap UTL with	95% Coverage	274	95% BCA Bootstrap UTL with	95% Coverage	274
	95% UPL	274		90% Percentile	84.9
	90% Chebyshev UPL	236.7		95% Percentile	121
	95% Chebyshev UPL	323.5		99% Percentile	243.4
	95% USL	274			