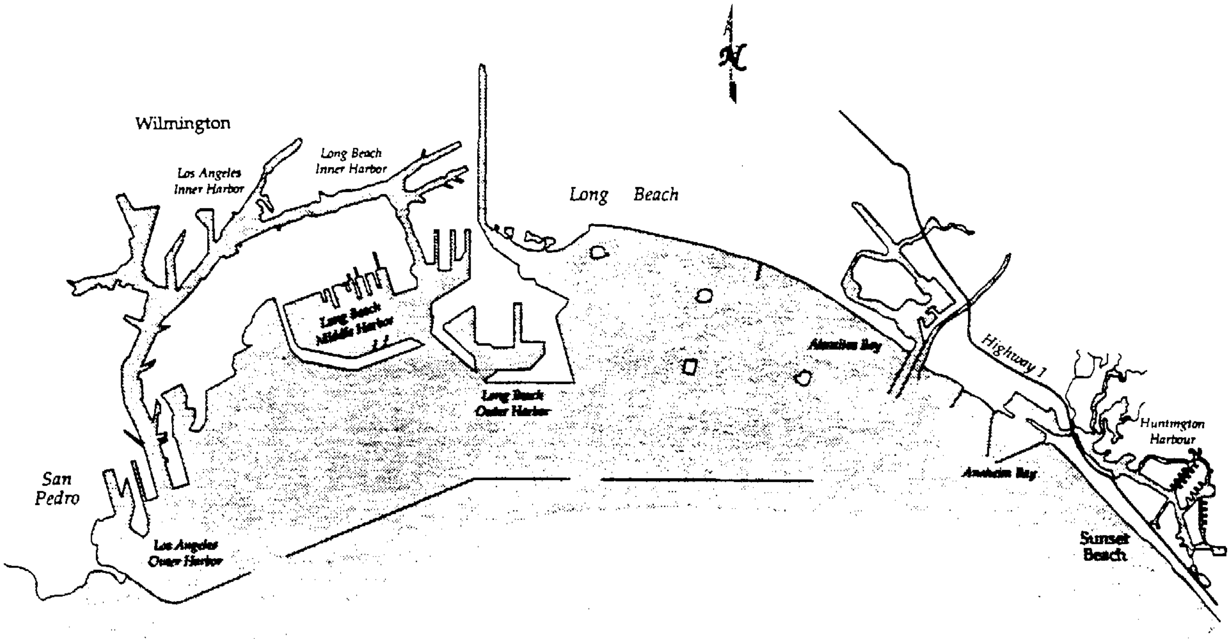

Sediment Chemistry and Toxicity in the Vicinity of the Los Angeles and Long Beach Harbors

DRAFT FINAL REPORT

November 1994

STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
and the
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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California State Water Resources Control Board
Division of Water Quality
Bay Protection and Toxic Cleanup Program

National Oceanic and Atmospheric Administration
Coastal Monitoring and Bioeffects Assessment Division
Bioeffects Assessment Branch

California Department of Fish and Game
Marine Pollution Studies Laboratory

November 1994

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ABSTRACT

This report describes a study to characterize the magnitude and relative spatial extent of toxicant-associated bioeffects in Los Angeles and Long Beach Harbors, Anaheim Bay, and Huntington Harbour in southern California. This study was the result of a cooperative effort between the State Water Resources Control Board's Bay Protection and Toxic Cleanup Program, the National Oceanic and Atmospheric Administration and the California Department of Fish and Game. Thirty-five sites were sampled (with three field-replicated stations per site) in the study area. Amphipod survival (Rhepoxynius abronius) and abalone larval development (Haliotis rufescens) toxicity tests were performed on the sediment samples and pore water, respectively. Measurements of trace metals and organic chemicals were performed on sediments from 45 stations, and measurements of trace metals were performed on pore water from 21 stations. Significant amphipod mortality compared to laboratory controls was observed at the majority of sites in the Los Angeles and Long Beach inner harbors. Most of the outer harbor site sediments were not toxic to amphipods. Many of the sediments from sites in Huntington Harbour, Anaheim Bay and Alamitos Bay were toxic to amphipods. Several chemicals (e.g., acenanaphthene, phenanthrene, fluoranthene, copper, lead, zinc) or chemical groups (e.g., total PAHs) were significantly correlated with amphipod survival. Lead and copper in pore water were correlated with inhibited abalone larvae development in sediment pore water. The results of the pore water test showed widespread response to undiluted pore water (100 percent pore water test concentration) compared to laboratory controls, although the source of the response is not clear. Sediment pore waters from sites in Huntington Harbour and off Cabrillo Beach produced the greatest abalone embryo response relative to laboratory controls. Collectively, the toxicity tests identified several areas that were toxic: Huntington Harbour, West Basin, Consolidated Slip, and portions of Alamitos Bay.

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LIST OF ABBREVIATIONS

AET	Apparent Effects Threshold
ASTM	American Society for Testing Materials
AVS	Acid Volatile Sulfide
BPTCP	Bay Protection and Toxic Cleanup Program
CDFG	California Department of Fish and Game
CH	Chlorinated Hydrocarbon
Cu	Copper
EPA	Environmental Protection Agency
ERL	Effects range low
ERM	Effects range median
FAAS	Flame atomic absorption spectroscopy
Fe	Iron
GFAAS	Graphite furance atomic absorption spectroscopy
HCl	Hydrochloric acid
HDPE	High density polyethylene
Hg	Mercury
HMW	High molecular weight
HPAH	High molecular weight polynuclear aromatic hydrocarbons
H_2S	Hydrogen sulfide
kgC	kilograms carbon
LA	Los Angeles
LC_{50}	Lethal Concentration (to 50 percent of test organisms)
LMW	Low molecular weight
LPAH	Low molecular weight polynuclear aromatic hydrocarbons
MPSL	Marine Pollution Studies Laboratory
MSD	Mean Significant Difference
NH_3	Ammonia
Ni	Nickel
NOAA	National Oceanic and Atmospheric Administration
NOEC	No observed effect concentration
NS&T	National Status and Trends Program
PAH	Polynuclear Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyl
PEL	Probable effects level
POLA	Port of Los Angeles
REF	Reference
Sb	Antimony
Sn	Tin
SQC	Sediment quality criteria
SWRCB	State Water Resources Control Board
T	Temperature
TEL	Threshold effects level
TIE	Toxicity identification evaluation
TOC	Total organic carbon
UCSC	University of California, Santa Cruz
WCS	Whole core squeezing
Zn	Zinc

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1. INTRODUCTION

In 1992, the State Water Resources Control Board (State Water Board) and the National Oceanic and Atmospheric Administration (NOAA) entered into a three-year cooperative agreement to assess the potential adverse biological effects in several coastal bays and harbors in Southern California (SWRCB and NOAA, 1991, 1992, 1993). This report presents the results from the first year of the cooperative agreement.

Purpose

This study was performed in San Pedro Bay, Los Angeles Harbor, Long Beach Harbor, Anaheim Bay, Alamitos Bay, and Huntington Harbour in southern California (Figure 1-1). The purposes of the study were: (1) to characterize the magnitude and relative spatial extent of toxicant-associated bioeffects in these nearshore areas; (2) to determine relationships between concentrations and mixtures of sediment-associated toxicants and the occurrence and severity of bioeffects; and (3) to distinguish more severely impacted sediments from less severely impacted sediments.

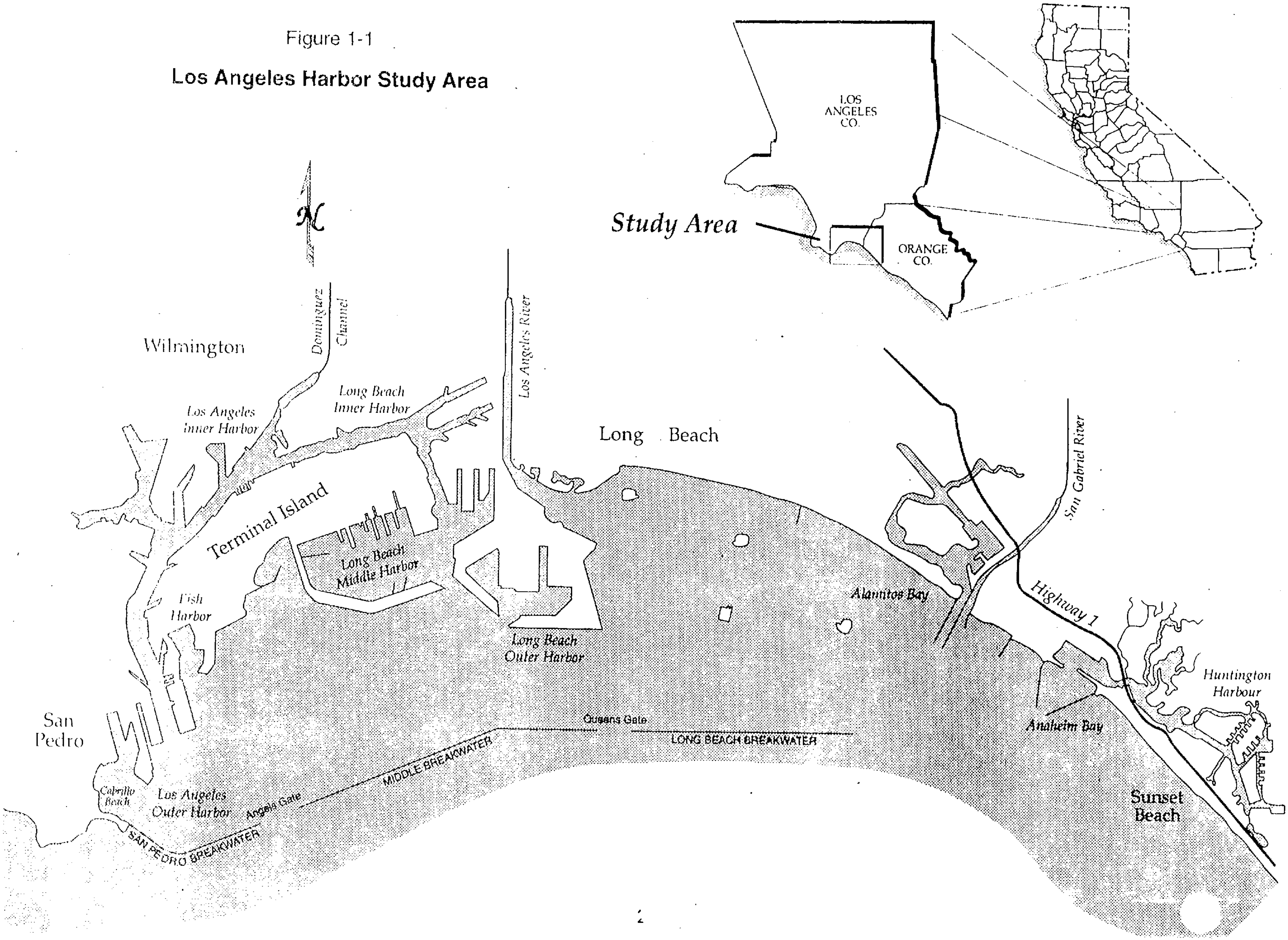
Programmatic Needs and Background

Both the State Water Board and NOAA have common programmatic needs for the research. While these needs are similar, they are not necessarily the same. NOAA is mandated by Congress to conduct a program of research and monitoring on marine pollution. Much of this research is being conducted through the National Status and Trends (NS&T) Program and the Coastal Ocean Program. The NS&T Program performs regional intensive studies of the magnitude and extent of toxicant-associated bioeffects in selected coastal embayments and estuaries. The areas chosen for these regional studies are those in which the contaminant concentrations indicate the greatest potential for biological effect. These biological studies augment the regular chemical monitoring activities of the Program, and provide a means of estimating the toxicity associated with measured concentrations of sediment pollutants.

The State Water Board and its nine Regional Water Boards are mandated by the Porter-Cologne Act (California Water Code, Div. 7, Section 13390 et seq.) to develop sediment quality objectives and apply those objectives in assessments of California's coastal bays and estuaries. The intent of the sediment quality objectives is to protect the beneficial uses of bays and estuaries, including protection of human health and aquatic life. The objectives are to be based upon scientific information, including but not limited to chemical monitoring, bioassays or established modeling procedures, and are intended to provide adequate protection for the most sensitive aquatic organisms.

Figure 1-1

Los Angeles Harbor Study Area



A strategy was developed for preparing these objectives in a workshop convened in February 1991 and the State Water Board approved a workplan for the development of sediment quality objectives in 1991 (Lorenzato and Wilson, 1991). The strategy includes the collection of new data from California to verify toxicity thresholds previously determined in research performed in California and elsewhere. Matching, paired chemical and biological data will be collected in studies performed in California for analysis and evaluation.

The types of sediment investigation and characterization approaches currently used by the BPTCP range from chemical or toxicity monitoring only, to monitoring designs that attempt to generally correlate the presence of pollutants with toxicity, to those that employ the more sophisticated and costly toxicity identification evaluation (TIE) approaches (SWRCB, 1993). Where the correlation designs attempt to link the presence of pollutants to effects seen in bioassays, the TIEs attempt to establish a causal relationship between the pollutants measured and the effects seen in bioassays.

Study Objectives

A considerable amount of sediment chemistry data exist for Los Angeles and Long Beach Harbors, and part of San Pedro Bay (Mearns et al., 1991). These data have been collected mostly as prerequisites to dredging projects. Data also exist from small site-intensive studies conducted by various researchers. Sediment toxicity has been determined to a lesser extent in these embayments in a number of small predredging studies, but not in any large synoptic surveys. In Los Angeles/Long Beach Harbor, most of the sediment toxicity data are available for specific maritime berths and navigation channels. No synoptic survey of the harbor has been conducted on a larger scale.

The objectives of the study were:

1. Determine the presence or absence of adverse biological effects in portions of Los Angeles and Long Beach Harbors, Alamitos Bay and Huntington Harbour in southern California;

2. Determine the relative degree or severity of adverse effects, and to distinguish more severely impacted sediments from less severely impacted sediments;

3. Determine the relative spatial distribution of toxicant-associated effects in Los Angeles and Long Beach Harbors, Alamitos Bay and Huntington Harbour;

4. Determine the relationships between toxicants and measures of effects in these bays.

Scope of Study

The study for the 3-year cooperative agreement covers the area from the Palos Verdes Peninsula south to the USA/Mexico border, and ranges from approximately the 60 meter isobath to the upper limit of tidally-influenced saltwater. However, most of the work has been focused upon selected coastal bays and lagoons. In the first phase of the study, samples were collected only in the Los Angeles/Long Beach areas (Figure 1-1).

The research involves biological testing and chemical analysis of sediments and sediment pore water. Biological testing and chemical analysis were performed using aliquots of homogenized sediment samples collected synoptically from each station, resulting in paired data. Measurements of the benthic community structure were also made, and will be made available along with any other related data at a later date.

The study was managed and coordinated by the California State Water Resources Control Board's (SWRCB) Bay Protection and Toxic Cleanup Program (BPTCP) as a cooperative effort with the National Atmospheric and Oceanic Administration's (NOAA) Bioeffects Assessment Branch, and the California Department of Fish and Game's (CDFG) Marine Pollution Studies Laboratory. Funding was provided by the SWRCB and NOAA, with all three agencies participating in planning and design activities.

The actual field and laboratory work was accomplished under interagency agreement to, and at the direction of the CDFG. The majority of the sample collections were done by staff of the San Jose State University Foundation at the Moss Landing Marine Laboratories, who also performed the Total Organic Carbon (TOC) and grain size analyses, as well as the benthic community analyses. The toxicity testing was conducted by University of California at Santa Cruz (UCSC) staff at the CDFG toxicity testing laboratory at Granite Canyon, California.

Trace metals analyses were performed by CDFG personnel at the trace metal facility at Moss Landing Marine Laboratories, Moss Landing, California. Synthetic organic pesticides, polyaromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) were analyzed at the UCSC trace organics facility at Long Marine Laboratory in Santa Cruz.

Study Area Description

The Los Angeles and Long Beach Harbors are located in the southeastern portion of the Los Angeles basin (Figure 1-1). Along the northern portion of San Pedro Bay is a natural embayment formed by a westerly extension of the coastline which contains both harbors, with the Palos Verdes Hills the dominant onshore feature. Offshore, a generally low topographic ridge is associated with the eastern flank of the Palos Verdes uplift and adjacent Palos Verdes fault zone, and extends northwest across the San Pedro shelf nearly to the breakwater of the Los Angeles Harbor.

The port and harbor have been modified over the course of more than one hundred years to include construction of breakwaters, landfills, slips and wharves, along with channelization of drainages, dredging of navigation channels, and reclamation of marshland. The inner harbor includes the Main Channel, the East and West Basins, and the East Channel Basin. The outer harbor is the basin area located between Terminal Island and the San Pedro and Middle Breakwaters. Both harbors are considered to be one oceanographic unit, and have a common breakwater across the mouth of San Pedro Bay. The inner harbors are of estuarine character with regards to aquatic life, while the outer harbors reflect the conditions of the coastal marine waters of the Southern California Bight. Ecological preserves in the area include Point Fermin Marine Life Refuge and Seal Beach National Wildlife Refuge (Port of Los Angeles, 1992).

In the presence of the strong currents and rocky habitat of the outer harbor, aquatic life resembles that of the nearby coast, with the inner harbor having biota generally found in bays and estuaries. The inner harbor has a mostly soft bottom character, and supports the expected assortment of infaunal worms, epifaunal starfish and urchins, and bottom dwelling fish such as halibut. Species common to the hard-substrate of the outer harbor, which include the rocky riprap areas, are the Blacksmith, kelp bass, señorita, and various surfperches. Both pelagic and epibenthic-demersal fish are common in both the inner and outer harbors, and include anchovy, white croaker, sardine, and queenfish.

In general, the outer harbor areas have a greater species diversity and lower density than inner harbor areas, with inner harbor species being more abundant than those in the outer harbor. The changes to the physical environment in the harbor areas have also altered the makeup of the biological communities present, with water quality conditions in the inner harbor improving over the last ten years. There is currently an extensive stand of giant kelp (*Macrocystis pyrifera*) along both sides of the San Pedro Breakwater, with large brown algae (*Sargassum muticum*) and ribbon kelp (*Egregia menzeii*) also represented. Kelp is an important source of primary production in these waters, and provides both food and habitat for nearshore fish and invertebrates.

The major surface drainages in the area include the Los Angeles River, which flows in a channel and drains parts of the San Fernando Valley into eastern San Pedro Bay at Long Beach. The Dominguez Channel drains the intensely urbanized area west of the Los Angeles River into the Consolidated Slip of the Los Angeles inner harbor, carrying with it mostly urban runoff and nonprocess industrial waste discharges. A major source of both freshwater and waste in the outer harbor is secondary effluent from the Terminal Island Treatment Plant (Port of Los Angeles, 1992).

Waste discharges to the inner harbor area of Los Angeles Harbor consist of both contact and non-contact industrial cooling waste water and stormwater runoff. Fuel spills and oil spills from marine vessel traffic or docking facilities, along with several toxic or hazardous waste sites also contribute pollutants to the inner harbor.

Circulation in the outer harbors results from tidal currents, with the general influx through Angels and Queens gates, and outflux at the east end of Long Beach Harbor. Studies have indicated the existence of a large clockwise eddy, or circular current extending east from the Los Angeles Main Channel to the Navy Mole, and another counter clockwise eddy at a depth of 20 feet. These and other minor eddy currents are considered to be partly responsible for relatively good quality water in the outer harbor.

Inner harbor circulation fluctuates with tidal flow, with less mixing than in the outer harbor. These patterns result in the greatest flushing rates due to tides occurring at the harbor entrances, Angels Gate, Queens Gate, and east of Freeman Island. The lowest flushing rates are in the Cerritos Channel, Middle Harbor, and Main Channel (Port of Los Angeles, 1992).

The Anaheim Bay/Huntington Harbour complex is located on the northern edge of the Orange County coast, approximately 20 miles southeast of Los Angeles. The complex consists of Anaheim Bay, the outer bay, Huntington Harbour--the inner harbour, and several ecologically significant wetlands such as the Anaheim Bay National Wildlife Refuge and Bolsa Chica Ecological Reserve.

The U.S. Navy controls access through the outer bay (Anaheim Bay) which serves as the sole entrance to the U.S. Naval Weapons Station--Seal Beach. The Navy also operates and manages the National Wildlife Refuge which is located on their property. The inner harbor, Huntington Harbour and Bolsa Chica Ecological Reserve, receive very little tidal flushing, thus freshwater inputs have significant impacts on the water quality. Two major storm drains, the Bolsa Chica flood control channel and the East Garden Grove Wintersburg flood control channel, as well as their tributaries, convey runoff from the northern portion of the heavily urbanized Orange County into Huntington Harbour. Inputs of stormwater and urban nuisance flows via these channels are potentially significant sources of pollutant loadings that are being addressed through the county's urban runoff/stormwater permit.

An additional potential source of toxics into Huntington Harbour is from a boatyard facility located in Huntington Harbour. The Santa Ana Regional Water Quality Control Board currently regulates boatyard dischargers under a general Boatyard NPDES permit.

2. METHODS

Sample Site Selection

Individual sampling locations consisted of three field replicates, referred to as stations, with each station located approximately 200 meters apart at the points of a triangle centered over the site (Figure 2-1 and Table 2-1). The Magellan Global Positioning System and reference photographs were used to precisely locate the sites. The stations at sites 40010 and 40032 were sampled twice, once on each of two separate sampling legs.

The sampling sites were selected to provide a broad representation of conditions and general trends of pollution throughout the study area resulting from various sources, with known point sources of pollution avoided, and only areas having relatively fine-grained (greater than 30 percent fines) sediments included. Reference sites were far removed from the harbor, and one additional site was chosen outside the harbor for general comparative purposes.

Sampling Methods

Field Collection

Sampling was conducted over five separate sampling legs during the months of July through October, 1992. Sediment was collected with a modified 0.1 m^2 van Veen grab sampler, with only the surficial sediment subsampled to a depth of 2 centimeters. All sampling equipment and sample containers were made of, or coated with, the plastics Teflon, Kynar, polycarbonate, or HDPE, and cleaned according to extensive "clean" technique procedures for trace metals and synthetic organic chemicals. Approximately 6 liters of sediment were collected at each station, with the sample container purged with nitrogen after reaching the final volume.

Homogenization and Aliquoting

The samples were kept refrigerated at 4°C and flown from the Los Angeles study area to the CDFG Trace Metal Facility in Moss Landing, California the same day they were collected. Since repeated deployments of the grab were needed to collect the required 6 liter volume of sediment, the sediment was homogenized in a "clean" room by stirring with a polycarbonate rod prior to aliquoting subsamples for the various laboratories. Subsamples were held either refrigerated at 4°C or frozen at 0°C, according to the respective holding criteria for each laboratory. Appropriate chain-of-custody procedures were followed during distribution of samples.

Figure 2-1

Location of Sampling Sites and Stations

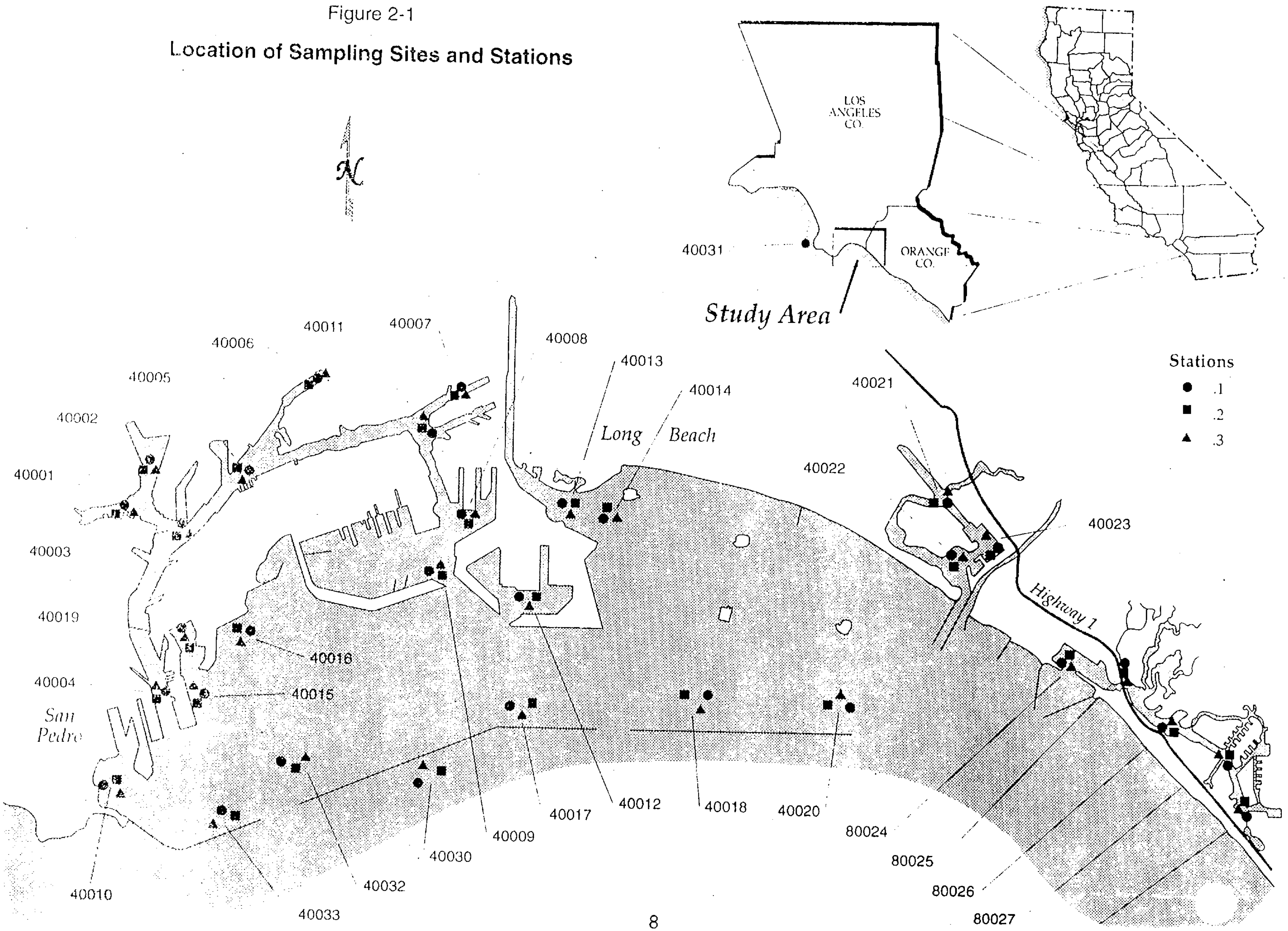


TABLE 2-1
LA Harbor Sampling Dates, Latitudes, Longitudes, and Depths of Sites Sampled during Summer-Fall 1992

Site Name	Station Number	Organizational Identification No.	Date	Leg Number	Latitude (Degrees North)	Longitude (Degrees West)	Depth (meters)
Monterey Bay-REF	30034.1	100	08/05/92	1	36°44'56"	121°52'37"	82.0
Monterey Bay-REF	30034.2	101	08/05/92	1	36°44'43"	121°52'46"	80.0
Monterey Bay-REF	30034.3	102	08/05/92	1	36°45'11"	121°52'35"	82.0
Southwest Slip	40001.1	1	07/29/92	1	33°45'23"	118°16'42"	15.5
Southwest Slip	40001.2	2	07/29/92	1	33°45'20"	118°16'46"	15.5
Southwest Slip	40001.3	3	07/29/92	1	33°45'18"	118°16'45"	18.0
West Basin, Pier 143	40002.1	4	07/30/92	1	33°45'45"	118°16'28"	16.5
West Basin, Pier 143	40002.2	5	07/30/92	1	33°45'43"	118°16'29"	16.0
West Basin, Pier 143	40002.3	6	07/30/92	1	33°45'42"	118°16'28"	15.0
Turning Basin, Pier 151	40003.1	7	07/31/92	1	33°45'12"	118°16'11"	16.5
Turning Basin, Pier 151	40003.2	8	07/31/92	1	33°45'09"	118°16'14"	16.5
Turning Basin, Pier 151	40003.3	9	07/31/92	1	33°45'11"	118°16'10"	10.5
Lower Main Channel	40004.1	10	07/29/92	1	33°43'37"	118°16'18"	17.0
Lower Main Channel	40004.2	11	07/29/92	1	33°43'38"	118°16'20"	17.0
Lower Main Channel	40004.3	12	07/29/92	1	33°43'37"	118°16'22"	17.5
East Basin,Turning Basin	40005.1	13	07/30/92	1	33°45'45"	118°15'18"	16.0
East Basin,Turning Basin	40005.2	14	07/30/92	1	33°45'48"	118°15'24"	16.5
East Basin,Turning Basin	40005.3	15	07/30/92	1	33°45'42"	118°15'22"	16.5
Consolidated Slip	40006.1	16	07/31/92	1	33°46'34"	118°14'39"	8.5
Consolidated Slip	40006.2	17	07/31/92	1	33°46'31"	118°14'44"	10.5
Consolidated Slip	40006.3	18	07/31/92	1	33°46'34"	118°14'34"	4.0
San Pedro Bay, POLA 19	40032.1	79	07/30/92	1	33°43'23"	118°14'51"	10.0
San Pedro Bay, POLA 19	40032.2	80	07/30/92	1	33°43'21"	118°14'44"	12.0
San Pedro Bay, POLA 19	40032.3	81	07/30/92	1	33°43'22"	118°14'45"	12.5
Outer Harbor, POLA 10	40033.1	82	07/30/92	1	33°42'54"	118°15'40"	19.0
Outer Harbor, POLA 10	40033.2	83	07/30/92	1	33°42'51"	118°15'36"	19.0
Outer Harbor, POLA 10	40033.3	84	07/30/92	1	33°42'50"	118°15'42"	18.5
East Basin Pier C	40008.1	22	08/18/92	2	33°45'24"	118°12'51"	16.5
East Basin Pier C	40008.2	23	08/18/92	2	33°45'20"	118°12'50"	25.5
East Basin Pier C	40008.3	24	08/18/92	2	33°45'21"	118°12'47"	14.5

TABLE 2-1
BPTCP LA Harbor Sampling Dates, Latitudes, Longitudes, and Depths of Sites Sampled during Summer-Fall 1992

Site Name	Station Number	Organizational Identification No.	Date	Leg Number	Latitude (Degrees North)	Longitude (Degrees West)	Depth (meters)
West Basin Entrance	40009.1	25	08/18/92	2	33°44'46"	118°13'12"	13.0
West Basin Entrance	40009.2	26	08/18/92	2	33°44'44"	118°13'07"	26.0
West Basin Entrance	40009.3	27	08/18/92	2	33°44'46"	118°13'10"	16.5
Off Cabrillo Beach	40010.1	28	08/18/92	2	33°42'51"	118°16'54"	4.5
Off Cabrillo Beach	40010.2	29	08/18/92	2	33°42'53"	118°16'54"	3.0
Off Cabrillo Beach	40010.3	30	08/18/92	2	33°42'49"	118°16'54"	4.0
Southeast Basin	40012.1	34	08/18/92	2	33°44'35"	118°12'19"	21.5
Southeast Basin	40012.2	35	08/18/92	2	33°44'38"	118°12'09"	21.5
Southeast Basin	40012.3	36	08/18/92	2	33°44'29"	118°12'13"	20.5
Fish Harbor Entrance	40015.1	43	08/19/92	2	33°43'45"	118°15'56"	6.5
Fish Harbor Entrance	40015.2	44	08/19/92	2	33°43'43"	118°15'57"	6.0
Fish Harbor Entrance	40015.3	45	08/19/92	2	33°43'47"	118°16'01"	5.5
Terminal Island STP	40016.1	46	08/18/92	2	33°43'49"	118°15'04"	8.5
Terminal Island STP	40016.2	47	08/18/92	2	33°43'54"	118°15'15"	7.0
Terminal Island STP	40016.3	48	08/18/92	2	33°43'48"	118°15'11"	6.5
Inner Fish Harbor	40019.1	55	08/19/92	2	33°44'16"	118°16'03"	8.0
Inner Fish Harbor	40019.2	56	08/19/92	2	33°44'10"	118°16'02"	7.5
Inner Fish Harbor	40019.3	57	08/19/92	2	33°44'13"	118°16'00"	7.5
San Pedro Breakwater	40030.1	73	08/19/92	2	33°42'52"	118°13'40"	18.0
San Pedro Breakwater	40030.2	74	08/19/92	2	33°42'54"	118°13'22"	18.0
San Pedro Breakwater	40030.3	75	08/19/92	2	33°42'53"	118°13'41"	16.5
San Pedro Bay, POLA 19	40032.1	103	08/19/92	2	33°43'23"	118°14'51"	12.0
San Pedro Bay, POLA 19	40032.2	104	08/19/92	2	33°43'20"	118°14'49"	12.0
San Pedro Bay, POLA 19	40032.3	105	08/19/92	2	33°43'21"	118°14'46"	13.0
Elkhorn Slough, Seal Point REF	30035.1	130	09/04/92	3	36°48'50"	121°45'40"	1.0
Elkhorn Slough, Seal Point REF	30035.2	131	09/04/92	3	36°48'49"	121°45'43"	1.0
Elkhorn Slough, Seal Point REF	30035.3	132	09/04/92	3	36°48'48"	121°45'41"	1.0
L.B. Hbr Channel 2	40007.1	19	09/01/92	3	33°46'33"	118°12'44"	13.5
L.B. Hbr Channel 2	40007.2	20	09/01/92	3	33°46'30"	118°12'48"	14.0
L.B. Hbr Channel 2	40007.3	21	09/01/92	3	33°46'32"	118°12'44"	14.0

TABLE 2-1
BPTCP LA Harbor Sampling Dates, Latitudes, Longitudes, and Depths of Sites Sampled during Summer-Fall 1992

Site Name	Station Number	Organizational Identification No.	Date	Leg Number	Latitude (Degrees North)	Longitude (Degrees West)	Depth (meters)
Inner Hbr Channel 3	40011.1	31	09/01/92	3	33°46'04"	118°13'19"	20.0
Inner Hbr Channel 3	40011.2	32	09/01/92	3	33°46'06"	118°13'21"	20.0
Inner Hbr Channel 3	40011.3	33	09/01/92	3	33°46'07"	118°13'20"	19.5
Inner Queensway Bay	40013.1	37	09/02/92	3	33°45'30"	118°11'56"	6.0
Inner Queensway Bay	40013.2	38	09/02/92	3	33°45'31"	118°11'54"	5.5
Inner Queensway Bay	40013.3	39	09/02/92	3	33°45'29"	118°11'52"	5.5
Outer Queensway Bay	40014.1	40	09/02/92	3	33°45'12"	118°11'07"	15.5
Outer Queensway Bay	40014.2	41	09/02/92	3	33°45'16"	118°11'06"	16.0
Outer Queensway Bay	40014.3	42	09/02/92	3	33°45'13"	118°11'04"	16.0
Long Beach Channel	40017.1	49	09/02/92	3	33°43'52"	118°12'04"	22.0
Long Beach Channel	40017.2	50	09/02/92	3	33°43'51"	118°11'59"	23.5
Long Beach Channel	40017.3	51	09/02/92	3	33°43'47"	118°12'02"	20.5
Long Beach Outer Hbr 18	40018.1	52	09/02/92	3	33°43'48"	118°10'02"	16.5
Long Beach Outer Hbr 18	40018.2	53	09/02/92	3	33°43'53"	118°10'03"	15.5
Long Beach Outer Hbr 18	40018.3	54	09/02/92	3	33°43'52"	118°09'58"	15.5
Long Beach Outer Hbr 20	40020.1	58	09/02/92	3	33°43'57"	118°08'23"	12.5
Long Beach Outer Hbr 20	40020.2	59	09/02/92	3	33°43'58"	118°08'29"	12.5
Long Beach Outer Hbr 20	40020.3	60	09/02/92	3	33°44'00"	118°08'24"	12.5
Palos Verdes(Swartz 6)	40031.1	76	09/01/92	3	33°45'56"	118°27'11"	75.0
Palos Verdes(Swartz 6)	40031.2	77	09/01/92	3	33°46'07"	118°27'18"	72.0
Palos Verdes(Swartz 6)	40031.3	78	09/01/92	3	33°46'14"	118°27'12"	68.5
Elkhorn Slough, Seal Bend REF	30036.1	133	09/11/92	4	36°48'56"	121°46'04"	1.0
Elkhorn Slough, Seal Bend REF	30036.2	134	09/11/92	4	36°48'55"	121°46'07"	1.0
Elkhorn Slough, Seal Bend REF	30036.3	135	09/11/92	4	36°48'55"	121°46'03"	1.0
Off Cabrillo Beach	40010.1	136	09/16/92	4	33°42'53"	118°16'56"	2.0
Off Cabrillo Beach	40010.2	137	09/16/92	4	33°42'54"	118°16'49"	2.0
Off Cabrillo Beach	40010.3	138	09/16/92	4	33°42'49"	118°16'53"	2.5
Alamitos Bay, Marine Stadium	40021.1	61	09/16/92	4	33°45'35"	118°07'14"	5.0
Alamitos Bay, Marine Stadium	40021.2	62	09/16/92	4	33°45'35"	118°07'18"	5.0
Alamitos Bay, Marine Stadium	40021.3	63	09/16/92	4	33°45'38"	118°07'15"	6.0

TABLE 2-1
BPTCP LA Harbor Sampling Dates, Latitudes, Longitudes, and Depths of Sites Sampled during Summer-Fall 1992

Site Name	Station Number	Organizational Identification No.	Date	Leg Number	Latitude (Degrees North)	Longitude (Degrees West)	Depth (meters)
Alamitos Bay, Entrance	40022.1	64	09/15/92	4	33°45'02"	118°07'12"	5.0
Alamitos Bay, Entrance	40022.2	65	09/15/92	4	33°44'57"	118°07'07"	4.0
Alamitos Bay, Entrance	40022.3	66	09/15/92	4	33°44'59"	118°07'05"	3.5
Alamitos Bay, Long Beach Marina	40023.1	67	09/16/92	4	33°45'07"	118°06'45"	5.0
Alamitos Bay, Long Beach Marina	40023.2	68	09/16/92	4	33°45'07"	118°06'48"	5.0
Alamitos Bay, Long Beach Marina	40023.3	69	09/16/92	4	33°45'09"	118°06'45"	5.0
Anaheim Bay, Outer	80024.1	85	09/15/92	4	33°44'06"	118°05'42"	13.5
Anaheim Bay, Outer	80024.2	86	09/15/92	4	33°44'11"	118°05'43"	15.0
Anaheim Bay, Outer	80024.3	87	09/15/92	4	33°44'08"	118°05'39"	13.5
Huntington Harbour, Lower	80026.1	91	09/15/92	4	33°43'34"	118°04'34"	4.0
Huntington Harbour, Lower	80026.2	92	09/15/92	4	33°43'35"	118°04'33"	4.0
Huntington Harbour, Lower	80026.3	93	09/15/92	4	33°43'36"	118°04'33"	4.0
Huntington Harbour, Middle	80027.1	94	09/15/92	4	33°43'15"	118°03'52"	7.0
Huntington Harbour, Middle	80027.2	95	09/15/92	4	33°43'20"	118°03'51"	6.0
Huntington Harbour, Middle	80027.3	96	09/15/92	4	33°43'19"	118°03'54"	6.0
Huntington Harbour, Upper	80028.1	97	09/15/92	4	33°42'46"	118°03'38"	8.0
Huntington Harbour, Upper	80028.2	98	09/15/92	4	33°42'50"	118°03'39"	7.5
Huntington Harbour, Upper	80028.3	99	09/15/92	4	33°42'49"	118°03'42"	6.0
Anaheim Bay, Oil Isl.	80025.1	88	10/14/92	5	33°44'04"	118°05'05"	0.5
Anaheim Bay, Oil Isl.	80025.2	89	10/14/92	5	33°44'04"	118°05'03"	0.5
Anaheim Bay, Oil Isl.	80025.3	90	10/14/92	5	33°44'03"	118°05'03"	0.5

Pore Water Extraction

Pore water was obtained from refrigerated (4°C) sediment samples using the whole core squeezing (WCS) method developed by Bender et al. (1987). This method employed mechanical force to squeeze pore water from interstitial spaces. The squeezing technique was a modification of the original Bender design, with some adaptations made based on the work of Carr et al. (1989) and Carr and Chapman (1991). This WCS method was developed for laboratory or field use in conjunction with standard coring techniques.

The major features of the squeezer consisted of an aluminum support framework, 10 cm i.d. acrylic core tubes with sampling ports, a pressure regulated pneumatic ram with air supply valves, and pH and oxygen electrodes placed in-line with sample effluent. Trace metal contamination was avoided by ensuring that all sample containers, filters and WCS surfaces in contact with the sample were plastics (acrylic, PVC, and TFE) and cleaned with Micro, 10% HCl, Type II Milli-Q' brand water and methanol.

One to two liters of homogenized sediment sample were placed in the squeezer tube for pore water extractions. The tubes were placed in the support framework and pressure was applied to the top piston by adjusting the air supply to the pneumatic ram. An initial air pressure of ≈ 20 psi was sufficient to maintain a steady flow of sample effluent through the top piston, and at no time during squeezing did air pressure exceed 200 psi.

A porous pre-filter (PPE or TFE) was inserted in the top of the piston and used to screen large (> 70 microns) sediment particles. Further filtration was accomplished with disposable TFE filters of 5 microns and 0.45 microns in-line with sample effluent. To compensate for filter clogging and sediment compaction during the course of squeezing, effluent flow was maintained by fine adjustment of the pressure regulator on the air supply to increase the air pressure to the ram.

Sample effluent of the required volume was collected in TFE containers under refrigeration. Pore water was then subsampled in the volumes and specific containers required for archiving and chemical or toxicological analysis. Samples to be analyzed for trace metals were acidified to an approximate pH of 2-3 to minimize oxidation of the metal and adsorption to sample container walls. Other subsamples were either refrigerated or frozen as required under normal holding time criteria for each specific analysis.

Upon completion of a sediment squeezing run, all squeezer surfaces in contact with sample were thoroughly cleaned to minimize metal or organic cross-contamination between samples. Blanks of Type II Milli-Q' brand water were substituted for sample and squeezed prior to and after the core tubes used for sample extractions. This squeezer blank was used as a quality control step to test for possible contaminations. Pore water samples were frozen until needed for testing.

Chemical Analyses

Trace Metals Analysis

Sediment samples were prepared for analysis by digesting with a concentrated 4:1 nitric:perchloric acid mixture in a teflon vessel. The sediment was then heated in the closed teflon vessel in a vented oven at 130°C for 4 hours. Hydrofluoric acid was added, and the sample returned to the oven to heat overnight. The following morning, 20 ml of 2.5% boric acid was added to the sample, which was then placed in the oven for an additional 8 hours. After the vessels were removed from the oven the vessel plus sample were weighed, and this solution was poured into a preweighed polyethylene bottle.

Sediment digestates were then analyzed for Ag, Al, Cu, Cd, Cr, Mn, Ni, Pb, Sb, Sn, and Zn by either Graphite Furnace Atomic Absorption Spectroscopy (GFAAS) on a Perkin-Elmer Model 3030 Zeeman or by FAAS on a Perkin-Elmer Model 2280 depending on concentration. Sediment samples analyzed for Cd must be done by GFAAS. Hg was analyzed by cold vapor using the Perkin-Elmer Model 2280 for both sediment and tissues (Stephenson et al., 1994).

To analyze sediment for Se and As, samples were first dry-ashed with magnesium nitrate for 13 hours. They were then redissolved in HCl and analyzed by Hydride Generation with a Varian model 45 Hydride generator (Stephenson et al., 1994).

Trace Organics Analyses

A 10 gram sample of sediment was extracted with methylene chloride in a 250-ml amber Boston round bottle on a modified rock tumbler. Prior to rolling, sodium sulfate, copper, and the extraction surrogates were added to the bottle. Sodium sulfate was used to remove any water from the sediment, and copper was added to remove sulfur.

Three extraction aliquots were collected and combined. The extract was divided into two portions, one for chlorinated hydrocarbon (CH) analysis and the other for aromatic hydrocarbons (AH). The CH portion was eluted through a silica/alumina column, separating the analytes into two fractions.

Fraction one (F1) was eluted with 1 percent methylene chloride in pentane containing > 90% of the p,p'-DDE and < 10% of the p,p'-DDT. Fraction two (F2) was eluted with 100% methylene chloride. The two fractions were concentrated to 500 µl using a combination of Rotavap, tube heater, and nitrogen gas evaporation. The CH fractions were then analyzed by gas chromatography utilizing an Electron Capture Detector (GC/ECD).

The AH portion was filtered through Pyrex glass wool in a 25-ml disposable pipet. The AH extract was concentrated to 500 µl using a combination of Rotavap, tube heater, and nitrogen gas evaporation. Any remaining interfering biologicals were then removed using size exclusion High Performance Liquid Chromatography on a DB-5ms column and analyzed in the single ion monitoring mode.

The concentrations of each DDT/DDD/DDE isomer were summed to determine total DDT (Table 2-2). Total low molecular weight PAHs (LPAHs) consisted of the sum of all 2- and 3-ring PAHs for each sample, with total high molecular weight PAHs (HPAHs) reflecting the sum of all 4- and 5-ring PAHs (Figure 2-2).

Table 2-2
DDT and Polynuclear Aromatic Hydrocarbon Analytes[1]

DDT and Metabolites	Low Molecular Weight Polyaromatic Hydrocarbons	High Molecular Weight Polyaromatic Hydrocarbons
o,p'-DDD	2-Ring	4-Ring
p,p'-DDD		
o,p'-DDE	biphenyl	fluoranthene
p,p'-DDE	naphthalene	pyrene
o,p'-DDT	1-methylnaphthalene	benz(a)anthracene
p,p'-DDT	2-methylnaphthalene	
	2,6-dimethylnaphthalene	5-Ring
	3-Ring	chrysene
		benzo(a)pyrene
	fluorene	benzo(e)pyrene
	phenanthrene	perylene
	1-methylphenanthrene	dibenz(a,h)anthracene
	anthracene	

[1] NOAA, 1989

Polychlorinated biphenyls (PCBs) are reported as the sum of the concentrations of PCBs at each level of chlorination, with eighteen distinct congeners quantified (NOAA, 1989).

Grain Size Determination

Sieve and hydrometer techniques were used to determine the particle size of sediment. Samples were held in a freezer at -20°C until immediately before sample splitting, at which time the sand/silt ratio was estimated and an appropriate sample weight calculated. The size of the subsample for analysis was determined by the sand/silt ratio of the sample. Subsamples were placed in beakers and dried in ovens at less than 55°C until completely dry (about 3 days), when they were weighed and sediments dis-aggregated by mixing with water/dispersant solution.

The resulting sediment slurries were screened through a 63 µm stainless steel sieve with running water. The fine fraction was discarded while the coarse fraction was retained, dried, and weighed. Fractional weights and percentages for the sieve fractions were calculated using custom software on a Macintosh computer. The weight of fine fraction was then computed by subtracting the coarse fraction from total sample weight, and percent fine composition was then calculated using the fine fraction and total sample weights.

Total Organic Carbon Determination

An elemental analyzer was used to determine the amount of total organic carbon in sediments. Samples were first transferred to vials and treated with 1N HCl to decompose all carbonate, and then centrifuged for 10 minutes; the supernatant was then decanted. Next, the vials containing samples were repeatedly filled with deionized water, vortexed, and centrifuged until the pH was between 6 and 7. The samples were then dried at less than 55°C until completely dry (approximately 3 days).

A ball mill was used to homogenize the dried sediments, which were then weighed into aluminum sleeves (1-3 mg) to the nearest 1 µg. The total organic carbon of the sediments was analyzed using a Control Equipment Corporation Model 240-XA Elemental Analyzer.

Toxicity Testing

All toxicity tests were conducted at the CDFG's Marine Pollution Studies Laboratory (MPSL) at Granite Canyon, California. Personnel from the Institute of Marine Sciences at Long Marine Laboratory, University of California, Santa Cruz conducted 10 day amphipod (Rhepoxynius abronius) toxicity tests on bedded sediment, and 48 hour abalone (Haliotis rufescens) larval development tests on pore water samples.

Pore water and bedded sediment samples were transported to MPSL from the sample processing laboratory at Moss Landing in ice chests at 4°C. Transport time was approximately one hour.

Various sample water quality parameters were measured to determine if they were within the acceptable range for toxicity testing. The values for dissolved oxygen and salinity were reported only for samples where these measurements were outside the acceptable range of the test acceptability criteria. For abalone tests, the acceptable range for oxygen was 4.91 - 8.19 mg/L at 15 ± 2°C, and for salinity was 34 ± 2‰. For amphipod tests, the acceptable range for oxygen was 5.09 - 8.49 mg/L at 15 ± 2°C, and the acceptable range for salinity was 28 ± 3‰.

The ammonia values reported from pore water tests are the higher of the two (beginning or end) measurements from each sample. The ammonia values reported from solid phase amphipod tests were taken from overlying water at end of the test. The pH values reported were measured at the same time as the reported ammonia values. The un-ionized ammonia (NH_3) concentration was calculated from the total ammonia and pH measurements using the following formula (@15°C):

$$(\text{total ammonia}) \times (3.5293 \times 10) \times 10(0.98209 \times \text{pH}) + 100 = NH_3 \text{ conc.}$$

This formula was derived by fitting a curve and equation to tabular data (APHA, 1985).

Sulfide concentrations were measured in archived pore water samples using a sulfide ion specific electrode after completion of the toxicity test. The archived samples were stored frozen, and then thawed for the sulfide measurement.

For solid phase tests (Rhepoxynius), the laboratory control consisted of sediment from the site where the test amphipods were collected (Yaquina Bay, Oregon). This "home" sediment is considered optimal for Rhepoxynius survival, and results from this control are used to verify the suitability of the test organisms and laboratory techniques, as well as for the statistical comparison with test sites. Nearly all of the test sediments had finer grain size than did the home sediment controls. The seawater controls for the pore water tests (Haliotis) were comprised of relatively clean Granite Canyon seawater, rather than pore water from uncontaminated local sites.

Red Abalone Larval Development Test

Samples were thawed the day of the test, and pH, temperature, and dissolved oxygen were measured in all samples to verify that water quality requirements were within the limits defined for the test protocol. Water quality parameters were measured at the beginning and end of the 48 hour development tests. Total ammonia concentrations were also measured at this time. No salinity adjustment was necessary because all pore water samples were within the specified limits for abalone tests (34 ± 2°C) at the test start.

The red abalone, Haliotis rufescens, embryo/larval development test (Anderson et al., 1990) was conducted on all pore water samples. Adult male and female abalone were induced to spawn separately using a dilute solution of hydrogen peroxide in sea water. Fertilized eggs were distributed to the test containers within 1 hour of fertilization. Test containers were polyethylene-capped, pre-cleaned glass shell vials containing 10 ml of pore water. Each test container was inoculated with 100 embryos (10/ml). Pore water samples were diluted with 1 micron-filtered Granite Canyon sea water to yield test concentrations of 100%, 50%, and 25% porewater. Each pore water sample concentration from each sample was laboratory replicated three times.

Positive control reference tests using zinc sulfate as the reference toxicant were conducted concurrently with each pore water test. A negative sea water control consisting of 1 micron-filtered Granite Canyon sea water was compared to all pore water samples, and to positive control reference tests.

Tests were conducted in five separate legs (batches) consisting of approximately 25 samples in each leg, except for only 3 samples in leg 5. After the 48 hour exposure period, developing larvae were fixed in 5% buffered formalin. All larvae in each container were examined using an inverted light microscope at 100x to determine the proportion of veliger larvae with normal shells (Anderson et al., 1990). Percent normal development was calculated as:

(number of normal larvae ÷ total number of larvae) x 100 = percent normal larvae.

Amphipod Bedded Sediment Tests

All sediment samples were processed according to procedures described in ASTM (1992a). Bedded sediment samples were held refrigerated at 4°C, until needed for testing, with solid phase amphipod tests initiated within 14 days of sample collection. Water quality parameters were measured at the beginning and end of the amphipod tests, and were also measured in the overlying water as described above. Sulfide concentrations were also measured in archived frozen pore water samples as described above.

The amphipod test followed ASTM (1992b) procedures for Rhepoxynius abronius. All animals were obtained from Northwestern Aquatic Sciences in Yaquina Bay, Oregon. Animals were separated into groups of approximately 100 and placed in polyethylene boxes containing Yaquina Bay collection site sediment, then shipped on ice via overnight courier. Upon arrival at Granite Canyon, the amphipods were salinity acclimated slowly (2 ppt per day) to 28 ppt (T = 15°C). Once acclimated to 28 ppt, the animals were held for an additional 48 hours prior to inoculation into the test containers.

Test containers were one liter borosilicate glass beakers containing 2 cm of sediment and filled to the 700 ml line with 28 ppt sea water. Sediments were covered during addition of overlying water to avoid disturbing the sediment. Sea water was adjusted to the appropriate salinity using spring water or distilled water. Test sediment and overlying water were allowed to equilibrate for 24 hours, then 20 amphipods were placed in each beaker along with 28 ppt sea water to fill test containers to the one liter line. The test chambers were then gently aerated and continuously illuminated.

Five laboratory replicates of each sample were tested for 10 days, and amphipod emergence was recorded daily. After 10 days, the sediments were sieved through a 0.5 mm nytex screen to recover the test animals. The number of survivors was recorded for each replicate.

Positive control reference tests using cadmium chloride as a reference toxicant were conducted concurrently with each sediment test. For reference tests, amphipod survival was recorded in three replicates of four cadmium concentrations after a 96 hour water-only exposure. A negative sea water control was compared to all cadmium positive control concentration results. In addition, a negative sediment control consisting of Yaquina Bay home sediment was compared with each sediment test. Tests were conducted in five separate legs (batches) consisting of approximately 25 samples in each leg.

Statistical Analyses of Toxicity Data

Toxicity data were analyzed two separate ways to describe both the variability in site toxicity, and also the variability in station toxicity (where stations are field replicates of sites). Since the statistical design of this study is intended to test the hypothesis that each mean site (or station) toxicity does not significantly differ from mean control toxicity, a two-sample t-test was considered a more appropriate analysis than a multiple sample test such as Analysis of Variance.

For each set of analyses, an approximate t-test (Sokal and Rohlf, 1981) was used to determine statistically significant differences between each site or station mean, and the appropriate laboratory control mean. In this test, the number of degrees of freedom is adjusted to account for unequal variances between the two groups under comparison. This analysis was selected because heterogeneity of variance was common in this data set, particularly between field replicates within a site. Using this analysis we were able to provide a more conservative computation of statistically significant differences between each site or station mean, and the laboratory control mean.

Toxicity data are reported in terms of statistically significant differences from controls. The sites are compared against laboratory controls, rather than against field sites. For comparisons between sites and controls, the means of each of three stations (i.e. field replicates) per site were used to characterize within-site variability. For analyses between stations and controls, the 5 lab replicates per field replicate sample in the amphipod test (3 lab replicates in the abalone test) were used to characterize within-station variability.

Rather than being true field replicates, control "field replicates" were simply additional splits from the same control sample (home sediment for solid phase and seawater for the pore water tests). This may have resulted in lower variance among control "field replicates", with a resulting increase in the power of the statistical tests to differentiate between control and test sediments. In addition to considering the significance of statistical comparisons with laboratory controls, the actual mean survival (amphipods) or mean normal larval development (abalone) for each site of concern should also be considered.

Statistical significance was determined at both alpha = 0.05, and 0.01 (i.e., with 95% and 99% confidence). All percent survival and percent normal development data were arcsin-squareroot transformed prior to analysis.

Amphipod Analyses

For the amphipod toxicity data, individual t-tests were used to compare data from each site (consisting of the mean for each of the three field replicates) with the laboratory control data (consisting of the mean of each of three field replicates of a home sediment control) specific to that leg.

In analyses of stations, individual t-tests were used to compare data from each station with the control from the same leg. The control data consisted of a single field replicate of home sediment (selected as the home replicate producing median survival out of the three replicates).

Abalone Analyses

Abalone data analyses were conducted at each pore water dilution (100%, 50%, 25%) in each leg. Individual t-tests compared data from each site with the laboratory control data. To produce a balanced comparison with the field replicated site data, the sea water control for each leg was replicated three times (n=3 groups, consisting of 3 lab replicates each).

In analyses of stations, individual t-tests again were used to compare data from each station with the control from the same leg. The control data consisted of one set of 3 laboratory replicates of sea water (selected as the home replicate producing median percent normal development out of the three replicates).

Correlation Analyses

In order to determine the degree of correlation, if any, between levels of pollutants in the sediments and the response observed in the amphipod and abalone bioassays, Spearman rank correlation coefficients (Rho) were calculated using Statview 4.0 software. Since the response of the control groups for each toxicity test was both acceptable and consistent (see Tables 3-2 through 3-16), the sediment toxicity test data were not normalized to control results. Rho values, corrected for ties, were determined for each toxicity test and each pollutant or pollutant class.

The concentrations of each DDT/DDD/DDE isomer were summed to determine total DDTs, and the concentrations of each PCB congener were summed for total PCBs. Total low molecular weight PAHs (LPAHs) consisted of the sum of all 2- and 3-ring PAHs for each sample, with total high molecular weight PAHs (HPAHs) reflecting the sum of all 4- and 5-ring PAHs. Selected organic compounds were normalized to (divided by) the TOC content of the sediment to determine if TOC content was associated with the toxicity observed in the presence of pollutants.

3. RESULTS AND DISCUSSION

Interpretation of Pollutant Concentrations

The primary objectives of the State Water Board's Bay Protection and Toxic Cleanup Program are to identify a method or methods to evaluate sediment quality, locate contaminated sediments in the State's enclosed bays and estuaries, and eventually to develop strategies to clean up the most highly polluted areas (SWRCB, 1993). The program anticipates using chemical-specific guidelines in order to both estimate the potential for biological effects of measured sediment pollutant concentrations, and as an aid to rank impacted sites. In this report chemical measurements made at the various stations are compared to available screening values. A brief discussion of the chemical-specific screening values and their calculation is presented below.

Chemical-Specific Screening Values

There are three sediment evaluation approaches being evaluated for use by the BPTCP. The sediment screening or guidance values produced using the following methods are being considered: (1) values developed by the National Oceanic and Atmospheric Administration (Long and Morgan, 1990; Long et al., in press);

(2) a recent modification of the NOAA method developed by the Florida Coastal Management Program (MacDonald, et al. 1993; MacDonald, in press); and the Apparent Effects Threshold (AET) developed jointly by the U.S EPA Region 10 and the Washington Department of Ecology (U.S. EPA, 1988).

These approaches use carefully screened available analytical chemistry and toxicity testing data from a variety of sources to correlate chemical concentrations with biological effects. Each method derives chemical or chemical class specific concentrations which were observed in association with measures of biological effects. The NOAA and Florida methods also include effects on benthic community structure in their analyses. Differences in the screening levels produced by the Florida and NOAA approaches result from which data are used, and from the use of different assumptions in analyzing the data.

The NOAA method produces what are referred to as Effects Range-Low (ERL) and Effects Range-Median (ERM) values. The ERL reflects the 10th percentile of the ranked studies in which elevated levels of a chemical were associated with adverse effects, and represents a level below which adverse effects are not expected to occur. The ERM reflects the 50th percentile of the ranked data and represents the level above which adverse effects are expected to occur. Long et al. (in press) established that effects generally occurred in 5 to 20 percent of the studies at concentrations below the ERL values, while effects occurred in 75 to 100 percent of the studies above the ERM values.

Since a cause-and-effect relationship in the data is not required by this method, adverse biological effects could be attributed to high or low levels of multiple chemicals in the same sediment sample, or even to none of the pollutants present. Both fresh and saltwater data were included together without being uniquely identified or subject to selective sorting in the database used by Long and Morgan (1990), whereas only data from studies performed in saltwater were used by Long et al. (in press). Studies not demonstrating adverse effects were excluded when deriving the ERL and ERM values.

The State of Florida (MacDonald, in press) modified the NOAA method in several significant ways to derive a Threshold Effect Level (TEL) and a Probable Effect Level (PEL). Only marine or estuarine data were included, with freshwater data excluded. MacDonald (in press) constructed two databases, one for the "no-effect" data and one for the "effects" data, and added a fairly large amount of new data from the Southeastern United States, much of which did not demonstrate adverse effects.

The PEL values were derived by taking the geometric mean of the 50th percentile of the effects database and the 85th percentile of the no-effects database. The TEL values were derived by taking the geometric mean of the 15th percentile of the effects database and the 50th percentile of the no-effects database. The inclusion of the no-effect data in the calculation of the TELs and PELs by MacDonald (in press) yields values generally somewhat more conservative than the ERL and ERM values of either Long and Morgan (1990) or Long et al. (in press). Both methods also provide for the estimation of chemical concentrations associated with the important no-effect, possible effect, and probable effect ranges of pollutants in sediments.

The Apparent Effects Threshold (AET) approach was evaluated by the U.S. EPA Science Advisory Board (U.S EPA, 1989) for establishing national Sediment Quality Criteria (SQC), and also by the BPTCP for use in California (SWRCB, 1990). This method was designed to identify pollutant levels in sediments above which adverse effects will always be seen. The review conducted by the U. S. EPA's Science Advisory Board (U.S. EPA, 1989) determined that the method was useful for detecting biological effects, including interactive effects of pollutants or other factors related to sediments. However, it was found to suffer from a lack of independent validation, and an applicability better suited to site-specific situations.

In addition to these considerations, the BPTCP (SWRCB, 1990) found that acceptable matched (synoptic) chemical and biological testing data sets from California studies were limited in number, with the number and distribution of stations, lack of reference site identification, and the observed ranges of chemical concentrations of particular concern. As more data become available, particularly for California, it is likely that this approach will be reconsidered.

For the purposes of this study the TELs and PELs of MacDonald (in press) were used to evaluate the pollutant concentrations analyzed in sediment samples relative to pollutant levels generally associated with biological effects. The NOAA and Florida values are listed in Table 3-1.

Chemical Concentration Compared to Sediment Screening Values

The analytical results for specific analytes and analyte classes used in the BPTCP have been displayed in Figures 3-1 through 3-9; these are compared with the State of Florida TEL and PEL levels (MacDonald, in press). The concentrations above the TEL and below the PEL represent the "possible effects" range.

PAHs

When the low molecular weight PAHs are considered separately (Figure 3-1), only two sites had sediments with concentrations above the PEL. Southwest Slip (site 40001) had two of three stations with concentrations above the PEL, and Consolidated Slip (site 40006) had one of two stations above the PEL. High molecular weight PAH concentrations above the PEL were measured at four sites. Southwest Slip (site 40001) had three of three

TABLE 3-1

Comparison of Sediment[1] Screening Levels Developed by NOAA and the State of Florida

SUBSTANCE	State of Florida[3] TEL	PEL	NOAA ERM[2]	ERL[4]	ERM[4]
<u>Organics ug/kg</u>					
Total PCBs	21.55	188.79	380	22.7	180
Acenaphthene	6.71	88.9	650	16	500
Acenaphthylene	5.87	127.89		44	640
Anthracene	46.85	245	960	85.3	1100
Fluorene	21.17	144.35	640	19	540
2-methyl naphthalene	20.21	201.28	670	70	670
Naphthalene	34.57	390.64	2100	160	2100
Phenanthrene	86.68	543.53	1380	240	1500
Total LMW-PAHs	311.7	1442.0		552	3160
Benz(a)anthracene	74.83	692.53	1600	261	1600
Benzo(a)pyrene	88.81	763.22	2500	430	1600
Chrysene	107.71	845.98	2800	384	2800
Dibenzo(a,h)anthracene	6.22	134.61	260	63.4	260
Fluoranthene	112.82	1493.54	3600	600	5100
Pyrene	152.66	1397.60	2200	665	2600
Total HMW-PAHs	655.34	6676.14		1700	9600
Total PAHs	1684.06	16770.54	35000	4022	44792
p,p'-DDE	2.07	374.17	15	2.2	27
Total DDT	3.89	51.70	350	1.58	46.1
p,p'-DDT	1.19	4.77			
Lindane	0.32	0.99			
Chlordane	2.26	4.79		0.5	6
Dieldrin	0.715	4.30		0.02	8
Endrin				0.02	45
2-methylnaphthalene				65	670
<u>Metals mg/kg</u>					
Arsenic	7.24	41.6	85	8.2	70.0
Antimony			2		2.5
Cadmium	0.676	4.21	9	1.2	9.6
Chromium	52.3	160.4	145	81.0	370.0
Copper	18.7	108.2	390	34.0	270.0
Lead	30.24	112.18	110	46.7	218.
Mercury	0.130	0.696	1.3	0.15	0.71
Nickel	15.9	42.8		20.9	51.6
Silver	0.733	1.77	2.5	1.0	3.7
Zinc	124	271.0	280	150.0	410.

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[1] Values are for bulk sediment expressed on a dry weight basis

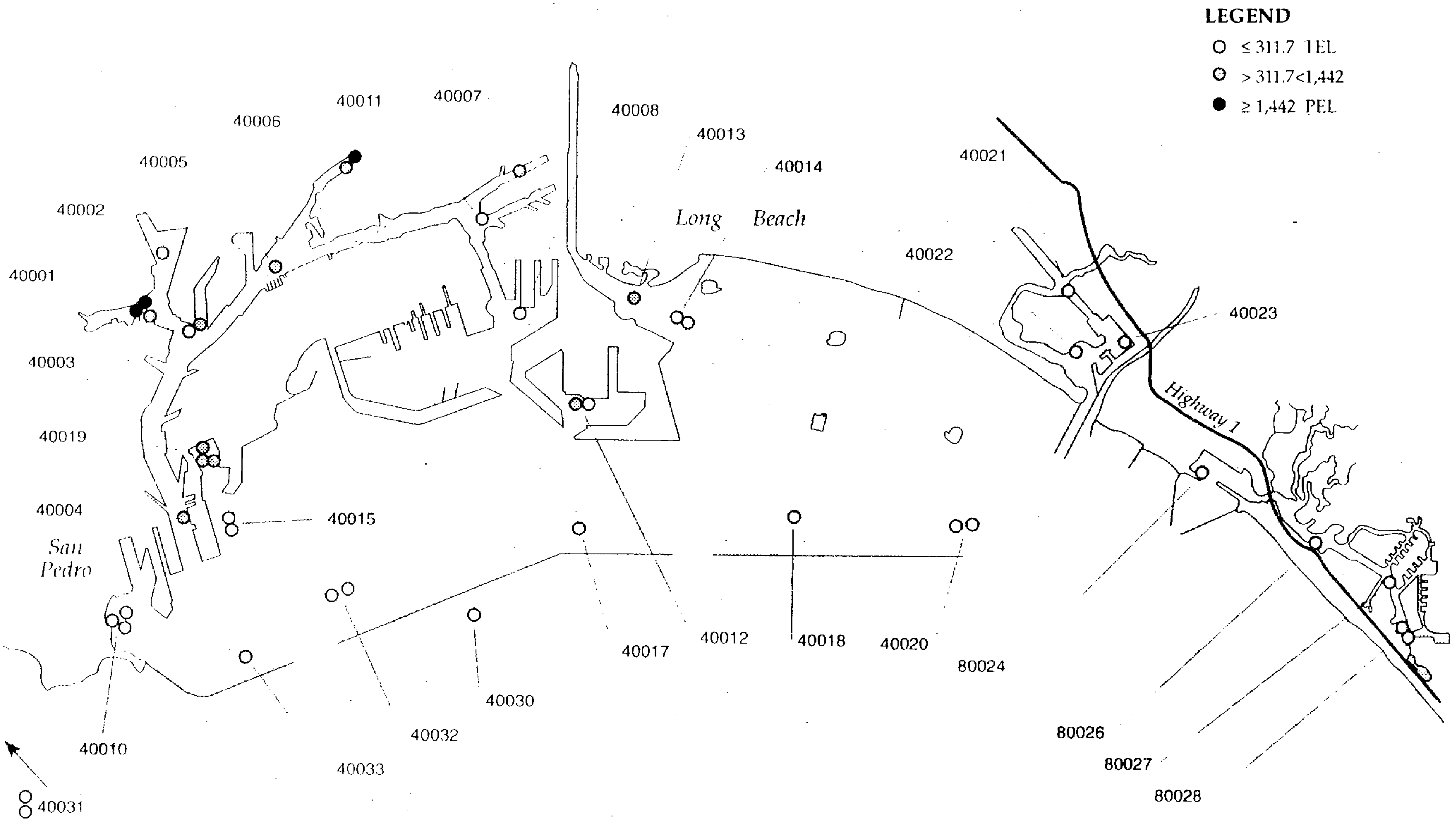
[3] McDonald, in press

[2] Long and Morgan, 1990

[4] Long et al., in press

FIGURE 3-1

Sum of Low Molecular Weight PAHs in Sediment
(µg/kg)



stations, Consolidated Slip (site 40006) had one of two stations, Long Beach Harbor Channel 2 (site 40007) had one of one station, and Inner Fish Harbor (site 40019) had two of three stations above the PEL (Figure 3-2).

The sum of all PAHs measured are shown in Figure 3-3. While there were no sites with stations having concentrations above the PEL, the inner harbor area from the Lower Main Channel (40004) to Long Beach Harbor Channel 2 (40007) had the greatest number of stations with PAH levels in the possible effects range but below the probable effects range. The PAH levels at the outer harbor sites were generally below the TEL value, except for one station at Outer Harbor POLA 10 (40033), which had high molecular weight PAHs in the possible effects range (i.e., above the TEL but below the PEL).

PCBs

PCBs measured at or above the PEL were found at two of two stations at Consolidated Slip (40006) and one of three stations at Inner Fish Harbor (40019). Sites with stations having PCBs within the possible effects range were found in both the inner, middle, and outer harbor areas, and also in both Huntington Harbour and Anaheim Bay (Figure 3-4).

DDE and DDT

All sites with stations having analytical data for DDE showed concentrations greater than the TEL, with both stations at site 40031 above the PEL (Figure 3-5). Total DDT concentrations (Figure 3-6) were above the PEL at many stations. Total DDT was below the TEL only at stations in Alamitos Bay-Marine Stadium (40021) and Alamitos Bay-Entrance (40022), with concentrations above the TEL but below the PEL at stations at the Turning Basin Pier (40003), Fish Harbor Entrance (40015), East Basin Pier C (40008), Southeast Basin (40012), Inner Queensway Bay (40013), Alamitos Bay Entrance (40022), Anaheim Bay Outer (80024), and Huntington Harbour Lower (80026).

Copper

The majority of sites had stations with copper concentrations above either the TEL or the PEL (Figure 3-7). The inner harbor, had the greatest number of sites with stations having copper concentrations above the PEL, along with a single station at the Outer Harbor-POLA 10 (40033) in the outer harbor. Only one site in the outer harbor, San Pedro Breakwater (40030), and one site in Huntington Harbour, Huntington Harbour-Lower (80026) had stations with copper concentrations below the TEL.

Zinc

Zinc concentrations above the PEL were measured at two of two stations at Consolidated Slip (40006), one of one station at Long Beach Harbor Channel 2 (40007), and three of three stations at Inner Fish Harbor (40019) in the Los Angeles and Long Beach Harbors (Figure 3-8). The majority of stations had zinc concentrations above the TEL but below the PEL.

FIGURE 3-2

Sum of High Molecular Weight PAHs in Sediment
(µg/kg)

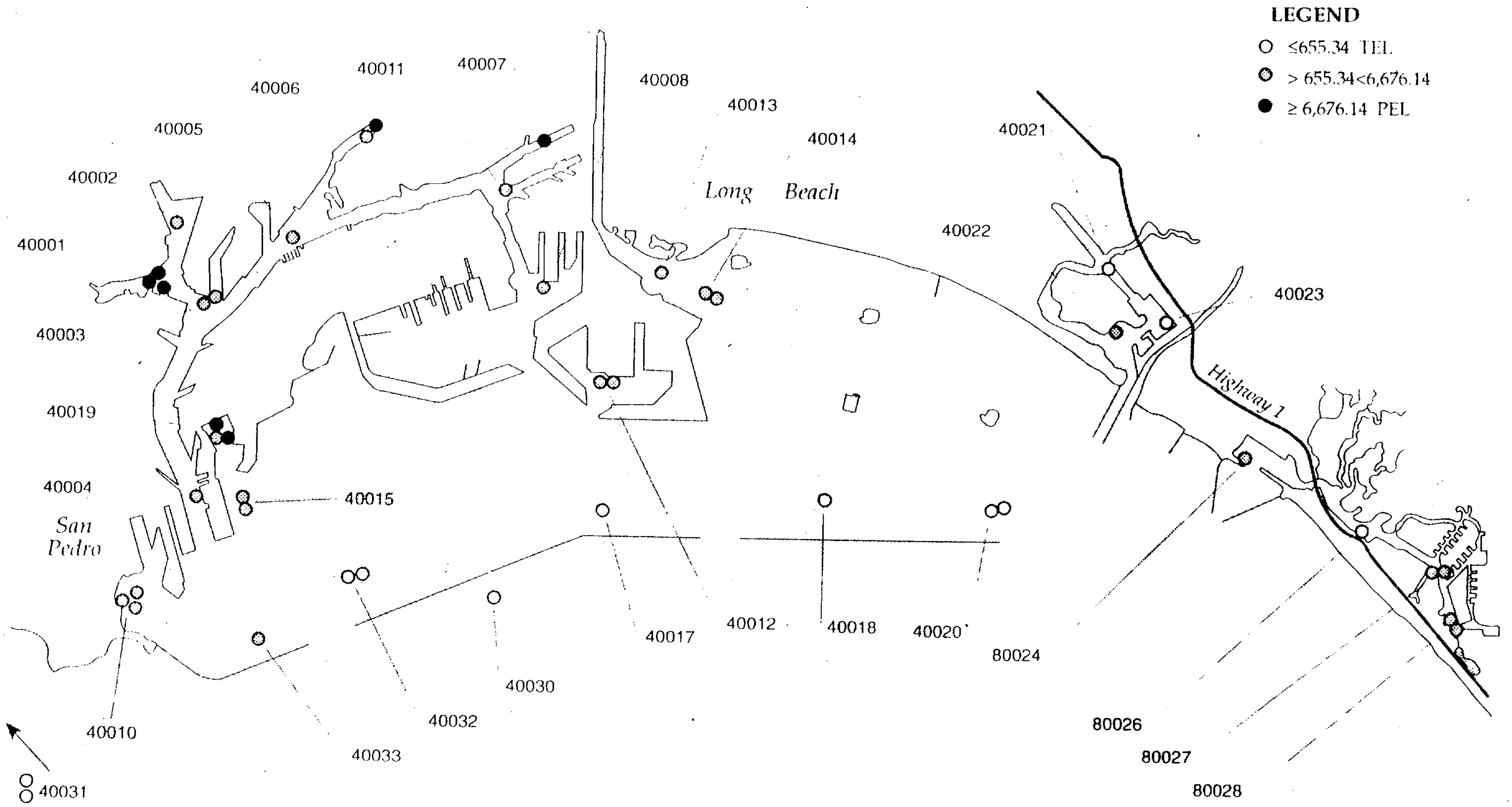


FIGURE 3-3

Sum of PAHs in Sediment
(µg/kg)

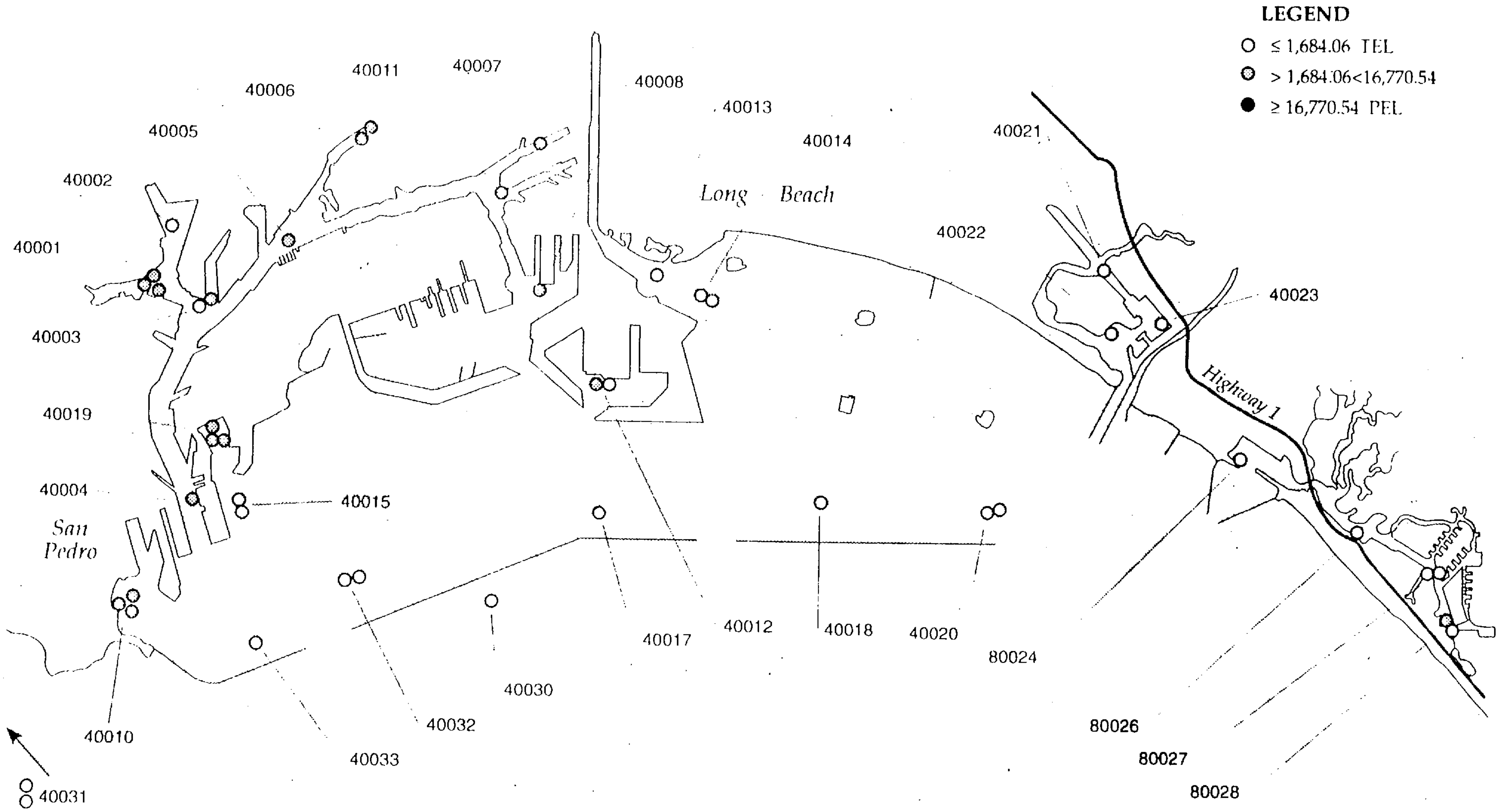


FIGURE 3-4

Sum of PCBs in Sediment
(µg/kg)

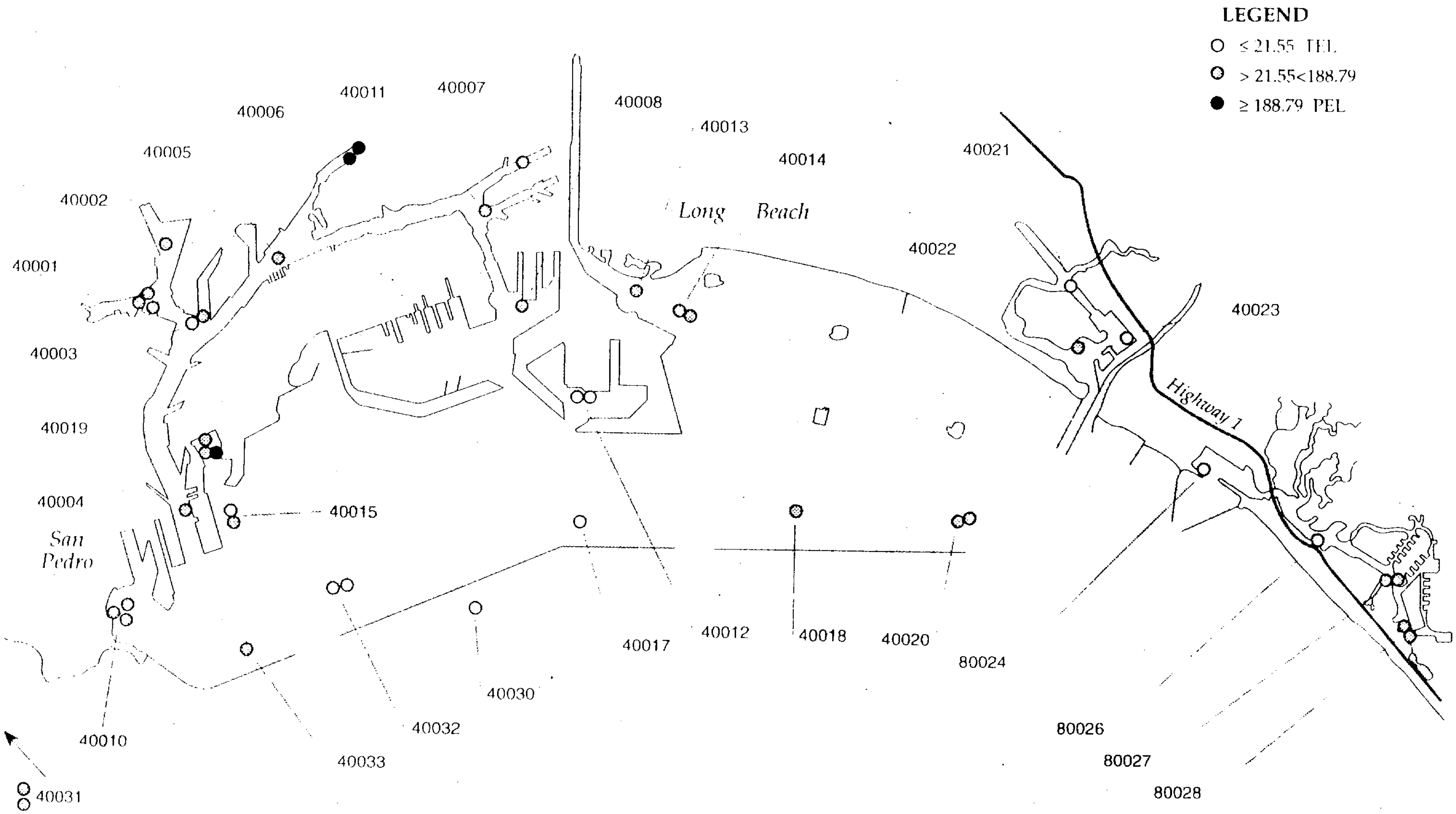


FIGURE 3-5

DDE in Sediment
(µg/kg)

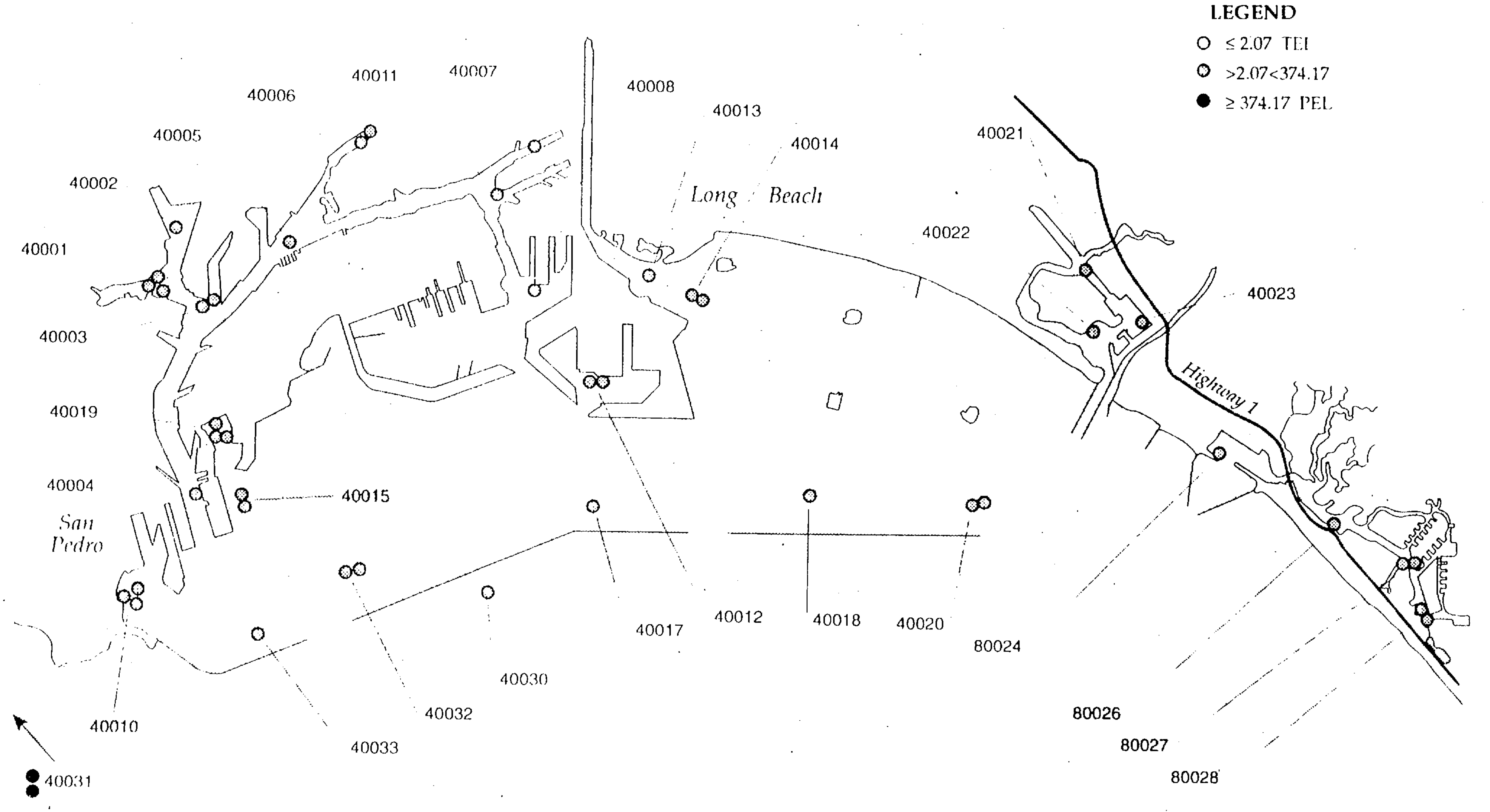


FIGURE 3-6

Total DDT in Sediment
(µg/kg)

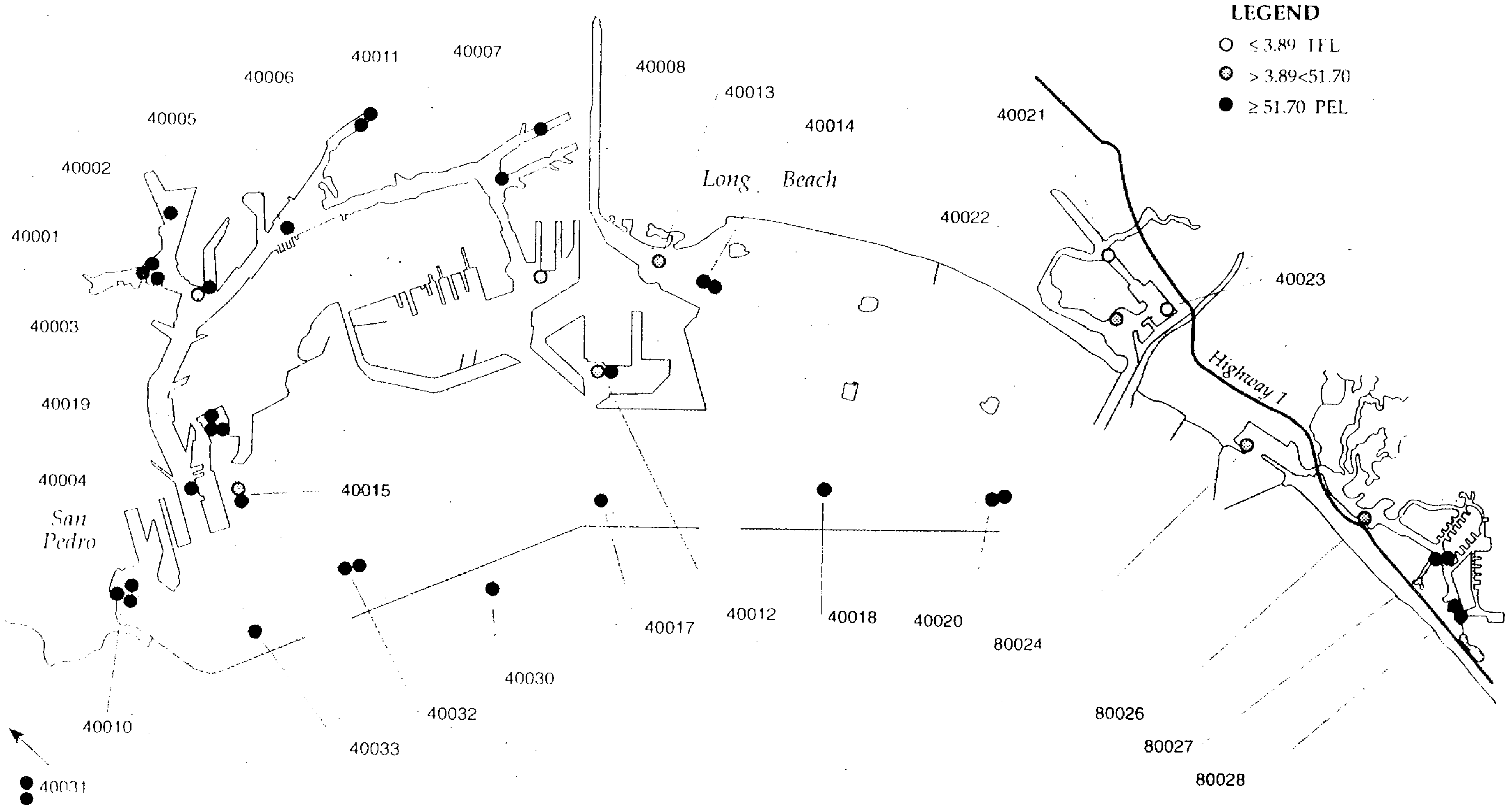


FIGURE 3-7

Copper in Sediment
(mg/kg)

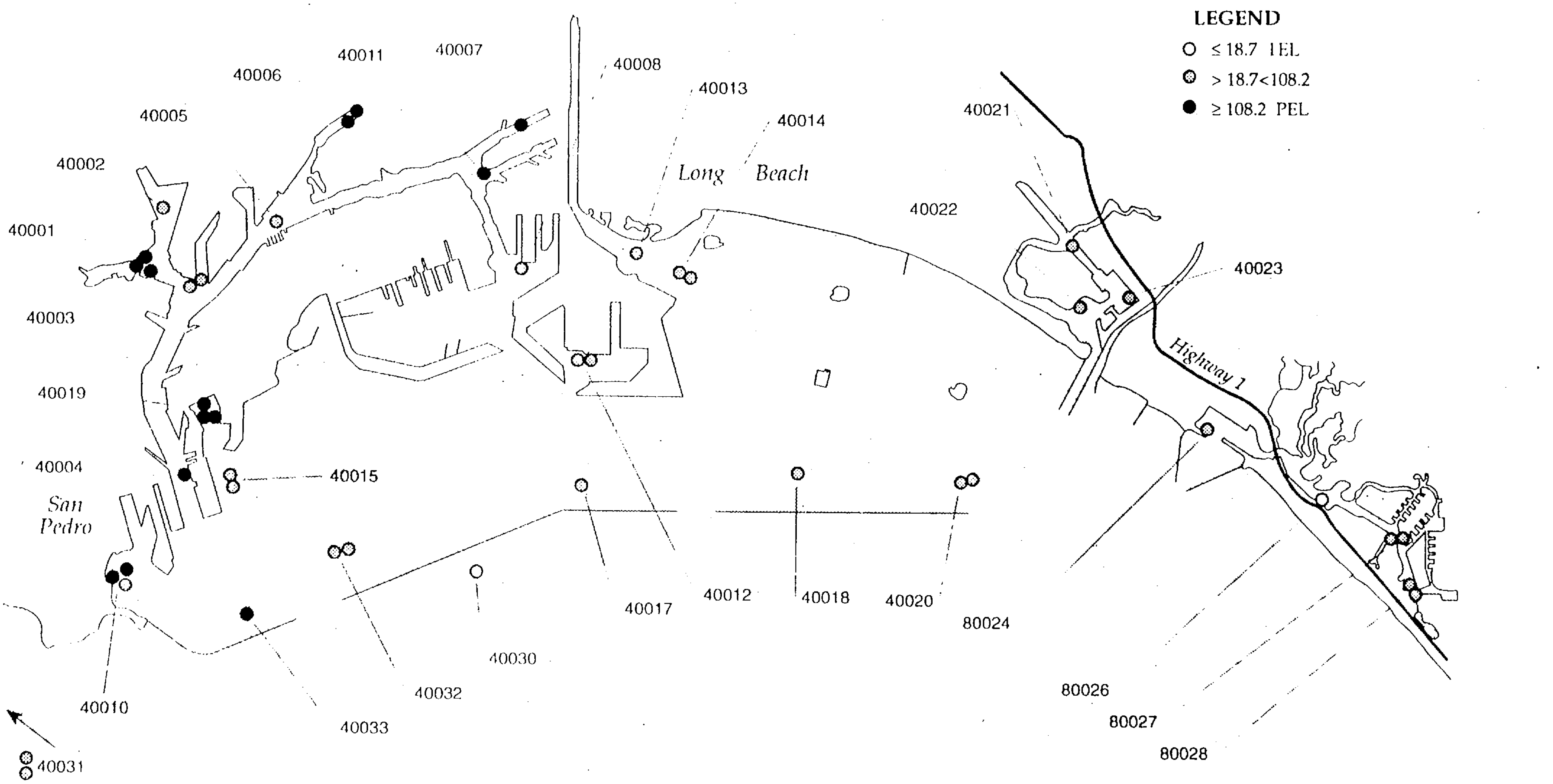
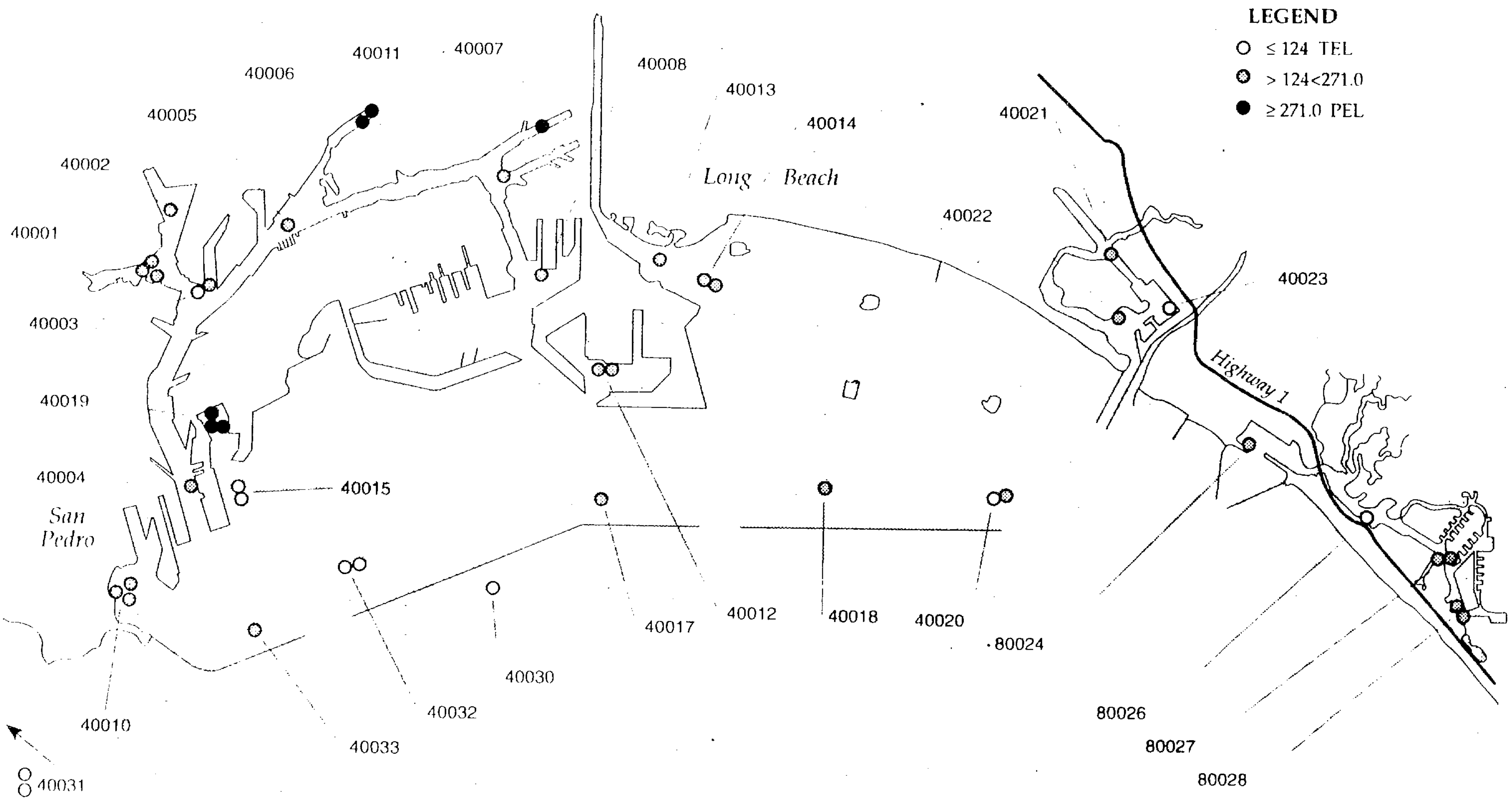


FIGURE 3-8

Zinc in Sediment
(mg/kg)



Nickel

Seven sites had stations with nickel concentrations above the PEL, while only two sites, Turning Basin-Pier (40003) and Huntington Harbour-Lower (80026), had stations with nickel concentrations below the TEL (Figure 3-9). The inner harbor again had the greatest number of sites with stations having nickel concentrations above the PEL. Outer Harbor-POLA 10 (40033) had one of one station with nickel concentrations above the PEL.

Amphipod Toxicity Testing Results

The results for both the laboratory controls (home sediment) and the samples collected and tested concurrently on each sampling leg for Los Angeles Harbor, Long Beach Harbor, Huntington Harbour, and Anaheim Bay are in Tables 3-2 through 3-6.

These tables show the mean proportion survival of amphipods at each station and site, with significant mortality relative to controls reported at both $p < 0.05$ and $p < 0.01$. The survival at each station is also graphically displayed in Figure 3-10.

A total of 61 of the 105 samples tested (58.1 percent) were significantly toxic relative to laboratory controls. Mean amphipod survival ranged from 46.3 percent to 103.3 percent relative to controls. Mean amphipod survival was less than 80 percent of control survival in 27 of the 105 samples (27.7 percent). A minimum significant difference (MSD) of 80 percent or greater relative to controls was determined for similar tests performed with Ampelisca abdita (Glen B. Thursby, SAIC, personal communication).

The inner harbor channel sites (Figure 3-10) from the Lower Main Channel (40004) to Inner Harbor Channel 3 (40011), and the adjacent sites, Southwest Slip (40001) and West Basin-Pier 143 (40002), had several stations with significant toxicity ($p < 0.01$). Sites at Long Beach Outer Harbor 18 (40018), Long Beach Channel (40017) and Outer Harbor-POLA 10 (40033) also had stations that showed significant toxicity ($p < 0.01$). Only one Huntington Harbour site, Huntington Harbour-Middle (80027), and one Alamitos Bay site, Alamitos Bay-Marine Stadium (40021) had stations with significant toxicity ($p < 0.01$ level).

Amphipod survival was also low in samples from the Consolidated Slip (40006), Fish Harbor (40019), and Southwest Slip (40001). Consolidated Slip receives drainage from Dominguez Channel, a historical repository of pesticide wastes, and is near several petroleum-related companies and a small vessel marina. Consolidated Slip (40006) was the only site with three of three stations having toxicity significant at $p < 0.01$. Fish Harbor is the site of fish processing and has a small vessel marina and

FIGURE 3-9

Nickel in Sediment
(µg/kg)

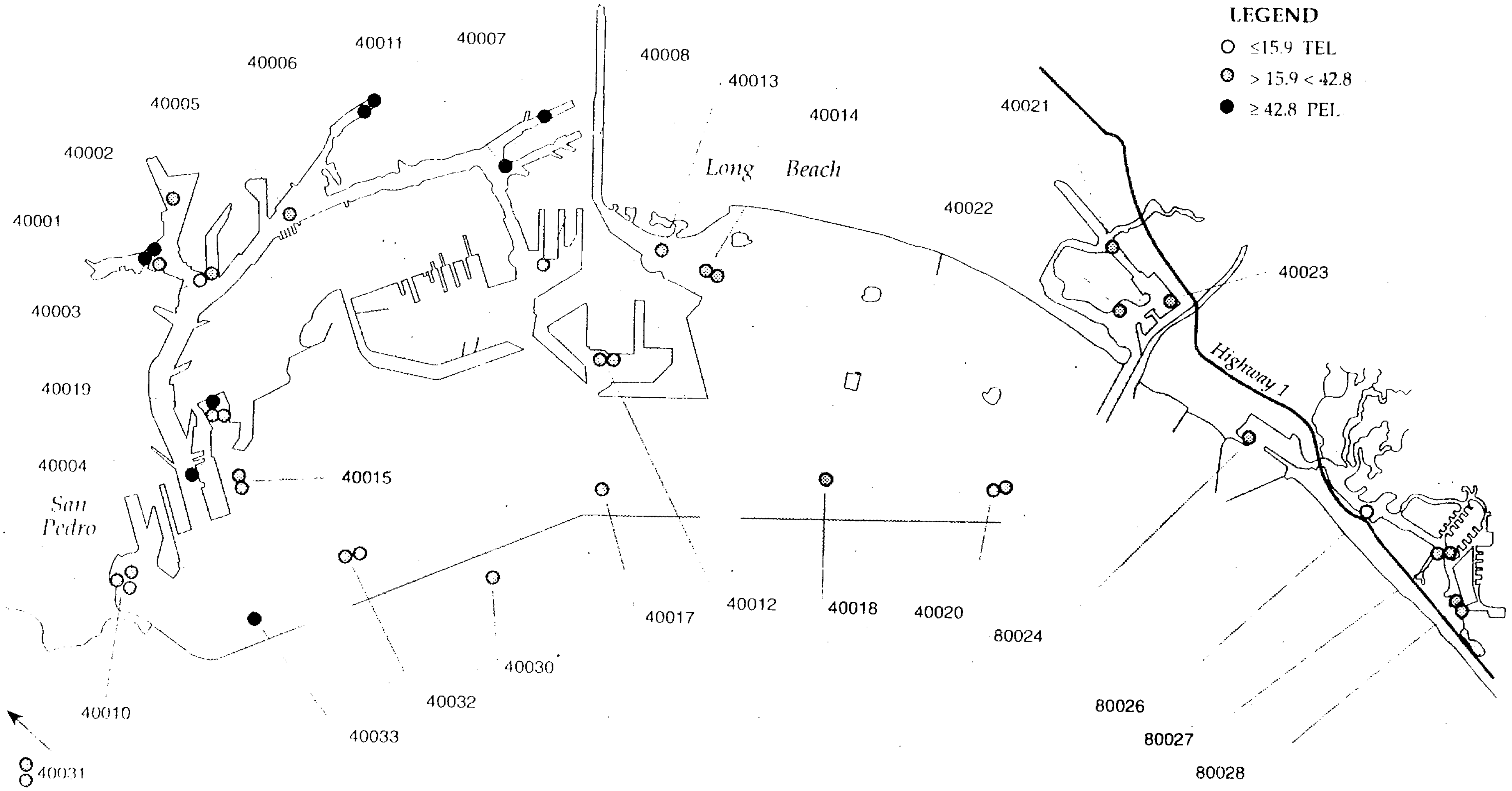


TABLE 3-2
LA Harbor Amphipod Toxicity Test Results - Percent Survival - Leg 1
(Compared to Home Sediment)

Station Name	Station Number	STATION Mean Percent Survival	+	Standard Deviation	Statistical Significance	SITE Mean Percent Survival	+	Standard Deviation	Statistical Significance
Leg 1 Home Sediment		90%	+	9.4		92.3%	+	2.08	
Leg 1 Home Sediment		93%		6.7					
Leg 1 Home Sediment		94%		6.5					
Southwest Slip						62%	+	10.3	*
Southwest Slip	40001.1	65.0%	+	28.9	*				
Southwest Slip	40001.2	51.0%	+	17.8	*				
Southwest Slip	40001.3	71.0%	+	13.4	**				
West Basin, Pier 143						76%	+	2.0	**
West Basin, Pier 143	40002.1	75.0%	+	13.9	*				
West Basin, Pier 143	40002.2	78.0%	+	13.0	ns				
West Basin, Pier 143	40002.3	74.0%	+	10.8	**				
Turning Basin, Pier 151						69%	+	10.1	*
Turning Basin, Pier 151	40003.1	64.0%	+	16.4	**				
Turning Basin, Pier 151	40003.2	63.0%	+	29.9	ns				
Turning Basin, Pier 151	40003.3	81.0%	+	9.6	*				
Lower Main Channel						80%	+	1.5	**
Lower Main Channel	40004.1	78.0%	+	6.7	*				
Lower Main Channel	40004.2	80.0%	+	7.9	*				
Lower Main Channel	40004.3	81.0%	+	9.6	*				
East Basin,Turning Basin						75%	+	3.2	**
East Basin,Turning Basin	40005.1	74.0%	+	11.9	**				
East Basin,Turning Basin	40005.2	73.0%	+	7.6	**				
East Basin,Turning Basin	40005.3	79.0%	+	15.6	*				

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ns = not significant
* = significant at 5% level
** = significant at 1% level
na = not analyzed

TABLE 3-2
LA Harbor Amphipod Toxicity Test Results - Percent Survival - Leg 1
(Compared to Home Sediment)

Station Name	Station Number	STATION Mean Percent Survival	+	STATION Standard Deviation	STATION Statistical Significance	SITE Mean Percent Survival	+	SITE Standard Deviation	SITE Statistical Significance
Leg 1 Home Sediment		90%	+	9.4		92.3%	+	2.08	
Leg 1 Home Sediment		93%		6.7					
Leg 1 Home Sediment		94%		6.5					
Consolidated Slip						61%	+	4.9	**
Consolidated Slip	40006.1	58.0%	+	17.2	**				
Consolidated Slip	40006.2	59.0%	+	16.4	**				
Consolidated Slip	40006.3	67.0%	+	11.5	**				
San Pedro Bay, POLA 19						88%	+	4.4	ns
San Pedro Bay, POLA 19	40032.1	86.0%	+	4.2	ns				
San Pedro Bay, POLA 19	40032.2	85.0%	+	9.4	ns				
San Pedro Bay, POLA 19	40032.3	93.0%	+	2.7	ns				
Outer Harbor, POLA 10						69%	+	3.2	**
Outer Harbor, POLA 10	40033.1	71.0%	+	20.4	*				
Outer Harbor, POLA 10	40033.2	70.0%	+	21.8	*				
Outer Harbor, POLA 10	40033.3	65.0%	+	17.3	**				

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-3
LA Harbor Amphipod Toxicity Test Results - Percent Survival - Leg 2
(Compared to Home Sediment)

		STATION				SITE			
Station Name	Station Number	Mean Percent Survival	+	Standard Deviation	Statistical Significance	Mean Percent Survival	+	Standard Deviation	Statistical Significance
Leg 2 Home Sediment		94%	+	6.5		93.7%	+	1.5	
Leg 2 Home Sediment		92%		2.7					
Leg 2 Home Sediment		95%		5.0					
East Basin Pier C						78%	+	2.0	**
East Basin Pier C	40008.1	80.0%	+	16.2	*				
East Basin Pier C	40008.2	78.0%	+	11.5	*				
East Basin Pier C	40008.3	76.0%	+	8.9	**				
West Basin Entrance						85%	+	3.8	*
West Basin Entrance	40009.1	88.0%	+	5.7	ns				
West Basin Entrance	40009.2	81.0%	+	2.2	*				
West Basin Entrance	40009.3	87.0%	+	5.7	ns				
Off Cabrillo Beach						90%	+	2.1	*
Off Cabrillo Beach	40010.1	92.0%	+	7.6	ns				
Off Cabrillo Beach	40010.2	88.0%	+	9.1	ns				
Off Cabrillo Beach	40010.3	91.0%	+	9.6	ns				
Southeast Basin						75%	+	4.9	**
Southeast Basin	40012.1	77.0%	+	14.0	ns				
Southeast Basin	40012.2	78.0%	+	13.5	*				
Southeast Basin	40012.3	69.0%	+	16.4	*				
Fish Harbor Entrance						86%	+	5.3	*
Fish Harbor Entrance	40015.1	83.0%	+	5.0	*				
Fish Harbor Entrance	40015.2	83.0%	+	7.6	*				
Fish Harbor Entrance	40015.3	92.0%	+	7.6	ns				
Terminal Island STP						80%	+	8.0	*
Terminal Island STP	40016.1	72.0%	+	5.7	**				
Terminal Island STP	40016.2	88.0%	+	8.4	ns				
Terminal Island STP	40016.3	80.0%	+	12.7	*				

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-3
LA Harbor Amphipod Toxicity Test Results - Percent Survival - Leg 2
(Compared to Home Sediment)

Station Name	Station Number	STATION				SITE			
		Mean Percent Survival	+	Standard Deviation	Statistical Significance	Mean Percent Survival	+	Standard Deviation	Statistical Significance
Leg 2 Home Sediment		94%	+	6.5		93.7%	+	1.5	
Leg 2 Home Sediment		92%		2.7					
Leg 2 Home Sediment		95%		5.0					
Inner Fish Harbor						70%	+	14.7	*
Inner Fish Harbor	40019.1	83.0%	+	18.9	ns				
Inner Fish Harbor	40019.2	73.0%	+	4.5	**				
Inner Fish Harbor	40019.3	54.0%	+	21.0	**				
San Pedro Breakwater						93%	+	2.6	ns
San Pedro Breakwater	40030.1	90.0%	+	3.5	ns				
San Pedro Breakwater	40030.2	94.0%	+	6.5	ns				
San Pedro Breakwater	40030.3	95.0%	+	6.1	ns				
San Pedro Bay, POLA 19						91%	+	4.6	ns
San Pedro Bay, POLA 19	40032.1	94.0%	+	5.5	ns				
San Pedro Bay, POLA 19	40032.2	94.0%	+	5.5	ns				
San Pedro Bay, POLA 19	40032.3	86.0%	+	15.2	ns				

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-4
LA Harbor Amphipod Toxicity Test Results - Percent Survival - Leg 3
(Compared to Home Sediment)

Station Name	Station Number	STATION				SITE			
		Mean Percent Survival	+	Standard Deviation	Statistical Significance	Mean Percent Survival	+	Standard Deviation	Statistical Significance
Leg 3 Home Sediment		94%	+	6.5		93.0%	+	1.7	
Leg 3 Home Sediment		91%		5.5					
Leg 3 Home Sediment		94%		6.5					
Elkhorn Slough, Seal Point REF						76%	+	2.1	**
Elkhorn Slough, Seal Point REF	30035.1	78.0%	+	2.7	*				
Elkhorn Slough, Seal Point REF	30035.2	75.0%	+	9.4	**				
Elkhorn Slough, Seal Point REF	30035.3	74.0%	+	10.2	**				
L.B. Harbor Channel 2						83%	+	5.0	*
L.B. Harbor Channel 2	40007.1	82.0%	+	10.4	ns				
L.B. Harbor Channel 2	40007.2	88.0%	+	11.5	ns				
L.B. Harbor Channel 2	40007.3	78.0%	+	14.4	ns				
Inner Harbor Channel 3						84%	+	1.5	**
Inner Harbor Channel 3	40011.1	85.0%	+	6.9	ns				
Inner Harbor Channel 3	40011.2	84.0%	+	5.3	ns				
Inner Harbor Channel 3	40011.3	82.0%	+	2.5	*				
Inner Queensway Bay						83%	+	1.5	**
Inner Queensway Bay	40013.1	83.0%	+	13.0	ns				
Inner Queensway Bay	40013.2	84.0%	+	6.5	ns				
Inner Queensway Bay	40013.3	81.0%	+	10.8	ns				
Outer Queensway Bay						74%	+	8.7	**
Outer Queensway Bay	40014.1	78.0%	+	10.4	*				
Outer Queensway Bay	40014.2	80.0%	+	14.6	ns				
Outer Queensway Bay	40014.3	64.0%	+	36.3	*				
Long Beach Channel						82%	+	6.0	*
Long Beach Channel	40017.1	76.0%	+	11.4	**				
Long Beach Channel	40017.2	82.0%	+	9.7	*				
Long Beach Channel	40017.3	88.0%	+	8.4	ns				

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-4
LA Harbor Amphipod Toxicity Test Results - Percent Survival - Leg 3
(Compared to Home Sediment)

		STATION				SITE			
Station Name	Station Number	Mean Percent Survival	+	Standard Deviation	Statistical Significance	Mean Percent Survival	+	Standard Deviation	Statistical Significance
Leg 3 Home Sediment		94%	+	6.5		93.0%	+	1.7	
Leg 3 Home Sediment		91%		5.5					
Leg 3 Home Sediment		94%		6.5					
Long Beach Outer Hbr 18						80%	+	13.0	ns
Long Beach Outer Hbr 18	40018.1	67.0%	+	14.4	**				
Long Beach Outer Hbr 18	40018.2	79.0%	+	11.4	*				
Long Beach Outer Hbr 18	40018.3	93.0%	+	4.5	ns				
Long Beach Outer Hbr 20	40020.1	83.0%	+	7.6	ns				
Long Beach Outer Hbr 20	40020.2	92.0%	+	11.0	ns				
Long Beach Outer Hbr 20	40020.3	84.0%	+	9.6	ns				
Palos Verdes(Swartz 6)						92%	+	5.1	ns
Palos Verdes(Swartz 6)	40031.1	86.0%	+	7.4	ns				
Palos Verdes(Swartz 6)	40031.2	93.0%	+	7.6	ns				
Palos Verdes(Swartz 6)	40031.3	96.0%	+	2.2	ns				

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-5
LA Harbor Amphipod Toxicity Test Results - Percent Survival - Leg 4
(Compared to Home Sediment)

Station Name	Station Number	STATION				SITE			
		Mean Percent Survival	+	Standard Deviation	Statistical Significance	Mean Percent Survival	+	Standard Deviation	Statistical Significance
Leg 4 Home Sediment		95%	+	7.1		95.0%	+	0.0	
Leg 4 Home Sediment		95%		6.1					
Leg 4 Home Sediment		95%		7.1					
Elkhorn Slough, Seal Bend REF						76%	+	13.5	**
Elkhorn Slough, Seal Bend REF	30036.1	82.0%	+	7.6	*				
Elkhorn Slough, Seal Bend REF	30036.2	67.0%	+	18.2	*				
Elkhorn Slough, Seal Bend REF	30036.3	79.0%	+	9.6	*				
Off Cabrillo Beach						87%	+	2.9	*
Off Cabrillo Beach	40010.1	89.0%	+	14.3	ns				
Off Cabrillo Beach	40010.2	89.0%	+	5.5	ns				
Off Cabrillo Beach	40010.3	84.0%	+	5.5	ns				
Alamitos Bay, Marine Stadium						74%	+	3.1	**
Alamitos Bay, Marine Stadium	40021.1	75.0%	+	11.7	**				
Alamitos Bay, Marine Stadium	40021.2	77.0%	+	16.0	*				
Alamitos Bay, Marine Stadium	40021.3	71.0%	+	12.9	**				
Alamitos Bay, Entrance						88%	+	6.4	ns
Alamitos Bay, Entrance	40022.1	92.0%	+	2.7	ns				
Alamitos Bay, Entrance	40022.2	92.0%	+	7.6	ns				
Alamitos Bay, Entrance	40022.3	81.0%	+	7.4	*				
Alamitos Bay, Long Beach Marina						84%	+	6.4	*
Alamitos Bay, Long Beach Marina	40023.1	81.0%	+	18.2	*				
Alamitos Bay, Long Beach Marina	40023.2	79.0%	+	12.9	*				
Alamitos Bay, Long Beach Marina	40023.3	91.0%	+	10.2	*				
Anaheim Bay, Outer						84%	+	2.5	**
Anaheim Bay, Outer	80024.1	87.0%	+	4.5	*				
Anaheim Bay, Outer	80024.2	84.0%	+	8.2	*				
Anaheim Bay, Outer	80024.3	82.0%	+	14.4	ns				

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-5
LA Harbor Amphipod Toxicity Test Results - Percent Survival - Leg 4
(Compared to Home Sediment)

Station Name	Station Number	STATION				SITE			
		Mean Percent Survival	+	Standard Deviation	Statistical Significance	Mean Percent Survival	+	Standard Deviation	Statistical Significance
Leg 4 Home Sediment		95%	+	7.1		95.0%	+	0.0	
Leg 4 Home Sediment		95%		6.1					
Leg 4 Home Sediment		95%		7.1					
Huntington Harbour, Lower						87%	+	5.0	ns
Huntington Harbour, Lower	80026.1	86.0%	+	8.2	*				
Huntington Harbour, Lower	80026.2	92.0%	+	5.7	ns				
Huntington Harbour, Lower	80026.3	82.0%	+	7.6	*				
Huntington Harbour, Middle	80027.1	64.0%	+	9.6	**				
Huntington Harbour, Middle	80027.2	67.0%	+	13.0	*				
Huntington Harbour, Middle	80027.3	44.0%	+	23.8	*				
Huntington Harbour, Upper	80028.1	73.0%	+	13.0	*				
Huntington Harbour, Upper	80028.2	73.0%	+	16.0	*				
Huntington Harbour, Upper	80028.3	52.0%	+	14.4	*				

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-6
LA Harbor Amphipod Toxicity Test Results - Percent Survival - Leg 5
(Compared to Home Sediment)

		STATION				SITE			
Station Name	Station Number	Mean Percent Survival	+	Standard Deviation	Statistical Significance	Mean Percent Survival	+	Standard Deviation	Statistical Significance
Leg 5 Home Sediment		98%	+	2.7		93.7%	+	4.0	
Leg 5 Home Sediment		90%		6.1					
Leg 5 Home Sediment		93%		5.7					
Anaheim Bay, Oil Isl.						73%	+	11.6	**
Anaheim Bay, Oil Isl.	80025.1	65.0%	+	11.2	*				
Anaheim Bay, Oil Isl.	80025.2	80.0%	+	10.0	*				
Anaheim Bay, Oil Isl.	80025.3	75.0%	+	10.0	*				

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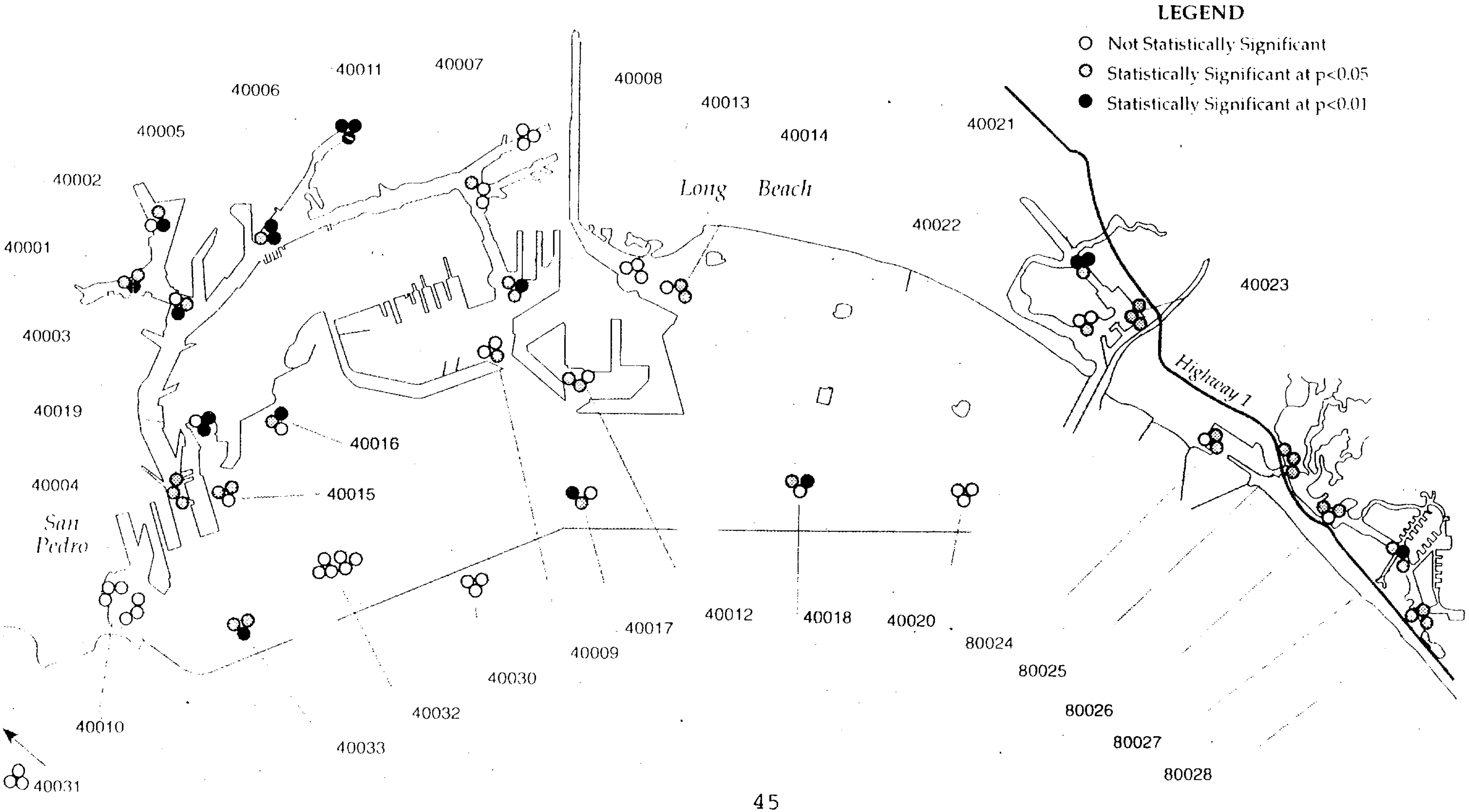
ns = not significant
* = significant at 5% level
** = significant at 1% level

FIGURE 3-10

Amphipod Stations vs. Controls
Statistical Significance of Toxicity Test Results



boat yard. Southwest Slip has a petroleum off-loading facility, shipping docks and a site formerly used as a large shipyard which is no longer in operation, and also receives drainage from storm drains in the area.

The stations at sites 40032 and 40010 were sampled on two separate legs. The results of testing both sets of samples were in agreement with each other, with no significant toxicity observed in either set of samples.

Overall, significant toxicity was found in samples from the Los Angeles Harbor, Long Beach Harbor, the mouth of the Los Angeles River, and Huntington Harbour (Figure 3-10). Toxicity diminished into lower San Pedro Bay (off Seal Beach) and offshore beyond the San Pedro breakwater.

Abalone Larvae Development Testing Results

The results using the abalone larvae are shown for each station in Tables 3-7 through 3-11. Data from negative laboratory controls (Granite Canyon seawater) are grouped with the samples for each of the five sampling legs. Site results are in Tables 3-12 through 3-16. The results for each of the pore water dilutions for each station grouped by site are also displayed in Figures 3-11 through 3-13.

At the 100 percent porewater concentration, the results show 62 percent of the sites (mean value of the stations in a site) had a response significant at $p < 0.01$, with 15 percent of the sites showing a response significant at $p < 0.05$ (Figure 3-11). All sites had one or more stations with a response significant at either the 95 percent and 99 percent confidence levels. At 66 percent of the sites all stations had a response significant at $p < 0.01$.

Using 50 percent pore water (Figure 3-12), 25 percent of the sites had a response significant at $p < 0.01$, with 12 percent of the sites having a significant response at $p < 0.05$. All stations at all sites in Alamitos Bay and Huntington Harbour had a response significant at $p < 0.01$, as did all stations at West Basin-Pier 143 (40002), and off Cabrillo Beach (40010). Sites having stations without a significant response at either confidence level include Turning Basin-Pier (40003), Lower Main Channel (40004), West Basin Entrance (40009), off Cabrillo Beach (40010), Fish Harbor Entrance (40015), Terminal Island STP (40016), and Anaheim Bay-Outer (80024). Of interest is the site off Cabrillo Beach (40010), which was sampled on two separate legs and had exactly opposite results for each sampling. For unknown reasons one sampling produced no significant response at any of the three stations, while the second sampling produced a response significant at $p < 0.01$ at all three stations at the site.

TABLE 3-7
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 1
(Compared to Control Water)

Station Name	Station Number	100% PORE WATER - STATION				50% PORE WATER - STATION				25% PORE WATER - STATION			
		Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 1 Control Water		97.8				97.8				97.8			
Leg 1 Control Water		90.6				90.6				90.6			
Leg 1 Control Water		94.3				94.3				94.3			
Monterey Bay-REF	30034.1	0.0%	+	0.0	**	0.4%	+	0.7	**	66.8%	+	25.6	ns
Monterey Bay-REF	30034.2	0.0%	+	0.0	**	0.0%	+	0.0	**	66.8%	+	36.7	ns
Monterey Bay-REF	30034.3	0.0%	+	0.0	**	0.0%	+	0.0	**	65.0%	+	25.7	ns
Southwest Slip	40001.1	72.3%	+	15.9	*	92.5%	+	2.9	ns	92.8%	+	3.9	ns
Southwest Slip	40001.2	81.4%	+	7.9	*	86.6%	+	8.4	ns	72.8%	+	18.9	ns
Southwest Slip	40001.3	0.7%	+	0.6	**	40.7%	+	24.2	*	76.5%	+	7.9	**
West Basin, Pier 143	40002.1	0.0%	+	0.0	**	1.4%	+	1.2	**	87.7%	+	1.8	ns
West Basin, Pier 143	40002.2	0.0%	+	0.0	**	0.0%	+	0.0	**	28.9%	+	27.6	ns
West Basin, Pier 143	40002.3	0.0%	+	0.0	**	0.0%	+	0.0	**	65.2%	+	23.0	*
Turning Basin, Pier 151	40003.1	0.0%	+	0.0	**	63.2%	+	24.1	ns	88.3%	+	8.8	ns
Turning Basin, Pier 151	40003.2	1.5%	+	2.6	**	97.9%	+	1.4	ns	95.8%	+	2.0	ns
Turning Basin, Pier 151	40003.3	23.3%	+	38.7	*	93.4%	+	5.2	ns	92.2%	+	6.3	ns
Lower Main Channel	40004.1	26.2%	+	33.5	*	93.3%	+	0.7	ns	93.7%	+	1.2	ns
Lower Main Channel	40004.2	69.1%	+	29.8	ns	94.6%	+	0.9	ns	95.2%	+	3.1	ns
Lower Main Channel	40004.3	78.7%	+	28.2	ns	91.3%	+	2.9	ns	96.9%	+	1.2	ns
East Basin,Turn Basin	40005.1	0.0%	+	0.0	**	41.9%	+	42.1	ns	97.5%	+	2.7	ns
East Basin,Turn Basin	40005.2	0.7%	+	1.3	**	88.6%	+	4.6	ns	94.0%	+	3.7	ns
East Basin,Turn Basin	40005.3	0.0%	+	0.0	**	54.0%	+	9.4	**	77.9%	+	10.4	ns
Consolidated Slip	40006.1	0.0%	+	0.0	**	90.3%	+	4.5	ns	92.9%	+	3.1	ns
Consolidated Slip	40006.2	0.0%	+	0.0	**	0.0%	+	0.0	**	0.4%	+	0.7	**
Consolidated Slip	40006.3	0.0%	+	0.0	**	0.7%	+	1.2	**	44.8%	+	38.0	ns

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-7

LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 1

(Compared to Control Water)

Station Name	Station Number	100% Pore water STATION Mean Percent Normal Dev.	+	Standard Deviation	Significance	50% PORE WATER STATION Mean Percent Normal Dev.	+	Standard Deviation	Significance	25% PORE WATER STATION Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 1 Control Water		97.8				97.8				97.8			
Leg 1 Control Water		90.6				90.6				90.6			
Leg 1 Control Water		94.3				94.3				94.3			
San Pedro Bay, POLA 19	40032.1	65.7%	+	23.9	ns	89.9%	+	4.5	ns	97.9%	+	2.7	ns
San Pedro Bay, POLA 19	40032.2	30.7%	+	53.1	ns	19.9%	+	34.5	*	83.8%	+	8.2	*
San Pedro Bay, POLA 19	40032.3	0.0%	+	0.0	**	15.0%	+	7.8	**	91.6%	+	5.0	ns
Outer Harbor, POLA 10	40033.1	0.7%	+	1.3	**	0.0%	+	0.0	**	25.5%	+	20.9	*
Outer Harbor, POLA 10	40033.2	8.8%	+	10.2	**	86.5%	+	10.8	ns	96.9%	+	2.9	ns
Outer Harbor, POLA 10	40033.3	3.3%	+	5.7	**	93.6%	+	5.6	ns	90.6%	+	5.1	ns

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-8
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 2
(Compared to Control Water)

Station Name	Station Number	100% PORE WATER - - - - - - STATION - - - - - - -				50% PORE WATER - - - - - STATION - - - - - - - -				25% PORE WATER - - - - - - - STATION - - - - - -			
		Mean Percent Normal Dev.	+	Standard Deviation	Signif-icance	Mean Percent Normal Dev.	+	Standard Deviation	Signif-icance	Mean Percent Normal Dev.	+	Standard Deviation	Signif-icance
Leg 2 Control Water		93.8				93.8				93.8			
Leg 2 Control Water		97.2				97.2				97.2			
Leg 2 Control Water		98.2				98.2				98.2			
East Basin Pier C	40008.1	93.1%	+	1.3	ns	0.3%	+	0.5	**	94.7%	+	3.1	ns
East Basin Pier C	40008.2	2.8%	+	2.5	**	95.2%	+	2.8	ns	97.6%	+	0.7	ns
East Basin Pier C	40008.3	0.0%	+	0.0	**	93.2%	+	3.7	ns	92.8%	+	3.0	ns
West Basin Entrance	40009.1	1.1%	+	1.1	**	95.3%	+	1.6	ns	95.2%	+	1.1	ns
West Basin Entrance	40009.2	0.0%	+	0.0	**	95.7%	+	2.5	ns	94.9%	+	1.9	ns
West Basin Entrance	40009.3	0.0%	+	0.0	**	96.8%	+	0.6	ns	94.7%	+	3.0	ns
Off Cabrillo Beach	40010.1	92.7%	+	3.4	**	96.4%	+	1.2	ns	96.9%	+	2.2	ns
Off Cabrillo Beach	40010.2	93.8%	+	1.8	**	96.7%	+	2.9	ns	96.1%	+	1.5	ns
Off Cabrillo Beach	40010.3	95.6%	+	2.4	ns	93.0%	+	0.7	ns	92.4%	+	8.2	ns
Southeast Basin	40012.1	23.5%	+	37.4	*	94.2%	+	4.6	ns	95.8%	+	2.6	ns
Southeast Basin	40012.2	94.3%	+	2.2	ns	96.8%	+	0.6	ns	97.5%	+	0.8	ns
Southeast Basin	40012.3	7.5%	+	12.2	**	62.5%	+	50.4	**	93.7%	+	1.2	ns
Fish Harbor Entrance	40015.1	51.3%	+	24.0	*	97.9%	+	2.2	ns	95.7%	+	1.5	ns
Fish Harbor Entrance	40015.2	34.9%	+	21.3	*	95.9%	+	0.3	ns	98.2%	+	1.0	ns
Fish Harbor Entrance	40015.3	9.8%	+	9.5	**	95.8%	+	0.8	ns	97.7%	+	1.4	ns
Terminal Island STP	40016.1	91.6%	+	2.5	*	97.7%	+	1.4	ns	97.1%	+	1.7	ns
Terminal Island STP	40016.2	71.2%	+	27.1	ns	96.9%	+	0.9	ns	96.5%	+	1.5	ns
Terminal Island STP	40016.3	94.5%	+	1.4	ns	96.6%	+	0.5	ns	95.8%	+	2.7	ns
Inner Fish Harbor	40019.1	0.0%	+	0.0	**	0.0%	+	0.0	**	0.0%	+	0.0	**
Inner Fish Harbor	40019.2	88.6%	+	6.1	**	95.8%	+	1.6	ns	95.8%	+	0.5	ns
Inner Fish Harbor	40019.3	0.0%	+	0.0	**	0.0%	+	0.0	**	93.0%	+	3.2	ns
San Pedro Breakwater	40030.1	0.0%	+	0.0	**	0.0%	+	0.0	**	35.5%	+	6.5	**

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-8
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 2
(Compared to Control Water)

Station Name	Station Number	100% PORE WATER STATION				50% PORE WATER STATION				25% PORE WATER STATION			
		Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 2 Control Water		93.8				93.8				93.8			
Leg 2 Control Water		97.2				97.2				97.2			
Leg 2 Control Water		98.2				98.2				98.2			
San Pedro Breakwater	40030.2	0.0%	+	0.0	**	48.5%	+	14.0	**	90.0%	+	5.6	ns
San Pedro Breakwater	40030.3	0.0%	+	0.0	**	59.5%	+	25.3	*	94.7%	+	1.3	ns
San Pedro Bay, POLA 19	40032.1	0.0%	+	0.0	**	11.0%	+	17.2	**	90.1%	+	8.1	ns
San Pedro Bay, POLA 19	40032.2	0.0%	+	0.0	**	16.3%	+	23.8	*	9.6%	+	5.6	**
San Pedro Bay, POLA 19	40032.3	0.0%	+	0.0	**	0.0%	+	0.0	**	60.6%	+	31.7	ns

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-9
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 3
(Compared to Control Water)

		100% PORE WATER				50% PORE WATER				25% PORE WATER			
		- - - - - - STATION - - - - - - -				- - - - - STATION - - - - - - - -				- - - - - - - STATION - - - - - -			
Station Name	Station Number	Mean Percent Normal Dev.	+	Standard Deviation	Signif-icance	Mean Percent Normal Dev.	+	Standard Deviation	Signif-icance	Mean Percent Normal Dev.	+	Standard Deviation	Signif-icance
Leg 3 Control Water		90.9				90.9				90.9			
Leg 3 Control Water		93.3				93.3				93.3			
Leg 3 Control Water		89.6				89.6				89.6			
Elkhorn Slough,Seal Pt.	30035.1	5.1%	+	5.0	**	80.9%	+	1.5	**	89.3%	+	4.3	ns
Elkhorn Slough,Seal Pt.	30035.2	0.0%	+	0.0	**	0.0%	+	0.0	**	17.1%	+	5.8	**
Elkhorn Slough,Seal Pt.	30035.3	0.0%	+	0.0	**	80.9%	+	5.8	*	87.3%	+	3.6	ns
L.B. Hbr Channel 2	40007.1	0.0%	+	0.0	**	91.6%	+	4.1	ns	90.7%	+	2.6	ns
L.B. Hbr Channel 2	40007.2	0.0%	+	0.0	**	0.4%	+	0.7	**	36.6%	+	20.5	*
L.B. Hbr Channel 2	40007.3	0.0%	+	0.0	**	0.4%	+	0.6	**	88.2%	+	5.1	ns
Inner Harbor Channel 3	40011.1	0.0%	+	0.0	**	75.1%	+	12.0	ns	90.0%	+	1.7	ns
Inner Harbor Channel 3	40011.2	0.0%	+	0.0	**	0.0%	+	0.0	**	87.6%	+	3.6	ns
Inner Harbor Channel 3	40011.3	0.0%	+	0.0	**	0.0%	+	0.0	**	62.2%	+	30.6	ns
Inner Queensway Bay	40013.1	0.0%	+	0.0	**	89.4%	+	0.8	ns	90.8%	+	1.5	ns
Inner Queensway Bay	40013.2	0.0%	+	0.0	**	87.1%	+	2.1	*	88.4%	+	1.2	ns
Inner Queensway Bay	40013.3	5.5%	+	7.7	**	90.0%	+	3.2	ns	92.2%	+	2.8	ns
Outer Queensway Bay	40014.1	0.0%	+	0.0	**	92.5%	+	5.2	ns	86.9%	+	1.4	*
Outer Queensway Bay	40014.2	0.0%	+	0.0	**	0.0%	+	0.0	**	90.8%	+	4.0	ns
Outer Queensway Bay	40014.3	0.0%	+	0.0	**	90.4%	+	5.1	ns	89.2%	+	3.8	ns
Long Beach Channel	40017.1	0.0%	+	0.0	**	72.2%	+	8.6	*	93.7%	+	0.3	ns
Long Beach Channel	40017.2	20.6%	+	8.9	**	86.8%	+	7.6	ns	91.6%	+	2.0	ns
Long Beach Channel	40017.3	50.7%	+	7.5	**	90.2%	+	1.4	ns	91.7%	+	2.1	ns
L.B. Outer Hbr. 18	40018.1	0.0%	+	0.0	**	86.9%	+	10.4	ns	90.0%	+	5.3	ns
L.B. Outer Hbr. 18	40018.2	0.0%	+	0.0	**	1.1%	+	1.9	**	94.2%	+	1.8	ns
L.B. Outer Hbr. 18	40018.3	92.3%	+	4.4	ns	91.4%	+	2.5	ns	93.3%	+	2.3	ns

TABLE 3-9
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 3
(Compared to Control Water)

Station Name	Station Number	100% PORE WATER - STATION				50% PORE WATER - STATION				25% PORE WATER - STATION			
		Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 3 Control Water		90.9				90.9				90.9			
Leg 3 Control Water		93.3				93.3				93.3			
Leg 3 Control Water		89.6				89.6				89.6			
L.B. Outer Hbr. 20	40020.1	0.0%	+	0.0	**	6.3%	+	11.0	**	64.3%	+	47.6	ns
L.B. Outer Hbr. 20	40020.2	0.0%	+	0.0	**	14.6%	+	4.1	**	90.6%	+	2.2	ns
L.B. Outer Hbr. 20	40020.3	24.2%	+	18.3	*	88.7%	+	0.6	ns	91.1%	+	3.0	ns
Palos Verdes (Swartz 6)	40031.1	0.0%	+	0.0	**	88.1%	+	3.2	ns	88.6%	+	2.6	ns
Palos Verdes (Swartz 6)	40031.2	55.6%	+	26.7	ns	90.3%	+	3.8	ns	92.0%	+	2.7	ns
Palos Verdes (Swartz 6)	40031.3	0.0%	+	0.0	**	72.0%	+	1.7	**	88.2%	+	0.9	ns

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-10
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 4
(Compared to Control Water)

		100% PORE WATER STATION				50% PORE WATER STATION				25% PORE WATER STATION			
Station Name	Station Number	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 4 Control Water		100.0				100.0				100.0			
Leg 4 Control Water		98.0				98.0				98.0			
Leg 4 Control Water		96.4				96.4				96.4			
Elkhorn Slough, Seal Bend REF	30036.1	28.7%	+	27.6	*	94.9%	+	5.0	ns	97.4%	+	0.6	ns
Elkhorn Slough, Seal Bend REF	30036.2	43.8%	+	4.7	**	95.8%	+	3.6	ns	97.5%	+	1.3	ns
Elkhorn Slough, Seal Bend REF	30036.3	0.0%	+	0.0	**	98.1%	+	1.2	ns	98.2%	+	1.7	ns
Off Cabrillo Beach	40010.1	1.7%	+	2.9	**	2.2%	+	0.9	**	52.9%	+	31.9	*
Off Cabrillo Beach	40010.2	0.0%	+	0.0	**	1.0%	+	1.8	**	47.6%	+	7.1	**
Off Cabrillo Beach	40010.3	33.3%	+	57.7	ns	7.1%	+	3.5	**	50.1%	+	19.2	**
Alamitos Bay, Marine Stadium	40021.1	0.4%	+	0.6	**	14.7%	+	3.9	**	96.5%	+	2.3	ns
Alamitos Bay, Marine Stadium	40021.2	0.0%	+	0.0	**	3.1%	+	1.1	**	91.4%	+	7.1	ns
Alamitos Bay, Marine Stadium	40021.3	0.0%	+	0.0	**	8.1%	+	6.6	**	96.2%	+	2.5	ns
Alamitos Bay, Entrance	40022.1	0.0%	+	0.0	**	54.4%	+	10.9	**	97.0%	+	1.6	ns
Alamitos Bay, Entrance	40022.2	0.3%	+	0.5	**	0.0%	+	0.0	**	46.2%	+	24.2	*
Alamitos Bay, Entrance	40022.3	0.3%	+	0.5	**	6.6%	+	9.3	**	66.1%	+	21.4	*
Alamitos Bay, L.B. Marina	40023.1	0.0%	+	0.0	**	2.2%	+	3.9	**	96.8%	+	3.5	ns
Alamitos Bay, L.B. Marina	40023.2	0.0%	+	0.0	**	0.0%	+	0.0	**	61.2%	+	27.1	*
Alamitos Bay, L.B. Marina	40023.3	0.0%	+	0.0	**	0.0%	+	0.0	**	81.2%	+	21.4	ns
Anaheim Bay, Outer	80024.1	12.1%	+	10.7	**	97.9%	+	1.3	ns	66.3%	+	53.7	ns
Anaheim Bay, Outer	80024.2	0.0%	+	0.0	**	97.6%	+	2.3	ns	97.2%	+	2.0	ns
Anaheim Bay, Outer	80024.3	17.5%	+	20.0	**	99.3%	+	0.6	ns	99.3%	+	1.2	ns
Huntington Harbour, Lower	80026.1	0.0%	+	0.0	**	0.0%	+	0.0	**	0.0%	+	0.0	**
Huntington Harbour, Lower	80026.2	0.0%	+	0.0	**	0.0%	+	0.0	**	0.0%	+	0.0	**
Huntington Harbour, Lower	80026.3	0.0%	+	0.0	**	0.0%	+	0.0	**	61.2%	+	27.6	*
Huntington Harbour, Middle	80027.1	0.0%	+	0.0	**	0.0%	+	0.0	**	0.0%	+	0.0	**
Huntington Harbour, Middle	80027.2	0.0%	+	0.0	**	0.0%	+	0.0	**	13.6%	+	10.7	**
Huntington Harbour, Middle	80027.3	0.0%	+	0.0	**	0.0%	+	0.0	**	0.0%	+	0.0	**

TABLE 3-10 (continued)
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 4
(Compared to Control Water)

Station Name	Station Number	100% PORE WATER STATION Mean Percent Normal Dev.	+	Standard Deviation	Signif-icance	50% PORE WATER STATION Mean Percent Normal Dev.	+	Standard Deviation	Signif-icance	25% PORE WATER STATION Mean Percent Normal Dev.	+	Standard Deviation	Signif-icance
Huntington Harbour, Upper	80028.1	0.0%	+	0.0	**	0.0%	+	0.0	**	64.7%	+	22.0	*
Huntington Harbour, Upper	80028.2	0.0%	+	0.0	**	0.4%	+	0.6	**	5.3%	+	5.2	**
Huntington Harbour, Upper	80028.3	0.0%	+	0.0	**	3.7%	+	6.4	**	82.4%	+	7.0	**

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-11
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 5
(Compared to Control Water)

Station Name	Station Number	100% PORE WATER - STATION Mean Percent Normal Dev.	+	Standard Deviation	Significance	50% PORE WATER - STATION Mean Percent Normal Dev.	+	Standard Deviation	Significance	25% PORE WATER - STATION Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 5 Control Water		99.1				99.1				99.1			
Leg 5 Control Water		93.2				93.2				93.2			
Leg 5 Control Water		92.7				92.7				92.7			
Anaheim Bay, Oil Isl.	80025.1	12.4%	+	8.7	**	91.1%	+	3.6	ns	97.0%	+	3.8	ns
Anaheim Bay, Oil Isl.	80025.2	32.2%	+	13.1	**	97.4%	+	0.8	ns	96.6%	+	1.6	ns
Anaheim Bay, Oil Isl.	80025.3	29.1%	+	24.2	**	73.8%	+	9.7	*	96.4%	+	1.3	ns

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-12
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 1
(Compared to Control Water)

		100% PORE WATER SITE				50% PORE WATER SITE				25% PORE WATER SITE			
Site Name	Site Number	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 1 Control Water Mean		94.2	+	3.6		94.2	+	3.6		94.2	+	3.6	
Monterey Bay-REF	30034.1	0%	+	0.0	**	0%	+	0.4	**	66%	+	25.8	**
Southwest Slip	40001.1	52%	+	39.3	ns	73%	+	27.8	ns	81%	+	13.9	ns
West Basin, Pier 143	40002.1	0%	+	0.0	**	1%	+	0.9	**	61%	+	31.3	ns
Turning Basin, Pier 151	40003.1	8%	+	22.4	**	85%	+	20.5	ns	92%	+	6.4	ns
Lower Main Channel	40004.1	58%	+	35.9	ns	93%	+	2.1	ns	95%	+	2.2	ns
East Basin,Turning Basin	40005.1	0%	+	0.7	**	62%	+	30.2	ns	90%	+	10.7	ns
Consolidated Slip	40006.1	0%	+	0.0	**	30%	+	45.1	ns	46%	+	44.4	ns
San Pedro Bay, POLA 19	40032.1	32%	+	40.7	*	40%	+	39.2	ns	91%	+	7.9	ns
Outer Harbor, POLA 10	40033.1	4%	+	6.8	**	60%	+	45.5	ns	71%	+	35.9	ns

---

ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-13
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 2
(Compared to Control Water)

		100% PORE WATER SITE				50% PORE WATER SITE				25% PORE WATER SITE			
Site Name	Site Number	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 2 Control Water Mean		96.4	+	2.3		96.4	+	2.3		96.4	+	2.3	
East Basin Pier C	40008.1	32%	+	45.9	ns	63%	+	47.0	ns	95%	+	3.0	ns
West Basin Entrance	40009.1	0%	+	0.8	**	96%	+	1.6	ns	95%	+	1.9	ns
Off Cabrillo Beach	40010.1	94%	+	2.6	ns	95%	+	2.4	ns	95%	+	4.8	ns
Southeast Basin	40012.1	42%	+	44.6	ns	85%	+	30.2	ns	96%	+	2.2	ns
Fish Harbor Entrance	40015.1	32%	+	24.6	*	97%	+	1.6	ns	97%	+	1.6	ns
Terminal Island STP	40016.1	86%	+	17.5	ns	97%	+	1.0	ns	97%	+	1.8	ns
Inner Fish Harbor	40019.1	30%	+	44.4	ns	32%	+	47.9	ns	63%	+	47.2	ns
San Pedro Breakwater	40030.1	0%	+	0.0	**	36%	+	31.0	*	73%	+	28.8	ns
San Pedro Bay, POLA 19	40032.1	0%	+	0.0	**	10%	+	21.1	**	53%	+	39.0	ns

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-14
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 3
(Compared to Control Water)

		100% PORE WATER				50% PORE WATER				25% PORE WATER			
		SITE				SITE				SITE			
Site Name	Site Number	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 3 Control Water Mean		91.3	+	1.9		91.3	+	1.9		91.3	+	1.9	
Elkhorn Slough, Seal Point REF	30035.1	2%	+	3.6	**	54%	+	40.5	ns	65%	+	35.8	ns
L.B. Harbor Channel 2	40007.1	0%	+	0.0	**	31%	+	45.7	ns	72%	+	28.5	ns
Inner Harbor Channel 3	40011.1	0%	+	0.0	**	25%	+	38.0	ns	80%	+	20.4	ns
Inner Queensway Bay	40013.1	2%	+	4.7	**	89%	+	2.3	ns	91%	+	2.4	ns
Outer Queensway Bay	40014.1	0%	+	0.0	**	61%	+	45.9	ns	89%	+	2.0	ns
Long Beach Channel	40017.1	24%	+	22.8	*	83%	+	10.1	ns	92%	+	1.8	ns
Long Beach Outer Harbor 18	40018.1	31%	+	46.2	ns	60%	+	44.4	ns	93%	+	3.6	ns
Palos Verdes (Swartz 6)	40031.1	19%	+	30.8	*	84%	+	9.0	ns	90%	+	2.6	ns

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-15
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Porewater - Leg 4
(Compared to Control Water)

Site Name	Site Number	100% POREWATER SITE Mean Percent Normal Dev.	+	Standard Deviation	Significance	50% POREWATER SITE Mean Percent Normal Dev.	+	Standard Deviation	Significance	25% POREWATER SITE Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 4 Control Water Mean		98.1	+	1.8		98.1	+	1.8		98.1	+	1.8	
Elkhorn Slough, Seal Bend REF	30036.1	24%	+	23.8	*	96%	+	3.5	ns	98%	+	1.2	ns
Off Cabrillo Beach	40010.1	12%	+	33.2	**	4%	+	3.4	**	50%	+	19.1	*
Alamitos Bay, Marin	40021.1	0%	+	0.4	**	9%	+	6.3	**	95%	+	4.6	ns
Alamitos Bay, Entrance	40022.1	0%	+	0.4	**	20%	+	29.7	*	70%	+	27.4	ns
Alamitos Bay, Long	40023.1	0%	+	0.0	**	1%	+	2.2	**	80%	+	23.3	ns
Anaheim Bay, Outer	80024.1	7%	+	8.8	**	81%	+	33.6	ns	90%	+	27.0	ns
Huntington Harbour, Lower	80026.1	0%	+	0.0	**	0%	+	0.0	**	20%	+	33.6	*

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ns = not significant
* = significant at 5% level
** = significant at 1% level

TABLE 3-16
LA Harbor Percent Normal Abalone Shell Development for Three Concentrations of Pore Water - Leg 5
(Compared to Control Water)

		100% PORE WATER				50% PORE WATER				25% PORE WATER			
		SITE				SITE				SITE			
Site Name	Site Number	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance	Mean Percent Normal Dev.	+	Standard Deviation	Significance
Leg 5 Control Water Mean		95.0	+	3.6		95.0	+	3.6		99.1			
Anaheim Bay, Oil Isl.	80025.1	25%	+	10.6	**	87%	+	12.2	ns	97%	+	2.2	ns

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ns = not significant
* = significant at 5% level
** = significant at 1% level

FIGURE 3-11

Abalone 100% Pore Water Toxicity Test
Station Statistical Significance Compared to Controls

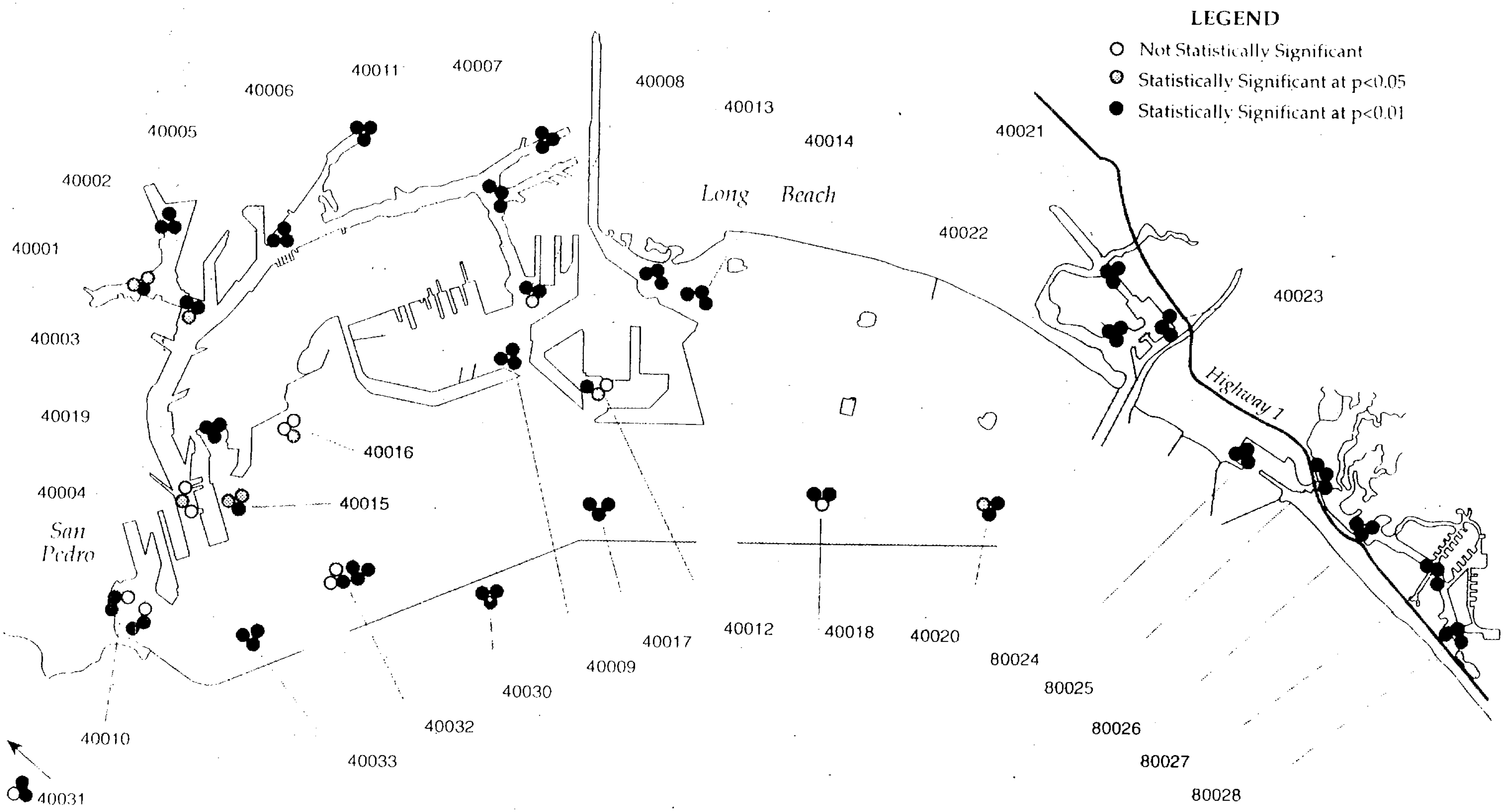


FIGURE 3-12

Abalone 50% Pore Water Toxicity Test
Station Statistical Significance Compared to Controls

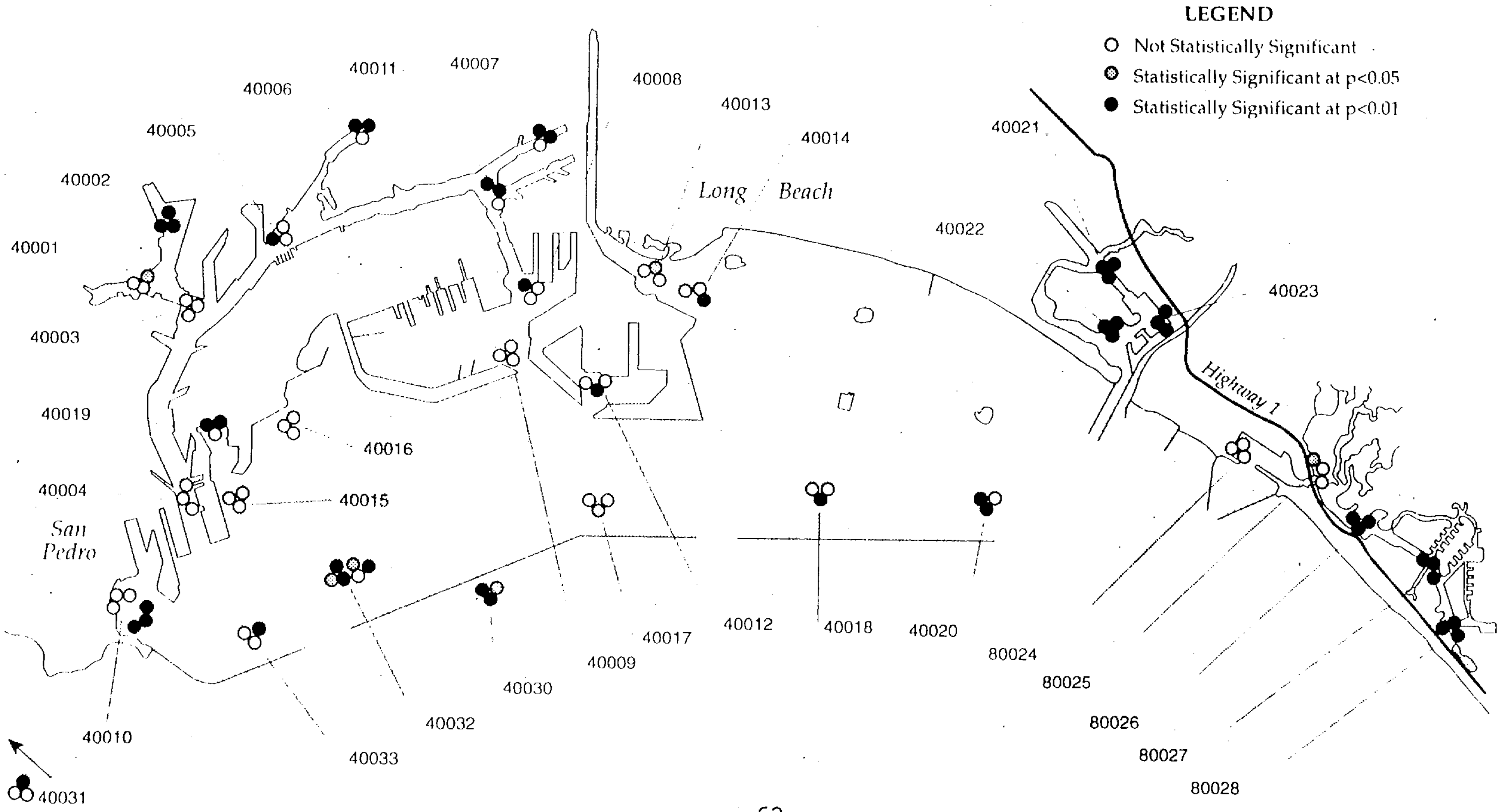
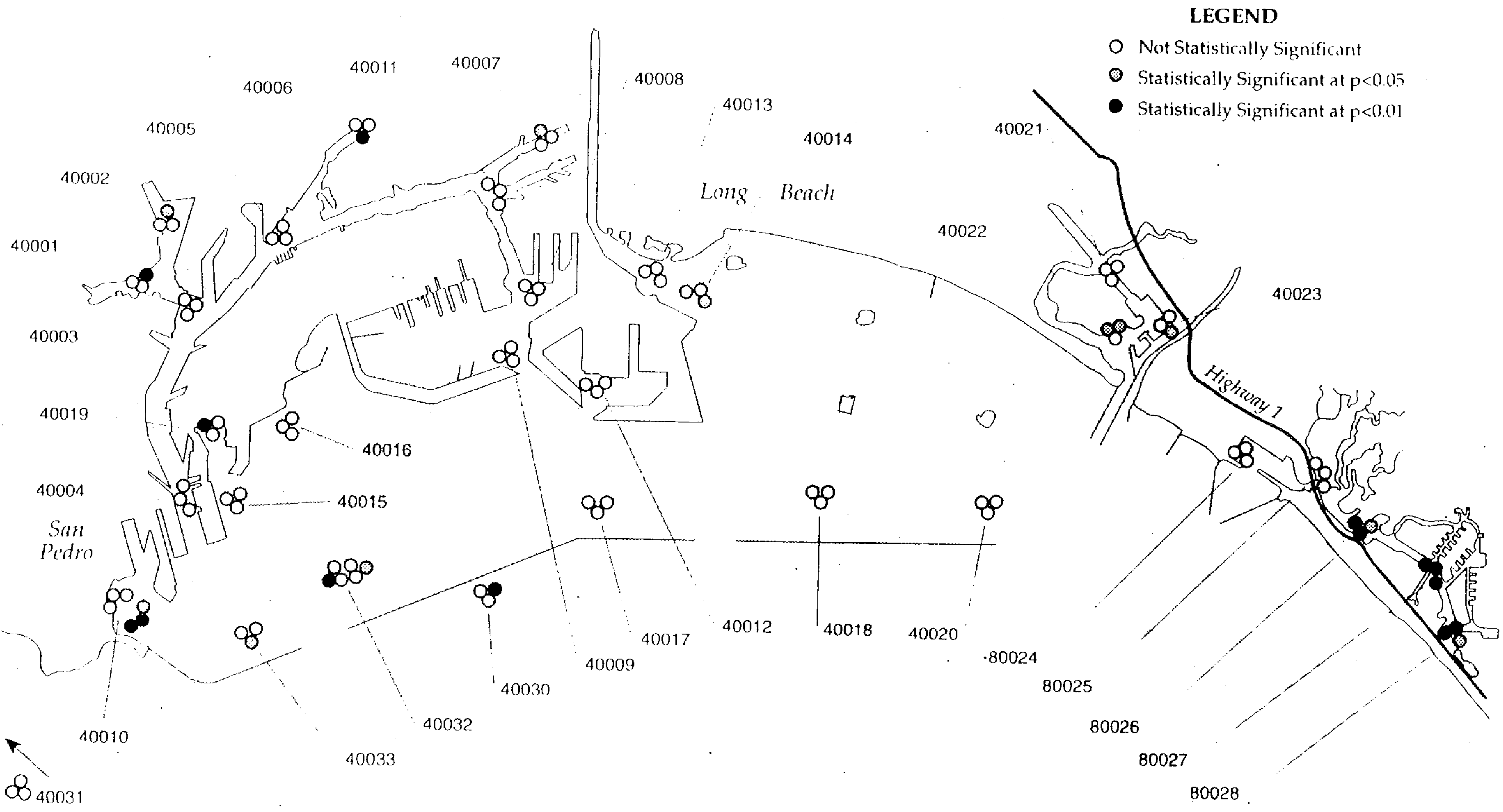


FIGURE 3-13

Abalone 25% Pore Water Toxicity Test
Station Statistical Significance Compared to Controls



A significant response at $p < 0.05$ was detected at 6 percent of the sites using the 25 percent pore water samples, and 3 percent of the sites showed a significant response at $p < 0.01$ (Figure 3-13). Huntington Harbour had the greatest number of sites in any one area with a significant response at 25 percent pore water, i.e., Huntington Harbour-Lower (80026), Huntington Harbour-Middle (80027), and Huntington Harbour-Upper (80028). Only Huntington Harbour-Middle (80027) between Anaheim Bay and Huntington Harbour had three of three stations with a response significant at $p < 0.01$. Inner harbor sites at Southwest Slip (40001), West Basin-Pier 143 (40002), Consolidated Slip (40006), Long Beach Harbor Channel 2 (40007), and outer harbor sites at San Pedro Breakwater (40030), San Pedro Bay-POLA 19 (40032), and Outer Harbor-POLA 10 (40033) also showed a significant response with 25 percent pore water. The site off Cabrillo Beach (40010), which was sampled on two separate legs again had, for reasons unknown, three of three stations showing a significant response on one leg, and three of three stations having no significant response on the other leg, a result similar to that observed at the 50 percent pore water concentration.

Interpretation of Pore Water Testing Results

The abalone development test was performed on three concentrations of pore water to allow the BPTCP to gain experience with pore water biological testing protocols and to evaluate their usefulness as component of the BPTCP. The results indicated that this test was extremely sensitive to pollutants and/or other pore water constituents in the study area, particularly at the 100 percent pore water concentration.

The high sensitivity of the pore water test relative to the amphipod bedded sediment test was not unexpected. In pore water tests a more sensitive life stage, i.e., embryo-larval development was used, whereas in the amphipod test the adult organisms were used. Also, any toxicants present in the pore water are likely to be in a dissolved phase, not in a particulate bound phase, and therefore should be more readily bioavailable to the test organism. This high sensitivity has been observed in other studies which have assessed pore water toxicity using sensitive life stages (Burgess et al., 1993; Carr and Chapman 1991; Long et al., 1990).

An important issue with regard to the interpretation of pore water testing results is the need to determine what effect the method of extracting pore water from sediment has on the observed toxicity. The discussion currently centers around whether pore water should be obtained from aquatic sediments by either squeezing or centrifugation. Many scientists are now using centrifugation to obtain pore water from sediment for toxicity testing, since this method may be subject to fewer toxicity artifacts (Lange et al., 1992; Giesy et al., 1990). Other concerns related to the testing of sediment pore waters which have not been completely resolved and require additional study include sediment sample handling and storage conditions prior to testing, the sample temperature at the time of pore water extraction, and oxygen contamination caused by high squeezing pressures (Lange et al., 1992).

Since there was decreasing response with increasing dilution of pore water observed in the study, clearly some factor in the pore water was influencing the organism response. However, the high sensitivity at the 100 percent pore water concentration limits the ability of this test and/or the method of pore water extraction, to discriminate more severely impacted sediments from less severely impacted sediments (a primary goal of the BPTCP).

As pore water test methods, test organism selection, and the interpretation of results continue to evolve, they will be evaluated for use by the BPTCP. At present the pore water toxicity data by themselves are difficult to interpret. However, the pore water toxicity test dilutions (100 percent, 50 percent, and 25 percent) if used in conjunction with other toxicity tests and chemical measurements provides a good estimate of the relative exposure of organisms to pollutants.

Amphipod and Abalone Toxicity Relative to Pollutant Levels

Sites with stations producing significant toxicity using the amphipod test did not always coincide with those producing a response in the abalone test. Three sites, Turning Basin-Pier (40003), Lower Main Channel (40004), and Fish Harbor Entrance (40015), had significant toxicity to amphipods but no significant response was seen in the abalone test; the reverse is also true for other stations. This result is not surprising since species-specific responses to toxicants or other stressors are both commonly observed and expected in biological assays.

Correlation Analyses Results

Amphipod Test Results Correlations

Significant decreases in amphipod survival showed a significant correlation with the sediment concentrations of Cu, Fe, Pb, Zn, LPAHs, HPAHs, and total PAHs (Tables 3-17 through 3-19). Amphipod survival was also significantly correlated with Sb, Ni, Sn, sum of total pesticides, total PCBs, and TBT. There was also a significant but weak correlation with percent fines (sediment characteristics may influence the response of this species). Toxicity was not significantly correlated with either unionized ammonia or H_2S in the test chambers.

Of interest is the lack of significant toxicity to amphipods relative to sediment total DDT concentrations in the current Los Angeles/Long Beach study. A study by Swartz et al. (1985) suggests that the lack of correlation between amphipod mortality and DDT (and its isomers) may be related to the acute nature of the 10-day amphipod test, rather than to a lack of toxicity associated with this compound. Swartz et al. (1985) found a significant correlation between a reduction in amphipod densities and DDT concentrations along a pollution gradient on the Palos Verde Shelf, which was thought to be indicative of chronic effects.

For those pollutants that had the strongest correlation with toxicity to amphipods, scattergrams were produced plotting mean amphipod survival against the concentration of the pollutant in the sediment. The State of Florida PEL and TEL values were included on these scattergrams for reference (Figures 3-14 through 3-16).

The scattergrams illustrate an inconsistent pattern of decreasing amphipod survival with increasing chemical concentration in the sediment. They also illustrate a wide variability in amphipod survival at concentrations below the TELs and lower, more clustered, percent survival above the TELs and PELs.

The plot of amphipod survival versus unionized ammonia shows most samples were near or below the NH_3 detection limits, with no pattern of co-variance. Only one sample exceeded the NOEC (no observed effect concentration).

The scattergram plots indicate several of the station mean concentrations of LPAHs and HPAHs exceeded both the TEL and the PEL guideline levels, with a number of station means, particularly PAHs, falling between these two values in the "possible effects range". However, the concentration of phenanthrene, fluoranthene, and acenaphthene at these sites did not equal or exceed the proposed U.S. EPA National Sediment

TABLE 3-17

Spearman Rank Correlation Coefficients (Rho)[1] Sediment Toxicity and Organic Pollutants[2]

San Pedro Bay

	Percent Amphipod	Abalone Percent Normal Morphological Development		
Chemical	**Survival**	**@100%**	**@50%**	**@25%**
Total DDTs	-0.029	+0.262	-0.013	-0.080
Total pesticides	-0.407*	-0.401*	-0.418*	-0.275
Tributyltin	-0.366*	+0.100	-0.208	-0.147
Total PCBs	-0.335*	+0.076	-0.095	-0.157
Total LMW PAHs	-0.597***	+0.121	+0.082	-0.015
Total HMW PAHs	-0.582***	+0.145	-0.026	-0.097
Sum of total PAHs	-0.586***	+0.148	-0.025	-0.097

---

[1] Rho, corrected for ties

[2] n=45

* $p < 0.05$
** $p < 0.001$
*** $p \leq 0.0001$

TABLE 3-18

Spearman Rank Correlation Coefficients (Rho)[1,2] Sediment Toxicity and Organic Pollutants[3]

San Pedro Bay

Chemical	Percent Amphipod Survival	Abalone Percent Normal Morphological Development		
		@100%	@50%	@25%
Total DDTs	+0.119	+0.155	+0.024	-0.056
Total pesticides	-0.034	-0.528**	-0.111	-0.058
Total PCBs	-0.247	-0.149	-0.132	-0.159
Acenaphthene	-0.327*	+0.216	+0.381	+0.231
Phenanthrene	-0.555**	-0.0007	+0.106	-0.015
Fluoranthene	-0.508**	+0.043	+0.054	0.035
Total LMW PAH	-0.531**	+0.012	+0.108	-0.018
Total HMW PAH	-0.522**	+0.048	-0.024	-0.115
Total PAHs	-0.516**	+0.060	-0.010	-0.106

---

[1] Rho corrected for ties

[2] Normalized to TOC

[3] n=45
* $p < 0.05$
** $p < 0.001$
*** $p \leq 0.0001$

TABLE 3-19
Spearman Rank Correlation Coefficients (Rho)[1] Sediment Toxicity and Trace Metal Pollutants[2]
San Pedro Bay

Chemical	Percent Amphipod Survival	Abalone Percent Normal Morphological Development		
		@100%	@50%	@25%
Aluminum	+0.103	-0.130	-0.069	-0.001
Antimony	-0.358*	+0.173	+0.055	+0.080
Arsenic	-0.293	+0.284	+0.084	+0.045
Cadmium	-0.097	+0.152	+0.021	+0.000006
Chromium	-0.208	+0.309	+0.030	-0.080
Copper	-0.529**	+0.144	-0.138	-0.152
Iron	-0.508**	+0.142	-0.147	-0.148
Lead	-0.527**	-0.249	-0.357*	-0.204
Manganese	-0.250	+0.228	+0.077	+0.024
Mercury	-0.221	+0.233	-0.007	-0.056
Nickel	-0.404*	+0.276	-0.020	-0.049
Silver	-0.035	+0.129	-0.097	-0.067
Selenium	-0.123	+0.333	+0.097	-0.040
Tin	-0.347*	-0.169	-0.303*	-0.362*
Zinc	-0.510**	+0.016	-0.211	-0.211
Percent fines	-0.303*	+0.132	-0.053	-0.077
Ammonia	-0.032	-0.281	+0.025	+0.134
Percent TOC	-0.256	+0.191	-0.018	-0.003
H_2S	-0.189	+0.142	-0.0009	-0.151

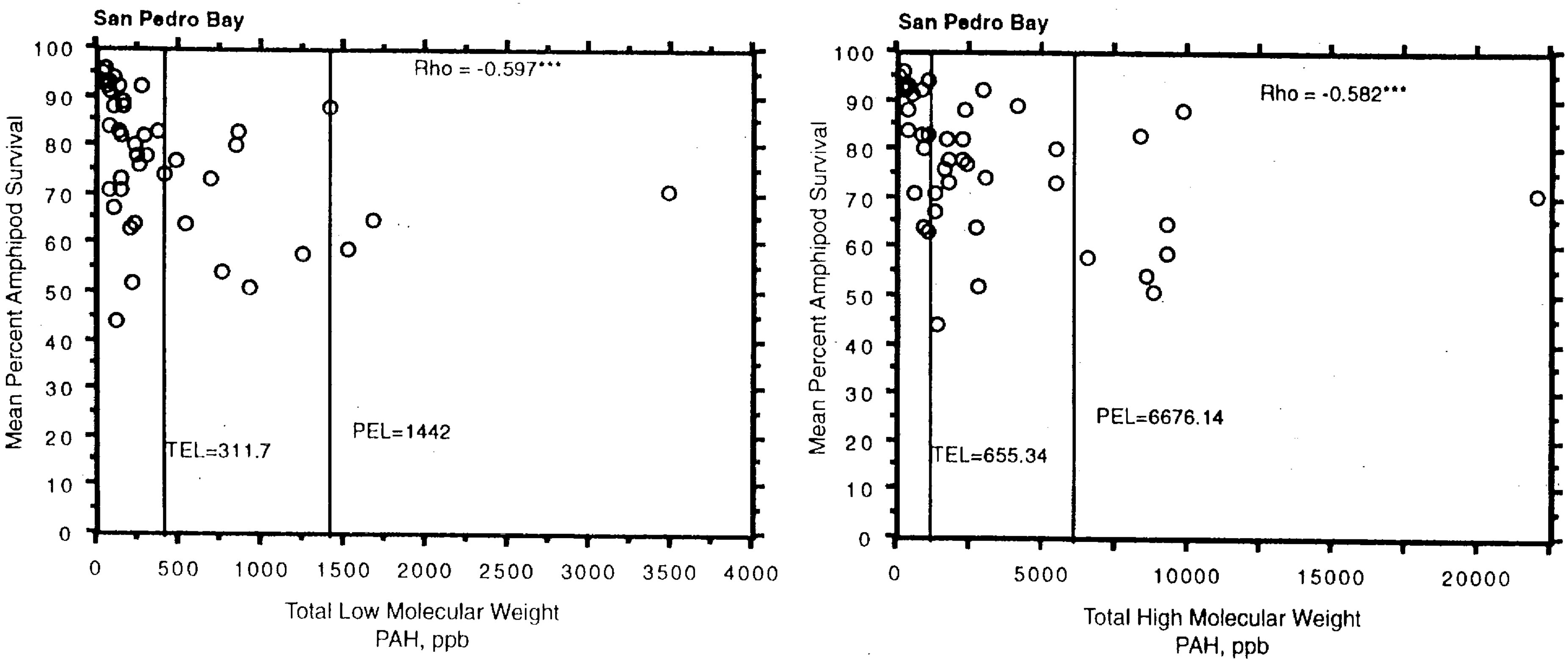
---

[1] Rho, corrected for ties

[2] n=45
* $p < 0.05$
** $p < 0.001$
*** $p < 0.0001$

FIGURE 3-14

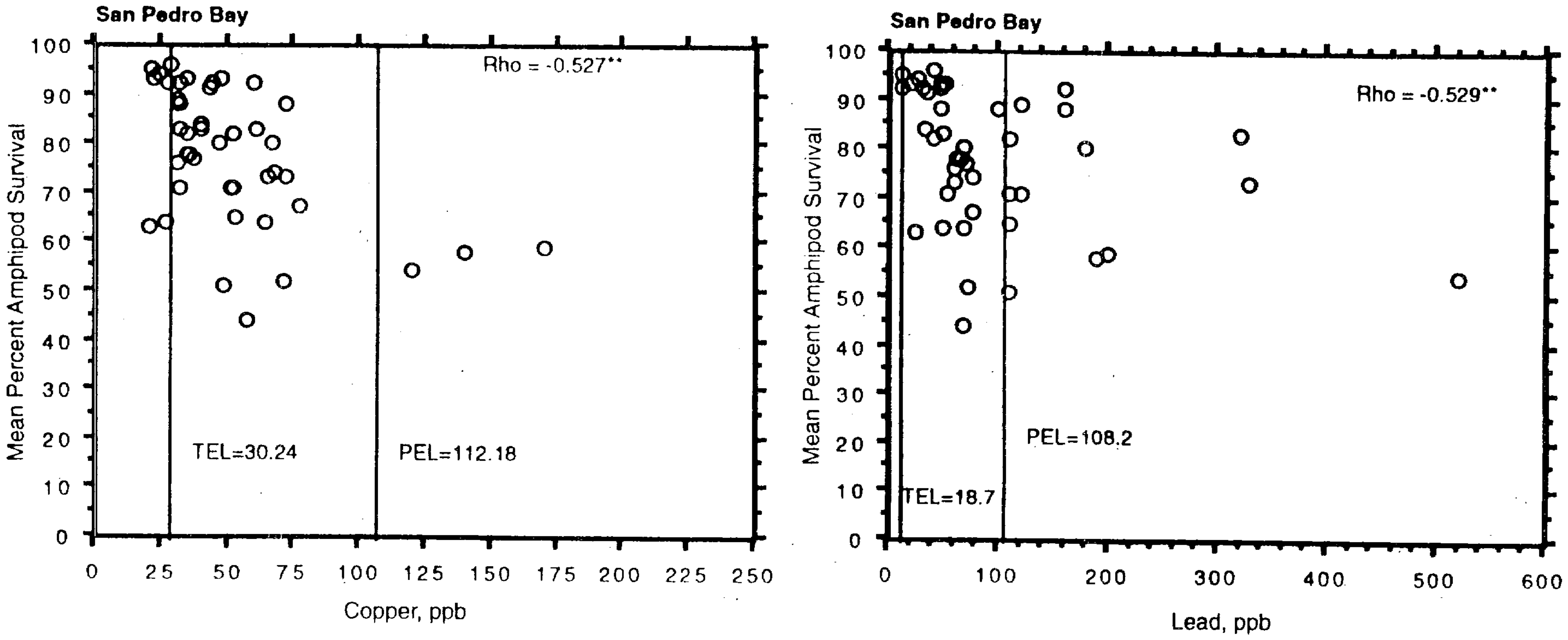
Mean Amphipod Survival and Sediment PAH Levels Comparison with TEL and PEL Values



Mean amphipod survival plotted against total low and high molecular weight PAHs in sediments from San Pedro Bay and compared with SQAGs of MacDonald, in press, 1994.
*** $p<0.0001$

FIGURE 3-15

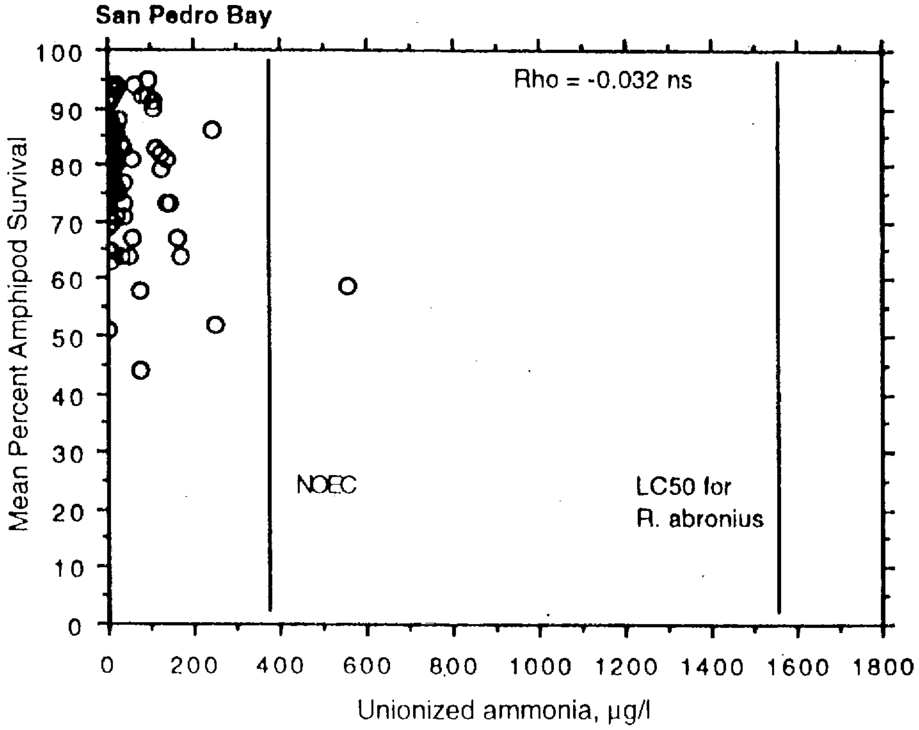
Mean Amphipod Survival and Sediment Metal Levels
Comparison with TEL and PEL Values



Mean amphipod survival plotted against total copper and total lead in sediments from San Pedro Bay and compared with SQAGs of MacDonald, in press, 1994.
** p<0.001

FIGURE 3-16

Mean Amphipod Survival and Unionized Ammonia Test Chamber Results



Mean amphipod survival plotted against unionized ammonia in the amphipod test chambers in tests of San Pedro Bay sediments.

Quality Criteria (SQC) of 160 mg/kgC, 1340 mg/kgC, and 240 mg/kgC, respectively (U.S EPA., 1993b, 1993c, 1993d). Furthermore, none equalled or exceeded the lower 95 percent confidence interval of these SQC. The correlation of toxicity with PAHs remained when the data were normalized to the TOC content of the sediment.

In the case of copper (Figure 3-15), nearly all site means exceeded the TEL value, with most falling in the possible effects range, with the remainder above the probable effects range. For lead, only a few site means were below the TEL, with most falling in the possible effects range, and a few more above the PEL.

Abalone Larvae Test Results Correlations

The pore water was analyzed only for the metals. The results of these correlation analyses shown in Table 3-20. Significant correlation with toxicity existed for lead (100 and 50 percent pore water) and copper (50 percent porewater) at the 95 percent confidence level.

The same correlation analyses were done for the other pollutants measured in the bulk sediments, and are included for comparison in Tables 3-17 through 3-19. The toxicity observed in the abalone larvae test was not strongly correlated with any of the pollutants analyzed in the sediments. Significant correlation was observed for sediment levels of tin (50 and 100 percent), and total pesticides (25 and 50 percent pore water), but the correlation coefficients were neither very large, nor were the correlations consistent for all dilutions of pore waters tested. These correlations appear to be heavily influenced by the values of only a few samples, resulting in the relatively weak correlations obtained.

Toxicity to test organisms caused by unionized ammonia in the test system is always a concern when conducting aquatic toxicity bioassays (Ankley et al., 1990). This parameter was monitored during the toxicity bioassays, and it was determined that toxicity observed during the amphipod survival bioassay or the abalone larvae test was not correlated with unionized ammonia in the test chambers (Table 3-19). Only one sediment exposure (Figure 3-16) had an unionized ammonia level which exceeded the average NOEC for most amphipods of about 400 µg/l, although it was still far below the LC_{50} of 1590 µg/l for this species (Kohn et al., 1994).

Summary of Correlation Analyses

The correlation analyses indicate that no single chemical or chemical group was associated with the toxicity observed in this study. Copper, lead, zinc, and PAHs are known to be very toxic to aquatic organisms and can be discharged from anthropogenic

TABLE 3-20

Spearman Rank Correlation Coefficients (Rho)[1] Sediment Toxicity and Porewater Trace Metals[2]

San Pedro Bay

Chemical	Abalone Percent Normal Morphological Development @100%	@50%	@25%
Aluminum	-0.436	-0.423	-0.276
Cadmium	-0.76	0.003	0.098
Copper	-0.326	-0.526*	-0.447
Iron	+0.354	+0.099	+0.182
Lead	-0.517*	-0.463*	-0.328
Manganese	+0.166	+0.136	+0.143
Nickel	-0.126	-0.149	-0.128
Silver	nd	nd	nd
Zinc	-0.297	-0.320	-0.268

---

[1] Rho corrected for ties

[2] n=19

* $p < 0.05$
** $p < 0.001$
*** $p \leq 0.0001$

sources in addition to occurring naturally. These pollutants were correlated with toxicity to the amphipods, and were determined to be present in sediments at concentrations known to be associated with toxicity. These particular chemicals were also found to be highly correlated with measures of sediment toxicity in similar studies of the Hudson-Raritan Estuary (Long, unpublished data) and in Tampa Bay (Long et al., 1994).

Because acid volatile sulfide (AVS) data were not generated, it was not possible to assess the relative bioavailability of metals in sediment based on consideration of AVS. Also, since pore water was not analyzed for organic chemicals due to cost constraints, correlation of toxicity in the abalone larvae test with levels of these organic substances in pore water were not completed.

4. CONCLUSIONS

The major conclusions of this study are:

1. Higher concentrations (relative to TEL and PEL screening levels) of PAHs were observed in samples from the Los Angeles and Long Beach Harbors than in samples from Los Alamitos Bay or Huntington Harbour. The highest levels of PAHs were observed in samples collected in the Los Angeles inner harbor and Long Beach inner harbor. Fish Harbor and Long Beach outer harbor had lower levels of PAHs.

2. Only Los Angeles inner harbor had high levels of PCBs. Several sites have stations with elevated levels of PCBs including Fish Harbor, Cabrillo Beach, Los Angeles inner harbor and Huntington Harbour.

3. DDE and DDT concentrations are relatively high throughout the study area relative to the screening levels used. Cabrillo Beach, Fish Harbor, and Long Beach inner harbor have notably high concentrations of DDE.

4. Concentrations of metals (Cu, Ni, and Zn) were high in Fish Harbor and Long Beach inner harbor.

5. Significant amphipod toxicity was observed at many sites in the Los Angeles and Long Beach inner harbors. Less toxicity was observed in the Los Angeles-Long Beach outer harbor. Most of the sites in Alamitos Bay, Anaheim Bay and Huntington Harbour showed toxicity to the amphipods.

6. Un-diluted pore water toxicity was observed throughout the study area. At the 50% dilution most of the

toxicity was observed in the Long Beach middle harbor, off Cabrillo Beach, in Alamitos Bay, and in Huntington Harbour. At the 25% dilution (the lowest concentration tested) toxicity was observed at stations off Cabrillo Beach and in Huntington Harbour.

7. Pore water toxicity tests are designed to assess exposure of marine animals to the bioavailable fraction of pollutants in sediments. Although this method of testing is becoming more frequently used for evaluating polluted sediments, the results should be considered preliminary until several issues are addressed. For example, even though the response observed in the abalone larvae appeared to be correlated with some of the contaminants measured in the pore water, it is likely that these animals may also be responding to other, unmeasured constituents in the pore water. It is also not clear what effect sample handling procedures and the method of pore water extraction has on the response of the test organisms. This study has indicated a need for more research devoted to sediment pore water toxicity testing methods, particularly with regard to the handling and storage of samples, the method of pore water extraction, and test organism selection for use by the BPTCP.

8. Several chemicals (acenanaphthene, phenanthrene, fluoranthene, copper, lead, zinc) or chemical groups (e.g., total PAH's) were weakly correlated with amphipod survival. There was not a significant correlation between amphipod toxicity and total DDT concentrations. Copper and lead were correlated with the results of the abalone development test. Even though several correlations were significant, no correlation coefficient exceeded 0.60.

9. A more detailed analysis of the ability of either the TEL and PEL, the ERL and ERM, or other approaches to predict toxicity in the test species used by the BPTCP relative to measured pollutant levels in sediments requires evaluation of additional data generated by BPTCP monitoring activities both in-progress and in the planning phase.

10. Collectively, the amphipod tests and the diluted pore water tests together identified the areas that were most toxic: Huntington Harbour, West Basin, Consolidated Slip, and portions of Alamitos Bay.

As with any scientific study there are many uncertainties and limitations of the data collected for the study. The major limitations and uncertainties of the data collected are:

1. In this study the spatial extent of toxicity and chemical concentrations cannot be determined because the sites were

not selected randomly (sites were selected using knowledge of the area and prospective sites).

2. Sediment toxicity tests are not designed to mimic natural exposure to pollutants, and the test results may be difficult to relate to an actual in situ response at a site. However, in combination with other measures, these tests are some of the best indicators currently available for measuring effects on organisms and exposure to pollutants. Furthermore, Swartz et al. (1985, 1994) have shown very strong associations between elevated chemical concentrations in sediments, toxicity of those sediments in biological assays performed with amphipods, and significantly altered benthic communities, including diminished resident amphipod abundance.

3. Toxicity data are reported in terms of statistically significant differences from laboratory controls rather than from field sites. For solid phase tests (Rhepoxynius), the laboratory control consisted of sediment from the site where the test amphipods were collected (Yaquina Bay, Oregon). The seawater controls for the pore water tests (abalone) were comprised of relatively clean Granite Canyon seawater, rather than pore water from uncontaminated local sites.

4. Toxicity may be observed in unexpected areas (i.e., clean sites) due to unidentified or unquantified factors of either human or natural origin (e.g., unidentified pollutants, sediment grain size, sampling methods, sample handling procedures, or naturally occurring toxicants or conditions).

5. The pore water tests can be further confounded by artifacts from sampling (i.e., sample handling and storage procedures and the influence of squeezing the pore water from the bulk sediment) or test organisms (e.g., exposure of organisms that would under natural conditions not come in contact with sediment pore water).

6. The red abalone (Haliotis rufescens) larvae development test was originally developed as a water column biological assay, and has not previously been used to evaluate pore water toxicity. The characteristic performance of this test when used with pore water has not been established, and will eventually become better defined over time with greater application of this test to the pore water matrix.

7. The study was not designed to determine the cause-effect relationships between chemical pollutant concentrations and effects on sediment dwelling organisms. These chemical data are only useful for assessing associations between effects on organisms and chemical concentrations.

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APPENDIX A

Method Detection Limits (Chemistry)

APPENDIX A

Method Detection Limits (Chemistry)

TABLE 5-1: Chemicals measured in the Study and their detection limits in sediments and tissue.

CHEMICAL ANALYSES REGULARLY PERFORMED FOR BPTCP

POLYCYCLIC AROMATIC HYDROCARBONS (PAH's):

Analyte	Detection Limit (ng/g dry)	
	Sediment	Tissue
Naphthalene	5	10
2-Methylnaphthalene	5	10
1-Methylnaphthalene	5	10
Biphenyl	5	10
2,6-Dimethylnaphthalene	5	10
Acenaphthylene	5	10
Acenaphthene	5	10
2,3,5-Trimethylnaphthalene	5	10
Fluorene	5	10
Dibenzothiophene	5	10
Phenanthrene	5	10
Anthracene	5	10
1-Methylphenanthrene	5	10
Fluoranthrene	5	10
Pyrene	5	10
Benz[a]anthracene	5	10
Chrysene	5	10
Benzo[b]fluoranthrene	5	10
Benzo[k]fluoranthrene	5	10
Benzo[e]pyrene	5	10
Benzo[a]pyrene	5	10
Perylene	10	15
Indo[1,2,3-cd]pyrene	10	15
Dibenz[a,h]anthracene	10	15
Benzo[ghi]perylene	5	10

DDT AND ITS METABOLITES:

Analyte	Detection Limit (ng/g dry)	
	Sediment	Tissue
o,p'-DDD	1	5
p,p'-DDD	0.4	3
o,p'-DDE	1	3
p,p'-DDE	1	1
o,p'-DDT	1	4
p,p'-DDT	1	4
p,p'-DDMS	3	20
p,p'-DDMU	2	5

CHLORINATED ORGANIC PESTICIDES OTHER THAN DDT:

Analyte	Detection Limit (ng/g dry)	
	Sediment	Tissue
Aldrin	0.5	1
Endrin	2	6
alpha-Chlordene	0.5	1
Endosulfan I	0.5	1
trans-Nonachlor	0.5	1
Dieldrin	0.5	1
Heptachlor	0.5	1
Heptachlor Epoxide	0.5	1
Hexachlorobenzene	0.2	1
gamma-HCH	0.2	0.8
Mirex	0.5	1
cis-Chlordane	0.5	1
trans-Chlordane	0.5	1
gamma-Chlordene	0.5	1
Chlorpyrifos	1	4
Dacthal	0.2	2
p,p'-Dichlorobenzophenone	3	25
Endosulfan II	1.0	3
Endosulfan sulfate	2	5
alpha-HCH	0.2	1

CHLORINATED ORGANIC PESTICIDES OTHER THAN DDT (Continued):

Analyte	Detection Limit (ng/g dry)	
beta-HCH	1	3
delta-HCH	0.5	2
Methoxychlor	1.5	15
cis-Nonachlor	0.5	1
Oxadiazon*	2	6
Oxychlordane	0.5	1
Toxaphene	10	100

*Not routinely analyzed, additional costs

NIST PCB CONGENERS:

Analyte	Detection Limit (ng/g dry) Sediment	 Tissue
2,4'-dichlorobiphenyl PCB 8	0.5	1
2,2',5-trichlorobiphenyl PCB 18	0.5	1
2,4,4'-trichlorobiphenyl PCB 28	0.5	1
2,2',3,5'-tetrachlorobiphenyl PCB 44	0.5	1
2,2',5,5'-tetrachlorobiphenyl PCB 52	0.5	1
2,3',4,4'-tetrachlorobiphenyl PCB 66	0.5	1
2,2',4,5,5'-pentachlorobiphenyl PCB 101	0.5	1
2,3,3',4,4'-pentachlorobiphenyl PCB 105	0.5	1
2,3',4,4',5-pentachlorobiphenyl PCB 118	0.5	1
2,2',3,3',4,4'-hexachlorobiphenyl PCB 128	0.5	1
2,2',3,4,4',5'-hexachlorobiphenyl PCB 138	0.5	1
2,2',4,4',5,5'-hexachlorobiphenyl PCB 153	0.5	1
2,2',3,3',4,4',5-heptachlorobiphenyl PCB 170	0.5	1
2,2',3,4,4',5,5'-heptachlorobiphenyl PCB 180	0.5	1
2,2',3,4',5,5',6-heptachlorobiphenyl PCB 187	0.5	1
2,2',3,3',4,4',5,6-octachlorobiphenyl PCB 195	0.5	1
2,2',3,3',4,4',5,5',6-nonachlorobiphenyl PCB 206	0.5	1
2,2',3,3',4,4',5,5',6,6'-decachlorobiphenyl PCB 209	0.5	1

ORGANOMETALIC COMPOUNDS:

Tributyltin	13 ng/g	20 ng/g

TRACE ELEMENTS: NOTE: Values for trace elements are micrograms/gram (ppm)

Element	**Detection Limit** (ug/g dry)	
	Sediment	**Tissue**
Aluminum	1	1
Antimony	0.1	0.1
Arsenic	0.1*	0.25
Cadmium	0.01	0.01
Chromium	0.1	0.1
Copper	0.1	0.1
Iron	0.1	0.1
Lead	0.1	0.1
Manganese	0.05	0.05
Mercury	0.03	0.03
Nickel	0.1	0.1
*Selenium	0.2*	0.1
Silver	0.01	0.01
Tin	0.02	0.02
Zinc	0.05	0.05

*denotes that for Arsenic and Selenium, an average percent moisture value is used for establishing these detection limits, with 50% moisture in sediments and 80% in tissue.

ADDITIONAL ANALYSES WHICH CAN BE PERFORMED IF AUTHORIZED
(not presently part of the regular suite of BPTCP chemical analyses)

ADDITIONAL PCB CONGENERS:

Analyte	**Detection Limit** (ng/g dry)	
	Sediment	**Tissue**
2,3-dichlorobiphenyl PCB 5	0.5	1
4,4'-dichlorobiphenyl PCB 15	0.5	1
2,3',6-trichlorobiphenyl PCB 27	0.5	1
2,4,5-trichlorobiphenyl PCB 29	0.5	1
2,4',4-trichlorobiphenyl PCB 31	0.5	1
2,2,'4,5'-tetrachlorobiphenyl PCB 49	0.5	1
2,3',4'.5-tetrachlorobiphenyl PCB 70	0.5	1
2,4,4',5-tetrachlorobiphenyl PCB 74	0.5	1

ADDITIONAL PCB CONGENERS (Continued):

Analyte	Detection Limit (ng/g dry)	
	Sediment	Tissue
2,2',3,5',6-pentachlorobiphenyl PCB 95	0.5	1
2,2',3',4,5-pentachlorobiphenyl PCB 97	0.5	1
2,2',4,4',5-pentachlorobiphenyl PCB 99	0.5	1
2,3,3',4',6-pentachlorobiphenyl PCB 110	0.5	1
2,2',3,3',4,6'-hexachlorobiphenyl PCB 132	0.5	1
2,2',3,4,4',5-hexachlorobiphenyl PCB 137	0.5	1
2,2',3,4',5',6-hexachlorobiphenyl PCB 149	0.5	1
2,2',3,5,5',6-hexachlorobiphenyl PCB 151	0.5	1
2,3,3',4,4',5-hexachlorobiphenyl PCB 156	0.5	1
2,3,3',4,4',5'-hexachlorobiphenyl PCB 157	0.5	1
2,3,3',4,4',6-hexachlorobiphenyl PCB 158	0.5	1
2,2',3,3',4,5,6'-heptachlorobiphenyl PCB 174	0.5	1
2,2',3,3',4',5,6-heptachlorobiphenyl PCB 177	0.5	1
2,2',3,4,4',5',6-heptachlorobiphenyl PCB 183	0.5	1
2,3,3',4,4',5,5'-heptachlorobiphenyl PCB 189	0.5	1
2,2',3,3',4,4',5,5'-octachlorobiphenyl PCB 194	0.5	1
2,2',3,3',4,5',6,6'-octachlorobiphenyl PCB 201	0.5	1
2,2',3,4,4',5,5',6-octachlorobiphenyl PCB 203	0.5	1

Additional chemical analyses that can be performed, if funded and authorized:

a) Terphenyl
b) Quantifying unknown chromatography peaks
c) Pthalates
c) Acid volatile sulfide (on sediment)

APPENDIX B

Quality Assurance/Quality Control Data

BPTCP 1992-1993 Task #2
First 45 Samples Data Report

Bay Protection and Toxic Cleanup Program

Prepared for

Mark Stephenson
Project Director
Marine Pollution Studies Laboratory
California Department of Fish and Game
PO Box 747
Moss Landing, CA 95039

By

Trace Organics Facility
University of California Santa Cruz
100 Shaffer Raod
Santa Cruz, California 95060

June 1993

June 2, 1993

To:
Mark Stephenson
Project Director
Marine Pollution Studies Laboratory
California Department of Fish and Game
PO Box 747
Moss Landing, CA 95039

From:
Trace Organics Facility
Joseph M. Long Marine Laboratory, UCSC
100 Shaffer Rd.
Santa Cruz, CA 95060

Subject: Bay Protection And Toxic Cleanup Project - Quality Assurance / Quality Control Package for First 45 Samples

Standard Reference Materials:

The SRM utilized in this project was purchased from the National Institute of Standards and Technology. NIST Sediment SRM 1941 was released to the Trace Organics Facility in June of 1992 along with a revision of certificate dated 10-29-89.

This SRM was analyzed a total of five times during along with the first 45 BPTCP samples. The results from the five replicate analyses were analyzed for both precision and accuracy in accord with the TOF SOP.

Precision Calculation Modifications:

The relative percent difference (RPD) for replicate analyses of n>2 were calculated utilizing a modification of the RPD calculation for duplicate analysis contained in our Standard Operating Proceedure (SOP).

$$RPD_i = \left(\{ [x_n - X_{residue}] / ([x_n - X_{residue}] / 2) \} * 100 \right)$$

and $X_{RPD} = RPD_1 + RPD_2 + \ldots + RPD_i \Big/ i$

where n = the number of analysis
x = the residue level in a given sample
$X_{residue}$ = the mean residue level
i = the total number of analyses
X_{RPD} = the mean RPD

If a copy of the QA/QC portion of the TOF SOP is needed please notify our laboratory.

Chlorinated Pesticide:

In general, the precision of all detectable analytes were within the control limits defined by the TOF SOP as determined by RPD calculations. For the duplicate analysis of the sample with IDORG #37 the p,p'-DDT < 5% greater than the control limit. This slight overage appeared due to a near detection limit positive hit in one sample followed by a non-detectable residue in the duplicate.

The accuracy of the pesticide data could not be rigorously tested since the SRM has no certified data for these analytes. However, the indicative values provided by NIST fell within a 95 % confidence interval generated from the replicate analysis of this SRM. Only p,p'-DDD fell considerably below the NIST comparative value. It is our opinion that the high value provided by NIST was generated by the quantitation of p,p'-DDD and cis-Nonachlor as an unresolved pair of analytes.

Polychlorinated Biphenyls:

The precision of the detectable analytes were generally within the control limits defined by the TOF SOP as determined by RPD calculations. When considering all replicate analysis as a group, 92% of the individual analyses were in control. Of the measurements which appeared out of control, 6% occurred in a single duplicate analysis and appear to have been caused by a slight positive bias from uncomplexed sulfur in the sample. The TOF RPD range generated by the replicate analysis for five SRMs were completely contained by the TOF SOP Control limits.

Again, the accuracy of the PCB data could not be rigorously tested since NIST has not certified these analytes in SRM 1941. Due to the high degree of precision and similarity of the NIST comparative values, and the TOF 95 % confidence intervals ranges, it is assumed that discrepancies in this comparative set are due to variations in PCB congener resolution between NIST and TOF.

Polycyclic Aromatic Hydrocarbons:

The precision of the PAH data set as indicated by replicate analyses indicates that 92% of the resultant data met TOF SOP control guidelines. The high variability indicated in the SRM Benzo[b]fluoranthene data is caused by a co-eluting homolog (Benzo[j]fluoranthene).

The accuracy for the PAH data set is indicated by comparisons of the TOF SRM replicate data to the comparative data supplied by NIST. Seven of the eleven certified PAH values in SRM 1941 fell within a 95 % confidence interval (95% CI) of the TOF data. All of the TOF 95% CI ranges overlap those supplied by NIST.

Surrogate Recoveries:

Surrogate recoveries were bounded by our SOP guidelines of 75 - 125% throughout this portion of the project with the exception of the samples indicated in the April 22, 1993 BPTCP data cover letter to Gary Ichikawa. A copy of said letter has been included.

Method Blanks:

A method blank was analyzed with each set of ten samples. No analytical interference were indicated.

If any questions arise which need clarification please contact either Deborah Holstad or John Newman at (408) 459-3159.

Sincerely,

John W. Newman

Deborah L Holstad

Deborah Holstad

April 22, 1993

Gary Ichikawa
California Department of Fish and Game
Moss Landing, CA 95039

Dear Gary,

Enclosed is the Data Analysis Report for the first 45 sediment samples of the 92-93 Bay Protection and Toxic Cleanup Project. As discussed earlier this week, the QA/QC aspect of the report will follow later. The results of the method blanks, method duplicates, and SRMs fall within our laboratory control limits.

Once we began the process of data reduction it became evident that many of the samples had PAH and pp-DDE levels greater than 10% above our upper quantitation range. Rather than diluting and reanalyzing over 50% of the samples we prepared additional standards to expand our quantitation range. We then reshot the appropriate fractions and reanalyzed the analytes whose levels were outside our QA/QC guidelines in the original analysis. We took the extra time to prepare the standards so as to minimize sample manipulation and prepare for future BPCTP sediment samples . There were still 8 samples that had extremely high DDT levels which required dilution to fall within our expanded quantitation range.

The F1 surrogate recoveries for two independent analyses of the Consolidated Slip samples, IDOrg 16 and 17, were 50%, while all of the other samples had F1 surrogate recoveries over 85%. Since no gross losses of the extract were reported during the extraction process, matrix inhibition of the F1 surrogate PCB 207, an octachlorinated congener, may have occurred. Normally we reextract samples with surrogate recoveries below 70%. But since these two samples were extracted in different sets and by different extractors, and because of the limiting time factor, they were not reextracted. In the next leg of the project we will reextract the two samples using the lower chlorinated PCB Congener 103 as the surrogate standard.

In this report, the data for the two Consolidated Slip samples were generated by quantitation versus the GC Internal Standard to produce a <u>minimum</u> value based on 100% recovery. Keep in mind that the reported amounts for the PCBs, pp-DDE, op-DDE, op-DDT, HCB, and Heptachlor <u>could be up to 50% too low</u>. If there are any significant changes in the data after reextraction I will notify you.

Should you have any questions please do not hesitate to call either John Newman or myself at 459-3159.

Sincerely,

Deborah Holstad
Trace Organics Facility

BPTCP 92-93 Data Report
April 21, 1993 First 46 Samples

IDOrg	Stanum	Staname	%Dry	%Moist	Date Coll	Date Rec	Date Ext	Date F1e on ECD	Date F2e on ECD	Date AHs on MSD
1	40001.1	Southwest Slip	49.46	50.54	7/29/92	1/26/93	1/29/93	2/20/93	2/18/93	2/22/93
2	40001.2	Southwest Slip	52.67	47.33	7/29/92	1/26/93	2/04/93	2/20/93	2/19/93	2/25/93
3	40001.3	Southwest Slip	47.46	52.54	7/29/92	1/26/93	2/10/93	3/3/93	3/5/93	3/16/93
5	40002.2	West Basin, Pier 143	59.09	40.91	7/30/92	1/26/93	1/29/93	2/20/93	2/18/93	2/22/93
7	40003.1	Turning Basin, Pier 151	57.86	42.14	7/31/92	1/26/93	1/29/93	2/20/93	2/18/93	2/22/93
8	40003.2	Turning Basin, Pier 151	69.77	30.23	7/31/92	1/26/93	2/04/93	2/20/93	2/19/93	2/25/93
11	40004.2	Lower Main Channel	40.83	59.17	7/29/92	1/26/93	1/29/93	2/20/93	2/18/93	2/22/93
13	40005.1	East Basin, Turning Basin	59.33	40.67	7/30/92	1/26/93	1/29/93	2/20/93	2/18/93	2/22/93
16	40006.1	Consolidated Slip	41.85	58.15	7/31/92	1/26/93	1/29/93	2/20/93	2/18/93	2/22/93
17	40006.2	Consolidated Slip	40.92	59.08	7/31/92	1/26/93	2/04/83	2/20/93	2/19/93	2/25/93
20	40007.2	Long Beach Har.(Chan 2)	51.72	48.28	9/1/92	1/26/93	2/04/93	2/20/93	2/19/93	2/25/93
24	40008.3	East Basin Pier C	58.01	41.99	8/18/92	1/26/93	1/29/93	2/20/93	2/18/93	2/22/93
28	40010.1	Off Cabrillo Beach	45.62	54.38	8/18/92	1/26/93	1/29/93	2/20/93	2/18/93	2/22/93
29	40010.2	Off Cabrillo Beach	50.39	49.61	8/18/92	1/26/93	2/04/93	2/20/93	2/19/93	2/25/93
33	40011.3	Inner Harbor (Channel 3)	46.77	53.23	9/1/92	1/26/93	2/22/93	3/4/93	3/5/93	3/12/93
34	40012.1	Southeast Basin	48.82	51.18	8/18/92	1/26/93	2/04/93	2/20/93	2/19/93	2/25/93
35	40012.2	Southeast Basin	46.81	53.19	8/18/92	1/26/93	2/10/93	3/3/93	3/5/93	3/16/93
37	40013.1	Inner Queensway Bay	45.45	54.55	9/2/92	1/26/93	2/04/93	2/20/93	2/19/93	2/25/93
41	40014.2	Outer Queensway Bay	34.74	65.26	9/2/92	1/26/93	2/10/93	3/3/93	3/5/93	3/16/93
42	40014.3	Outer Queensway Bay	36.03	63.97	9/2/92	1/26/93	2/22/93	3/4/93	3/5/93	3/12/93
43	40015.1	Fish Harbor Entrance	61.64	38.36	8/19/92	1/26/93	2/04/93	2/20/93	2/19/93	2/25/93
45	40015.3	Fish Harbor Entrance	63.35	36.65	8/19/92	1/26/93	2/10/93	3/3/93	3/5/93	3/16/93
51	40017.3	Long Beach Channel	46.91	53.09	9/2/92	1/26/93	2/04/93	2/20/93	2/19/93	2/25/93
54	40018.3	Long Beach Outer Har-1B	45.83	54.17	9/2/92	1/26/93	2/10/93	3/3/93	3/5/93	3/16/93
55	40019.1	Inner Fish Harbor	39.62	60.38	8/19/92	1/26/93	3/3/93	3/16/93	3/13/93	3/20/93
56	40019.2	Inner Fish Harbor	43.73	56.27	8/19/92	1/26/93	2/22/93	3/4/93	3/5/93	3/12/93
57	40019.3	Inner Fish Harbor	37.36	62.64	8/19/92	1/26/93	2/22/93	3/4/93	3/5/93	3/12/93
59	40020.2	Long Beach Outer Har.-20	57.24	42.76	9/2/92	1/26/93	2/10/93	3/3/93	3/5/93	3/16/93
60	40020.3	Long Beach Outer Har.-20	56.27	43.73	9/2/92	1/26/93	2/22/93	3/4/93	3/5/93	3/12/93
63	40021.3	Alamitos bay, Marina Stad	57.27	42.73	9/16/92	1/26/93	2/10/93	3/3/93	3/5/93	3/16/93
64	40022.1	Alamitos Bay, Entrance	54.48	45.52	9/15/92	1/26/93	2/22/93	3/4/93	3/5/93	3/12/93
69	40023.3	Alamitos Bay, l.b. Marina	62.15	37.85	9/16/92	1/26/93	3/3/93	3/16/93	3/13/93	3/20/93
75	40030.3	San Pedro Breakwater	70.85	29.15	8/19/92	1/26/93	3/3/93	3/16/93	3/13/93	3/20/93
77	40031.2	Palos Verdes (Swartz 6)	56.08	43.92	9/1/92	1/21/93	2/22/93	3/4/93	3/5/93	3/12/93
78	40031.3	Palos Verdes (Swartz 6)	58.40	41.60	9/1/92	1/21/93	3/3/93	3/16/93	3/13/93	3/20/93
81	40032.3	San Pedro Bay, Pole 19	72.66	27.34	7/30/92	1/26/93	2/22/93	3/4/93	3/5/93	3/12/93
82	40033.1	Outer Harbor, Pole 10	43.92	56.08	7/30/92	1/26/93	2/22/93	3/4/93	3/5/93	3/12/93
87	80024.3	Anaheim Bay, Outer	52.22	47.78	9/15/92	1/26/93	3/3/93	3/16/93	3/13/93	3/20/93
92	80026.2	Huntington Harbor, lower	72.53	27.47	9/15/92	1/26/93	1/29/93	2/20/93	2/18/93	2/22/93
95	80027.2	Huntington Harbor, Middle	47.58	52.42	9/15/92	1/26/93	2/10/93	3/3/93	3/5/93	3/16/93
96	80027.3	Huntington Harbor, Middle	48.02	51.98	9/15/92	1/26/93	2/04/93	2/20/93	2/19/93	2/25/93
98	80028.2	Huntington Harbor, Upper	54.76	45.24	9/15/92	1/26/93	2/22/93	3/4/93	3/5/93	3/12/93
99	80028.3	Huntington Harbor, Upper	47.38	52.62	9/15/92	1/26/93	3/3/93	3/16/93	3/13/93	3/20/93
103	40032.1	San Pedro Bay Pole 19	71.95	28.05	8/19/92	1/26/93	3/3/93	3/16/93	3/13/93	3/20/93
136	40010.4	Cabrillo Beach	50.34	49.66	9/16/92	1/26/33	3/3/93	3/16/93	3/13/93	3/20/93

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	Pesticides, ng/g dry weight																				
IDOrg	Aldrin	o-chlor	opDDD	ppDDD	opDDE	ppDDE	opDDT	ppDDT	Dield	Endo I	Endo II	ESO4	Endrin	Hepta	HE	HCB	g-HCH	Methoxy	Mirex	Toxe	t-non
1	ND	1.2	3.8	15	9.7	89	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2
2	ND	1.3	4.6	16	9.6	96	5.4	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3
3	ND	2.2	3.8	17	9.3	93	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4
5	ND	1.2	2.4	8.8	5.4	41	ND	3.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1
7	ND	0.5	2.1	7.5	4.9	42	ND	9.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8	ND	ND	1.0	2.5	2.1	17	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11	ND	0.8	7.7	20	48	270	ND	2.5	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	0.8
13	ND	4.6	8.7	29	5.0	84	2.2	34	1.2	ND	ND	ND	ND	0.5	ND	0.4	ND	ND	ND	51	5.3
16	ND	26	35	140	10	270	9.7	52	7.1	ND	ND	ND	ND	1.9	ND	1.6	ND	ND	ND	160	24
17	ND	23	33	140	12	270	7.5	36	6.2	ND	ND	ND	ND	2.8	ND	1.6	ND	ND	ND	100	23
20	ND	2.0	3.3	11	9.9	88	ND	ND	ND	ND	ND	ND	ND	2.1	ND	0.3	ND	ND	1.4	ND	2.0
24	ND	ND	1.1	3.3	4.4	27	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
28	ND	0.7	4.5	10	32	220	ND	ND	0.5	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	0.6
29	ND	0.7	3.3	8.0	25	170	ND	ND	0.7	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	ND
33	ND	0.6	2.1	6.5	8.1	61	ND	ND	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6
34	ND	ND	ND	2.9	7.4	59	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
35	ND	ND	1.0	4.0	6.5	55	ND	5.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
37	ND	7.4	1.6	11	1.4	27	1.2	7.3	3.7	ND	ND	ND	ND	ND	ND	0.4	ND	ND	ND	ND	7.4
41	ND	9.4	1.2	16	4.4	47	ND	6.7	4.3	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND	8.1
42	ND	9.9	4.1	17	4.1	41	ND	4.6	2.2	ND	ND	ND	ND	1.2	ND	0.4	ND	ND	ND	ND	9.0
43	ND	ND	ND	2.9	6.6	70	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
45	ND	ND	ND	2.2	3.7	33	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
51	ND	ND	1.7	4.6	13	110	ND	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
54	ND	1.6	2.9	7.9	11	73	ND	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4
55	ND	1.1	2.7	8.8	17	210	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	1.8	ND	ND	0.8
56	ND	1.0	3.5	9.5	21	200	ND	1.0	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND	0.8
57	ND	1.6	5.1	16	23	260	1.0	7.8	ND	ND	ND	ND	ND	0.6	ND	ND	ND	ND	ND	ND	1.2
59	ND	1.1	1.4	5.9	7.4	54	ND	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0
60	ND	1.4	1.6	5.5	7.6	61	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4
63	ND	1.6	ND	3.2	1.7	20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.9
64	ND	3.5	1.4	6.0	3.2	36	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	3.8
69	ND	1.2	1.1	2.7	1.5	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4
75	ND	ND	1.3	3.6	8.9	85	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
77	ND	0.7	36	69	310	2900	1.5	21	ND	ND	ND	ND	ND	0.7	ND	ND	ND	ND	ND	ND	0.9
78	ND	1.0	31	57	230	2200	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
81	ND	ND	1.9	5.5	13	110	ND	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82	ND	0.9	7.8	22	33	440	ND	5.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6
87	ND	1.1	1.8	3.7	2.4	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2
92	ND	0.8	1.4	2.5	ND	5.6	ND	3.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8
95	ND	4.3	3.0	11	2.3	76	ND	3.4	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND	ND	ND	4.9
96	ND	4.3	2.7	9.5	2.0	72	ND	5.1	0.9	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	5.0
98	ND	8.6	3.6	12	1.8	82	ND	3.8	1.8	ND	ND	ND	ND	ND	ND	0.3	ND	ND	ND	ND	8.8
99	ND	8.0	2.8	12	1.9	93	ND	4.3	ND	ND	ND	ND	ND	ND	ND	0.3	ND	ND	ND	ND	8.4
103	ND	ND	1.2	3.1	8.8	75	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
136	ND	0.6	3.0	8.6	23	160	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND	ND	ND	ND

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	PCBs, ng/g dry weight																		
IDOrg	8	18	28	44	52	66	87	101	105	118	128	138	153	170	180	187	195	206	209
1	ND	ND	ND	1.7	3.0	3.1	3.9	10	3.6	9.3	2.7	16	12	2.9	6.1	3.3	ND	1.9	1.2
2	ND	ND	ND	2.2	4.6	3.4	4.9	12	4.2	11	3.2	19	14	4.0	8.7	3.8	ND	1.1	ND
3	ND	ND	ND	2.2	4.7	3.5	5.1	14	3.8	13	3.4	21	13	3.8	7.9	3.5	ND	1.0	ND
5	ND	ND	ND	1.2	2.2	1.9	2.9	7.1	2.8	6.8	2.0	11	7.6	1.9	3.8	1.9	ND	ND	ND
7	ND	ND	ND	ND	1.3	1.3	ND	2.9	1.1	2.7	ND	4.6	3.8	1.0	2.2	1.2	ND	ND	ND
8	ND	ND	1.0	1.9	2.6	4.0	ND	2.3	1.1	2.2	ND	2.6	2.2	ND	1.8	ND	ND	ND	ND
11	ND	ND	2.1	3.2	4.9	5.8	4.1	10	3.8	9.7	2.3	13	9.9	2.0	4.3	2.4	ND	ND	ND
13	ND	1.4	2.4	3.1	4.4	4.8	1.0	9.0	2.5	6.8	1.6	18	16	6.1	15	7.5	1.1	1.4	ND
16	ND	4.6	9.9	11	14	16	8.4	23	6.8	18	4.3	38	35	11	26	15	1.8	2.0	ND
17	1.5	7.7	13	13	17	20	8.4	24	7.6	18	4.1	39	36	11	35	16	1.9	2.2	ND
20	1.4	5.2	11	11	14	19	6.0	14	6.1	14	2.9	19	15	5.3	11	5.4	ND	2.0	1.9
24	ND	ND	ND	ND	1.1	1.3	ND	2.5	ND	2.2	ND	4.7	4.4	1.7	3.2	1.9	ND	2.4	ND
28	ND	1.4	2.4	3.6	6.1	4.9	2.6	7.2	2.7	6.4	1.3	7.6	5.2	1.4	2.7	1.4	ND	ND	ND
29	ND	1.3	2.3	3.3	5.2	4.4	2.5	6.2	2.3	5.3	1.2	5.9	4.4	1.0	1.9	1.1	ND	ND	ND
33	ND	ND	1.0	1.4	2.4	2.8	1.7	4.9	1.8	4.9	1.1	8.1	5.8	1.9	3.9	2.2	ND	1.3	1.7
34	ND	ND	1.0	ND	1.2	1.8	ND	2.1	1.0	2.3	ND	3.4	2.9	ND	1.7	1.1	ND	ND	ND
35	ND	ND	ND	ND	ND	1.6	ND	1.7	ND	2.1	ND	3.1	2.2	ND	1.5	ND	ND	ND	2.2
37	ND	1.0	1.7	2.3	2.8	2.7	ND	3.1	1.7	3.0	1.0	4.9	3.7	1.6	3.2	1.4	ND	ND	ND
41	1.1	3.1	5.4	6.4	8.3	9.3	3.0	6.7	1.8	6.6	1.1	8.2	4.5	2.2	4.8	2.1	ND	ND	ND
42	1.3	3.0	5.0	6.2	8.1	9.2	2.6	6.7	2.9	6.3	1.1	8.0	4.7	2.3	4.7	2.1	ND	ND	ND
43	ND	ND	ND	1.1	2.0	2.1	1.7	4.3	1.8	4.4	1.1	5.9	4.3	1.1	2.0	1.1	ND	ND	ND
45	ND	ND	ND	ND	1.2	1.4	1.1	2.8	1.0	2.7	ND	4.5	3.0	1.1	2.1	ND	ND	ND	ND
51	ND	ND	ND	ND	1.1	1.9	ND	2.0	1.0	2.3	ND	3.1	2.4	ND	1.3	ND	ND	ND	ND
54	ND	ND	2.2	2.4	3.1	4.4	1.7	4.1	1.8	4.3	ND	5.8	3.7	1.5	2.9	1.5	ND	ND	ND
55	ND	1.7	4.0	6.5	12	14	8.2	20	7.7	21	3.6	26	23	4.6	9.9	14	ND	5.4	2.1
56	ND	2.1	5.2	9.1	15	18	10	25	9.9	21	3.9	29	16	4.9	11	5.1	ND	2.9	2.4
57	ND	3.0	6.8	10	19	22	13	35	14	9.8	5.1	41	25	7.6	18	9.0	1.0	3.6	3.5
59	ND	ND	1.0	1.1	1.4	2.1	1.0	2.5	1.1	2.7	ND	4.2	2.8	1.1	2.3	1.4	ND	ND	ND
60	ND	ND	1.1	1.2	1.7	2.2	1.1	2.8	1.3	ND	ND	4.4	3.2	1.3	2.7	1.5	ND	1.0	ND
63	ND	ND	ND	ND	ND	1.5	ND	2.2	ND	2.5	ND	3.9	3.0	ND	1.5	1.0	ND	ND	ND
64	ND	ND	1.0	1.2	1.9	2.3	1.4	3.7	1.5	ND	1.0	6.1	4.3	1.5	3.1	1.6	ND	ND	ND
69	ND	ND	ND	ND	ND	ND	ND	1.6	ND	1.6	ND	2.6	2.1	ND	1.2	ND	ND	ND	ND
75	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	ND	ND	ND
77	ND	ND	3.3	5.8	7.1	16	7.1	16	7.9	18	3.7	22	15	4.2	8.7	4.5	ND	1.5	1.2
78	ND	ND	2.3	4.1	5.2	11	5.6	12	6.0	13	2.8	17	12	3.4	6.7	3.7	ND	1.1	1.0
81	ND	ND	ND	ND	ND	1.1	ND	1.3	ND	1.4	ND	1.9	1.2	ND	ND	ND	ND	ND	ND
82	ND	ND	2.1	2.9	4.3	5.8	3.1	7.7	3.8	8.2	1.7	10	6.1	1.9	4.0	2.1	ND	ND	ND
87	ND	ND	ND	ND	ND	1.6	ND	1.9	ND	1.3	ND	2.7	1.8	ND	1.3	ND	ND	ND	ND
92	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
95	ND	ND	1.0	ND	ND	1.5	1.0	3.2	ND	3.0	1.0	7.3	5.8	1.8	4.0	2.1	ND	ND	ND
96	ND	ND	ND	ND	ND	1.4	1.1	2.8	1.2	2.7	1.0	5.8	4.9	1.5	3.2	1.9	ND	ND	ND
98	ND	ND	ND	1.3	1.6	1.6	1.3	3.4	1.3	3.3	1.1	6.8	4.5	1.5	3.1	1.6	ND	ND	ND
99	ND	ND	ND	1.1	1.4	1.6	1.5	3.8	1.6	3.8	1.5	8.3	6.3	1.9	3.9	2.3	ND	ND	ND
103	ND	ND	ND	ND	ND	1.0	ND	1.0	ND	1.1	ND	1.4	1.1	ND	ND	ND	ND	ND	ND
136	ND	ND	1.8	2.7	4.3	4.3	2.3	5.7	1.9	5.1	ND	6.0	4.4	ND	2.1	1.2	ND	ND	ND

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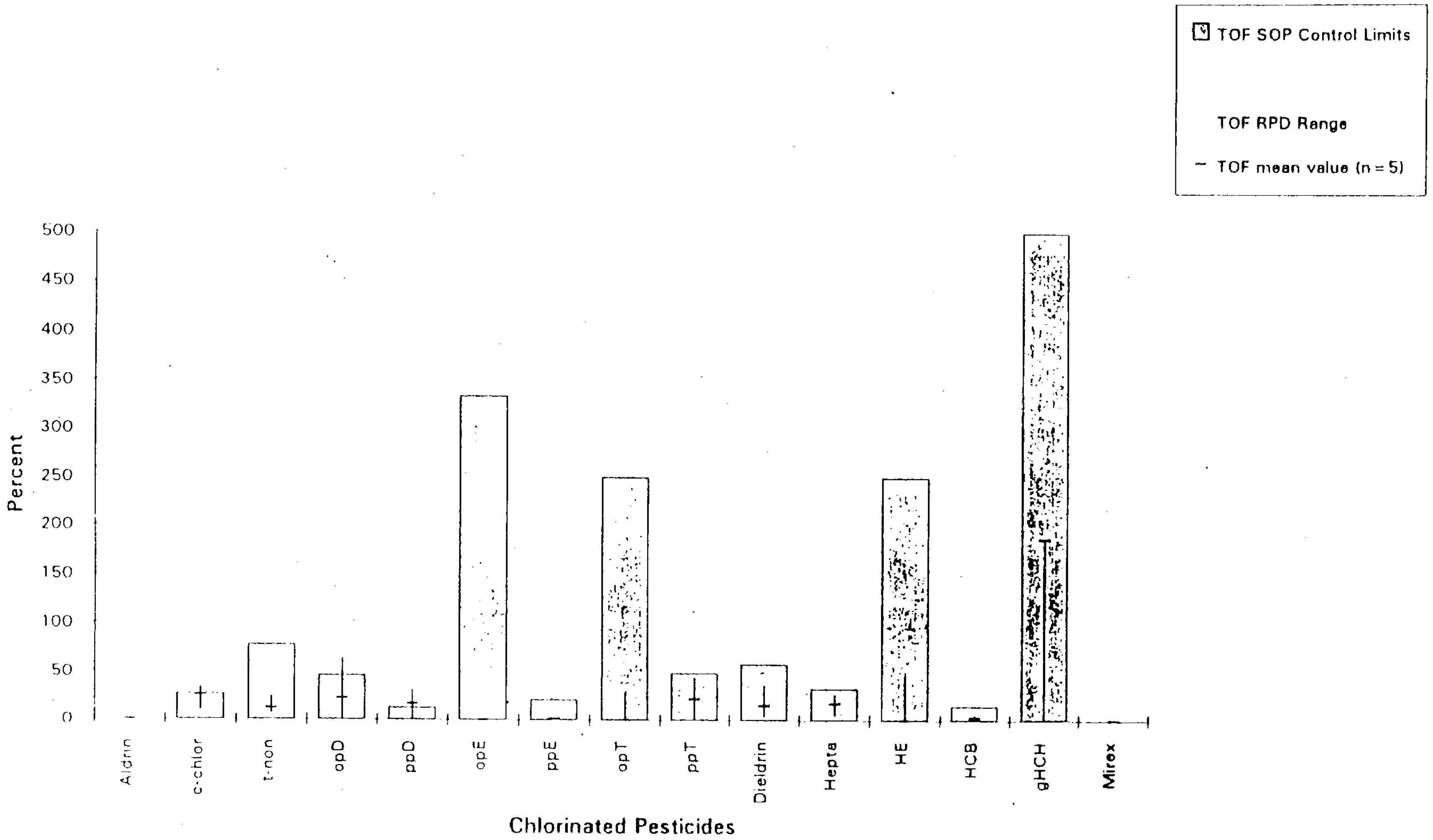
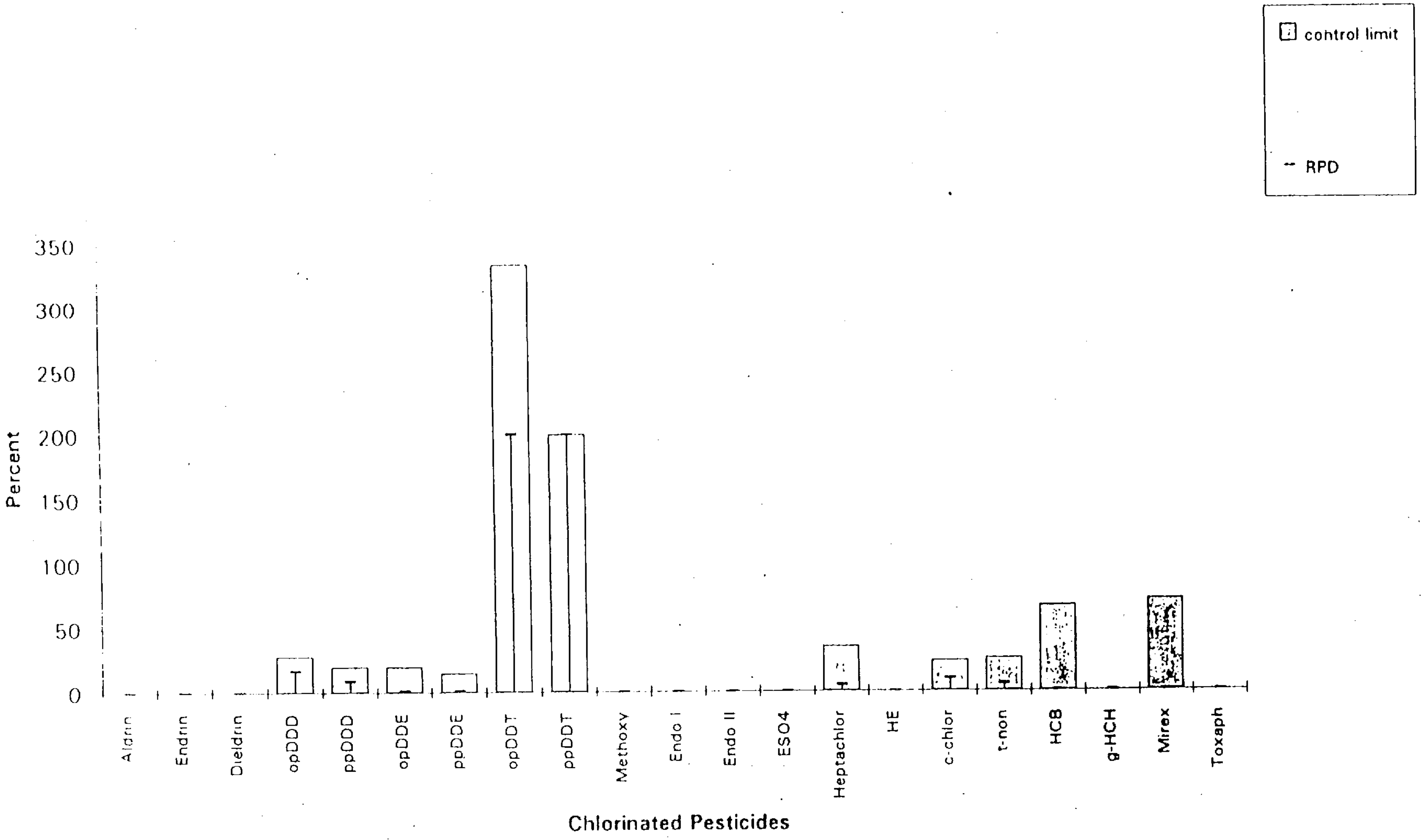
	PAHs, ng/g dry weight																
IDOrg	ACE	ANT	BAA	BAP	BEP	BPH	CHR	DBA	DMN	FLA	FLU	1-MNP	2-MNP	1-MPH	PHN	PER	PYR
1	83	620	970	1100	950	19	1700	180	11	2000	150	23	60	60	660	370	1400
2	21	390	860	1600	1400	7.3	1600	270	9.5	1000	77	8.5	26	36	350	450	1300
3	130	1400	2200	3300	2500	23	4000	510	ND	4400	310	25	70	130	1400	820	2900
5	6.2	97	210	400	370	ND	370	70	5.6	280	21	5.1	13	12	84	140	370
7	20	190	280	280	250	ND	410	48	6.0	680	47	7.6	20	20	220	120	440
8	8.5	60	120	120	120	ND	190	24	ND	230	20	ND	7.4	7.5	84	65	160
11	35	240	410	420	350	9.8	560	73	11	1200	70	24	46	48	360	910	1200
13	16	79	270	460	430	6.3	410	94	19	490	26	15	43	30	180	130	580
16	38	160	690	630	660	20	1100	150	47	1300	76	74	230	130	480	190	1400
17	62	220	1000	920	820	29	1500	200	67	1700	97	79	210	160	610	250	2200
20	65	440	910	1600	1400	25	1600	310	23	1600	120	28	57	69	690	360	1600
24	12	86	170	240	180	ND	300	41	ND	260	18	5.1	12	12	110	68	250
28	8.1	58	200	290	270	5.1	250	55	12	450	22	27	51	22	76	930	440
29	8.1	36	130	150	180	ND	150	29	5.8	400	19	13	23	14	44	850	390
33	5.9	100	220	430	350	ND	400	100	8.6	240	25	8.2	21	13	100	130	280
34	9.8	140	280	300	330	7.8	500	110	18	290	31	19	50	29	180	73	340
35	5.4	82	230	240	240	5.2	400	71	11	210	26	14	36	18	110	65	230
37	6.0	19	92	100	130	28	150	29	13	200	36	39	56	33	140	62	220
41	ND	14	72	99	110	14	100	27	18	180	24	22	34	15	88	53	190
42	ND	14	88	95	110	13	100	28	10	190	22	19	30	24	94	52	210
43	7.4	13	62	110	99	ND	81	25	ND	130	7.4	ND	7.0	15	75	130	150
45	26	23	66	91	69	ND	90	19	8.3	160	21	6.9	9.4	16	120	90	170
51	ND	11	34	44	44	ND	44	11	15	72	9.6	5.0	11	15	39	33	92
54	ND	ND	28	45	45	ND	40	12	9.9	61	6.7	ND	8.6	5	28	24	74
55	16	420	790	1000	980	6.0	1200	170	9.3	1700	46	10	24	49	280	470	1800
56	15	210	420	930	820	5.4	750	210	10	720	120	9.7	21	48	250	370	1000
57	16	290	840	1600	1300	11	1400	290	7.1	840	45	16	36	57	290	530	1500
59	ND	ND	28	41	39	ND	42	10	6.4	63	5.7	ND	5.7	5.3	32	18	68
60	ND	6.3	32	47	45	ND	45	12	ND	82	ND	ND	6.4	6.6	39	21	94
63	ND	5.7	41	62	75	ND	140	15	8.9	130	6.2	ND	8.7	5.9	34	22	130
64	ND	9.5	68	97	98	ND	100	27	12	190	ND	ND	11	11	76	30	190
69	ND	8.4	54	60	67	ND	79	14	ND	110	ND	ND	5.9	5.2	40	23	110
75	ND	ND	7.6	9.0	12	ND	11	ND	ND	11	ND	ND	ND	ND	ND	20	12
77	ND	8.4	14	35	41	ND	16	12	ND	22	7.8	ND	10	ND	21	45	35
78	ND	6.2	16	26	44	ND	22	9.9	ND	18	ND	ND	7.4	ND	14	40	27
81	ND	ND	17	31	27	ND	21	7.4	ND	35	ND	ND	5.8	ND	10	57	38
82	ND	25	71	130	120	ND	99	35	14	170	8.9	12	23	12	53	500	160
87	13	22	110	67	120	ND	210	20	ND	180	13	ND	8.5	7.9	75	23	170
92	ND	8.7	21	26	26	ND	30	5.8	ND	58	6.8	ND	ND	ND	29	8.9	56
95	ND	17	53	88	110	ND	90	24	13	150	ND	ND	8.5	7.1	52	29	170
96	ND	9.9	59	83	110	ND	110	24	6.9	160	8.2	ND	8.5	10	67	28	180
98	ND	16	82	110	130	ND	130	31	5.4	230	6.8	ND	12	11	93	38	260
99	ND	17	140	160	200	7.2	240	34	18	390	8.5	ND	13	19	140	53	400
103	ND	14	71	58	56	ND	79	15	ND	130	7.9	ND	ND	17	48	59	130
136	ND	29	160	210	250	ND	200	43	11	370	8.6	15	28	17	49	710	340

Reference Material Relative Percent Difference

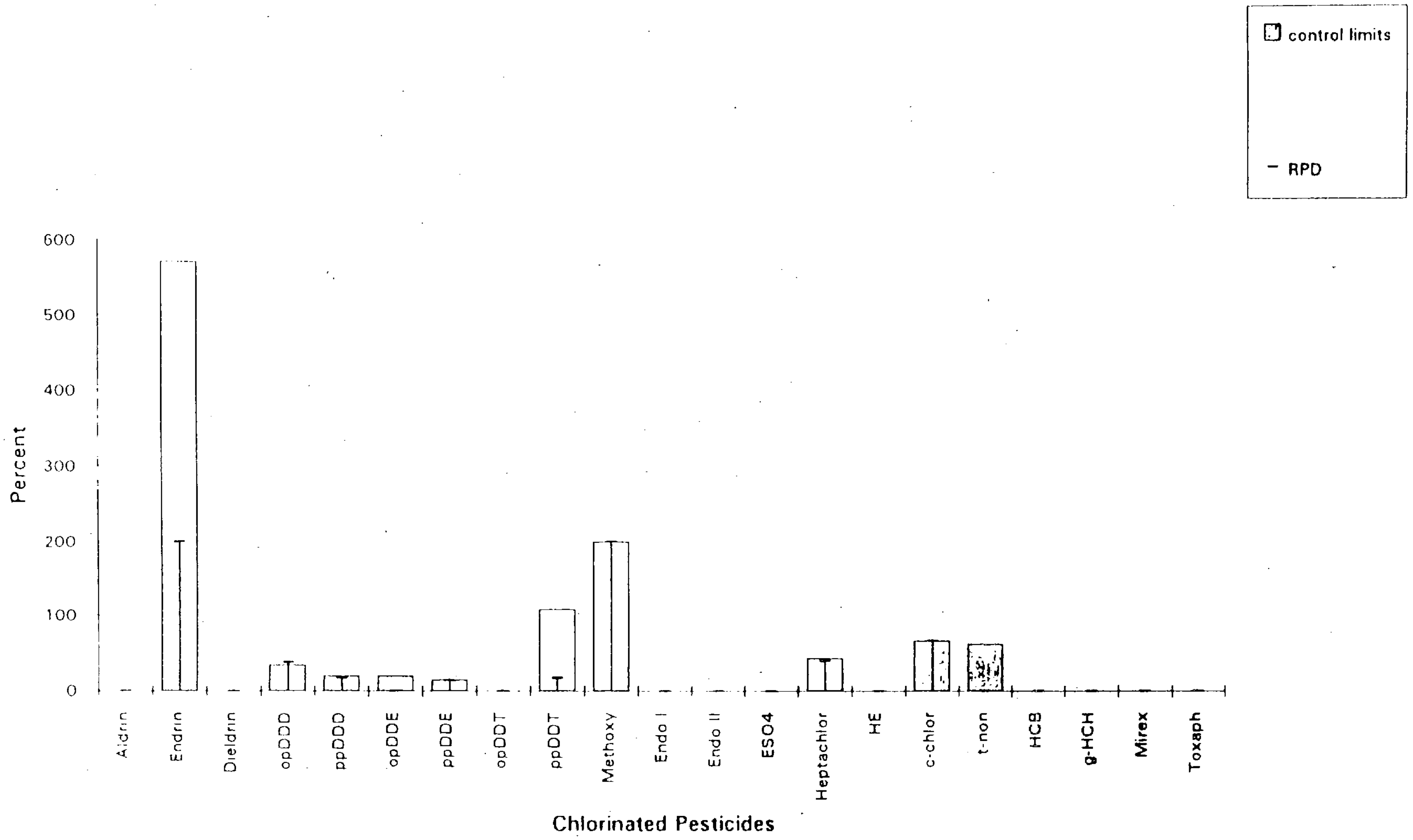
Reference Material Relative Percent Difference for Pesticide Data: NIST Sediment SRM 1941



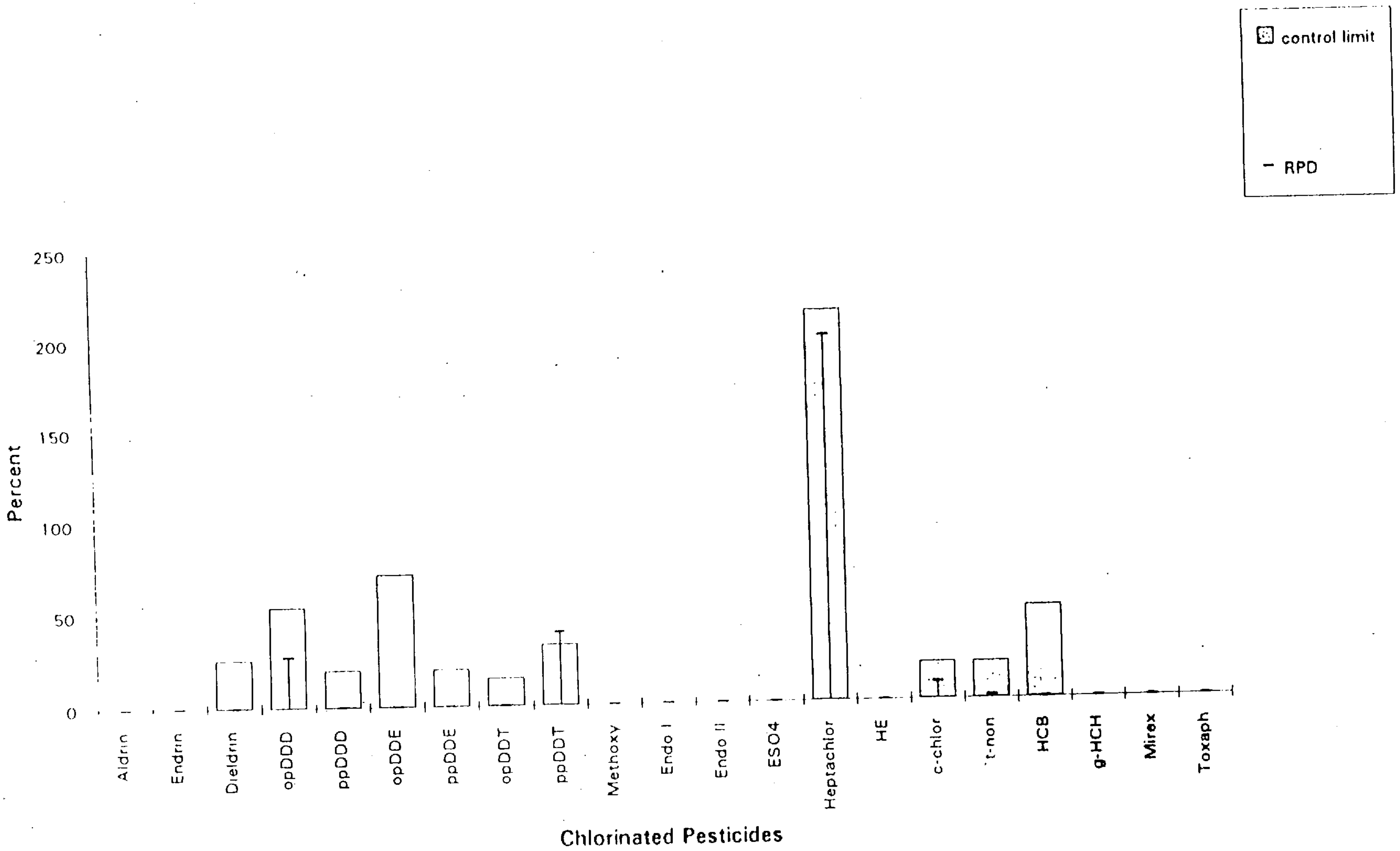
Method Duplicate Relative Percent Difference for Pesticide Data: IDORG # 20; Long Beach Harbor (Channel 2)



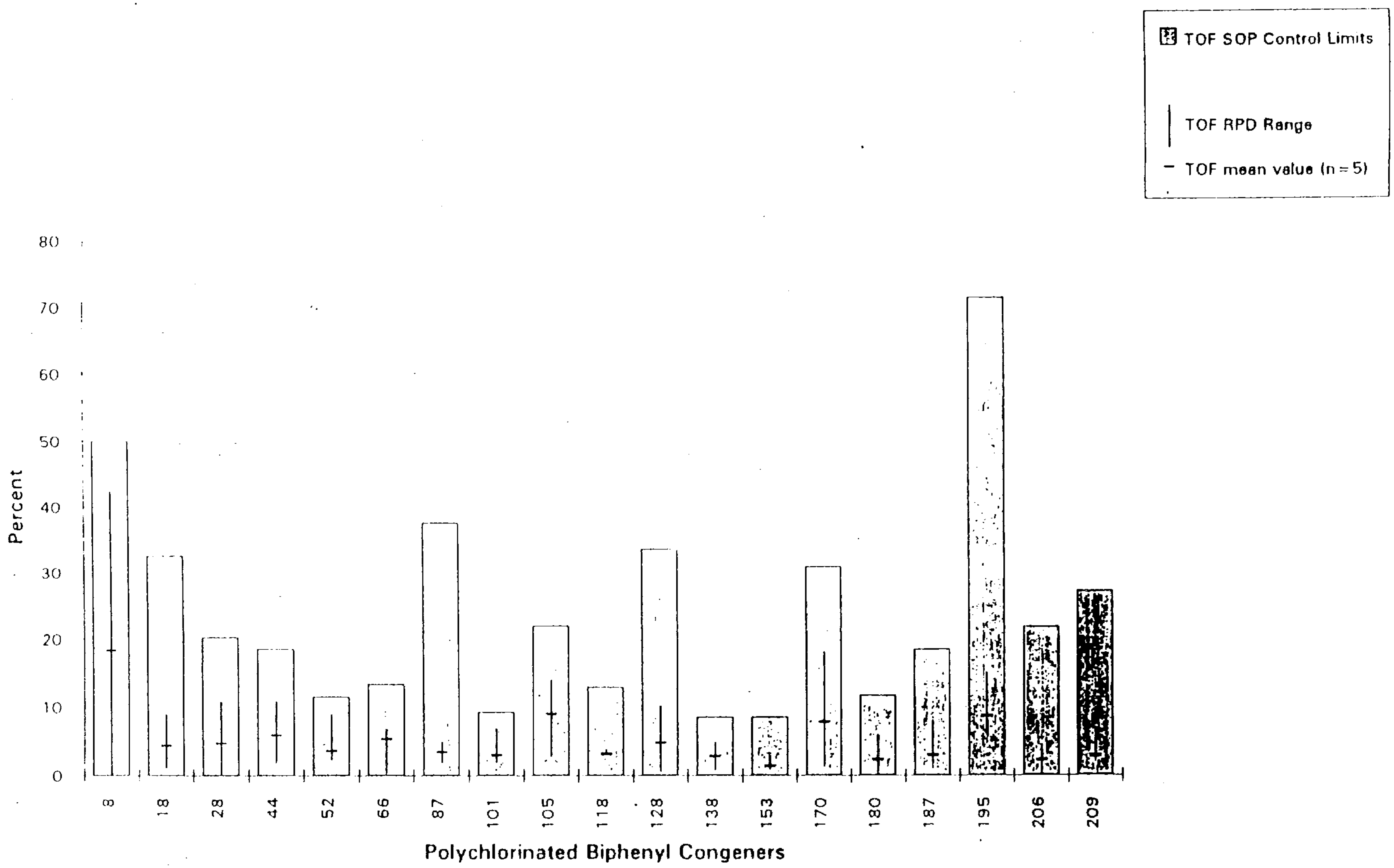
Method Duplicate Relative Percent Difference for Pesticide Data: IDORG #56; Inner Fish Harbor



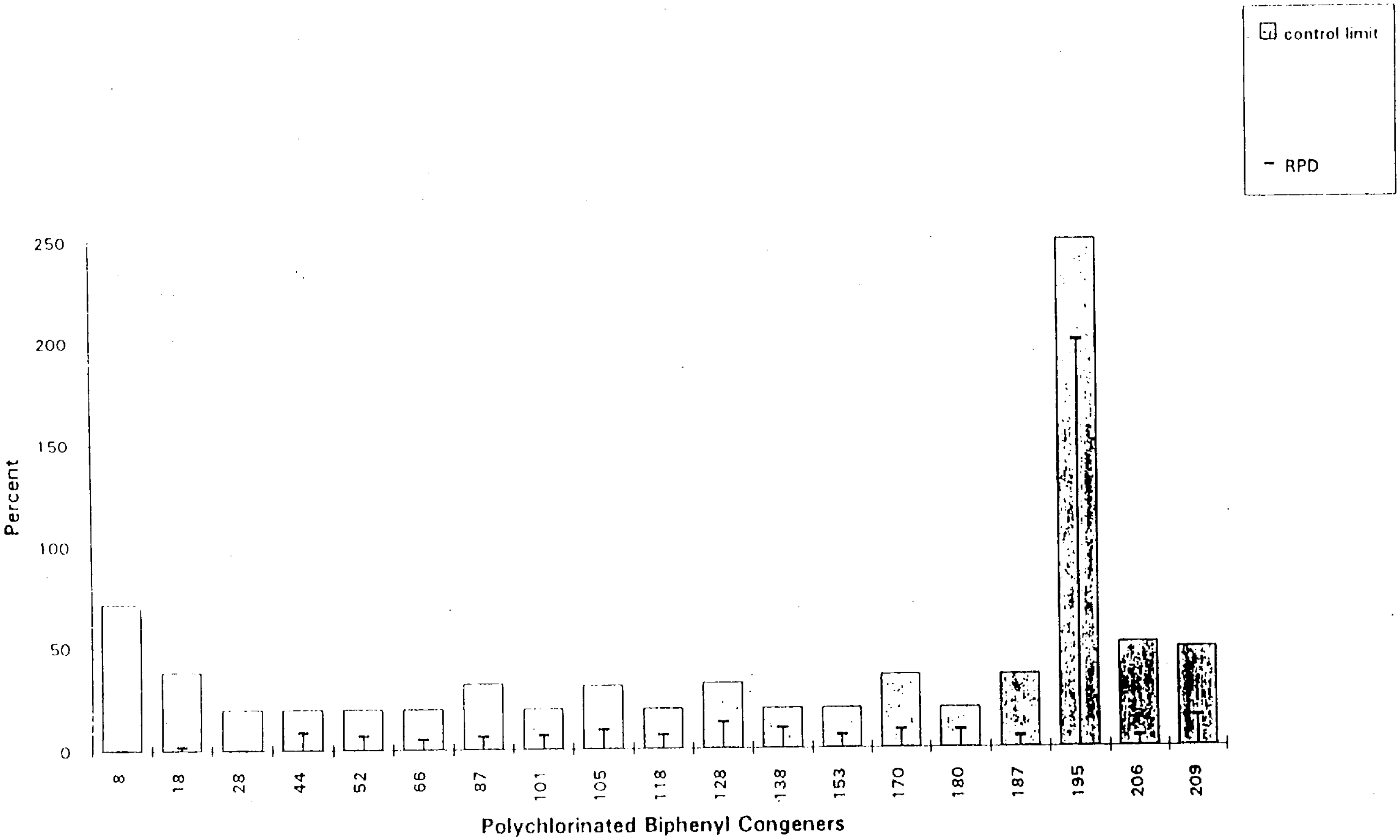
Method Duplicate Relative Percent Difference for Pesticide Data: IDORG #37; Inner Queensway Bay



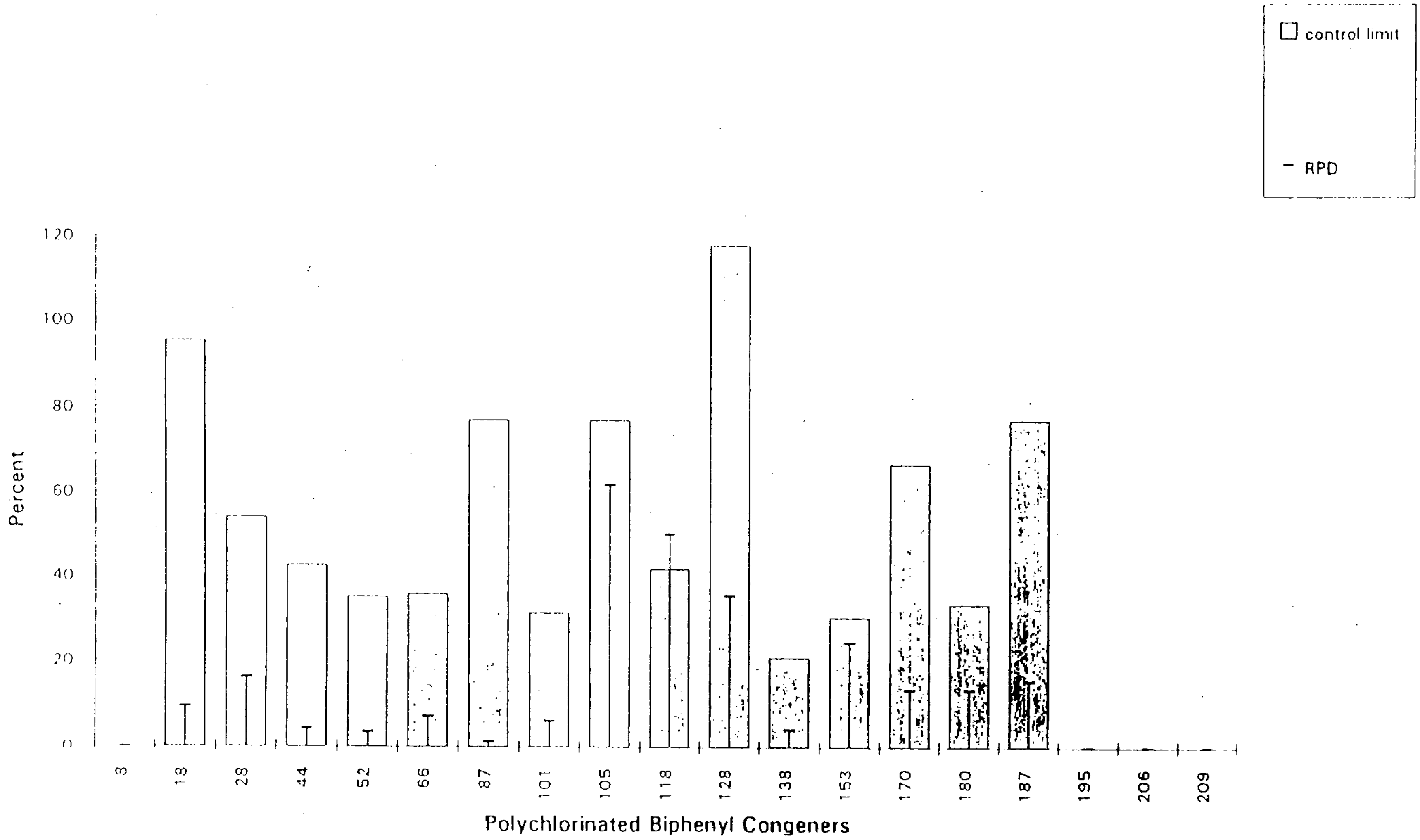
Reference Material Relative Percent Difference for PCB Data: NIST Sediment SRM 1941



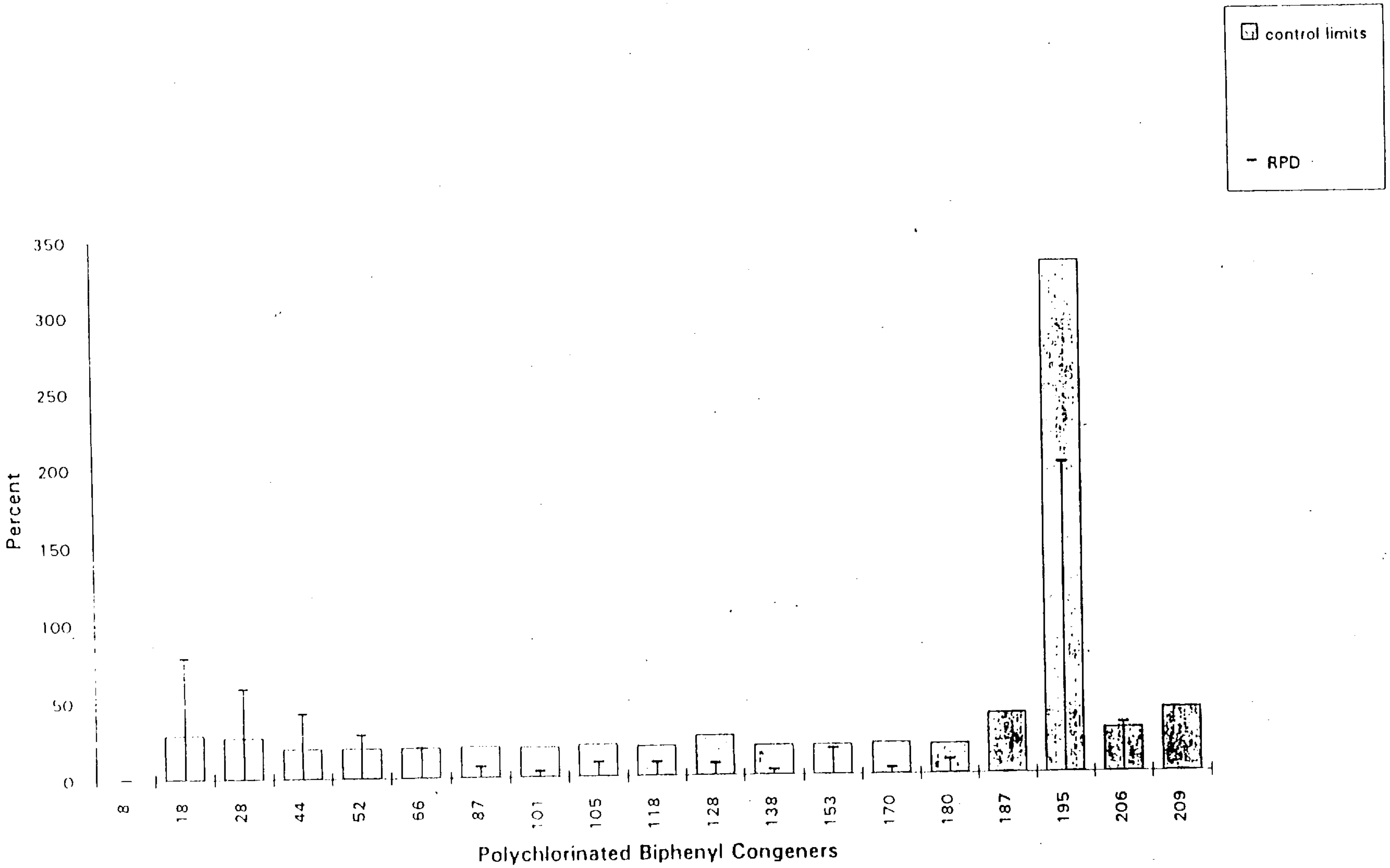
Method Duplicate Relative Percent Difference for PCB Data: IDORG #20; Long Beach Harbor (Channel 2)



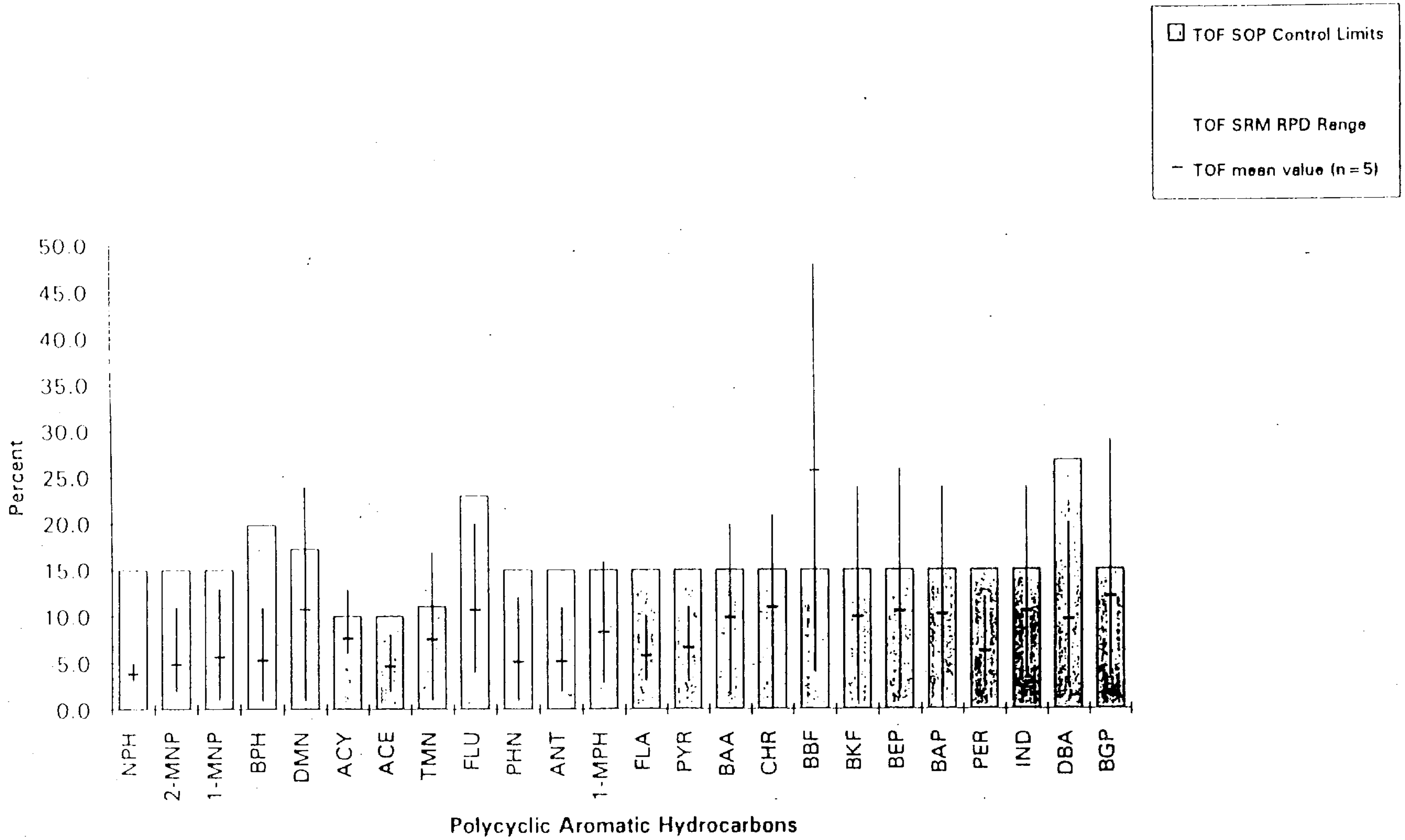
Method Duplicate Relative Percent Difference for PCB Data: IDORG #37; Inner Queensway Bay



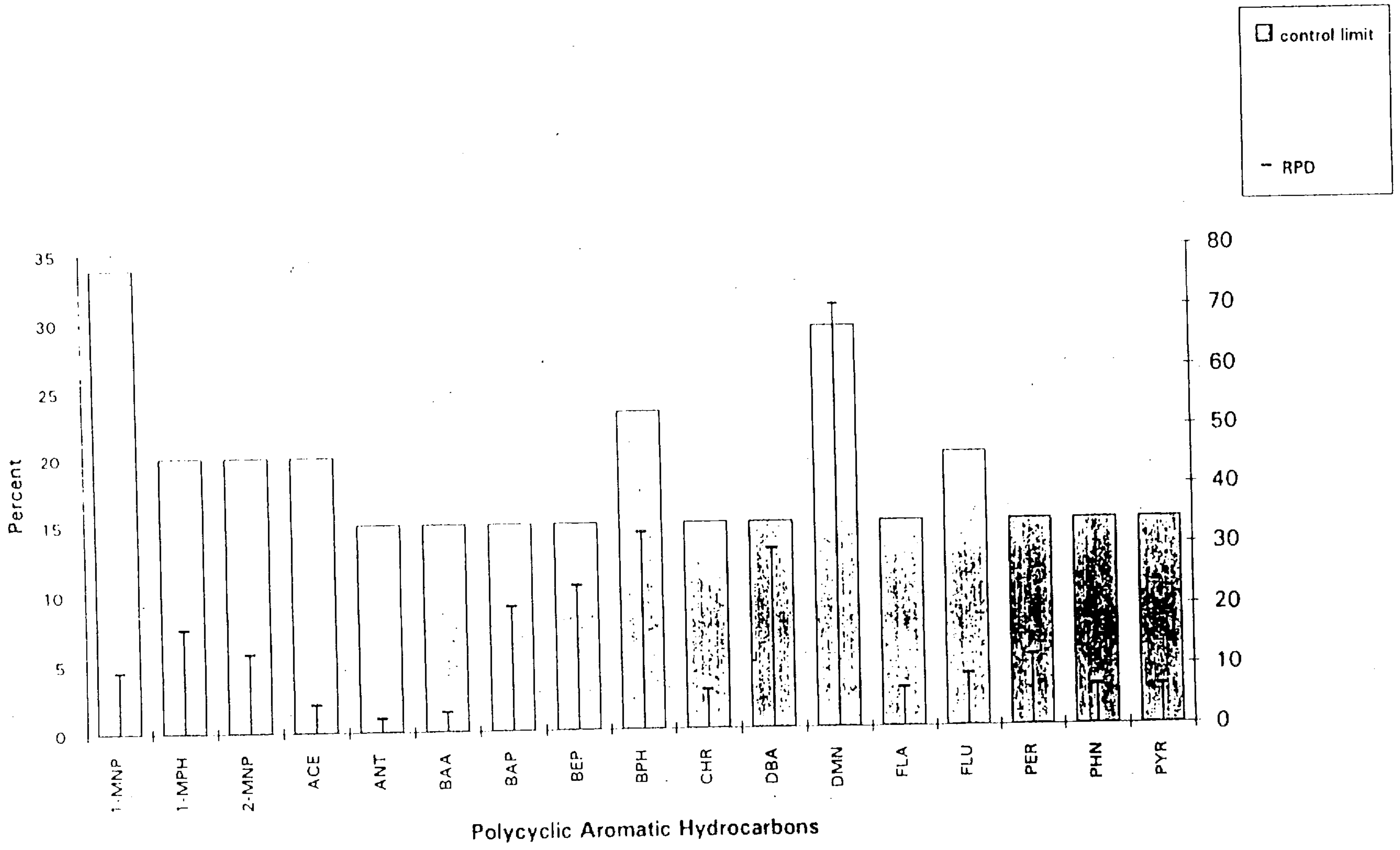
Method Duplicate Relative Percent Difference for PCB Data: IDORG #56; Inner Fish Harbor



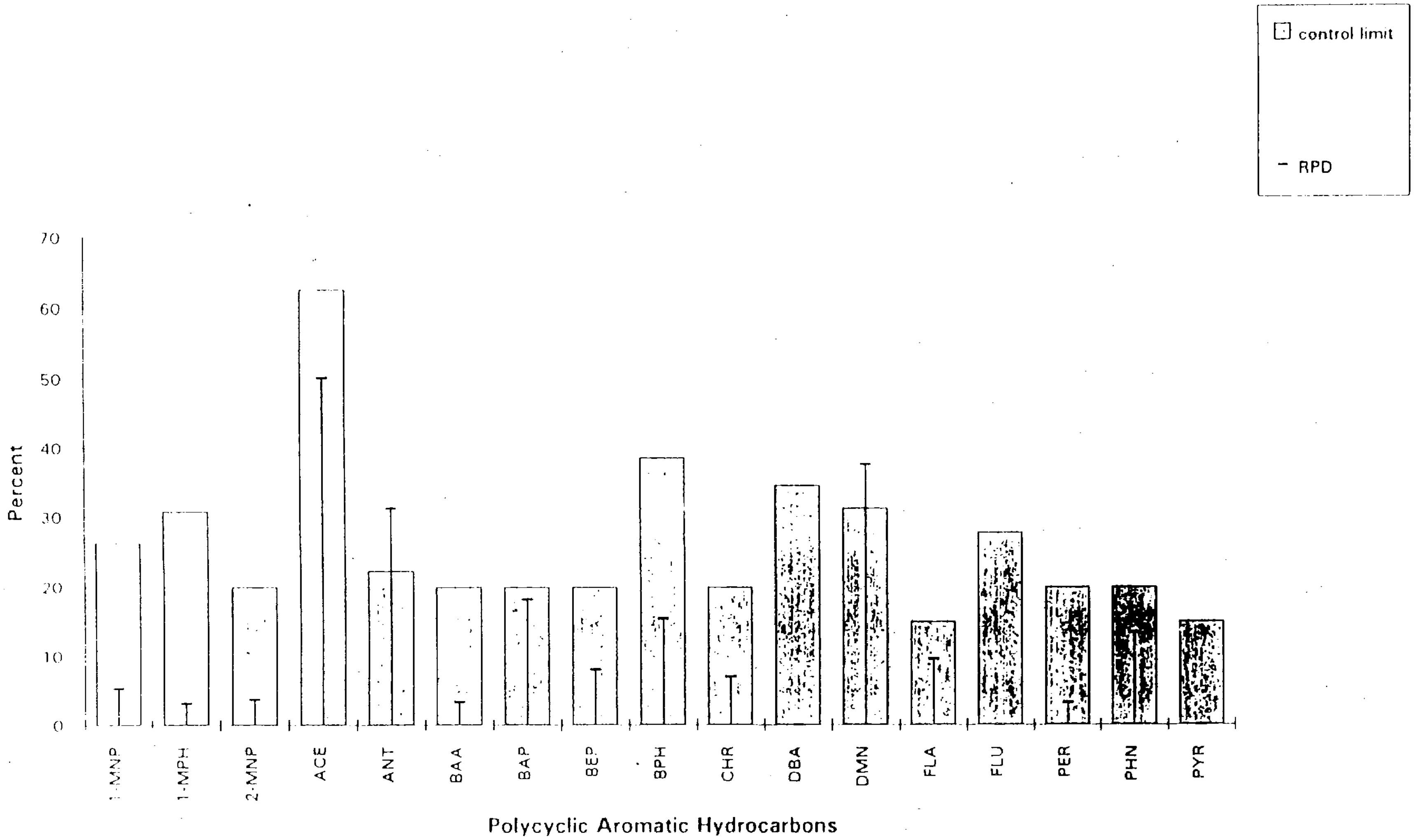
Reference Material Replicate Relative Percent Difference for PAH Data: **NIST Sediment**
SRM 1941



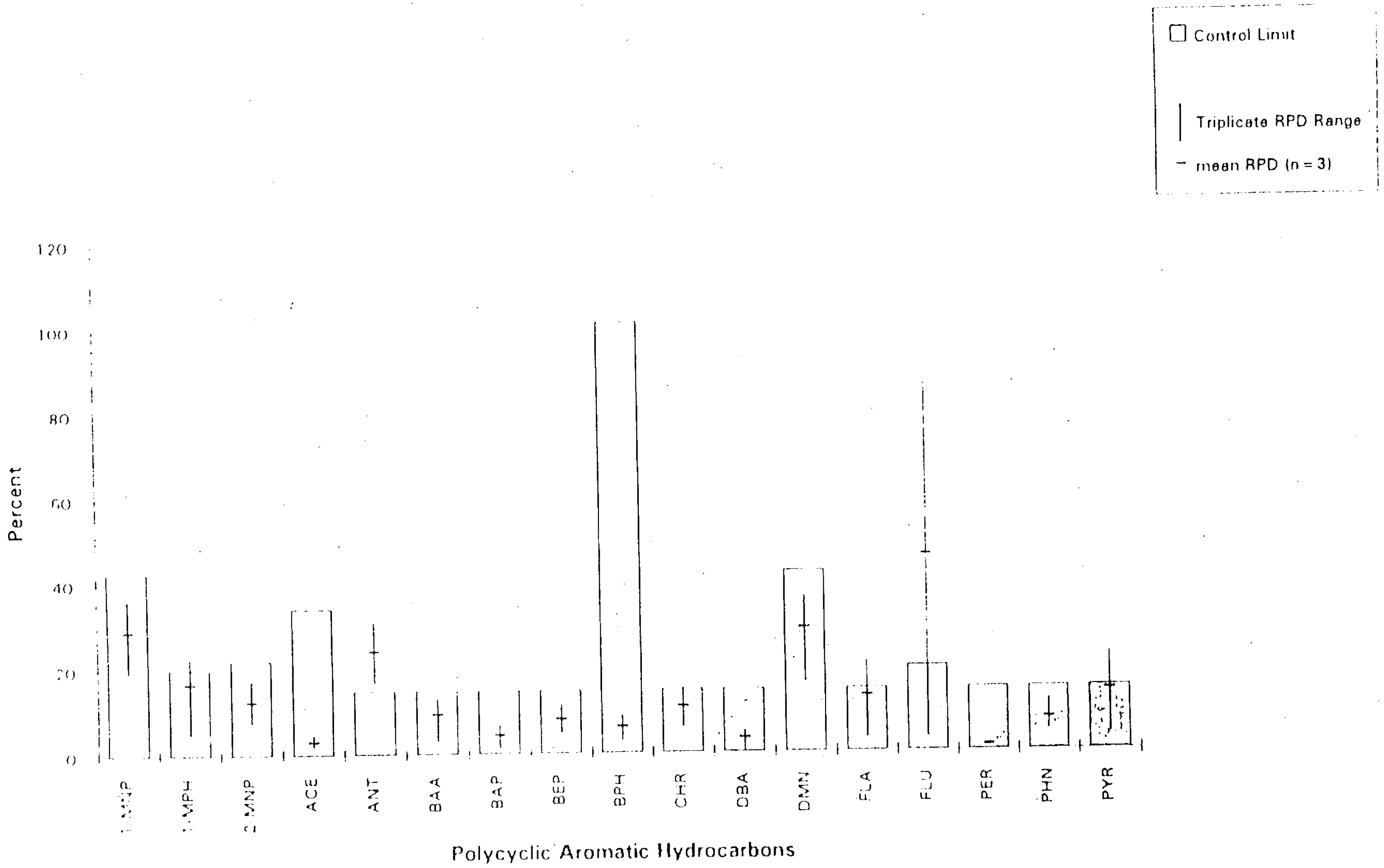
Method Duplicate Relative Percent Difference for PAH Data: IDORG #20; Long Beach Harbor (channel 2)



Method Duplicate Relative Percent Difference for PAH Data: IDORG #37; Inner Queensway Bay



Method Triplicate Relative Percent Difference for PAH Data: IDORG #56; Inner Fish Harbor

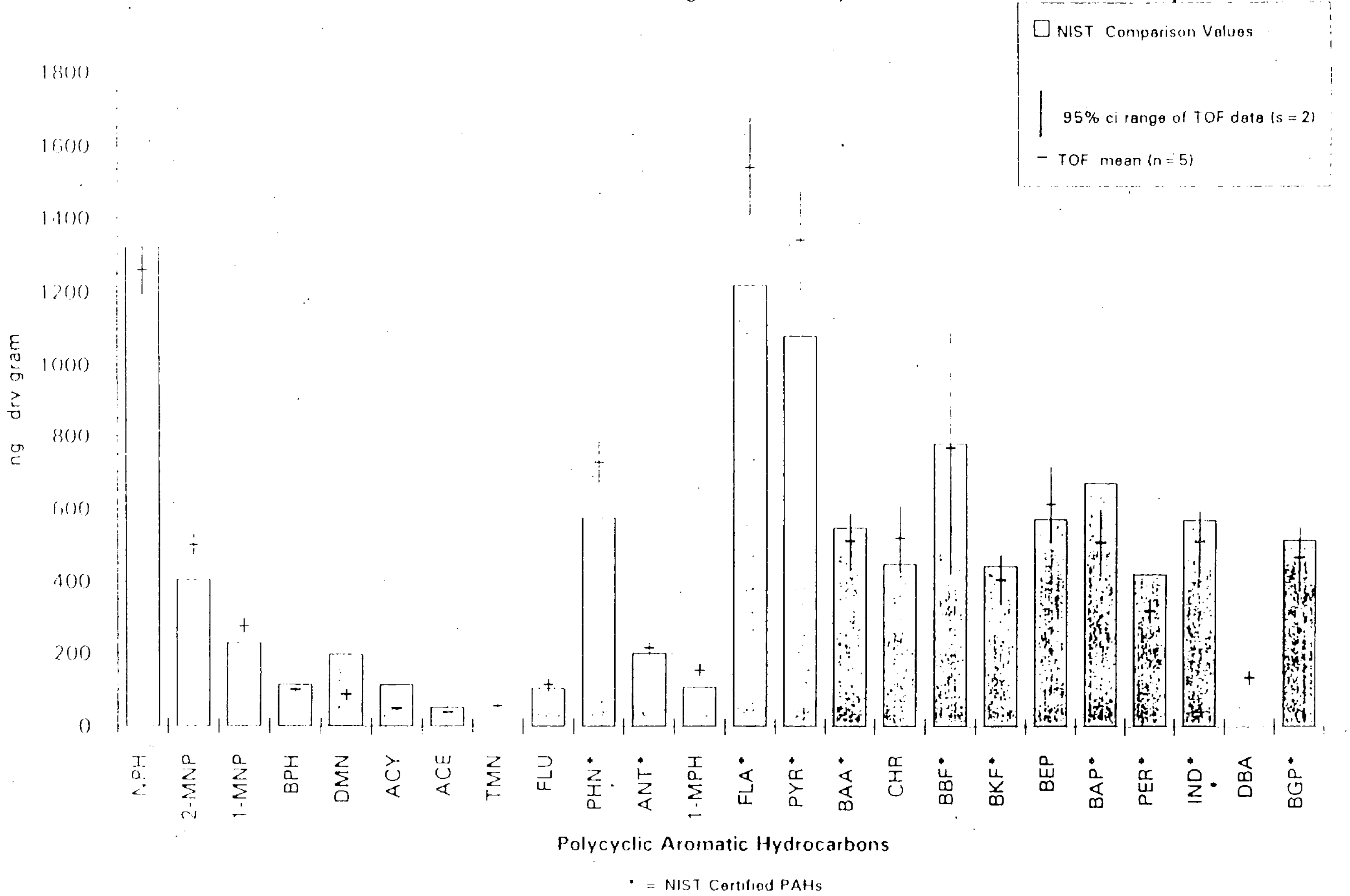


Trace Organics Facility, University of California Santa Cruz
Results NIST 1941 Sediment SRM
June 1,1993
ng/g dry weight
n=5

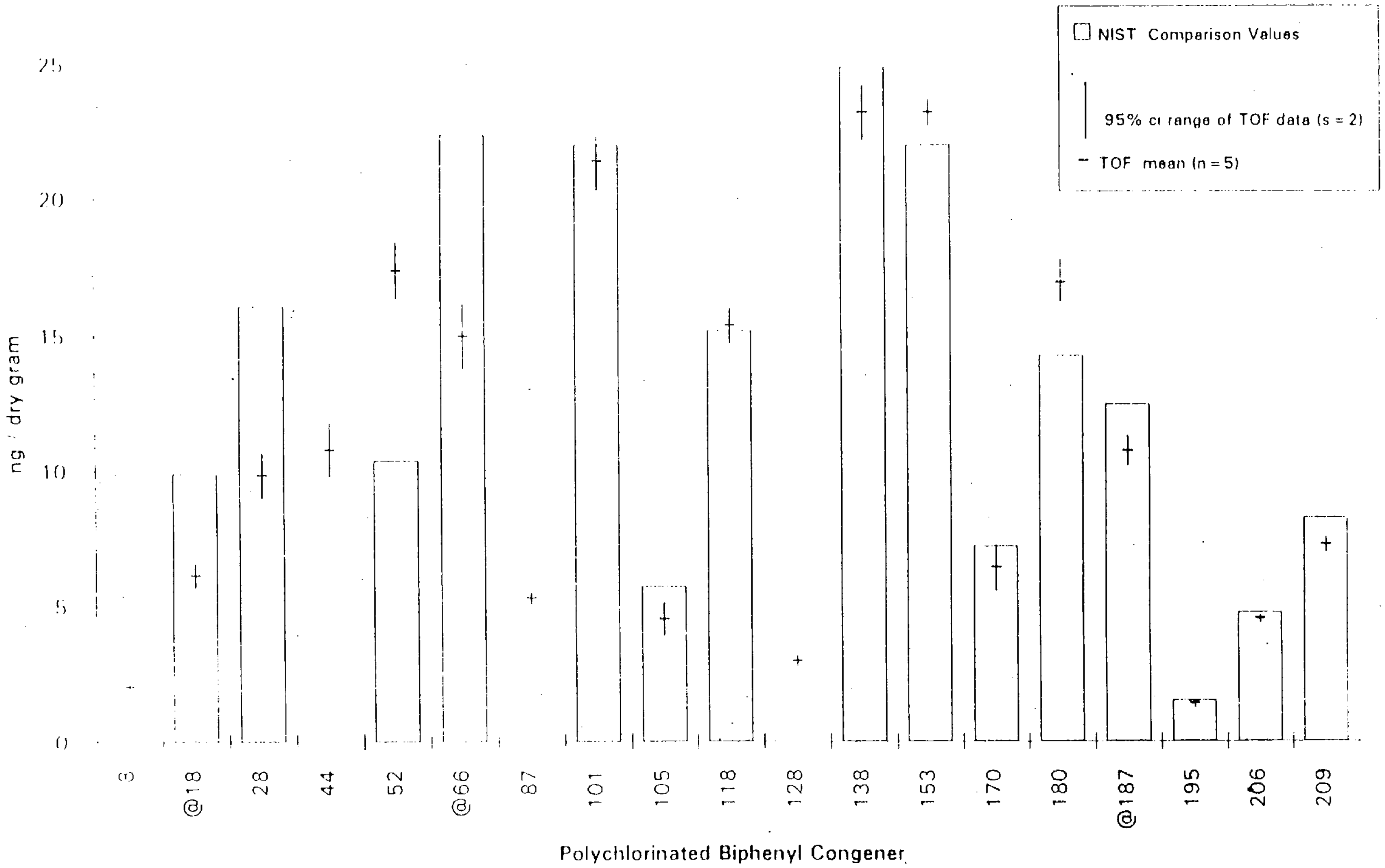
PCBs	mean	s	rsd	PESs	mean	s	rsd	PAHs	mean	s	rsd
8	2.0	0.54	27	Aldrin	ND			NPH	1260	54.8	4.3
18	6.1	0.37	6.1	c-chlor	1.9	0.57	31	2-MNP	500	33.2	6.6
28	9.9	0.69	7.0	t-non	0.6	0.09	14	1-MNP	274	21.9	8.0
44	11	0.84	7.7	opD	2.2	0.62	29	BPH	99	7.3	7.4
52	17	0.89	5.1	ppD	6.2	1.33	21	DMN	86.2	14.1	16
66	15	1.00	6.7	opE	1.5	n=1		ACY	48	4.3	9.0
87	5.3	0.22	4.1	ppE	9.5	0.13	1.4	ACE	37.8	2.3	6.0
101	21	0.89	4.2	opT	0.7	0.15	23	TMN	55.4	6.2	11
105	4.5	0.51	11	ppT	2.0	0.70	34	FLU	114.8	15.3	13
118	15	0.55	3.6	Dieldrin	0.9	0.18	21	PHN	726	54.6	7.5
128	3.0	0.22	7.3	Hepta	3.0	0.67	22	ANT	216	15.2	7.0
138	23	0.84	3.6	HE	0.3	0.15	46	1-MPH	154	16.7	11
153	23	0.45	1.9	HCB	35	1.34	3.9	FLA	1540	114	7.4
170	6.5	0.71	11	gHCH	0.2	n=1		PYR	1340	114	8.5
180	17	0.71	4.2	Mirex	ND			BAA	512	65.3	13
187	11	0.45	4.1					CHR	520	74.5	14
195	1.4	0.14	10					BBF	768	278	36
206	4.6	0.13	2.8					BKF	406	56.4	14
209	7.4	0.25	3.4					BEP	612	85.3	14
								BAP	568	70.5	14
								PER	320	25.5	8.0
								IND	510	69.6	14
								DBA	134	18.2	14
								BGP	468	73.6	16

95 Percent Confidence Interval - Trace Organics

95 % Confidence Interval for Trace Organics Facility NIST SRM 1941 PAH Analysis

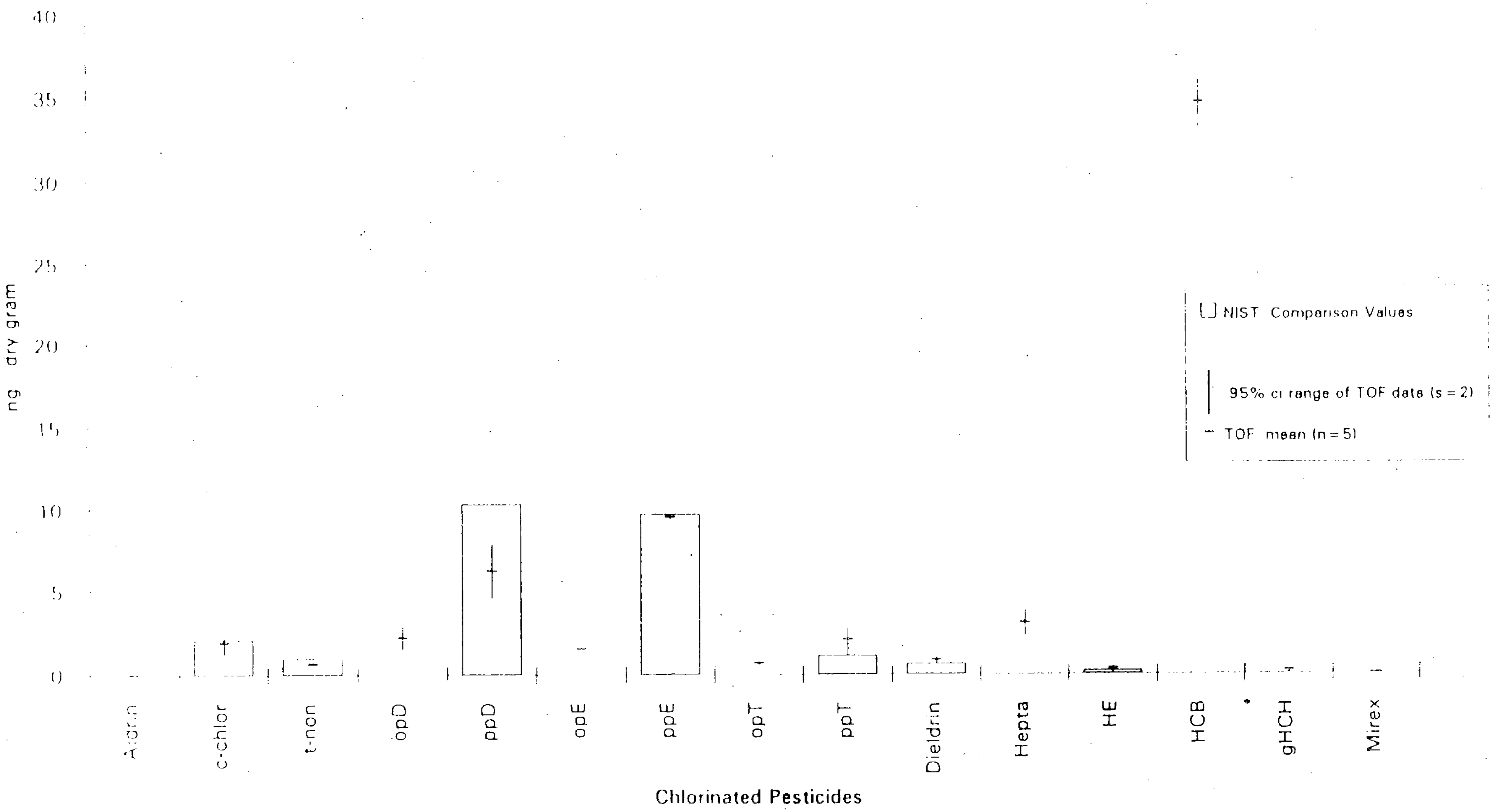


95 % Confidence Intervals for Trace Orgaanics Facility NIST SRM 1941 PCB Analysis



@ = NISTcomparison value is cited as an unresolved pair resolved by TOF

95 % Confidence Intervals for Trace Organics Facility NIST SRM 1941 Chlorinated Pesticide Analysis



Toxicity Testing QA/QC

QA/QC TEST ACCEPTABILITY CRITERIA

This is a list of acceptability criteria outlined in published protocols for each toxicity test performed on samples collected in Los Angeles Harbor (BPTCP/NOAA legs 1-4). Compliance with these criteria in all tests is noted in the QA/QC checklist that accompanies this report.

Amphipod sediment tests using *Rhepoxynius* (Protocol: ASTM, 1992)

1. The mean survival for all control replicates must be ≥90%.
2. Survival in each control replicate must be ≥ 80%.
3. Home sediment sample should be included in each test.
4. A reference toxicant test should be run with each test.
5. Amphipods can be held in the lab no longer than 14 days between time of collection and test start date.
6. Amphipods must be acclimated at test conditions for at least 48 hours before start of test.
7. Temperature (°C) and dissolved oxygen (DO) must be measured for each test.
8. Dissolved oxygen must not be below 4.8mg/L (60% saturation).

Abalone tests (Protocol: Anderson et al., 1990)

1. Mean normality in the controls must be ≥80%.
2. Brine controls must not be significantly different from sea water controls (t-test; alpha=0.05)
3. The response at 56 µg/L zinc in the reference toxicant test must be significantly different from the seawater control.
4. The ANOVA MSE (Mean Square Error) must be ≤100 for arcsine transformed data in degrees.

Table 1. Checklist of test acceptability criteria for amphipod and abalone toxicity tests conducted during BPTCP/NOAA Legs 1-4. Note: x's indicate compliance with criteria; number codes (1-3) indicate deviations from acceptable limits. Explanations for deviations are given in Table 2.

	LA Harbor Leg Number			
	1	2	3	4
AMPHIPOD				
Control mean≥ 90%	x	x	x	x
All control reps ≥ 80%	x	x	x	x
Reference sed. included	x	x	x	x
Cd Reference Tox. Test	x	x	x	x
Sed. Held ≤ 2 weeks	x	x	x	x
Amph. ≥ 48 hr acclim	x	x	x	x
°C, DO measured	x	x	x	x
DO > 4.8 mg/l	x	x	x	x
Sal 28±3 ppt	1	1	1	1
Temp 15±1°C	x	x	x	x
DO, pH initial*				
Precision ≤5%	x x	x x	x x	x x
Accuracy ≤10%	x x	x x	x x	x x
DO, pH final				
Precision ≤5%	x x	x x	x x	x x
Accuracy ≤10%	2 x	x x	x x	x x
	1	2	3	4
ABALONE				
Seawater Control ≥80%	x	x	x	x
Zn ref. tox. results	3	x	x	x
ANOVA MSE ≤ 100	x	x	x	x
Sal 34±2 ppt	x	x	x	x
Temp 15±2 °C	x	x	x	x
DO, pH initial				
Precision ≤5%	x x	x x	x x	x x
Accuracy ≤10%	x -	x x	x x	x x
DO, pH final				
Precision ≤5%	x x	x x	x x	x x
Accuracy ≤10%	x x	x x	x x	x x

* There is one x for DO compliance and one x for pH compliance.

Table 2. Water quality parameters and test acceptability criteria listed on the QA/QC checklist that did not meet QA/QC standards with explanations for deviations.

ITEM	QA/QC REQUIREMENT	EXPLANATION
	Amphipods	
1	Test salinity 28±3 ppt	Salinity of several samples from Legs 1-4 varied from the salinity requirement (see Table 3, attached).
2	Accuracy for DO ≤10%	On Leg 1, accuracy of the DO measurement was 13.80%.
	Abalone	
3	Ref test Zn [56] significantly different from Zn [0]	In the Leg 1 reference toxicant test, the 56µg/L Zn concentration was not significantly different from the control. There may have been an error in Zn dilutions.

Table 3. Deviations from water quality salinity criteria for amphipod (*Rhepoxynius abronius*) toxicity tests in sediment samples for BPTCP/NOAA Legs 1-4. All deviations are from overlying water sampled at the end of the test. Start of test salinity measurements all met prescribed water quality criteria. No Leg 4 samples deviated from the criteria.*

Leg 1	S‰	Leg 2	S‰	Leg 3	S‰
40002.2	32	40008.3	32	40011.1	32
40002.3	32	40009.1	33	40017.1	32
40004.3	32	40009.2	32		
40005.2	32	40010.2	32		
40006.1	33	40010.3	32		
40006.2	32	40012.3	32		
40032.2	32	40015.1	33		
40032.3	32	40015.2	33		
40033.2	32	40015.3	33		
40033.3	32	40016.2	32		
40034.1	32	40030.1	32		
40034.3	32	Home 1	32		
40035.1	32				
Home 1	32				

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* Note - Although all of the exposure beakers were covered as described in the protocol, variation in salinity measurements between start and end samples may be due to evaporation over the course of the 10 day experiments. Deviations may also be explained by differences between sub-samples of standards that were used to calibrate refractometers. In cases where more than one refratometer was used to test samples within one test, variation may have been due to differences in calibration.

Metal Chemistry Analyses QA/QC - Sediment and Pore Water

Standard Reference Material For Sediments (Values in ppm, dry weight)

SRM	Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Sb	Sn	Zn
MESS-1 #1	0.090	41000	0.550	70.1	25.0	28000	452	30.5	32.1	0.81	4.1	172
MESS-1 #2	0.100	48000	0.510	74.7	24.4	28000	480	30.6	33.1	0.67	4.0	177
Mean	0.100	44000	0.530	72.4	24.7	28000	466	30.6	32.6	0.74	4.0	175
SD	0.01	5000	0.030	3.3	0.4	0	20	0.1	0.7	0.10	0.1	4
Certified Value	no	no	0.590	71.0	25.1	no	513	29.5	34.0	0.73	4.0	191
SD	value	value	0.100	11.0	3.8	value	25	2.7	6.1	0.08	0.4	17

SRM	As	Se
1646 #1	9.98	0.395
1646 #2	9.95	0.426
1646 #3	9.67	0.394
Mean	9.9	0.405
SD	0.2	0.018
Certified value	11.6	6*
SD	1.3	no value

SRM	As	Se
2704 #1	20.8	0.750
2704 #2	20.5	0.773
2704 #3	19.5	0.745
Mean	20.3	0.756
SD	0.7	0.015
Certified value	23.4	1.1*
SD	0.8	no value

SRM	Hg
BCSS-1 #1	0.215
BCSS-1 #2	0.259
Mean	0.237
SD	0.031
Certified Value	0.175
SD	0.081

* value for Se not certified

MESS-1 = River Estuary Sediment

BCSS-1 = River Estuary Sediment

2704=Buffalo River Sediment

1646= Estuarine Sediment

Standard Reference Material For Sediments (Values in ppm, dry weights) Mean Values

REFERENCE MATERIAL		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Sb	Sn	Zn
MESS-1	Sample Values	1.0 ± 0.01	44000 ± 5000	0.53 ± 0.03	72.4 ± 3.3	24.7 ± 0.4	28000	466±20	30.6 ± 0.1	32.6 ± 0.7	0.74 ± 0.10	4.0 ± 0.1	175 ± 4
	Reference Values	**	**	0.59 ± 0.10	71.0 ± 11	25.1 ± 3.8	**	513 ± 25	29.5 ± 2.7	34.0 ± 6.1	0.73 ± 0.08	3.98 ± 0.44	191 ± 17

		As	Se
1646	Sample Values	9.87±.17	.405±.018
	Reference Values	11.6±1.3	0.6*

		As	Se
2704	Sample Values	20.3±.68	.756±.015
	Reference Values	23.4±.8	1.1*

		Hg
BCSS-1	Sample Values	0.237 ± 0.031*
	Reference Values	0.175 ± 0.081

** No value is given

* Value for Se not certified

MESS-1 and BCSS-1 are standard reference materials from the National Research Council of Canada

1646 and 2704 are standard reference materials from the National Institute of Standards and Technology, U.S. Dept of Commerce

Mess 1=River Estuary Water

BCSS-1=River Estuary Water

1646= Estuarine Sediment

2704= Buffalo River Sediment

Standard Reference Material For Pore Water (Values in ppb)

SRM	Ag	Al	Cd	Cu	Fe	Mn	Ni	Pb	Zn
CASS #1	0.006		0.019	0.671	1.09		0.283	0.014	1.91
CASS #2	0.003		0.016	0.660	1.12		0.31	0.017	1.87
mean	0.004		0.018	0.666	1.10		0.296	0.016	1.89
SD	0.002		0.002	0.008	0.02		0.019	0.002	0.03
certified value	no	no	0.019	0.675	1.20	no	0.298	0.019	1.97
SD	value	value	0.004	0.039	0.12	value	0.036	0.006	0.12

SLEW #1	<.002		0.018	1.70	1.86		0.721	0.028	1.47
SLEW #2	0.002		0.025	1.78	2.34		0.777	0.022	1.37
SLEW #3	0.001		0.016	1.69	2.68		0.715	0.024	1.23
mean			0.020	1.72	2.29		0.738	0.025	1.36
SD			0.005	0.05	0.41		0.034	0.003	0.12
certified value	no	no	0.018	1.76	2.08	no	0.743	0.028	0.86
SD	value	value	0.003	0.09	0.34	value	0.078	0.007	0.15

CASS = Near Shore Sea Water
SLEW = Estuarine Sea Water

Standard Reference Material For Pore Water (values In ppb) Mean Values

REFERENCE MATERIAL		Ag	Al	Cd	Cu	Fe	Mn	NI	Pb	Zn
CASS	Sample Value	0.004 + 0.002		0.018 + 0.002	0.666 + 0.008	1.10 + 0.02		0.296 + 0.019	0.016 + 0.002	1.89 + 0.03
	Reference Value	no value**	no value	0.019 + 0.004	0.675 + 0.039	1.20 + 0.12	no value	0.298 + 0.036	0.019 + 0.006	1.97 + 0.12
SLEW	Sample Value			0.020 + 0.005	1.72 + 0.05	2.29 + 0.41		0.738 + 0.034	0.026 + 0.003	1.36 + 0.12
	Reference Value	no value	no value	0.018 + 0.003	1.76 + 0.09	2.08 + 0.34	no value	0.743 + 0.078	0.028 + 0.007	0.86 + 0.16

CASS and SLEW are standard reference materials from the National Research Council of Canada
** no certified value
CASS = Near Shore Sea Water
SLEW = Estuarine Sea Water

METAL DETECTION LIMITS FOR SEDIMENTS AND PORE WATER

	Ag	Al	As	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Sn	Zn
Sediments (Values in ppm, dry weight)	0.01	20	0.25	0.01	0.10	1.0	10	0.03	1.0	0.1	0.1	0.25	0.1	0.5	5
Pore Water (Values in ppb)	0.001	3	*	0.00001	*	0.06	1	*	10	0.04	0.01	*	*	*	0.3

* Pore water was not analysed on these metals.

Precision of Analysis for BPTC Sediment Samples

#	STATION	Ag	Al	As	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Sn	Zn
	Southwest Slip	0.310	41000		0.370	108.40	110.00	47000	0.62	590.00	42.8	52.8	2.08		6.3	200
1 qc		0.279	36000		0.320	89.80	100.00	46000	0.49	550.00	38.4	46.1	2.06		5.4	180
16	Consolidated Slip	0.885	30000		2.820	142.30	190.00	43000	0.73	350.00	44.9	142.6	3.66		8.0	540
16 qc		0.948	21000		2.890	132.90	190.00	39000	0.69	330.00	44.5	128.6	3.75		7.9	480
35	Southeast Basin	0.273	38000		0.320	82.80	67.00	45000	0.22	650.00	39.9	34.8	2.09		3.8	170
35 qc		0.288	33000		0.340	77.10	67.00	43000	0.25	530.00	43.7	32.4	1.67		4.3	150
56	Inner Fish Harbor	0.621	22000		1.210	103.50	330.00	36000	1.90	460.00	39.0	65.2	3.03		9.1	320
56 qc		0.643	22000		1.260	96.20	350.00	40000	2.40	440.00	44.3	69.4	3.03		9.1	300
95	Huntington Harbor, Middle	0.215	47000		0.270	59.70	77.00	40000	0.15	560.00	29.3	76.5	0.55		4.9	230
95 qc		0.218	43000		0.280	54.60	63.00	37000	0.21	470.00	27.8	59.4	0.67		4.9	190
43	Fish Harbor Entrance			10.0										0.41		
43 qc				10.0										0.39		
69	Alamitos Bay, L.B. Marina			5.5										nd		
69 qc				5.6										nd		
103	San Pedro Bay, Pola 19			6.0										0.20		
103 qc				5.8										0.21		
136	Cabrillo Beach			13.0										1.4		
136 qc				13.0										1.3		
	Average Difference	5%	13%	1%	6%	9%	7%	6%	18%	10%	8%	12%	8%	4%	5%	11%

nd = not detected

APPENDIX C

Analytical Chemistry Data

Sediment PCB Chemistry Analyses Data

BPTC LA HARBOR PCB CONGENERS (ng/g, dry weight)

STATION #	STATION	IDORG	LEQ	PCB8	PCB18	PCB28	PCB44	PCB52	PCB66	PCB87	PCB101	PCB105	PCB118	PCB128	PCB138	PCB153
40001.1	Southwest Slip	1	1	-8.0	-8.0	-8.0	1.7	3.0	3.1	3.9	10.0	3.6	9.3	2.7	16.0	12.0
40001.2	Southwest Slip	2	1	-8.0	-8.0	-8.0	2.2	4.6	3.4	4.9	12.0	4.2	11.0	3.2	19.0	14.0
40001.3	Southwest Slip	3	1	-8.0	-8.0	-8.0	2.2	4.7	3.5	5.1	14.0	3.8	13.0	3.4	21.0	13.0
40002.2	West Basin, Pier 143	5	1	-8.0	-8.0	-8.0	1.2	2.2	1.9	2.9	7.1	2.8	8.8	2.0	11.0	7.6
40003.1	Turning Basin, Pier 151	7	1	-8.0	-8.0	-8.0	-8.0	1.3	1.3	-8.0	2.9	1.1	2.7	-8.0	4.6	3.6
40003.2	Turning Basin, Pier 151	8	1	-8.0	-8.0	1.0	1.9	2.6	4.0	-8.0	2.3	1.1	2.2	-8.0	2.6	2.2
40004.2	Lower Main Channel	11	1	-8.0	-8.0	2.1	3.2	4.9	6.8	4.1	10.0	3.8	9.7	2.3	13.0	9.9
40005.1	East Basin,Turning Basin	13	1	-8.0	1.4	2.4	3.1	4.4	4.8	1.0	9.0	2.5	6.8	1.6	18.0	16.0
40006.1	Consolidated Slip	16	1	-8.0	4.6	9.9	11.0	14.0	16.0	8.4	23.0	6.8	18.0	4.3	38.0	36.0
40006.2	Consolidated Slip	17	1	1.5	7.7	13.0	13.0	17.0	20.0	8.4	24.0	7.6	18.0	4.1	39.0	36.0
40032.3	San Pedro Bay, POLA 19	81	1	-8.0	-8.0	-8.0	-8.0	-8.0	1.1	-8.0	1.3	-8.0	1.4	-8.0	1.9	1.2
40033.1	Outer Harbor, POLA 10	82	1	-8.0	-8.0	2.1	2.9	4.3	5.8	3.1	7.7	3.8	8.2	1.7	10.0	6.1
40008.3	East Basin Pier C	24	2	-8.0	-8.0	-8.0	-8.0	1.1	1.3	-8.0	2.6	-8.0	2.2	-8.0	4.7	4.4
40010.1	Off Cabrillo Beach	28	2	-8.0	1.4	2.4	3.6	6.1	4.9	2.6	7.2	2.7	6.4	1.3	7.6	6.2
40010.2	Off Cabrillo Beach	29	2	-8.0	1.3	2.3	3.3	5.2	4.4	2.5	6.2	2.9	5.3	1.2	5.9	4.4
40012.1	Southeast Basin	34	2	-8.0	-8.0	1.0	-9.0	1.2	1.8	-8.0	2.1	1.0	2.3	-8.0	3.4	2.9
40012.2	Southeast Basin	36	2	-8.0	-8.0	-8.0	-8.0	-8.0	1.6	-8.0	1.7	-8.0	2.1	-8.0	3.1	2.2
40015.1	Fish Harbor Entrance	43	2	-8.0	-8.0	-8.0	1.1	2.0	2.1	1.7	4.3	1.8	4.4	1.1	5.9	4.3
40015.3	Fish Harbor Entrance	45	2	-8.0	-8.0	-8.0	-8.0	1.2	1.4	1.1	2.8	1.0	2.7	-8.0	4.6	3.0
40019.1	Inner Fish Harbor	55	2	-8.0	1.7	4.0	6.5	12.0	14.0	8.2	20.0	7.7	21.0	3.6	26.0	23.0
40019.2	Inner Fish Harbor	56	2	-8.0	2.1	5.2	9.1	15.0	18.0	10	26.0	9.9	21.0	3.9	29.0	16.0
40019.3	Inner Fish Harbor	57	2	-8.0	3.0	6.8	10.0	19.0	22.0	13	36.0	14.0	9.8	6.1	41.0	26.0
40030.3	San Pedro Breakwater	75	2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.1	-9.0
40032.1	San Pedro Bay, POLA 19	103	2	-8.0	-8.0	-8.0	-8.0	-8.0	1.0	-8.0	1.0	-8.0	1.1	-8.0	1.4	1.1
40007.2	Long Beach Harbor(Channel2)	20	3	1.4	6.2	11.0	11.0	14.0	19.0	6.0	14.0	6.1	14.0	2.9	19.0	16.0
40011.3	Inner Harbor (Channel 3)	33	3	-8.0	-8.0	1.0	1.4	2.4	2.8	1.7	4.9	1.8	4.9	1.1	8.1	6.8
40013.1	Inner Queensway Bay	37	3	-8.0	1.0	1.7	2.3	2.8	2.7	-8.0	3.1	1.7	3.0	1.0	4.9	3.7
40014.2	Outer Queensway Bay	41	3	1.1	3.1	6.4	8.4	8.9	9.3	3.0	6.7	1.8	6.6	1.1	8.2	4.6
40014.3	Outer Queensway Bay	42	3	1.3	3.0	5.0	6.2	8.1	9.2	2.6	6.7	2.9	6.3	1.1	8.0	4.7
40017.3	Long Beach Channel	51	3	-8.0	-8.0	-8.0	-8.0	1.1	1.9	-8.0	2.0	1.0	2.3	-8.0	3.1	2.4
40018.3	Long Beach Outer Harbor-18	54	3	-8.0	-8.0	2.2	2.4	3.1	4.4	1.7	4.1	1.8	4.3	-8.0	5.8	3.7
40020.2	Long Beach Outer Harbor-20	59	3	-8.0	-8.0	1.0	1.1	1.4	2.1	1.0	2.5	1.1	2.7	-8.0	4.2	2.8
40020.3	Long Beach Outer Harbor-20	60	3	-8.0	-8.0	1.1	1.2	1.7	2.2	1.1	2.8	1.3	-8.0	-8.0	4.4	3.2
40031.2	Palos Verdes (Swartz 6)	77	3	-8.0	-8.0	3.3	6.8	7.1	16.0	7.1	16.0	7.9	18.0	3.7	22.0	15.0
40031.3	Palos Verdes (Swartz 6)	78	3	-8.0	-8.0	2.3	4.1	5.2	11.0	5.6	12.0	6.0	13.0	2.8	17.0	12.0
40010.1	Off Cabrillo Beach	136	4	-8.0	-8.0	1.8	2.7	4.3	4.3	2.3	5.7	1.9	5.1	-8.0	6.0	4.4
40021.3	Alamitos Bay, Marine Stadium	63	4	-8.0	-8.0	-8.0	-8.0	-8.0	1.5	-8.0	2.2	-8.0	2.5	-8.0	3.9	3.0
40022.1	Alamitos Bay, Entrance	64	4	-8.0	-8.0	1.0	1.2	1.9	2.3	1.4	3.7	1.5	-8.0	1.0	6.1	4.3
40023.3	Alamitos Bay, Long Beach Marina	69	4	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.6	-8.0	1.6	-8.0	2.6	2.1
80024.3	Anaheim Bay, Outer	87	4	-8.0	-8.0	-8.0	-8.0	-8.0	1.6	-8.0	1.9	-8.0	1.3	-8.0	2.7	1.8
80026.2	Huntington Harbor, Lower	92	4	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
80027.2	Huntington Harbor, Middle	95	4	-8.0	-8.0	1.0	-8.0	-8.0	1.5	1.0	3.2	-8.0	3.0	1.0	7.3	5.8
80027.3	Huntington Harbor, Middle	96	4	-8.0	-8.0	-8.0	-8.0	-8.0	1.4	1.1	2.8	1.2	2.7	1.0	5.8	4.9
80028.2	Huntington Harbor, Upper	98	4	-8.0	-8.0	-8.0	1.3	1.6	1.6	1.3	3.4	1.3	3.3	1.1	6.8	4.5
80028.3	Huntington Harbor, Upper	99	4	-8.0	-8.0	-8.0	1.1	1.4	1.6	1.5	3.8	1.6	3.8	1.5	8.3	6.3

-8 - not detected
-9 - not analyzed

BPTC LA HARBOR PCB CONGENERS (ng/g dry weight)

STATION #	PCB170	PCB180	PCB187	PCB195	PCB206	PCB209
40001.1	2.9	6.1	3.3	-8.0	1.9	1.2
40001.2	4.0	8.7	3.8	-8.0	1.1	-8.0
40001.3	3.8	7.9	3.5	-8.0	1.0	-8.0
40002.2	1.9	3.8	1.9	-8.0	8.0	-8.0
40003.1	1.0	2.2	1.2	-8.0	-8.0	-8.0
40003.2	-8.0	1.8	-8.0	-8.0	8.0	-8.0
40004.2	2.0	4.3	2.4	-8.0	-8.0	-8.0
40005.1	6.1	15.0	7.5	1.1	1.4	-8.0
40006.1	11.0	28.0	16.0	1.8	2.0	-8.0
40006.2	11.0	36.0	18.0	1.9	2.2	8.0
40032.3	-8.0	-8.0	-8.0	-8.0	8.0	-8.0
40033.1	1.9	4.0	2.1	-8.0	-8.0	8.0
40008.3	1.7	3.2	1.9	-8.0	2.4	-8.0
40010.1	1.4	2.7	1.4	-8.0	-8.0	-8.0
40010.2	1.0	1.9	1.1	-8.0	-8.0	-8.0
40012.1	8.0	1.7	1.1	-8.0	-8.0	-8.0
40012.2	-8.0	1.5	-8.0	-8.0	-8.0	2.2
40015.1	1.1	2.0	1.1	-8.0	-8.0	-8.0
40015.3	1.1	2.1	-8.0	-8.0	-8.0	-8.0
40019.1	4.6	9.9	14.0	-8.0	5.4	2.1
40019.2	4.9	11.0	5.1	-8.0	2.0	2.4
40019.3	7.6	18.0	9.0	1.0	3.0	3.5
40030.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40032.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40007.2	5.3	11.0	5.4	-8.0	2.0	1.9
40011.3	1.9	3.9	2.2	-8.0	1.3	1.7
40013.1	1.8	3.2	1.4	-8.0	-8.0	-8.0
40014.2	2.2	4.8	2.1	-8.0	-8.0	-8.0
40014.3	2.3	4.7	2.1	-8.0	-8.0	-8.0
40017.3	-8.0	1.3	-8.0	-8.0	-8.0	-8.0
40018.3	1.5	2.9	1.5	-8.0	-8.0	-8.0
40020.2	1.1	2.3	1.4	-8.0	-8.0	-8.0
40020.3	1.3	2.7	1.5	-8.0	1.0	-8.0
40031.2	4.2	8.7	4.5	8.0	1.5	1.2
40031.3	3.4	8.7	3.7	-8.0	1.1	1.0
40010.1	-8.0	2.1	1.2	-8.0	8.0	-8.0
40021.3	-8.0	1.5	1.0	-8.0	8.0	-8.0
40022.1	1.5	3.1	1.6	-8.0	-8.0	-8.0
40023.3	-8.0	1.2	-8.0	-8.0	-8.0	-8.0
80024.3	-8.0	1.3	-8.0	-8.0	-8.0	-8.0
80026.2	8.0	-8.0	-8.0	-8.0	-8.0	-8.0
80027.2	1.8	4.0	2.1	-8.0	-8.0	-8.0
80027.3	1.5	3.2	1.9	-8.0	8.0	-8.0
80028.2	1.5	3.1	1.6	-8.0	-8.0	-8.0
80028.3	1.9	3.9	2.3	-8.0	-8.0	-8.0

-8 = not detected
-9 = not analyzed

Sediment PAH Chemistry Analyses Data

BPTC LA HARBOR PA.. DATA (ng/g. dry weight)

STATION #	STATION	IDORG	LEG	ACE	ANT	BAA	BAP	BEP	BPH	CHR	DBA	DMN
40001.1	Southwest Slip	1	1	83.0	620.0	970.0	1100.0	950.0	19.0	1700.0	180.0	11.0
40001.2	Southwest Slip	2	1	21.0	390.0	860.0	1800.0	1400.0	7.3	1600.0	270.0	9.5
40001.3	Southwest Slip	3	1	130.0	1400.0	2200.0	3300.0	2500.0	23.0	4000.0	510.0	8.0
40002.2	West Basin, Pier 143	5	1	6.2	97.0	210.0	400.0	370.0	-8.0	370.0	70.0	5.6
40003.1	Turning Basin, Pier 151	7	1	20.0	190.0	280.0	280.0	250.0	-8.0	410.0	48.0	8.0
40003.2	Turning Basin, Pier 151	8	1	8.5	80.0	120.0	120.0	120.0	-8.0	190.0	24.0	-8.0
40004.2	Lower Main Channel	11	1	35.0	240.0	410.0	420.0	350.0	9.8	560.0	73.0	11.0
40005.1	East Basin,Turning Basin	13	1	18.0	79.0	270.0	480.0	430.0	6.3	410.0	94.0	19.0
40006.1	Consolidated Slip	16	1	38.0	160.0	890.0	630.0	660.0	20.0	1100.0	150.0	47.0
40006.2	Consolidated Slip	17	1	52.0	220.0	1000.0	920.0	920.0	29.0	1500.0	200.0	67.0
40032.3	San Pedro Bay, POLA 19	81	1	-8.0	-8.0	17.0	31.0	27.0	-8.0	21.0	7.4	8.0
40033.1	Outer Harbor, POLA 10	82	1	-8.0	25.0	71.0	130.0	120.0	-8.0	99.0	35.0	14.0
40008.3	East Basin Pier C	24	2	12.0	88.0	170.0	240.0	180.0	-8.0	300.0	41.0	-8.0
40010.1	Off Cabrillo Beach	28	2	8.1	58.0	200.0	290.0	270.0	5.1	250.0	55.0	12.0
40010.2	Off Cabrillo Beach	29	2	8.1	38.0	130.0	150.0	180.0	-8.0	150.0	29.0	5.8
40012.1	Southeast Basin	34	2	9.8	140.0	280.0	300.0	330.0	7.8	500.0	110.0	18.0
40012.2	Southeast Basin	35	2	5.4	82.0	230.0	240.0	240.0	6.2	400.0	71.0	11.0
40016.1	Fish Harbor Entrance	43	2	7.4	13.0	62.0	110.0	99.0	-8.0	81.0	25.0	-8.0
40016.3	Fish Harbor Entrance	46	2	26.0	23.0	66.0	91.0	69.0	-8.0	90.0	19.0	8.3
40019.1	Inner Fish Harbor	55	2	16.0	420.0	790.0	1000.0	980.0	6.0	1200.0	170.0	9.3
40019.2	Inner Fish Harbor	56	2	16.0	210.0	420.0	930.0	820.0	5.4	750.0	210.0	10.0
40019.3	Inner Fish Harbor	57	2	16.0	290.0	840.0	1600.0	1300.0	11.0	1400.0	290.0	7.1
40030.3	San Pedro Breakwater	75	2	-8.0	-8.0	7.8	9.0	12.0	-8.0	11.0	-8.0	-8.0
40032.1	San Pedro Bay, POLA 19	103	2	-8.0	14.0	71.0	68.0	56.0	-8.0	79.0	15.0	-8.0
40007.2	Long Beach Harbor(Channel2)	20	3	65.0	440.0	910.0	1600.0	1400.0	25.0	1600.0	310.0	23.0
40011.3	Inner Harbor (Channel 3)	33	3	5.9	100.0	220.0	430.0	350.0	-8.0	400.0	100.0	8.6
40013.1	Inner Queensway Bay	37	3	6.0	19.0	92.0	100.0	130.0	28.0	150.0	29.0	13.0
40014.2	Outer Queensway Bay	41	3	-8.0	14.0	72.0	99.0	110.0	14.0	100.0	27.0	18.0
40014.3	Outer Queensway Bay	42	3	-8.0	14.0	68.0	95.0	110.0	13.0	100.0	28.0	10.0
40017.3	Long Beach Channel	51	3	-8.0	11.0	34.0	44.0	44.0	-8.0	44.0	11.0	15.0
40018.3	Long Beach Outer Harbor-18	54	3	-8.0	-8.0	28.0	45.0	45.0	-8.0	40.0	12.0	9.9
40020.2	Long Beach Outer Harbor-20	59	3	-8.0	-8.0	28.0	41.0	39.0	-8.0	42.0	10.0	6.4
40020.3	Long Beach Outer Harbor-20	60	3	-8.0	6.3	32.0	47.0	46.0	-8.0	46.0	12.0	-8.0
40031.2	Palos Verdes (Swartz 6)	77	3	-8.0	6.4	14.0	35.0	41.0	-8.0	18.0	12.0	-8.0
40031.3	Palos Verdes (Swartz 6)	78	3	-8.0	6.2	18.0	26.0	44.0	-8.0	22.0	9.8	-8.0
40010.4	Cabrillo Beach	138	4	-8.0	29.0	160.0	210.0	250.0	-8.0	200.0	43.0	11.0
40021.3	Alamitos Bay, Marine Stadium	63	4	-8.0	5.7	41.0	82.0	75.0	-8.0	140.0	15.0	8.9
40022.1	Alamitos Bay, Entrance	64	4	-8.0	9.5	68.0	97.0	98.0	-8.0	100.0	27.0	12.0
40023.3	Alamitos Bay, Long Beach Marina	69	4	-8.0	8.4	54.0	60.0	67.0	-8.0	79.0	14.0	-8.0
80024.3	Anaheim Bay, Outer	87	4	13.0	22.0	110.0	67.0	120.0	-8.0	210.0	20.0	-8.0
80026.2	Huntington Harbor, Lower	92	4	-8.0	8.7	21.0	26.0	26.0	-8.0	30.0	5.8	-8.0
80027.2	Huntington Harbor, Middle	95	4	-8.0	17.0	53.0	88.0	110.0	-8.0	90.0	24.0	13.0
80027.3	Huntington Harbor, Middle	96	4	-8.0	9.9	59.0	83.0	110.0	-8.0	110.0	24.0	6.9
80028.2	Huntington Harbor, Upper	98	4	-8.0	16.0	82.0	110.0	130.0	-8.0	130.0	31.0	5.4
80028.3	Huntington Harbor, Upper	99	4	-8.0	17.0	140.0	150.0	200.0	7.2	240.0	34.0	18.0

[illegible] not detected

[illegible] not analyzed

BPTC LA HARBOR F ATA (ng/g. dry weight)

STATION #	FLA	FLU	MNP1	MNP2	MPH1	PHN	PER	PYR
40001.1	2000.0	160.0	23.0	60.0	60.0	660.0	370.0	1400.0
40001.2	1000.0	77.0	8.5	26.0	38.0	350.0	450.0	1300.0
40001.3	4400.0	310.0	25.0	70.0	130.0	1400.0	820.0	2900.0
40002.2	280.0	21.0	5.1	13.0	12.0	84.0	140.0	370.0
40003.1	680.0	47.0	7.6	20.0	20.0	220.0	120.0	440.0
40003.2	230.0	20.0	-8.0	7.[illegible]	7.5	84.0	56.0	160.0
40004.2	1200.0	70.0	24.0	46.0	48.0	360.0	910.0	1200.0
40006.1	490.0	26.0	16.0	43.0	30.0	180.0	130.0	580.0
40008.1	1300.0	76.0	74.0	230.0	130.0	480.0	190.0	1400.0
40008.2	1700.0	97.0	79.0	210.0	160.0	610.0	250.0	2200.0
40032.3	36.0	-8.0	-8.0	5.8	-8.0	10.0	67.0	98.0
40033.1	170.0	8.9	12.0	23.0	12.0	63.0	600.0	160.0
40008.3	260.0	18.0	5.1	12.0	12.0	110.0	68.0	250.0
40010.1	450.0	22.0	27.0	51.0	22.0	76.0	930.0	440.0
40010.2	400.0	19.0	13.0	23.0	14.0	44.0	850.0	390.0
40012.1	290.0	31.0	19.0	60.0	29.0	180.0	73.0	340.0
40012.2	210.0	26.0	14.0	36.0	19.0	110.0	65.0	230.0
40016.1	130.0	7.4	-8.0	7.0	15.0	75.0	130.0	150.0
40016.3	160.0	21.0	6.9	9.4	16.0	120.0	90.0	170.0
40019.1	1700.0	46.0	10.0	24.0	49.0	280.0	470.0	1800.0
40019.2	720.0	120.0	9.7	21.0	48.0	250.0	370.0	1000.0
40019.3	840.0	46.0	18.0	38.0	67.0	290.0	530.0	1500.0
40030.3	11.0	-8.0	-8.0	-8.0	-8.0	-8.0	20.0	12.0
40032.1	130.0	7.9	-8.0	-8.0	17.0	48.0	59.0	130.0
40007.2	1500.0	120.0	28.0	67.0	69.0	590.0	360.0	1600.0
40011.3	240.0	25.0	8.2	21.0	13.0	100.0	130.0	280.0
40013.1	200.0	36.0	39.0	56.0	33.0	140.0	62.0	220.0
40014.2	180.0	24.0	22.0	34.0	15.0	88.0	53.0	190.0
40014.3	190.0	22.0	19.0	30.0	24.0	94.0	52.0	210.0
40017.3	72.0	9.6	5.0	11.0	15.0	39.0	33.0	92.0
40018.3	61.0	6.7	-8.0	8.6	5.0	28.0	24.0	74.0
40020.2	63.0	5.7	-8.0	5.7	6.3	32.0	18.0	68.0
40020.3	82.0	-8.0	-8.0	6.4	6.6	39.0	21.0	94.0
40031.2	22.0	7.6	-8.0	10.0	-8.0	21.0	45.0	35.0
40031.3	18.0	-8.0	-8.0	7.4	-8.0	14.0	40.0	27.0
40010.4	370.0	8.6	15.0	28.0	17.0	49.0	710.0	340.0
40021.3	130.0	6.2	-8.0	8.7	5.9	34.0	22.0	130.0
40022.1	190.0	-8.0	-8.0	11.0	11.0	76.0	30.0	190.0
40023.3	110.0	-8.0	-8.0	5.9	5.2	40.0	23.0	110.0
80024.3	180.0	13.0	-8.0	8.5	7.9	75.0	23.0	170.0
80026.2	58.0	6.8	-8.0	-8.0	-8.0	29.0	8.9	56.0
80027.2	150.0	-8.0	-8.0	8.5	7.1	52.0	29.0	170.0
80027.3	160.0	8.2	-8.0	8.5	10.0	67.0	28.0	180.0
80028.2	230.0	6.8	-8.0	12.0	11.0	93.0	38.0	260.0
80028.3	390.0	8.6	-8.0	13.0	19.0	140.0	53.0	400.0

= -8 - not detected

= -9 - not analyzed

Sediment Pesticide Chemistry Analyses Data

BPTC LA HARBOR PESTICIDES (ng/g. dry weight)

STATION #	STATION	IDORG	LEG	ALDRIN	CCHLOR	OPDDD	PPDDD	OPDDE	PPDDE	OPDDT	PPDDT	DIELDRIN
40001.1	Southwest Slip	1	1	-8.0	1.2	3.6	15.0	9.7	88.0	-8.0	10.0	-8.0
40001.2	Southwest Slip	2	1	-8.0	1.3	4.6	16.0	9.6	96.0	5.4	10.0	-8.0
40001.3	Southwest Slip	3	1	-8.0	2.2	3.8	17.0	9.3	93.0	-8.0	-8.0	-8.0
40002.2	West Basin, Pier 143	5	1	-8.0	1.2	2.4	8.6	5.4	41.0	-8.0	3.7	-8.0
40003.1	Turning Basin, Pier 151	7	1	-8.0	0.6	2.1	7.5	4.9	42.0	-8.0	9.7	-8.0
40003.2	Turning Basin, Pier 151	8	1	-8.0	-8.0	1.0	2.5	2.1	17.0	-8.0	2.2	-8.0
40004.2	Lower Main Channel	11	1	-8.0	0.8	7.7	20.0	48.0	270.0	-8.0	2.5	-8.0
40005.1	East Basin,Turning Basin	13	1	-8.0	4.6	8.7	29.0	5.0	84.0	2.2	34.0	1.2
40006.1	Consolidated Slip	16	1	8.0	26.0	35.0	140.0	10.0	270.0	9.7	52.0	7.1
40006.2	Consolidated Slip	17	1	-8.0	23.0	33.0	140.0	12.0	270.0	7.5	36.0	6.2
40032.3	San Pedro Bay, POLA 19	81	1	-8.0	-8.0	1.9	5.5	13.0	110.0	-8.0	2.5	-8.0
40033.1	Outer Harbor, POLA 10	82	1	-8.0	0.9	7.8	22.0	33.0	440.0	-8.0	5.1	-8.0
40008.3	East Basin Pier C	24	2	-8.0	-8.0	1.1	3.3	4.4	27.0	-8.0	1.6	-8.0
40010.1	Off Cabrillo Beach	28	2	-8.0	0.7	4.5	10.0	32.0	220.0	-8.0	-8.0	0.5
40010.2	Off Cabrillo Beach	29	2	-8.0	0.7	3.3	8.0	25.0	170.0	-8.0	-8.0	0.7
40012.1	Southeast Basin	34	2	-8.0	-8.0	-8.0	2.9	7.4	59.0	-8.0	-8.0	-8.0
40012.2	Southeast Basin	35	2	-8.0	-8.0	1.0	4.0	6.5	55.0	-8.0	5.0	-8.0
40016.1	Fish Harbor Entrance	43	2	-8.0	-8.0	-8.0	2.9	8.6	70.0	-8.0	-8.0	-8.0
40016.3	Fish Harbor Entrance	46	2	-8.0	-8.0	-8.0	2.2	3.7	33.0	-8.0	-8.0	-8.0
40019.1	Inner Fish Harbor	55	2	-8.0	1.1	2.7	8.8	17.0	210.0	-8.0	-8.0	-8.0
40019.2	Inner Fish Harbor	56	2	-8.0	1.0	3.5	9.5	21.0	200.0	-8.0	1.0	-8.0
40019.3	Inner Fish Harbor	57	2	-8.0	1.6	5.1	16.0	23.0	260.0	1.0	7.8	8.0
40030.3	San Pedro Breakwater	75	2	-8.0	--8.0	1.3	3.6	8.9	85.0	-8.0	-8.0	-8.0
40032.1	San Pedro Bay, POLA 19	103	2	-8.0	-8.0	1.2	3.1	8.8	75.0	-8.0	-8.0	-8.0
40007.2	Long Beach Harbor(Channel2)	20	3	-8.0	2.0	3.3	11.0	9.9	88.0	-8.0	-8.0	-8.0
40011.3	Inner Harbor (Channel 3)	33	3	-8.0	0.6	2.1	6.5	8.1	61.0	-8.0	-8.0	2.4
40013.1	Inner Queensway Bay	37	3	-8.0	7.4	1.6	11.0	1.4	27.0	1.2	7.3	3.7
40014.2	Outer Queensway Bay	41	3	-8.0	9.4	1.2	16.0	4.4	47.0	-8.0	6.7	4.3
40014.3	Outer Queensway Bay	42	3	-8.0	9.9	4.1	17.0	4.1	41.0	-8.0	4.6	2.2
40017.3	Long Beach Channel	51	3	-8.0	-8.0	1.7	4.6	13.0	110.0	-8.0	1.3	-8.0
40018.3	Long Beach Outer Harbor-18	54	3	-8.0	1.6	2.9	7.9	11.0	73.0	-8.0	3.0	-8.0
40020.2	Long Beach Outer Harbor-20	59	3	-8.0	1.1	1.4	5.9	7.4	54.0	-8.0	2.4	-8.0
40020.3	Long Beach Outer Harbor-20	60	3	-8.0	1.4	1.6	5.5	7.6	61.0	-8.0	1.2	-8.0
40031.2	Palos Verdes (Swartz 6)	77	3	-8.0	0.7	36.0	69.0	310.0	2900.0	1.6	21.0	-8.0
40031.3	Palos Verdes (Swartz 6)	78	3	-8.0	1.0	31.0	67.0	230.0	2200.0	-8.0	2.2	-8.0
40010.4	Cabrillo Beach	136	4	-8.0	0.6	3.0	8.6	23.0	160.0	-8.0	-8.0	-8.0
40021.3	Alamitos Bay, Marine Stadium	83	4	-8.0	1.6	-8.0	3.2	1.7	20.0	-8.0	-8.0	-8.0
40022.1	Alamitos Bay, Entrance	84	4	-8.0	3.5	1.4	8.0	3.2	36.0	-8.0	-8.0	-8.0
40023.3	Alamitos Bay, Long Beach Marina	89	4	-8.0	1.2	1.1	2.7	1.5	14.0	-8.0	-8.0	-8.0
80024.3	Anaheim Bay, Outer	87	4	-8.0	1.1	1.8	3.7	2.4	25.0	-8.0	-8.0	-8.0
80026.2	Huntington Harbor, Lower	92	4	-8.0	0.8	1.4	2.5	-8.0	5.6	-8.0	3.5	8.0
80027.2	Huntington Harbor, Middle	95	4	-8.0	4.3	3.0	11.0	2.3	76.0	-8.0	3.4	-8.0
80027.3	Huntington Harbor, Middle	96	4	-8.0	4.3	2.7	9.5	2.0	72.0	-8.0	6.1	0.9
80028.2	Huntington Harbor, Upper	98	4	-8.0	8.6	3.8	12.0	1.8	82.0	-8.0	3.8	1.8
80028.3	Huntington Harbor, Upper	99	4	-8.0	8.0	2.8	12.0	1.9	93.0	-8.0	4.3	-8.0

-8 not detected
-9 not analyzed

BPTC LA HARBOR PESTICIDES (ng/g, dry weight)

STATION #	ENDO_I	ENDO_II	ESO4	ENDRIN	HEPTACHLOR	HE	HCB	GHCH	METHOXY	MIREX	TOXAPH	T_NON
40001.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.2
40001.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.3
40001.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	2.4
40002.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.1
40003.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40003.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40004.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.2	-8.0	-8.0	-8.0	-8.0	0.6
40005.1	-8.0	-8.0	-8.0	-8.0	0.5	-8.0	0.4	-8.0	-8.0	-8.0	51.0	5.3
40006.1	-8.0	-8.0	-8.0	-8.0	1.9	-8.0	1.6	-8.0	-8.0	-8.0	160.0	24.0
40006.2	-8.0	-8.0	-8.0	-8.0	2.8	-8.0	1.6	-8.0	-8.0	-8.0	100.0	23.0
40032.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40033.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.6
40008.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40010.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.2	-8.0	-8.0	-8.0	-8.0	0.6
40010.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.2	-8.0	-8.0	-8.0	-8.0	-8.0
40012.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40012.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40016.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40015.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40019.1	-8.0	-8.0	-8.0	-8.0	1.0	-8.0	-8.0	-8.0	1.8	-8.0	-8.0	0.8
40019.2	-8.0	-8.0	-8.0	-8.0	1.4	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.8
40019.3	-8.0	-8.0	-8.0	-8.0	0.6	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.2
40030.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40032.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40007.2	-8.0	-8.0	-8.0	-8.0	2.1	-8.0	0.3	-8.0	-8.0	1.4	-8.0	2.0
40011.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.6
40013.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.4	-8.0	-8.0	-8.0	-8.0	7.4
40014.2	-8.0	-8.0	-8.0	-8.0	1.4	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	8.1
40014.3	-8.0	-8.0	-8.0	-8.0	1.2	-8.0	0.4	-8.0	-8.0	-8.0	-8.0	9.0
40017.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40018.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.4
40020.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.0
40020.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.4
40031.2	-8.0	-8.0	-8.0	-8.0	0.7	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.9
40031.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
40010.4	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.2	-8.0	-8.0	-8.0	-8.0	-8.0
40021.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.9
40022.1	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.2	-8.0	-8.0	-8.0	-8.0	3.8
40023.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.4
80024.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	1.2
80026.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.8
80027.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.5	-8.0	-8.0	-8.0	-8.0	4.9
80027.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.2	-8.0	-8.0	-8.0	-8.0	5.0
80028.2	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.3	-8.0	-8.0	-8.0	-8.0	8.8
80028.3	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	0.3	-8.0	-8.0	-8.0	-8.0	8.4

-8 = not detected
-9 = not analyzed

Sediment Metal Chemistry Analyses Data

BPTC LA HARBOR TRACE METALS (ug/g dry weight)

STATION #	STATION	IDORG	LEG	Aluminum	Antimony	Arsenic	Cadmium	Chromium	Copper
40001.1	Southwest Slip	1	1	41000	2.1	14.0	0.37	110	110
40001.2	Southwest Slip	2	1	37000	2.4	13.0	0.48	95	110
40001.3	Southwest Slip	3	1	34000	2.0	15.0	0.57	100	120
40002.2	West Basin, Pier 143	5	1	42000	1.3	9.4	0.22	67	62
40003.1	Turning Basin, Pier 151	7	1	48000	1.3	7.8	0.19	55	49
40003.2	Turning Basin, Pier 151	8	1	68000	0.7	5.9	0.13	39	26
40004.2	Lower Main Channel	11	1	24000	2.0	17.0	1.20	110	180
40005.1	East Basin,Turning Basin	13	1	20000	2.0	8.7	0.69	63	78
40006.1	Consolidated Slip	16	1	30000	3.7	18.0	2.80	140	190
40006.2	Consolidated Slip	17	1	22000	4.4	17.0	2.90	140	200
40031.3	Palos Verdes (Swartz 6)	78	1	14000	1.0	5.8	1.20	110	42
40032.1	San Pedro Bay POLA 19	103	1	53000	0.43	6.0	0.24	47	27
40008.3	East Basin Pier C	24	2	43000	1.8	11.0	0.31	64	60
40010.1	Off Cabrillo Beach	28	2	30000	1.3	18.0	1.90	90	160
40010.2	Off Cabrillo Beach	29	2	37000	1.4	15.0	1.70	81	100
40011.3	Inner Harbor (channel 3)	33	2	30000	3.0	16.0	0.47	90	110
40012.1	Southeast Basin	34	2	35000	2.0	13.0	0.31	8.3	71
40014.3	Outer Queensway Bay	42	2	24000	2.1	15.0	1.60	71	68
40015.1	Fish Harbor Entrance	43	2	50000	1.4	10.0	0.47	67	50
40018.3	Long Beach Outer Harbor-18	54	2	24000	1.4	12.0	0.63	72	47
40019.1	Inner Fish Harbor	55	2	26000	2.1	19.0	0.89	96	320
40019.2	Inner Fish Harbor	56	2	22000	3.0	16.0	1.20	100	330
40023.3	Alamitos Bay, Long Beach Marina	69	2	43000	0.9	5.5	0.36	44	35
80028.2	Huntington Harbor, Upper	98	2	39000	0.63	4.9	0.62	46	60
40007.2	Long Beach Harbor(channel2)	20	3	41000	2.2	19.0	0.56	110	160
40010.1	Off Cabrillo Beach	136	3	30000	1.5	13.0	1.20	79	120
40012.2	Southeast Basin	35	3	38000	2.1	13.0	0.32	83	67
40013.1	Inner Queensway Bay	37	3	31000	1.6	8.3	1.20	55	51
40014.2	Outer Queensway Bay	41	3	30000	2.3	14.0	1.50	76	68
40015.3	Fish Harbor Entrance	45	3	48000	1.2	6.7	0.32	43	40
40017.3	Long Beach Channel	51	3	35000	1.8	11.0	0.41	78	47
40019.3	Inner Fish Harbor	57	3	34000	4.1	34.0	1.60	120	520
40020.2	Long Beach Outer Harbor-20	59	3	49000	1.1	8.1	0.39	57	31
40030.3	San Pedro Breakwater	75	3	57000	0.6	5.0	0.22	50	12
40031.2	Palos Verdes (Swartz 6)	77	3	15000	1.1	6.5	1.40	140	53
40020.3	Long Beach Outer Harbor-20	60	4	49000	1.1	7.7	0.43	60	33
40021.3	Alamitos Bay, Marine Stadium	63	4	83000	1.3	6.2	0.29	52	55
40022.1	Alamitos Bay, Entrance	64	4	37000	1.4	6.8	0.62	52	48
40032.3	San Pedro Bay POLA 19	81	4	65000	0.89	5.0	0.25	46	21
40033.1	Outer Harbor, POLA 10	82	4	51000	1.5	14.0	0.79	110	110
80024.3	Anaheim Bay, Outer	87	4	32000	0.68	6.7	0.30	49	42
80026.2	Huntington Harbor, Lower	92	4	68000	0.54	2.0	0.09	25	13
80027.2	Huntington Harbor, Middle	95	4	47000	0.55	6.6	0.27	60	77
80027.3	Huntington Harbor, Middle	96	4	33000	0.62	6.0	0.34	57	68
80028.3	Huntington Harbor, Upper	99	4	28000	0.45	6.2	0.74	49	72

BPTC LA HARBOR TRACE METALS (ug/g dry weight)

STATION #	Iron	Lead	Manganese	Mercury	Nickel	Silver	Selenium	Tin	Zinc
40001.1	47000	53	590	0.62	43	0.31	0.46	6.3	200
40001.2	48000	49	550	0.76	40	0.30	0.47	4.5	190
40001.3	44000	52	530	0.57	43	0.31	0.59	4.8	200
40002.2	36000	36	450	0.22	28	0.16	0.27	4.3	130
40003.1	33000	27	430	0.19	23	0.16	0.28	3.3	100
40003.2	24000	21	710	0.12	15	0.10	0.12	3.6	70
40004.2	47000	47	490	0.46	47	0.79	2.40	3.1	220
40005.1	28000	68	400	0.36	28	0.29	0.33	3.1	190
40006.1	43000	140	350	0.73	45	0.89	0.64	8.0	540
40006.2	46000	170	420	0.56	46	0.92	0.53	8.7	570
40031.3	20000	29	250	0.26	23	1.20	0.49	10.7	88
40032.1	25000	24	430	0.18	18	0.14	0.20	3.6	79
40008.3	40000	31	590	0.22	33	0.23	0.22	3.8	140
40010.1	40000	32	340	0.30	38	0.55	1.90	3.4	230
40010.2	32000	31	410	0.43	34	0.41	1.60	2.7	230
40011.3	44000	52	650	3.10	43	0.52	0.33	5.6	220
40012.1	45000	37	620	0.20	39	0.27	0.25	4.2	170
40014.3	38000	64	380	0.22	38	0.45	0.75	4.4	210
40015.1	31000	32	500	0.34	27	0.24	0.41	4.2	120
40018.3	37000	48	470	0.24	33	0.36	0.40	3.6	150
40019.1	43000	51	360	1.60	39	0.54	1.60	6.5	310
40019.2	36000	65	450	1.90	39	0.62	1.00	9.1	320
40023.3	26000	43	410	0.09	24	0.22	-8.00	3.3	120
80028.2	31000	72	440	0.21	24	0.19	0.22	4.4	230
40007.2	48000	72	580	1.20	45	0.60	0.42	7.7	330
40010.4	35000	31	510	0.49	36	0.43	1.40	3.5	220
40012.2	45000	35	650	0.23	40	0.27	0.24	3.8	170
40013.1	37000	40	410	0.23	31	0.35	0.47	3.7	190
40014.2	50000	67	350	0.31	38	0.49	0.80	4.1	200
40015.3	29000	34	400	0.54	21	0.15	0.28	2.5	110
40017.3	40000	32	600	0.18	34	0.29	0.36	3.8	140
40019.3	57000	120	530	2.40	48	0.76	1.60	11.3	490
40020.2	35000	44	490	0.10	26	0.25	0.28	4.9	120
40030.3	28000	22	630	0.08	18	0.05	-8.00	3.6	63
40031.2	17000	35	250	0.30	26	1.60	0.57	15.1	100
40020.3	37000	40	490	0.12	29	0.26	0.16	4.7	130
40021.3	37000	51	430	0.14	26	0.42	-8.00	3.9	140
40022.1	32000	60	460	0.12	30	0.37	0.17	4.5	160
40032.3	24000	23	440	0.15	17	0.11	0.15	3.3	75
40033.1	48000	32	620	0.26	47	0.72	1.80	5.1	200
80024.3	34000	36	460	0.15	27	0.20	0.15	2.9	130
80026.2	21000	28	350	0.04	11	0.28	-8.00	1.8	73
80027.2	40000	77	560	0.15	29	0.22	0.15	4.9	230
80027.3	39000	57	480	0.16	27	0.21	0.20	4.9	210
80028.3	33000	71	470	0.22	26	0.22	0.23	6.5	270

* -8 = not detected
* -9 = not analyzed

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DATE	IDORG	LEG	STATION	CDFG_NO	TBT(ppm, dry
29-Jul-92	1	1	southwest slip	40001.1	0.12
29-Jul-92	2	1	southwest slip	40001.2	0.27
29-Jul-92	3	1	southwest slip	40001.3	0.19
30-Jul-92	5	1	west basin, pier 143	40002.2	0.13
31-Jul-92	7	1	turning basin, pier 151	40003.1	ND
31-Jul-92	8	1	turning basin, pier 151	40003.2	ND
29-Jul-92	11	1	lower main channel	40004.2	0.09
30-Jul-92	13	1	east basin,turning basin	40005.1	0.47
31-Jul-92	16	1	consolidated slip	40006.1	0.38
31-Jul-92	17	1	consolidated slip	40006.2	5.1
30-Jul-92	81	1	san pedro bay, pola 19	40032.3	0.028
30-Jul-92	82	1	outer harbor, pola 10	40033.1	0.086
18-Aug-92	24	2	east basin pier c	40008.3	0.017
18-Aug-92	28	2	off cabrillo beach	40010.1	0.1
18-Aug-92	29	2	off cabrillo beach	40010.2	0.091
18-Aug-92	34	2	southeast basin	40012.1	0.28
18-Aug-92	35	2	southeast basin	40012.2	0.035
19-Aug-92	43	2	fish harbor entrance	40015.1	0.027
19-Aug-92	45	2	fish harbor entrance	40015.3	0.029
19-Aug-92	55	2	inner fish harbor	40019.1	0.69
19-Aug-92	56	2	inner fish harbor	40019.2	0.65
19-Aug-92	57	2	inner fish harbor	40019.3	1.7
19-Aug-92	75	2	san pedro breakwater	40030.3	ND
19-Aug-92	103	2	san pedro bay pola 19	40032.1	0.015
01-Sep-92	20	3	long beach har.(channel2)	40007.2	0.22
01-Sep-92	33	3	inner harbor (channel 3)	40011.3	0.046
02-Sep-92	37	3	inner queensway bay	40013.1	0.031
02-Sep-92	41	3	outer queensway bay	40014.2	0.042
02-Sep-92	42	3	outer queensway bay	40014.3	0.048
02-Sep-92	51	3	long beach channel	40017.3	ND
02-Sep-92	54	3	long beach outer har.-18	40018.3	0.055
02-Sep-92	59	3	long beach outer har.-20	40020.2	ND
02-Sep-92	60	3	long beach outer har.-20	40020.3	ND
01-Sep-92	77	3	palos verdes (swart 6)	40031.2	0.018
01-Sep-92	78	3	palos verdes (swartz 6)	40031.3	ND
16-Sep-92	63	4	alamitos bay, marine stad	40021.3	0.024
15-Sep-92	64	4	alamitos bay, entrance	40022.1	0.042
16-Sep-92	69	4	alamitos bay, l.b. marina	40023.3	0.027
15-Sep-92	87	4	anaheim bay, outer	80024.3	ND
15-Sep-92	92	4	huntington harbor, lower	80026.2	0.048
15-Sep-92	95	4	huntington harbor, middle	80027.2	0.063
15-Sep-92	96	4	huntington harbor, middle	80027.3	0.028
15-Sep-92	98	4	huntington harbor, upper	80028.2	0.041
15-Sep-92	99	4	huntington harbor, upper	80028.3	0.042
16-Sep-92	136	4	cabrillo beach	40010.1	0.16

Porewater Metal Chemistry Analyses Data

BPTC LA HARBOR TRACE METALS IN PORE WATER (ng/g, dry weight)

STATION #	STATION	IDORG	LEG	Silver	Aluminum	Cadmium	Copper	Iron	Manganese	Nickel	Lead	Zinc
40001 1	Southwest Slip	1	1	-8 0	16	0 00001	1 50	9200	2600	2 10	0 02	4 20
40001 2	Southwest Slip	2	1	-8 0	42	0 00680	7 70	9500	2900	2 30	0 59	9 90
40002 2	West Basin, Pier 143	5	1	-8 0	520	0 18000	7 40	8700	1900	4 60	8 60	72 00
40004 2	Lower Main Channel	11	1	-8 0	23	0 03300	1 40	9900	980	2 60	0 17	5 50
40006 1	Consolidated Slip	16	1	-8 0	98	0 02300	1 00	1800	390	1 20	1 50	4 60
40006 2	Consolidated Slip	17	1	-8 0	55	0 01200	0 99	1100	600	2 20	0 66	3 00
40033 1	Outer Harbor, POLA 10	82	1	-8 0	37	0 03500	1 60	9300	580	2 30	0 68	15 00
40010 2	Off Cabrillo Beach	29	2	-8 0	16	0 08900	1 80	8400	810	8 90	0 21	9 40
40012 2	Southeast Basin	35	2	-8 0	74	0 02000	0 81	2200	1200	1 20	0 66	3 90
40015 1	Fish Harbor Entrance	43	2	-8 0	8	0 03500	0 72	7300	2000	3 50	0 35	9 20
40019 1	Inner Fish Harbor	55	2	-8 0	14	0 01300	1 30	610	30	2 00	0 35	2 80
40019 2	Inner Fish Harbor	56	2	-8 0	19	0 01300	0 54	1300	130	0 34	0 58	2 30
30036 1	Elkhorn Slough,Seal Point	130	3	-8 0	140	0 07900	1 30	1300	330	2 00	0 28	8 90
30035 2	Elkhorn Slough,Seal Point	131	3	-8 0	1300	0 18000	1 10	8000	270	7 20	0 69	32 00
40007 2	Long Beach Harbor(Channel?)	20	3	-8 0	600	0 19000	39 00	7000	2200	4 00	18 00	98 00
40017 3	Long Beach Channel	61	3	-8 0	82	0 02500	1 60	8300	970	2 10	0 93	3 10
40018 3	Long Beach Outer Harbor-18	54	3	-8 0	33	0 05200	0 79	11000	720	3 20	0 32	5 50
40031 2	Palos Verdes (Swartz 6)	77	3	-8 0	64	0 05600	1 20	3900	80	1 40	0 93	16 00
40010 4	Cabrillo Beach	136	4	-8 0	300	0 18000	6 20	16000	620	8 20	6 90	61 00
80027 2	Huntington Harbor, Middle	95	4	-8 0	76	0 01900	2 60	7600	2300	3 00	1 30	14 00
80028 2	Huntington Harbor, Upper	98	4	-8 0	45	0 02500	1 50	1900	600	2 70	0 56	25 00

[illegible] not detected
9 not analyzed

Grain Size and Total Organic Carbon Analyses Data

NOAA- LA HARBOR TOTAL ORGANIC CARBON AND GRAIN SIZE DATA* PAGE 1 0F 2

DATE	IDORG	LEG	STATION	CDFG_NO	GRAIN_SIZE	TOC
29-Jul-92	1	1	southwest slip	40001.1	70.00	1.59
29-Jul-92	2	1	southwest slip	40001.2	71.00	1.44
29-Jul-92	3	1	southwest slip	40001.3	81.00	2.01
30-Jul-92	4	1	west basin, pier 143	40002.1	54.00	1.50
30-Jul-92	5	1	west basin, pier 143	40002.2	75.00	0.88
30-Jul-92	6	1	west basin, pier 143	40002.3	60.00	0.85
31-Jul-92	7	1	turning basin, pier 151	40003.1	8.00	0.72
31-Jul-92	8	1	turning basin, pier 151	40003.2	24.00	0.63
31-Jul-92	9	1	turning basin, pier 151	40003.3	32.00	0.77
29-Jul-92	10	1	lower main channel	40004.1	44.00	1.30
29-Jul-92	11	1	lower main channel	40004.2	89.00	3.43
29-Jul-92	12	1	lower main channel	40004.3	82.00	0.89
30-Jul-92	13	1	east basin,turning basin	40005.1	52.00	1.95
30-Jul-92	14	1	east basin turning basin	40005.2	71.00	0.59
30-Jul-92	15	1	east basin turning basin	40005.3	77.00	0.61
31-Jul-92	16	1	consolidated slip	40006.1	91.00	4.58
31-Jul-92	17	1	consolidated slip	40006.2	93.00	4.27
31-Jul-92	18	1	consolidated slip	40006.3	78.00	4.40
30-Jul-92	79	1	san pedro bay, pola 19	40032.1	26.00	0.56
30-Jul-92	80	1	san pedro bay, pola 19	40032.2	15.00	1.80
30-Jul-92	81	1	san pedro bay, pola 19	40032.3	18.00	0.53
30-Jul-92	82	1	outer harbor, pola 10	40033.1	87.00	2.73
30-Jul-92	83	1	outer harbor, pola 10	40033.2	92.00	0.60
30-Jul-92	84	1	outer harbor, pola 10	40033.3	94.00	1.60
05-Aug-92	100	1	monterey bay ref.	30034.1	93.00	0.59
05-Aug-92	101	1	monterey bay ref.	30034.2	91.00	0.65
05-Aug-92	102	1	monterey bay ref.	30034.3	90.00	0.50
18-Aug-92	22	2	east basin pier c	40008.1	88.00	0.60
18-Aug-92	23	2	east basin pier c	40008.2	63.00	0.52
18-Aug-92	24	2	east basin pier c	40008.3	71.00	0.76
18-Aug-92	25	2	west basin entrance	40009.1	57.00	0.38
18-Aug-92	26	2	west basin entrance	40009.2	73.00	0.40
18-Aug-92	27	2	west basin entrance	40009.3	83.00	0.39
18-Aug-92	28	2	off cabrillo beach	40010.1	93.00	2.94
18-Aug-92	29	2	off cabrillo beach	40010.2	76.00	2.53
18-Aug-92	30	2	off cabrillo beach	40010.3	90.00	1.10
18-Aug-92	34	2	southeast basin	40012.1	82.00	1.45
18-Aug-92	35	2	southeast basin	40012.2	88.00	1.51
18-Aug-92	36	2	southeast basin	40012.3	79.00	0.69
19-Aug-92	43	2	fish harbor entrance	40015.1	63.00	0.88
19-Aug-92	44	2	fish harbor entrance	40015.2	37.00	0.61
19-Aug-92	45	2	fish harbor entrance	40015.3	30.00	0.82
18-Aug-92	46	2	terminal island stp	40016.1	75.00	0.69
18-Aug-92	47	2	terminal island stp	40016.2	68.00	0.49
18-Aug-92	48	2	terminal island stp	40016.3	91.00	0.55
19-Aug-92	55	2	inner fish harbor	40019.1	78.00	2.48
19-Aug-92	56	2	inner fish harbor	40019.2	77.00	2.30
19-Aug-92	57	2	inner fish harbor	40019.3	91.00	2.95
19-Aug-92	73	2	san pedro breakwater	40030.1	82.00	0.25
19-Aug-92	74	2	san pedro breakwater	40030.2	29.00	0.28
19-Aug-92	75	2	san pedro breakwater	40030.3	20.00	0.75
19-Aug-92	103	2	san pedro bay pola 19	40032.1	26.00	0.38
19-Aug-92	104	2	san pedro bay pola 19	40032.2	40.00	0.29
19-Aug-92	105	2	san pedro bay pola 19	40032.3	40.00	0.28

* Grain size reported as % fines.
Total organic carbon reported as % of dry weight.

NOAA- LA HARBOR TOTAL ORGANIC CARBON AND GRAIN SIZE DATA PAGE 2 OF 2

DATE	IDORG	LEG	STATION	CDFG_NO	GRAIN_SIZE	TOC
01-Sep-92	19	3	long beach har (channel2)	40007.1	75.00	1.20
01-Sep-92	20	3	long beach har (channel2)	40007.2	80.00	1.64
01-Sep-92	21	3	long beach har (channel2)	40007.3	77.00	0.68
01-Sep-92	31	3	inner harbor (channel 3)	40011.1	87.00	1.00
01-Sep-92	32	3	inner harbor (channel 3)	40011.2	89.00	2.10
01-Sep-92	33	3	inner harbor (channel 3)	40011.3	88.00	1.54
02-Sep-92	37	3	inner queensway bay	40013.1	95.00	1.98
02-Sep-92	38	3	inner queensway bay	40013.2	90.00	1.50
02-Sep-92	39	3	inner queensway bay	40013.3	91.00	1.70
02-Sep-92	40	3	outer queensway bay	40014.1	89.00	0.92
02-Sep-92	41	3	outer queensway bay	40014.2	97.00	2.34
02-Sep-92	42	3	outer queensway bay	40014.3	94.00	2.30
02-Sep-92	49	3	long beach channel	40017.1	80.00	0.76
02-Sep-92	50	3	long beach channel	40017.2	81.00	1.30
02-Sep-92	51	3	long beach channel	40017.3	83.00	1.40
02-Sep-92	52	3	long beach outer har -18	40018.1	71.00	0.56
02-Sep-92	53	3	long beach outer har -18	40018.2	77.00	0.76
02-Sep-92	54	3	long beach outer har -18	40018.3	79.00	1.41
02-Sep-92	58	3	long beach/outer har -20	40020.1	57.00	0.53
02-Sep-92	59	3	long beach outer har -20	40020.2	65.00	1.10
02-Sep-92	60	3	long beach outer har -20	40020.3	70.00	0.90
01-Sep-92	76	3	palos verdes(swartz 6)	40031.1	63.00	0.85
01-Sep-92	77	3	palos verdes (swart 6)	40031.2	63.00	2.77
01-Sep-92	78	3	palos verdes (swartz 6)	40031.3	52.00	0.70
01-Sep-92	111	3	inner harbor (channel 3)	40011.4	88.00	0.71
04-Sep-92	130	3	elkhorn slough,seal point	30035.1	88.00	1.70
04-Sep-92	131	3	elkhorn slough,seal point	30035.2	81.00	0.69
04-Sep-92	132	3	elkhorn slough,seal point	30035.3	83.00	0.45
16-Sep-92	61	4	alamitos bay, marine stad	40021.1	53.00	0.61
16-Sep-92	62	4	alamitos bay, marine stad	40021.2	79.00	0.97
16-Sep-92	63	4	alamitos bay, marine stad	40021.3	39.00	0.95
15-Sep-92	64	4	alamitos bay, entrance	40022.1	77.00	1.10
15-Sep-92	65	4	alamitos bay, entrance	40022.2	91.00	0.90
15-Sep-92	66	4	alamitos bay, entrance	40022.3	90.00	0.90
16-Sep-92	67	4	alamitos bay, l.b. marina	40023.1	58.00	0.68
16-Sep-92	68	4	alamitos bay, l.b. marina	40023.2	53.00	0.76
16-Sep-92	69	4	alamitos bay, l.b. marina	40023.3	32.00	0.70
15-Sep-92	85	4	anaheim bay, outer	80024.1	31.00	0.29
15-Sep-92	86	4	anaheim bay, outer	80024.2	73.00	0.61
15-Sep-92	87	4	anaheim bay, outer	80024.3	65.00	0.37
15-Sep-92	91	4	huntington harbor, lower	80026.1	27.00	0.37
15-Sep-92	92	4	huntington harbor, lower	80026.2	10.00	1.40
15-Sep-92	93	4	huntington harbor, lower	80026.3	44.00	0.42
15-Sep-92	94	4	huntington harbor, middle	80027.1	79.00	0.61
15-Sep-92	95	4	huntington harbor, middle	80027.2	89.00	0.80
15-Sep-92	96	4	huntington harbor, middle	80027.3	81.00	1.41
15-Sep-92	97	4	huntington harbor, upper	80028.1	42.00	0.64
15-Sep-92	98	4	huntington harbor, upper	80028.2	60.00	1.52
15-Sep-92	99	4	huntington harbor, upper	80028.3	68.00	2.05
11-Sep-92	109	4	seal bend travel control	30036.4	95.00	1.20
11-Sep-92	133	4	elkhorn slough, seal bend	30036.1	91.00	0.53
11-Sep-92	134	4	elkhorn slough, seal bend	30036.2	90.00	0.56
11-Sep-92	135	4	elkhorn slough, seal bend	30036.3	87.00	0.83
16-Sep-92	136	4	cabrillo beach	40010.1	88.00	2.26
16-Sep-92	137	4	cabrillo beach	40010.2	72.00	1.30
16-Sep-92	138	4	cabrillo beach	40010.3	95.00	1.30
15-Sep-92	145	4	anaheim bay, outer	80024.4	59.00	0.52
14-Oct-92	88	5	anaheim bay, oil island	80025.1	48.00	0.69
14-Oct-92	89	5	anaheim bay, oil island	80025.2	52.00	1.00
14-Oct-92	90	5	anaheim bay, oil island	80025.3	56.00	0.64