Appendix for Section 15

Reference Sediment Quality Conditions

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Reference Sediment Quality Condition

Reference Condition Purpose
In order to distinguish impairment at the Shipyard Investigation Site using the triad approach, it was necessary to establish the ambient sediment chemistry, toxicity, and benthic community condition, minus the influence from the Shipyard Investigation Site, with synoptic sediment chemistry and biological data that is representative of a reference condition.

Reference Condition Definition
The reference condition is the sediment quality condition that would be expected to exist within and adjacent to the area of concern in the absence of the discharges to the shipyard sediment site. This ambient condition is not representative of pristine conditions as it considers the global spread of pollutants in the bay from current and historical discharges (U.S EPA, 1992a). In this report the term “Reference Condition” is used to define “background conditions” (i.e., the water quality that existed before the discharges) as described in Finding 4 of the State Water Resources Control Board Resolution No. 92-49 (SWRCB, 1996).

Selection Criteria for the Reference Condition
In order to increase the statistical power of the original Shipyard Sediment Site investigation reference pool of five reference stations, it was decided that additional reference station data was needed to the pool of data. Reference stations from two independent studies were used in establishing a background or reference condition. The three studies that were used in establishing a reference condition were:

1. Sediment assessment study for the mouths of Chollas and Paleta Creek, San Diego Bay, 2001.
2. NASSCO and BAE (formerly Southwest Marine) Sediment Site investigation, 2001
3. Southern California Bight 1998 Regional Monitoring Program (Bight 98).

A discussion of the individual reference station selection process from the above mentioned studies is detailed below. The 2 key concepts in finding reference locations was to find sites with similar biological and physical conditions to the study site and find areas that are representative of ambient background contamination levels for San Diego Bay. In addition, it was also necessary for the analytical methods and tests needed to be comparable between the three studies.

Sediment Assessment Study for the Mouths of Chollas and Paleta Creek, San Diego Bay, 2001.
A pool of potential reference stations were selected from the most recent sediment quality survey of San Diego Bay, the Bight 98 regional survey. This survey had 46 station locations throughout San Diego Bay. The reference station selection criteria was as follows:

- Located within San Diego Bay.
- Similar physical habitat to the study sites.
- Best sediment quality (chemistry, toxicity, and benthic community) present in San Diego Bay.
- Proximity to the study sites (SCCWRP and U.S. Navy, 2005).

The first level screening of the 46 Bight 98 stations used physical properties (grain size and TOC), sediment toxicity, sediment chemistry, and benthic community parameters in selecting the best reference stations. This first screening identified five potential reference stations. However, the grain size range from these five stations was relatively small and all stations were not located in proximity to the study sites, central San Diego Bay. See Figure 1 below.

The second level screening focused on finding reference stations from the Bight 98 stations that had similar range of grain size and TOC found at the study sites (mouths of Chollas and Paleta Creek). This second step initially identified 22 candidate reference stations. From this pool of 22 stations, they were again screened against toxicity, sediment chemistry, and benthic community thresholds to find the best of the candidate stations. From this second level screening, five additional stations were identified, however none of these stations met the proximity requirement. See Figure 1 below.

The third level screening focused on finding potential reference stations closer to the Chollas and Paleta study sites. The initial pool of Bight 98 stations that were located in the mid San Diego Bay region was 16. The selected stations were once again screened against toxicity, sediment chemistry, and benthic community thresholds to find the best of the candidate stations. This third screening identified two candidate reference stations. See Figure 1 below.

From the three levels of screening of the Bight 98 stations, a total of 12 stations were identified as candidate reference stations. This pool of 12 stations was screened against NPDES reference station data for San Diego Bay to see if the sediment chemistry were comparable historical data (SCCWRP and U.S. Navy. 2005). From this pool of 12 candidate stations, five stations were selected that best met the physical, chemical and biological objectives of a reference station.

For the Chollas and Paleta Creek study, the following stations were identified and sampled as reference stations: CP 2441, CP 2433, CP 2440, CP 2231, and CP 2243. Because of some unexpected changes in benthic community composition at station CP2231 since the initial sampling in 1998, an additional reference station from the candidate reference pool, CP 2238, was sampled to ensure an adequate reference pool of data. Locations of the six stations are shown in Figure 2 below.

Subsequent to sample collection, station CP 2440 was dropped from the reference pool due to elevated levels of sediment contamination, specifically PAHs and PCBs. Benthic community data from CP 2231 was found to be atypical and not used in the reference pool but toxicity and chemistry data were accepted into the pool.

NASSCO and BAE Systems Marine Sediment Investigation.
For the Shipyard Sediment Site investigation at NASSCO and BAE Systems, the same reference stations were selected to represent background conditions based on the decision process and information provided by the Chollas and Paleta study. The only exception was station 2238 was not samples as part of the Phase 1 investigation. Therefore the following stations were identified and samples as reference stations: SY2441, SY2433, SY2440, SY 2231, and SY 2243. Reference station locations are in Figure 2 below.

Subsequent to sample collection, station SY 2440 was dropped from the reference pool due to elevated levels of sediment contamination, specifically PAHs and PCBs. Benthic community data from SY 2231 was found to be atypical and not used in the reference pool but toxicity and chemistry data were accepted into the pool.

Bight 98 Regional Monitoring Survey.
In order to increase the statistical power of the reference data provided by the Cholla/Paleta and Shipyard Sediment Site Investigation, it was necessary to add selected Bight 98 stations to the reference pool.

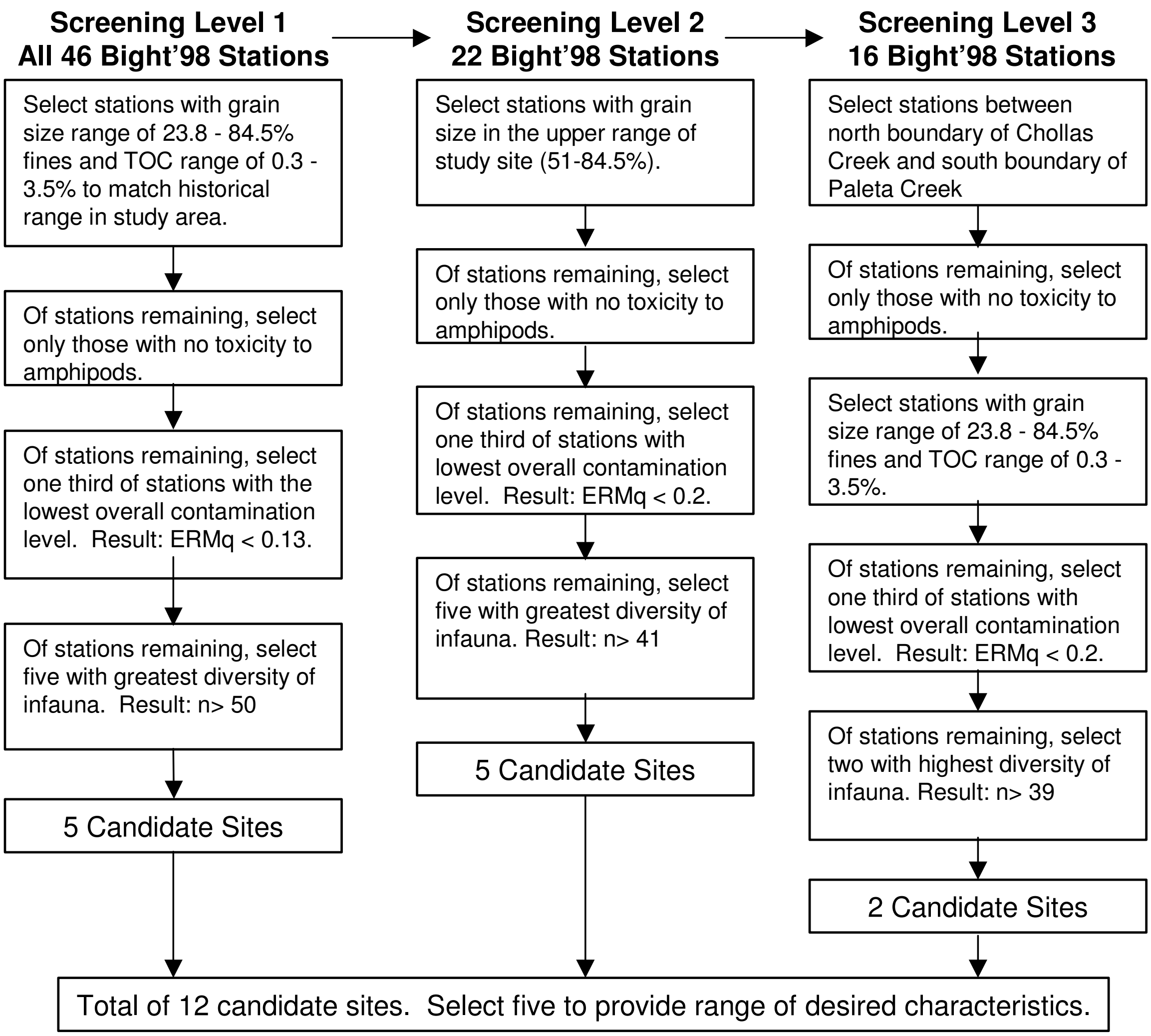
An approach was developed to identify candidate reference stations in San Diego Bay using the Bight 98 data. This approach, named the "Distance from Shore" approach assumed that contaminants in bay sediment are from land-based sources. Therefore, the farther offshore one moves in the bay, one expects that the sediment contaminant concentrations in bay sediment should decrease until some background or ambient condition is reached. Once this background contaminant threshold value(s) is determined, candidate reference stations below the sediment chemistry threshold value, regardless of their distance from shore, can be used in a reference pool (SCCWRP and U.S. Navy, 2005). A description of the "Distance from Shore" approach is included in this Appendix.

Using the Distance from Shore approach, 22 candidate reference stations were initially identified. A maximum of nine Bight 98 stations was needed in order to provided a temporal balance with the other nine reference stations from the other two studies San Diego Bay studies.

From the 22 candidate stations, nine stations were selected based on location in San Diego Bay, sediment chemistry and grain size. The nine selected reference stations were: 2235, 2241, 2242, 2243, 2256, 2257, 2258, 2260, and 2265. Reference station locations presented in Figure 2 below.

A summary of all the reference stations used in establishing the reference condition is presented in Table 1.

Figure 1. Reference Station Screening Procedure



SCCWRP and U.S. Navy, 2005

Figure 2. Reference Station Locations

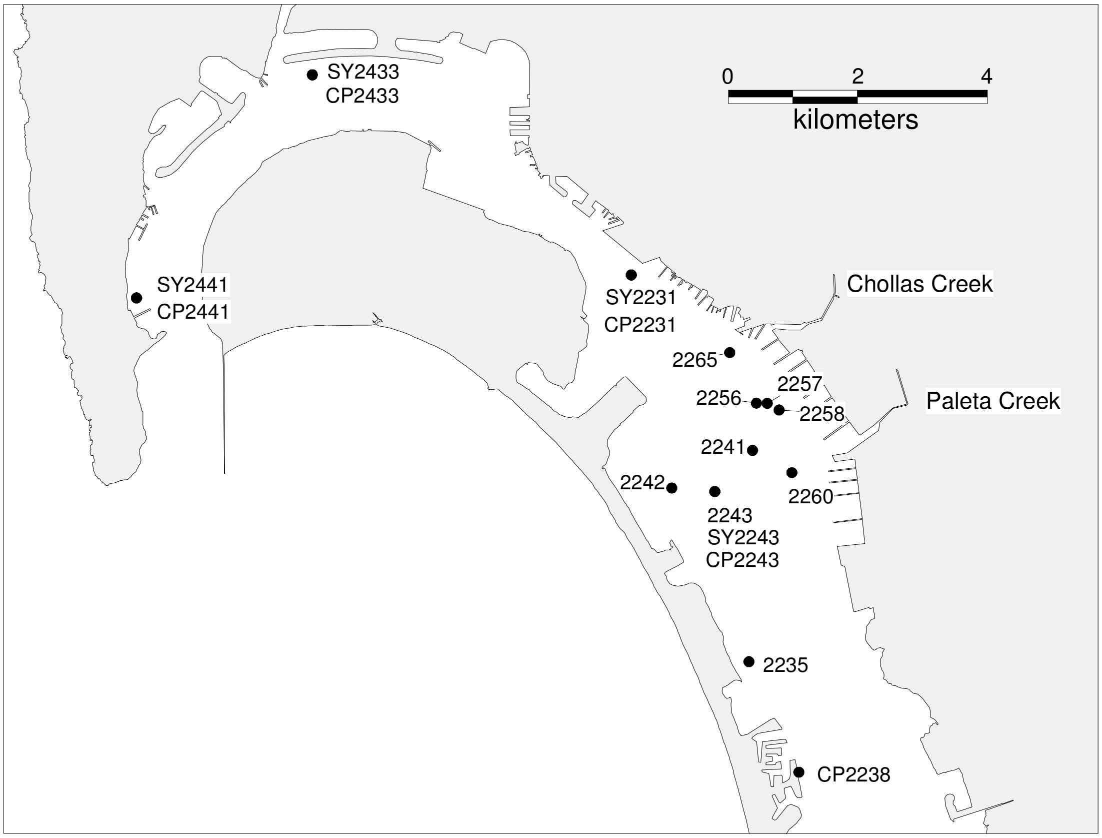


Table 1. Reference Stations Selected from Three Independent Sediment Studies

2001 Chollas/Paleta Reference Stations	2001 NASSCO/BAE Systems (formerly Southwest Marine) Reference Stations	1998 Bight'98 Reference Stations
2231	2231	2235
2243	2243	2241
2433	2433	2242
2441	2441	2243
2238		2256
		2257
		2258
		2260
		2265

The resulting reference condition pool of stations included a total of 18 stations. The reference condition acknowledges the potential presence of background contamination as well as natural variability in toxicity and benthic community condition. Reference stations were excluded from this pool if there was an indication of contamination or toxicity that appeared to be related to a nearby source.

Recognizing the importance of incorporating natural variability of sediment toxicity and benthic community structure, threshold screening values for sediment toxicity and benthic community health were not used in the selection of the pool of 18 stations.

Reference Condition Characteristics

The reference condition was used to represent the current background condition for sediment chemistry, toxicity, and benthic communities that would be expected to exist at the Shipyard Investigation sites in the absence of direct influence from contamination sources. In addition to the results of individual parameters and summary statistics for those parameters, the upper or lower 95th percentile prediction limit were calculated for each test result. The prediction limits were used as a threshold to determine if conditions at the shipyard sites differed significantly from the reference condition. Although multiple comparisons were made to the reference condition predictive limits, no correction for multiple comparisons was applied to the predictive limits so the comparisons would remain conservative and more protective.

Although the reference stations were originally developed the Mouth of Chollas Creek and Seventh Street Channel TMDL studies, the Regional Board selected to use the reference condition over the alternative suggested reference station pools for the NASSCO and BAE (formerly Southwest Marine) investigation for the following reasons:

- The reference condition represents the pre-discharge conditions at the shipyard sites.
- The reference condition provides an adequate sample size for statistical analysis.
- The reference condition provides greater temporal and methodological comparability to the site data.
- The reference condition incorporates the natural variability in toxicity and benthic communities in San Diego Bay.
- The pool of data captures the range of fines content present at the shipyard sites.
- The reference condition provides threshold values that show reasonable protection of the benthic community.
- The reference condition pool of stations shares some of the same reference stations between the Shipyard Site investigation and the Chollas and Paleta Creek TMDL studies.

Results of the Selected Reference Pool of Data.
A summary of the physical, chemical, and biological characteristics is presented in the following sections. 95% PL were used in determining exceedances when comparing Shipyard Sediment Site data to the reference pool.

Physical Properties
The range of fines content and TOC for the Reference Pool was 13% to 82.8% and 0.4% to 1.8%, respectively. Fines and TOC are in Table 2 below.

Table 2. Reference Pool Physical Characteristics and Metals Concentrations

Station	% Fines	%TOC	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
CP 2231	41.2	1.0	0.29	7.8	0.03	46.6	71	0.36	11.5	40.3	129
CP 2238	69.0	1.0	0.51	7.8	0.13	59.2	71	0.26	16.5	28.8	214
CP 2243	30.3	0.6	0.65	5.9	0.14	40.2	56	0.33	10.2	30.7	125
CP 2433	38.4	0.5	0.38	5.6	0.29	42.15	43	0.25	11.15	23.3	115
CP 2441	82.8	1.8	0.39	8.8	0.41	54.0	78	0.24	17.5	26.7	143
SY 2231	45.0	1.3	0.26	8.3	0.10	37.0	82	0.43	10	42.0	120
SY 2243	28.0	0.5	0.56	4.3	0.12	23.0	47	0.25	5.6	21.0	93
SY 2433	41.0	0.7	0.39	4.6	0.29	24.0	40	0.21	7.4	19.0	92
SY 2441	41.0	1.1	0.24	5.4	0.29	22.0	37	0.16	9.9	13.0	80
2235	45.0	0.6	0.48	6.4	0.10	37.5	58	0.24	10.7	21.3	136
2241	18.0	0.5	0.54	4.5	0.09	27.5	59	0.21	7.3	26.3	104
2242	31.0	0.7	0.49	4.3	0.10	25.4	42	0.30	6.8	17.8	89.8
2243	35.0	0.5	0.50	3.7	0.10	20.8	39	0.24	5.1	19.9	81.2
2256	67.0	1.3	1.29	7.5	0.20	54.3	128	0.63	14.3	54.1	197
2257	77.0	1.6	1.25	9.1	0.18	66.7	157	0.51	18.7	64.1	233
2258	71.0	1.4	0.95	7.8	0.16	60	143	0.66	16.4	53.0	211
2260	27.0	0.5	0.45	4.1	0.09	23.9	51	0.22	7.1	20.4	88
2265	13.0	0.4	0.19	2.5	0.07		18	0.07	1.5	12.0	43
N	18	18	18	18	18	17	18	18	18	18	18
Minimum	13.0	0.4	0.19	2.5	0.03	20.8	18	0.07	1.5	12.0	43
Maximum	82.8	1.8	1.29	9.1	0.41	66.7	157	0.66	18.7	64.1	233
Mean	44.5	0.9	0.55	6.0	0.16	39.1	68	0.31	10.4	29.6	127
Std Dev	20.5	0.4	0.32	2.0	0.10	15.4	38	0.16	4.7	15.0	53
RSD	46%	50%	58%	33%	62%	39%	56%	51%	45%	51%	42%
95% PL			1.11	9.6	0.34	66.7	136	0.59	18.9	56.5	223

SCCWRP and U.S. Navy, 2004

Sediment Chemistry

Metals
Metal concentrations in the reference condition were generally low, and showed minimal variation from station to station. Metal characteristics and summary statistics for the reference condition are shown in Table 1. The 95% upper predictive limit (UPL) for metals was based on a regression analysis with fines content to minimize the confounding influence of natural variations in background metal concentrations. Thus, the 95% UPL for metals was dependent on the fines content at each station. Methods used in the metals to fines regression analysis are described in the attachment to this Appendix.

Effects Range Median: All metals in the reference condition pool of data were below the ERM.

Effects Range Low: All reference condition data for cadmium, chromium, and nickel were below the ERL. Furthermore, 83 to 89% of the data for arsenic, lead, silver, and zinc were below their ERL.

Organics

Polynuclear Aromatic Hydrocarbons (PAH)

PAH summary statistics and 95% UPL for the reference condition pool of data are shown in Table 2. The predictive limit for PPPAH was based on N of 18. The PAH data were ln transformed to ensure normality when making statistical comparisons.

Consensus Based Guidelines: None of the PAH levels measured at these stations exceeded the consensus based SQG value of 1800 ug/kg OC.

Polychlorinated Biphenyls

Because the PCB data for all Bight 98 stations had elevated method detection limits (MDL), this data was not used in calculating the upper predictive limit. The predictive limit was therefore based on an N of 9. The PCB data were ln transformed to insure normality when making statistical comparisons.

Consensus Based Guidelines: None of the PCB levels measured at these stations exceeded the consensus based SQG value of 400 ug/kg.

Chlordane

The chlordane summary statistics and 95% UPL for the reference pool of data are shown in Table 2. Total chlordane data were normally distributed. The predictive limits for both total chlordane and total DDT were based on an N of five instead of 18 because the station data obtained from the Shipyard Investigation study did not contain measurements on pesticides and all station data from the Bight 98 stations yielded non-detect information only.

Effects Range Median: None of the chlordane levels measured these stations exceeded the ERM value of 6 ug/kg.

DDT

The DDT summary statistics and 95% UPL for the reference pool of data are shown in Table 2. Total DDT was data ln transformed to make its distribution normal. The predictive limits for both total chlordane and total DDT were based on an N of five instead of 18 because the station data obtained from the shipyard study did not contain measurements on pesticides and all station data from the Bight 98 stations yielded non-detect information only.

<u>Consensus Based Guidelines</u>: All DDT values were below their SQG value of 100ug/kg OC.

Table 3. Reference Condition Organics Concentrations

Station	LMWPAH	HMWPAH	PPPAH	TPCB	TCHLOR	TDDT
CP 2231	86	536	1063	43	0.9	10.8
CP 2238	17	103	199	11	0.2	1.3
CP 2243	20	118	267	21	0.2	1.5
CP 2433	56	415	780	27	0.6	2.1
CP 2441	236	1210	2143	34	0.8	3.8
SY 2231	63	339	687	77		
SY 2243	23	90	204	22		
SY 2433	44	250	486	21		
SY 2441	45	174	343	11		
2235	111	77	234	50	0.6	1.7
2241	111	77	234	50	0.6	1.7
2242	111	127	359	50	0.6	3.3
2243	111	77	234	50	0.6	1.7
2256	111	142	369	50	0.6	1.7
2257	111	184	449	51	0.6	1.7
2258	111	182	424	50	0.6	1.7
2260	111	77	234	50	0.6	1.7
2265	111	77	234	50	0.6	1.7
N	9	18	18	9	5	5
Min	17	77	199	11	0	1
Max	236	1210	2143	77	1	11
Mean	47*	163*	388*	30	0.5	3.9
Std Dev	n/a	n/a	n/a	20.5	0.3	4.0
RSD	n/a	n/a	n/a	69%	63%	102%
95% PL	233*	673*	1233*	70	1.3	13.2

Organic units in ng/g
SCCWRP and U.S. Navy, 2005

SQGQ1 Calculation

The SQGQ1 quotient is an empirically derived guideline that was best predictive of acute toxicity to marine amphipods (Fairey et al., 2001). Dieldrin data was not analyzed for in the Shipyard Investigation therefore the SQGQ1 was calculated without its quotient and the overall denominator was adjusted from nine to eight. The SQGQ1 was calculated for all stations in the reference condition pool as well as all the shipyard stations. See Table 4 below.

Table 4. Reference Condition SQGQ 1 Calculations

Station	SQGQ1
CP 2231	0.18
CP 2238	0.18
CP 2243	0.16
CP 2433	0.15
CP 2441	0.19
SY 2231	0.21
SY 2243	0.15
SY 2433	0.13
SY 2441	0.10
2235	0.17
2241	0.17
2242	0.14
2243	0.14
2256	0.31
2257	0.35
2258	0.30
2260	0.14
2265	0.09
N	18
Minimum	0.09
Maximum	0.35
Mean	0.18
Std Dev	0.07
RSD	39%
95% PL	0.32

SCCWRP and U.S. Navy, 2004

Toxicity

Amphipod Survival
Summary statistics and 95% Lower Prediction Limit (LPL) for the reference condition is shown in Table 5. The mean control adjusted survival for the amphipod test was 88% and the 95% LPL was 72.9%.

Bivalve Sediment Water Interface
Summary statistics and 95% Lower Prediction Limit (LPL) for the reference condition is shown in Table 5. The mean control adjusted development for the bivalve test was 82.5% and the 95% LPL was 37.4%. The bivalve development statistics were calculated using an N of four instead of 18 because this test was not used in the Bight 98 study and a different test species was selected for the mouths of Chollas/Paleta Creek study.

Sea Urchin Fertilization
Summary statistics and 95% Lower Prediction Limit (LPL) for the reference condition is shown in Table 5. The mean control adjusted development for the sea urchin fertilization test was 85% and the 95% LPL was 41.9%. The urchin fertilization 95% LPL was calculated using an N of nine instead of 18 because this test was not conducted as part of the Bight 98 sediment toxicity bioassays.

Table 5. Reference Pool Toxicity Data

Station	Amphipod	Bivalve	Urchin Pore Water
CP 2231	76		66
CP 2238	90		36
CP 2243	84		97
CP 2433	84		100
CP 2441	82		102
SY 2231	84	101	99
SY 2243	92	70	92
SY 2433	96	66	79
SY 2441	95	93	90
2235	71		
2241	98		
2242	92		
2243	96		
2256	100		
2257	91		
2258	92		
2260	73		
2265	85		
N	18	4	9
Minimum	71	66	36
Maximum	100	101	102
Mean	88	82.5	85
Std Dev	8.4	17.1	22
95% PL	72.9	37.4	41.9

Benthic Community

Summary statistics and 95% PLs for the reference condition are shown in Table 6. The prediction limits for the benthic community measurements were calculated using an N of 16 instead of 18 because the benthic data for CP 2231 and SY 2231 were considered anomalous and therefore benthic community parameters were not computed for these two stations.

Abundance

The mean abundance for the reference condition was 842 and the 95% LPL was 239.

Number of Taxa

The mean number of taxa for the reference condition was 50 and the 95% LPL was 22.

Shannon-Wiener Diversity Index

The mean Shannon-Wiener Diversity Index for the reference condition was 2.4 and the 95% LPL was 1.8.

The Benthic Response Index

The mean BRI for the reference condition was 36.5 and the 95% UPL was 57.7.

Table 6. Reference Condition – Benthic Community

Station	Abundance	# Taxa	S-W Diversity	BRI
CP 2231				
CP 2238	419	32	2.6	60.3
CP 2243	691	41	2.3	55.1
CP 2433	421	57	2.8	22.8
CP 2441	476	66	2.9	30.0
SY 2231				
SY 2243	989	78	2.5	45.1
SY 2433	441	77	2.6	16.8
SY 2441	506	108	2.8	19.9
2235	551	29	2.1	42.1
2241	1526	44	2.3	34.7
2242	1117	28	1.8	36.6
2243	966	47	2.7	36.4
2256	237	28	2.7	37.9
2257	503	37	2.3	38.1
2258	826	36	2.3	43.2
2260	2263	49	1.8	39.1
2265	1543	48	2.4	26.7
N	16	16	16	16
Minimum	237	28	1.8	16.8
Maximum	2263	108	2.9	60.3
Mean	842	50	2.4	36.5
Std Dev	544	22	0.3	11.7
RSD	65%	44%	14%	32%
95% PL	-141	10.2	1.8	57.7

SCCWRP and U.S. Navy, 2004

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Using Percent Fines to Determine Trace Metal Enrichment in Chollas and Paleta Creek THS Sediments for the Regional Board's Reference Pool (SCCWRP and U.S. Navy, 2005b)

Introduction

This document describes the procedure used to help identify concentrations of metals that were enriched in Chollas and Paleta Creek study site sediments. Metal enrichment was determined using %fines:metals relationships based on regression analysis with the Reference Pool. The procedure was based on the methods reported by Schiff and Weisberg (1997) that used iron as a reference element.

Methods

The first step was to eliminate data from the Reference Pool that were not normally distributed. To do this, regressions were developed between each metal and %fines in the Reference Pool (excluding Cr at Bight'98 Station 2265), then normality of the regression residuals was assessed with the Kolmogorov-Smirnov test. If the residuals were not normally distributed, sites with residuals >2 standard deviations were eliminated, and the regression was recalculated. The process of testing for normality and removal of data based on standard deviations was iterated until a normal distribution was achieved.

The second step was to identify background levels for each metal. After the non-normally distributed data were eliminated, the slope and y-intercept of the regression lines were calculated for each metal (Table 1, Figure 1).

The third step was to identify concentrations of metals in the field samples that were enriched. This was performed by comparing the metal concentration to a threshold value based in part on the % fines measured at each station. Because the % fines varied by station and sampling event, the threshold used to evaluate metal enrichment was also variable. The threshold value was calculated as the background level + the 95% prediction limit. The 95% prediction limit is derived as:

$$\text{95\% prediction limit} = SE\sqrt{1+\frac{1}{n}+\frac{(X-\overline{X})^2}{(n-1)(SD^2)}} * (t - statistic)$$

The t-statistic for a one-tailed test, n-2, α = 0.05 was used. Measured concentrations of metals that exceeded the threshold value were identified as being enriched (Figure 2, Table 2).

Results

Cadmium was the only element that had non-normally distributed residuals. Three stations were removed from the Reference Pool for Cd. All other metals had normally distributed residuals, and thus data from all 22 stations were used (except for Cr, which had data from 21 stations).

Table 1. Regression results of fines:metals relationships in the Reference Pool. Results are for the data pool after removing residuals that exceed 2 standard deviations. All relationships are significant at $p < 0.05$.

Element	Sample size	r^2	Slope	Y-intercept	Range in thresholds	
					9% fines	80% fines
Ag	22	0.330	0.00990	0.0366	0.63	1.33
As	22	0.776	0.0846	1.9158	4.30	10.30
Cd	19	0.557	0.00238	0.0140	0.12	0.29
Cr	21	0.625	0.632	4.866	27.60	72.37
Cu	22	0.526	1.27	3.72	57.98	148.48
Hg	22	0.364	0.0045	0.0676	0.32	0.64
Ni	22	0.860	0.222	0.107	5.31	21.03
Pb	22	0.368	0.434	5.422	29.50	60.55
Zn	22	0.673	2.18	20.23	94.08	248.99

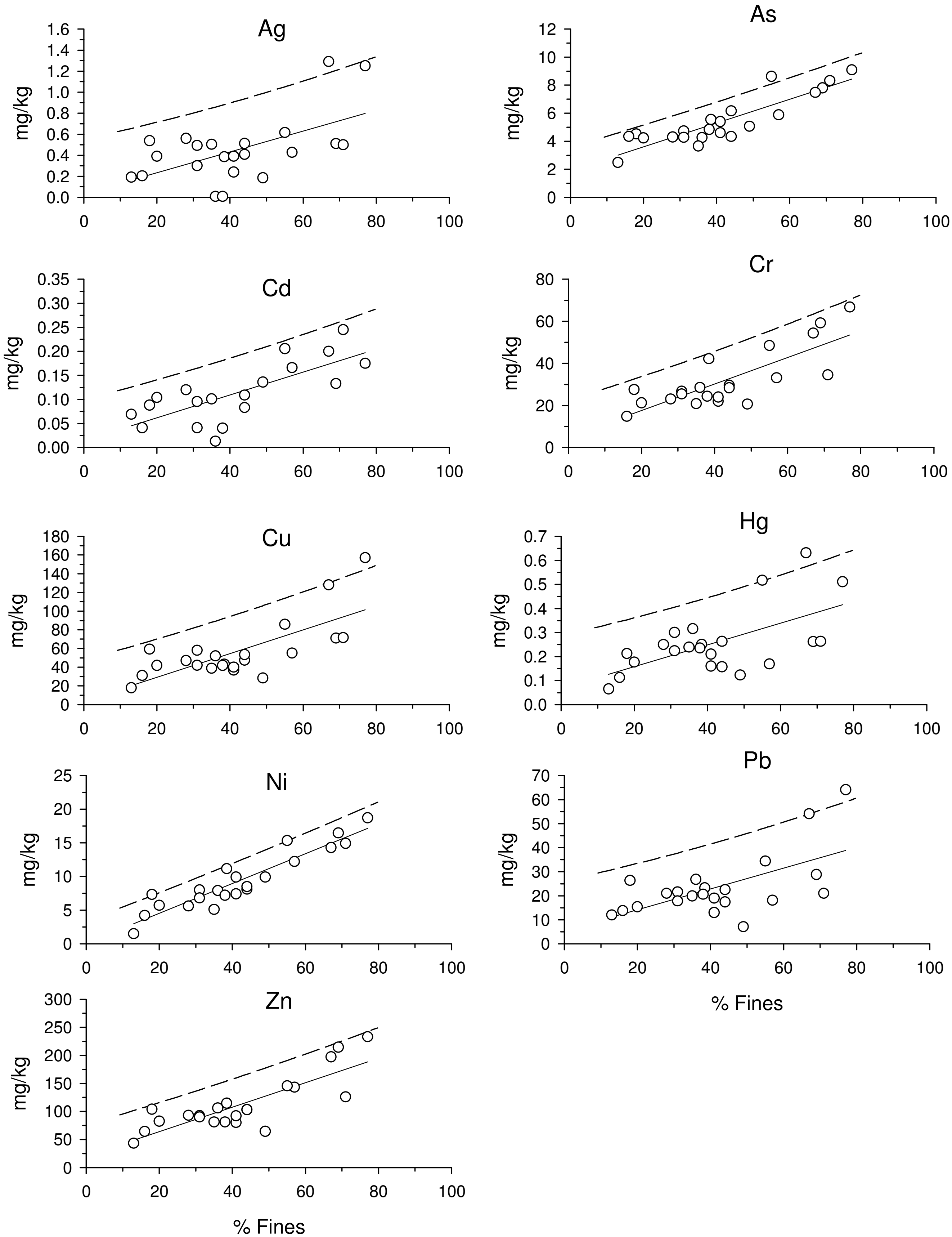

Figure 1. % Fines:metals plots from the Reference Pool. The solid line is the relationship from linear regression. The dashed line is the threshold (predicted value + 95% prediction interval).

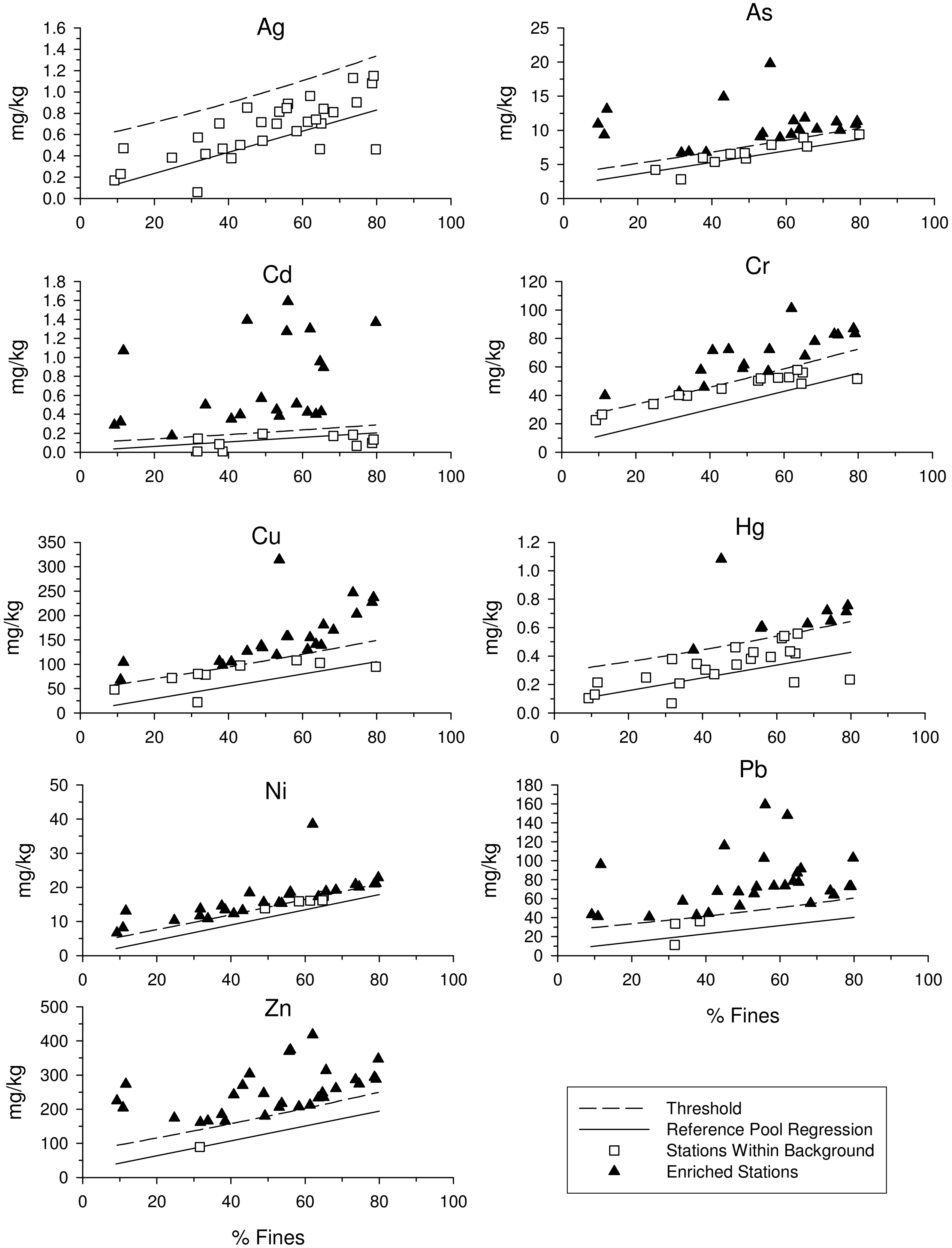

Figure 2. %Fines:metals plots from the Chollas and Paleta Creek sites overlaid on the threshold and regression lines from the Reference Pool. Sites which fall below the threshold are considered uncontaminated. Sites which lie above the threshold are considered enriched.

Table 2. Identification of Chollas and Paleta Creek THS sediment metal concentrations (Value) that exceed the threshold values (Thrsh). The threshold values were derived from the Reference Pool, using the fines:metal regression approach. Boxed measured values are those which exceed the threshold.

Station	% Fines	Ag		As		Cd		Cr		Cu		Hg		Ni		Pb		Zn	
		Value	Thrsh	Value	Thrsh	Value	Thrsh	Value	Thrsh	Value	Thrsh	Value	Thrsh	Value	Thrsh	Value	Thrsh	Value	Thrsh
C01	65	0.70	1.16	11.8	8.97	0.428	0.25	56.0	62.10	139.0	127.50	0.419	0.56	17.5	17.60	77.3	53.08	235.0	214.03
C02	61	0.72	1.12	9.4	8.64	0.424	0.24	52.7	59.61	130.0	122.43	0.526	0.55	16.1	16.75	73.7	51.29	212.0	205.50
C03	62	0.96	1.13	11.4	8.70	1.300	0.24	101.0	60.05	155.0	123.34	0.541	0.55	38.5	16.90	148.0	51.61	418.0	207.03
C04	43	0.50	0.93	14.9	7.07	0.396	0.19	44.6	47.70	97.4	98.28	0.273	0.46	13.2	12.63	67.7	42.91	270.0	164.51
C05	58	0.63	1.09	8.9	8.38	0.510	0.23	52.3	57.60	108.0	118.34	0.395	0.53	15.9	16.07	73.3	49.86	207.0	198.62
C06	64	0.74	1.15	10.1	8.84	0.400	0.24	57.9	61.11	141.0	125.49	0.433	0.56	17.3	17.26	78.4	52.37	233.0	210.65
C07	9	0.17	0.63	10.9	4.30	0.286	0.12	22.5	27.60	47.9	57.98	0.104	0.32	6.7	5.31	43.1	29.50	225.0	94.08
C08	11	0.23	0.64	9.3	4.43	0.321	0.12	26.6	28.53	68.0	59.83	0.130	0.33	8.1	5.66	41.3	30.10	204.0	97.37
C09	53	0.70	1.03	9.1	7.91	0.446	0.22	50.3	54.04	119.0	111.12	0.381	0.50	15.5	14.84	65.4	47.34	206.0	186.41
C10	54	0.81	1.04	9.6	7.97	0.381	0.22	51.9	54.50	314.0	112.04	0.427	0.51	15.3	15.00	72.3	47.66	217.0	187.97
C11	12	0.47	0.64	13.1	4.49	1.070	0.12	39.9	28.95	104.0	60.67	0.215	0.33	13.1	5.82	96.1	30.37	273.0	98.86
C12	34	0.42	0.84	6.8	6.28	0.499	0.17	39.7	41.89	78.5	86.55	0.208	0.42	10.8	10.57	57.6	38.92	166.0	144.30
C13	65	0.46	1.16	8.9	8.94	0.956	0.25	48.2	61.86	103.0	127.02	0.216	0.56	16.2	17.52	87.2	52.91	248.0	213.21
C14	80	0.46	1.33	9.4	10.30	1.370	0.29	51.6	72.37	94.9	148.48	0.235	0.64	22.8	21.03	103.0	60.55	347.0	248.99
P01	32	0.57	0.82	6.7	6.11	0.144	0.17	42.4	40.65	80.2	84.06	0.379	0.41	13.7	10.12	33.7	38.08	161.7	139.98
P02	68	0.81	1.20	10.2	9.26	0.172	0.26	78.0	64.35	170.0	132.08	0.627	0.58	19.2	18.35	55.2	54.70	260.6	221.69
P03	38	0.47	0.88	6.8	6.66	0.009	0.18	45.8	44.73	98.1	92.27	0.345	0.44	13.4	11.58	36.1	40.86	165.2	154.19
P04	75	0.90	1.27	10.0	9.83	0.067	0.27	82.5	68.71	203.0	140.98	0.648	0.61	20.1	19.81	64.1	57.87	274.2	236.54
P05	79	1.08	1.32	10.9	10.21	0.098	0.28	87.0	71.67	227.0	147.04	0.713	0.64	21.0	20.80	72.8	60.03	293.5	246.60
P06	74	1.13	1.26	11.3	9.74	0.184	0.27	83.1	68.03	247.0	139.61	0.719	0.61	20.8	19.59	68.3	57.38	286.5	234.25
P07	79	1.15	1.33	11.3	10.25	0.133	0.29	83.4	71.95	237.0	147.61	0.755	0.64	21.2	20.89	73.0	60.24	288.2	247.54
P08	38	0.71	0.87	6.0	6.59	0.086	0.18	57.7	44.19	106.0	91.19	0.444	0.43	14.6	11.39	42.4	40.49	184.4	152.32
P09	32	0.06	0.82	2.8	6.10	0.009	0.17	40.2	40.57	22.1	83.90	0.068	0.41	11.7	10.09	11.3	38.03	89.3	139.70
P10	41	0.38	0.90	5.4	6.86	0.351	0.19	71.5	46.18	105.0	95.21	0.304	0.45	12.3	12.10	44.4	41.86	242.4	159.24
P11	45	0.85	0.95	6.5	7.22	1.392	0.20	72.2	48.89	127.0	100.68	1.081	0.47	18.4	13.05	116.0	43.73	303.9	168.62
P12	49	0.54	0.99	5.9	7.58	0.195	0.21	61.5	51.54	134.0	106.04	0.341	0.49	13.9	13.98	52.3	45.58	180.1	177.77
P13	25	0.38	0.76	4.2	5.54	0.173	0.15	33.9	36.48	71.9	75.69	0.250	0.38	10.3	8.61	40.7	35.29	174.4	125.38
P14	49	0.72	0.99	6.6	7.55	0.569	0.21	58.9	51.33	138.0	105.62	0.462	0.49	15.6	13.90	67.2	45.44	246.4	177.06
P15	56	0.89	1.06	7.9	8.17	1.589	0.23	72.3	56.03	157.0	115.17	0.606	0.52	18.6	15.53	159.1	48.75	373.6	193.25
P16	66	0.84	1.17	7.6	9.03	0.894	0.25	67.8	62.52	181.0	128.35	0.558	0.57	18.8	17.74	91.4	53.38	313.8	215.45
P17	56	0.85	1.06	19.8	8.15	1.273	0.22	57.0	55.82	157.0	114.72	0.597	0.52	18.0	15.45	102.8	48.60	369.5	192.50

Reference

Schiff, K. and S.B. Weisberg. 1997. Iron as a reference element for determining trace metal enrichment in California coastal shelf sediments. Pp 68-77 *in*: S.B. Weinberg, C. Francisco and D. Hallock (eds.) Southern California Coastal Water Research Project Annual Report 1996. Westminster, CA.

Station	Fines	Ag			As			Cd			Cr			Cu			Hg			Ni			Pb			Zn	
		Value	Threshold		Value	Threshold		Value	Threshold		Value	Threshold		Value	Threshold		Value	Threshold		Value	Threshold		Value	Threshold		Value	Threshold
C01	65	0.70	1.22	0	11.8	8.77	1	0.428	0.37	1	56.0	67.04	0	139.0	143.68	0	0.419	0.64	0	17.5	18.08	0	77.3	61.00	1	235.0	226.30
C02	61	0.72	1.19	0	9.4	8.45	1	0.424	0.36	1	52.7	64.43	0	130.0	138.00	0	0.526	0.62	0	16.1	17.26	0	73.7	59.04	1	212.0	217.73
C03	62	0.96	1.19	0	11.4	8.51	1	1.300	0.36	1	101.0	64.90	1	155.0	139.01	1	0.541	0.63	0	38.5	17.41	1	148.0	59.39	1	418.0	219.26
C04	43	0.50	1.03	0	14.9	6.90	1	0.396	0.32	1	44.6	51.93	0	97.4	110.94	0	0.273	0.53	0	13.2	13.29	0	67.7	49.90	1	270.0	176.52
C05	58	0.63	1.16	0	8.9	8.19	1	0.510	0.35	1	52.3	62.33	0	108.0	133.42	0	0.395	0.61	0	15.9	16.60	0	73.3	57.48	1	207.0	210.81
C06	64	0.74	1.21	0	10.1	8.64	1	0.400	0.37	1	57.9	66.01	0	141.0	141.43	0	0.433	0.63	0	17.3	17.76	0	78.4	60.22	1	233.0	222.91
C07	9	0.17	0.78	0	10.9	4.15	1	0.286	0.25	1	22.5	30.61	0	47.9	65.65	0	0.104	0.39	0	6.7	6.25	1	43.1	35.23	1	225.0	105.68
C08	11	0.23	0.79	0	9.3	4.28	1	0.321	0.25	1	26.6	31.60	0	68.0	67.74	1	0.130	0.40	0	8.1	6.58	1	41.3	35.89	1	204.0	109.00
C09	53	0.70	1.11	0	9.1	7.73	1	0.446	0.34	1	50.3	58.60	0	119.0	125.33	0	0.381	0.58	0	15.5	15.42	1	65.4	54.73	1	206.0	198.53
C10	54	0.81	1.12	0	9.6	7.79	1	0.381	0.34	1	51.9	59.07	0	314.0	126.36	1	0.427	0.58	0	15.3	15.57	0	72.3	55.08	1	217.0	200.10
C11	12	0.47	0.80	0	13.1	4.34	1	1.070	0.25	1	39.9	32.05	1	104.0	68.68	1	0.215	0.40	0	13.1	6.73	1	96.1	36.19	1	273.0	110.50
C12	34	0.42	0.95	0	6.8	6.12	1	0.499	0.29	1	39.7	45.79	0	78.5	97.78	0	0.208	0.49	0	10.8	11.30	0	57.6	45.55	1	166.0	156.20
C13	65	0.46	1.22	0	8.9	8.74	1	0.956	0.37	1	48.2	66.79	0	103.0	143.13	0	0.216	0.64	0	16.2	18.00	0	87.2	60.81	1	248.0	225.48
C14	80	0.46	1.37	0	9.4	10.07	0	1.370	0.42	1	51.6	77.78	0	94.9	167.18	0	0.235	0.72	0	22.8	21.41	1	103.0	69.15	1	347.0	261.50
P01	32	0.57	0.94	0	6.7	5.95	1	0.144	0.29	0	42.4	44.48	0	80.2	94.98	0	0.379	0.48	0	13.7	10.87	1	33.7	44.63	0	161.7	151.85
P02	68	0.81	1.25	0	10.2	9.06	1	0.172	0.38	0	78.0	69.39	1	170.0	148.81	1	0.627	0.66	0	19.2	18.81	1	55.2	62.76	0	260.6	234.02
P03	38	0.47	0.99	0	6.8	6.50	1	0.009	0.30	0	45.8	48.79	0	98.1	104.20	0	0.345	0.51	0	13.4	12.27	1	36.1	47.66	0	165.2	166.14
P04	75	0.90	1.31	0	10.0	9.61	1	0.067	0.40	0	82.5	73.95	1	203.0	158.78	1	0.648	0.69	0	20.1	20.23	0	64.1	66.22	0	274.2	248.96
P05	79	1.08	1.36	0	10.9	9.98	1	0.098	0.41	0	87.0	77.05	1	227.0	165.57	1	0.713	0.72	0	21.0	21.18	0	72.8	68.58	1	293.5	259.09
P06	74	1.13	1.30	0	11.3	9.53	1	0.184	0.40	0	83.1	73.25	1	247.0	157.24	1	0.719	0.69	1	20.8	20.01	1	68.3	65.68	1	286.5	246.65
P07	79	1.15	1.36	0	11.3	10.02	1	0.133	0.41	0	83.4	77.34	1	237.0	166.20	1	0.755	0.72	1	21.2	21.27	0	73.0	68.81	1	288.2	260.04
P08	38	0.71	0.98	0	6.0	6.43	0	0.086	0.30	0	57.7	48.22	1	106.0	102.98	1	0.444	0.51	0	14.6	12.09	1	42.4	47.26	0	184.4	164.26
P09	32	0.06	0.94	0	2.8	5.94	0	0.009	0.29	0	40.2	44.40	0	22.1	94.81	0	0.068	0.48	0	11.7	10.84	1	11.3	44.57	0	89.3	151.58
P10	41	0.38	1.01	0	5.4	6.69	0	0.351	0.31	1	71.5	50.32	1	105.0	107.49	0	0.304	0.52	0	12.3	12.77	0	44.4	48.75	0	242.4	171.21
P11	45	0.85	1.04	0	6.5	7.05	0	1.392	0.32	1	72.2	53.18	1	127.0	113.63	1	1.081	0.54	1	18.4	13.69	1	116.0	50.80	1	303.9	180.65
P12	49	0.54	1.08	0	5.9	7.40	0	0.195	0.33	0	61.5	55.96	1	134.0	119.64	1	0.341	0.56	0	13.9	14.58	0	52.3	52.81	0	180.1	189.85
P13	25	0.38	0.89	0	4.2	5.38	0	0.173	0.28	0	33.9	40.06	0	71.9	85.58	0	0.250	0.45	0	10.3	9.41	1	40.7	41.58	0	174.4	137.18
P14	49	0.72	1.07	0	6.6	7.38	0	0.569	0.33	1	58.9	55.75	1	138.0	119.17	1	0.462	0.56	0	15.6	14.51	1	67.2	52.65	1	246.4	189.13
P15	56	0.89	1.14	0	7.9	7.99	0	1.589	0.35	1	72.3	60.69	1	157.0	129.86	1	0.606	0.60	1	18.6	16.08	1	159.1	56.27	1	373.6	205.41
P16	66	0.84	1.23	0	7.6	8.82	0	0.894	0.37	1	67.8	67.48	1	181.0	144.63	1	0.558	0.65	0	18.8	18.22	1	91.4	61.32	1	313.8	227.74
P17	56	0.85	1.13	0	19.8	7.96	1	1.273	0.35	1	57.0	60.46	0	157.0	129.36	1	0.597	0.59	1	18.0	16.01	1	102.8	56.10	1	369.5	204.66
Background	50		1.08	0		7.48	0		0.33	0		56.54	0		120.89	0		0.57	0		14.77	0		53.23	0		191.75
NewData2	60		1.17	0		8.33	0		0.36	0		63.47	0		135.91	0		0.62	0		16.96	0		58.33	0		214.57
NewData3	69		1.26	0		9.12	0		0.38	0		69.90	0		149.91	0		0.66	0		18.97	0		63.14	0		235.68