TMDL Sediment Quality Assessment Study at the B Street/Broadway Piers, Downtown Anchorage, and Switzer Creek, San Diego

PHASE II

Final Report

TEMPORAL VARIABILITY, CAUSES OF IMPACTS, AND LIKELY SOURCES OF CONTAMINANTS OF CONCERN

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LIST OF ACRONYMS

BCA BENTHIC COMMUNITY ANALYSIS
BRI BENTHIC RESPONSE INDEX
BIGHT'98 SOUTHERN CALIFORNIA BIGHT 1998 REGIONAL MARINE MONITORING SURVEY
BPJ BEST PROFESSIONAL JUDGMENT
BPTCP BAY PROTECTION AND TOXIC CLEANUP PROGRAM
BTAG BIOLOGICAL TECHNICAL ASSISTANCE GROUP
CBGV CONSENSUS-BASED SEDIMENT QUALITY GUIDELINE
COPC CONTAMINANTS OF POTENTIAL CONCERN
CSM CONCEPTUAL SITE MODEL
DDD DICHLORODIPHENYLDICHLOROETHANE
DDE DICHLORODIPHENYLDICHLOROETHYLENE
DDT DICHLORODIPHENYLTRICHLOROETHANE
DQO DATA QUALITY OBJECTIVES
EPA ENVIRONMENTAL PROTECTION AGENCY
ERL EFFECTS RANGE LOW
ERM EFFECTS RANGE MEDIAN
ERMQ EFFECTS RANGE MEDIAN QUOTIENT
GC/ECD GAS CHROMATOGRAPH/ELECTRON CAPTURE DETECTOR
GC/MS GAS CHROMATOGRAPH/MASS SPECTROMETER
HMWPAH HIGH MOLECULAR WEIGHT PAH
HPLC HIGH-PRESSURE LIQUID CHROMATOGRAPHY
HQ HAZARD QUOTIENT
LMWPAH LOW MOLECULAR WEIGHT PAH
LOE LINE OF EVIDENCE
MSD MINIMUM SIGNIFICANT DIFFERENCE
PAH POLYNUCLEAR AROMATIC HYDROCARBONS
PCB POLYCHLORINATED BIPHENYLS
PEL PROBABLE EFFECTS LEVEL
PELQ PROBABLE EFFECTS LEVEL QUOTIENT
PPB PARTS PER BILLION
PPM PARTS PER MILLION
PPPAH PRIORITY POLLUTANT PAH
PPT PARTS PER THOUSAND
RSD RELATIVE STANDARD DEVIATION
QA/QC QUALITY ASSURANCE/QUALITY CONTROL
SAP SAMPLING AND ANALYSIS PLAN

SCCWRP SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT
SDRWQCB REGIONAL WATER QUALITY CONTROL BOARD, SAN DIEGO REGION
SIM SELECTIVE ION MONITORING
SQG SEDIMENT QUALITY GUIDELINE
TCHLOR TOTAL CHLORDANE
TDDT TOTAL DDT
TEL THRESHOLD EFFECTS LEVEL
THS TOXIC HOT SPOT
TIE TOXICITY IDENTIFICATION EVALUATIONS
TMDL TOTAL MAXIMUM DAILY LOAD
TOC TOTAL ORGANIC CARBON
TPAH TOTAL PAH
TPCB TOTAL PCB
TRV TOXICITY REFERENCE VALUES
UPL UPPER PREDICTION LIMIT
WOE WEIGHT OF EVIDENCE

1.0 INTRODUCTON

Sediments in San Diego Bay in the vicinity of B Street/Broadway Piers, Downtown Anchorage, and near the mouth of Switzer Creek are contaminated with anthropogenic chemicals. In addition, these sites contain degraded benthic macroinvertebrate communities, and samples from these areas have been demonstrated to be toxic to various marine invertebrate species in laboratory toxicity tests. As a consequence, these sites have been identified as areas of impaired water quality. In response to this contamination, the San Diego Regional Water Quality Control Board (SDRWQCB) has initiated efforts to develop total maximum daily loads (TMDLs) for these sites in order to reduce ongoing loadings of contaminants of concern.

The SDRWQCB has initiated studies to determine the extent and potential source reduction and clean up requirements for the impaired environment. These efforts require similar information in order to initiate action: delineation of the spatial extent and magnitude of impairment, information on temporal variability of contamination and bioeffects, causes of impacts, and descriptions of the sources of contaminants. Such information is needed by the SDRWQCB in order to prioritize TMDL actions. Similar information is needed for remediation planning, so that the affected area can be defined, and effective clean-up standards established. The primary objective of these actions is elimination of the impairment of benthic animal communities. In addition, the SDRWQCB has determined that these efforts should also minimize human health and wildlife impacts resulting from the accumulation and possible biomagnification of contaminants in the food web.

This report discusses results of Phase II TMDL studies. Phase II monitoring emphasized a temporal assessment of marine sediments adjacent to the B Street/Broadway Piers, Downtown Anchorage and Switzer Creek areas in San Diego Bay. The purpose of this study was to examine temporal variability of chemical contamination of sediments and associated bioeffects, and to investigate causes of impacts in order to provide further information needed to plan TMDL and cleanup activities. This study was developed jointly by the University of California, Davis, the City of San Diego, the San Diego Unified Port District, and the SDRWQCB in an effort to minimize duplication of effort and to provide comparable data throughout San Diego Bay. This study was similar in scope and design to ongoing sediment assessment studies being conducted throughout San Diego Bay, and the approach followed methods described for other sediment TMDL studies, particularly those at the Chollas and Paleta Creek hotspots (SCCWRP et al 2004; Brown and Bay 2005).

The relationship of the proposed study, TMDL, and cleanup activities is shown in Figure 1-1. Phase I studies were designed to determine the magnitude and spatial extent of contamination and bioeffects. Spatial assessment information is an integral component of both cleanup and TMDL activities at the study sites, consequently this information will be obtained during the initial portions of the program (Phase I in Figure 1-1). The Phase I data was used to identify areas of greatest concern for detailed investigations to support the development of TMDLs (Phase II).

The purpose of this document is to provide a more detailed description of the Phase II investigations. These activities included laboratory research to identify causes of sediment toxicity (toxicity identification evaluations - TIEs), assessment of temporal patterns in contamination and associated bioeffects, and evaluation of likely sources of the contaminants of concern.

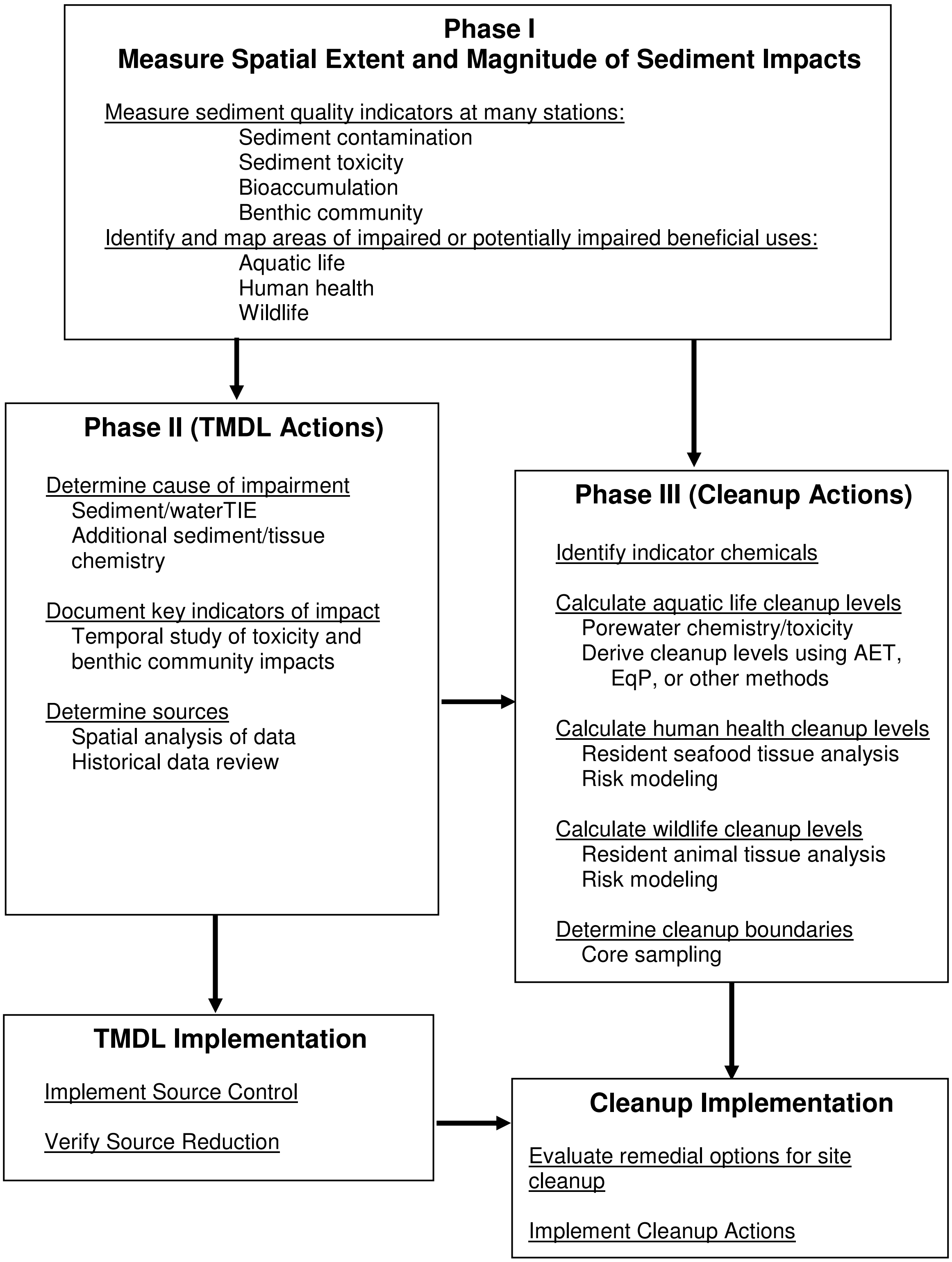

Figure 1-1. Relationship of study plan to potential subsequent TMDL and cleanup activities at the study sites.

Products from the Phase II studies and Phase III source identification and TMDL implementation will likely influence potential cleanup activities at the sites, through the identification of contaminants of concern and identification of ongoing contaminant sources. Studies that are being planned to support cleanup actions in other portions of San Diego Bay are expected to include the same components included in Phase I and II, plus additional studies necessary to derive numerical cleanup levels and determine the vertical extent of contamination (shown in Phase III). These Phase III studies may be conducted at a later date and at a reduced number of stations, depending upon the results of Phases I and II, in order to provide a more efficient and cost effective study design. Information in the Phase I and II SAPs describes the statistical analysis of the data for the purposes of determining the presence and extent of contamination or effects. However, procedures for the determination of numerical load reductions or clean up levels are not included; determination of these parameters requires the consideration of additional factors (e.g., costs and degree of protection desired) and is outside the scope of this study.

Detailed descriptions of the Phase II study design, field sampling effort, laboratory analysis, and data analysis procedures were included in the Phase II Sediment Assessment Plan. This SAP followed the general approach of the California Bay Protection and Toxic Cleanup Program (BPTCP) and the Bight'98 regional survey in measuring multiple indicators of sediment quality and using a weight of evidence approach to identify areas of impaired sediment quality. Included in this effort were determinations of the temporal patterns of:

- Sediment contamination
- Sediment physical/chemical characteristics (e.g., grain size, TOC)
- Sediment and interstitial water toxicity
- Bioaccumulation of contaminants by a marine invertebrate
- Altered benthic community composition

The four lines-of-evidence were ranked based on severity of impact used a tiered approach. This approach resulted from detailed discussions between the various stakeholders involved in the sediment TMDLs in San Diego Bay. The resulting categorizations for each indicator were then combined in a weight-of-evidence to arrive at overall categorizations for each site. This approach is described in (SCCWRP 2004).

The approach for determining causes of toxicity also involved a weight-of-evidence based on correlations between contaminant concentrations and bioeffects, tissue concentrations, and solid-phase and porewater TIEs. TIEs followed procedures developed by the U.S. Environmental Protection Agency, as well as novel techniques developed by UC Davis (MPSL-Granite Canyon).

1.1 BACKGROUND

The SDRWQB has established a cleanup plan for designated "known toxic hot spots" in San Diego Bay based on findings from the BPTCP. The cleanup plan provides definitions, rankings, and a preliminary assessment of actions for a number of sites around the bay. Under this definition, five specific areas were designated as toxic hot spots (THS), four with a ranking of moderate and one with a ranking of high. Many of the areas lie at the inlet of creeks or storm drains, indicating that stormwater may be a significant contributing factor. The three areas that are the focus of this study, one at the B Street/Broadway Piers, one in the vicinity of Downtown Anchorage, and one at the discharge of Switzer Creek, are shown in Figure 1-2.

Figure 1-2. Switzer Creek, B Street/Broadway Piers, and Downtown Anchorage study sites (in crosshatch; RWQCB – San Diego).

designated as moderate priority sites. The B Street/BroadwayPiers site was designated on the basis of benthic community degradation, and elevated concentrations of polycyclic aromatic hydrocarbons (PAHs), copper, chlordane, and total chemistry. The Downtown Anchorage area was designated on the basis of metal and organochlorine pesticide contamination, sediment toxicity, and benthic community degradation. The Switzer Creek site was designated on the basis of toxicity, benthic community degradation, and elevated concentrations of copper, PAHs, chlordane and total chemistry (Fairey et al., 1996; Fairey et al., 1998). Historical data for the B Street/Broadway Piers, Downtown Anchorage area, and Switzer Creek sites were compiled from BPTCP reports (Fairey et al., 1996; Fairey et al. 1998), and are summarized in the Phase I SAP (UC Davis – MPSL, May 2002).

2.0 STUDY DESIGN AND METHODS

2.1 OBJECTIVES AND APPROACH

The primary goals of this study were to investigate temporal patterns and chemical causes of impacts on the benthic environment in the vicinity of the B Street/Broadway Piers, Downtown Anchorage, and the area adjacent to the mouth of Switzer Creek. Once chemicals of concern were identified, likely sources of these chemicals were to be identified.

The conceptual approach of the study is based on three key assumptions. First, that the determination of biological impairment is best assessed through the measurement of biological effects associated with the study site (e.g. toxicity, bioaccumulation, and benthic community degradation). Second, multiple indicators of sediment quality must be measured in order to provide a confident assessment of impacts because no single test or parameter is a consistently reliable, accurate, and predictive indicator of impairment. The final assumption is that there may be unknown site-specific factors in the study areas that will significantly affect causal relationships between contamination and effects, thus site-specific information is needed to accurately assess impacts.

This study will build on results of analyses conducted as part of the Phase I Sediment Quality Assessment. In Phase I, multiple measures of sediment quality were conducted at each station to identify the spatial extent of contamination and associated impacts. The Phase II study design entailed the collection of sediment from a subset of stations investigated as part of the Phase I studies.

As in the Phase I studies, we measured four indicators of sediment quality in Phase II: sediment contamination, sediment toxicity, benthic community composition, and bioaccumulation. These four indicators are directly related to the reasons for including these sites on the 303(d) list of impaired water bodies. We also measured other habitat factors that are necessary for the comprehensive interpretation of these indicator data. The use of multiple indicators supports a weight-of-evidence approach that increases the likelihood that the sediment quality at each sampling site will be accurately assessed.

The results of the Phase I spatial studies were used to plan subsequent studies that are needed to support TMDL and cleanup activities at the sites. Spatial distribution of contamination and toxicity were be used to select a subset of stations for toxicity identification evaluations (TIEs) in order to identify contaminants of concern for development of TMDL targets. A subset of the studies identified from the Phase I studies were also selected to determine temporal patterns of contamination and bioeffects as part of Phase II. Determination of the spatial extent of impairment will also facilitate identification of the area requiring remediation, and provide a baseline upon which to assess the effectiveness of load reductions and remediation actions.

2.2 SITE CONCEPTUAL MODEL

Based on existing data, site conceptual models were developed to help clarify the potential linkages between sources, exposure pathways, and receptors. All of the sites share similar characteristics including identified impairment of sediments, stormwater inputs from shoreline sources, and shoreline industrial activities. In addition, the Switzer Creek study area receives considerable upland inputs from the creek itself. Thus, the conceptual models for each study area reflect the generic processes that are expected to be dominant at the sites. The models are broken into two parts, the first illustrating the potential for ongoing sources to impact the site, and the second illustrating the potential exposure pathways for contaminated sediments to reach receptors.

The primary categories of potential ongoing sources are illustrated in Figures 2-1 and 2-2. These include stormwater from the upland watershed that enters the Switzer Creek site via creek drainage, stormwater from the neighboring shipping facilities and shipyards that enters the site primarily via small storm drains, and in-water sources primarily from ships via release from antifouling coatings and zinc cathodic protection systems. A significant fraction of this source material is likely to enter the site in association with particulate matter, or adsorb onto particulate matter at the site. Because of the relatively weak currents in the Switzer Creek study area, it is anticipated that much of the source material that enters the site will deposit to the sediment bed within the site, rather than be transported to the bay. This is the process that is conceptualized in Figure 2-1. In the B Street/Broadway Piers and Downtown Anchorage areas (Figure 2-2), there is greater potential for transport of contaminated sediment from adjoining areas because of tidal eddys in this part of the bay (Fairey et al. 1996). There are also a number of storm drains in the vicinity of the Downtown Anchorage. Additional insight into the links between these sources and the sediment will be gained from supporting and follow-on studies for source quantification and TIE characterization.

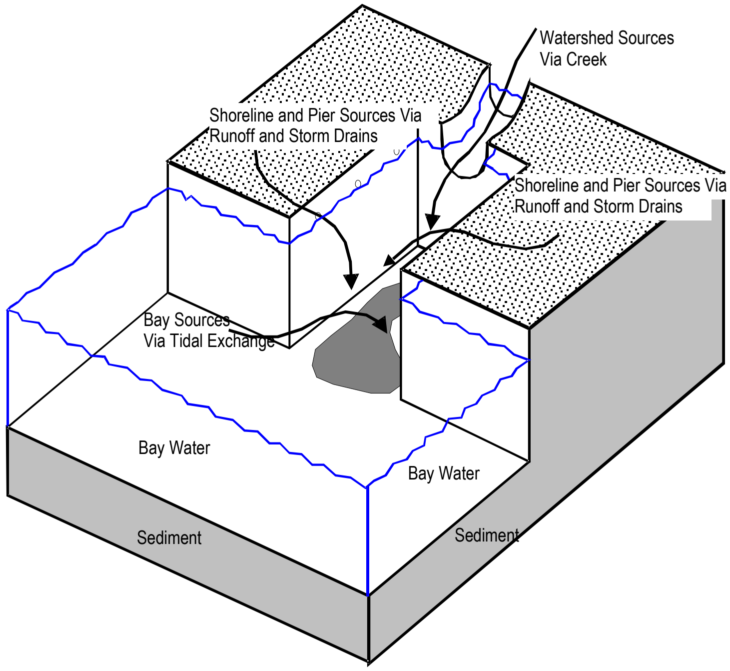

Figure 2-1. Generic site conceptual model for the Switzer Creek study area showing potentialsources and pathways to the sediment.

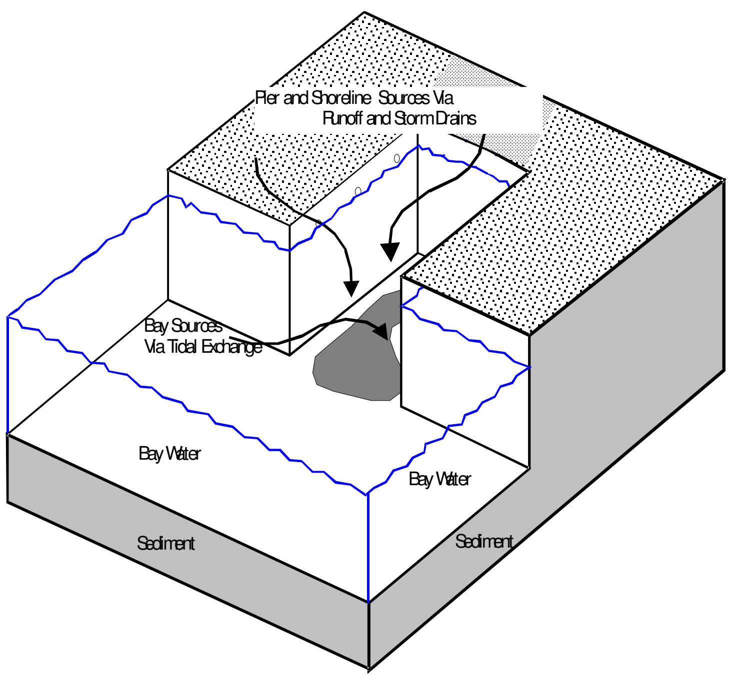

Figure 2-2. Generic site conceptual model for the B Street/Broadway Piers and Downtown Anchorage study areas showing potential sources and pathways to the sediment.

Potential pathways of exposure and receptors are illustrated in Figure 2-3. All of the sites under investigation are intermediate water depth environments. This has important implications for the potential exposure pathways that may exist. For the contaminants in the sediment, one potential ecological exposure pathway is for direct contact or ingestion by benthic infauna, primarily invertebrates such as crustaceans, polychaetes and mollusks (Fairy et al., 1996). In association with this pathway, a second level of ecological exposure may occur for bottom feeding fish that prey on these benthic invertebrates. Existing survey data suggests that in these areas exposure would be primarily to species such as the California Halibut, Round Stingray, and Barred Sand Bass (U.S. Navy/SDUPD, 2000). Because of the depth of the sites, it is unlikely that transfer to fish-eating bird species would occur. Diving birds and surface feeding birds generally limit their activities to shallow water areas, and there are few upper level receptors that feed directly on the bottom fish species mentioned above. It is possible that surf scoters (*Melanitta perspicillata*) or lesser scaup (*Aythya affinis*) feeding on shellfish may be exposed to bioaccumulatable contaminants at these sites, particularly at the Switzer Creek and Downtown Anchorage sites. Potential exposure to humans may occur through fishing activities that involve direct take of those bottom fish. Although fishing activity is generally not common within the direct confines of the sites, the mobility of the fish could provide a complete pathway for fishing activities that occur outside the site at nearby public fishing piers or in the open areas of the bay to the east of the site.

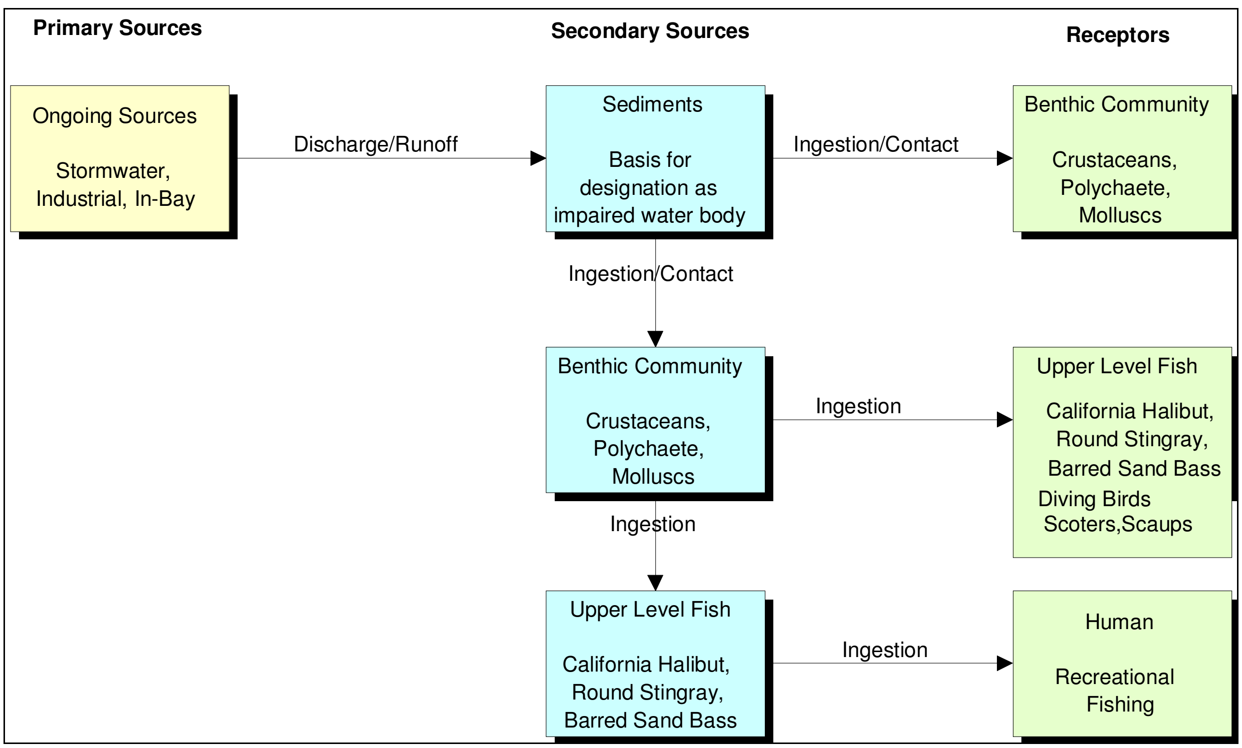

Figure 2-3. Generic site conceptual model for B Street/Broadway Piers. Downtown Anchorage and Switzer Creek showing the relationship between potential sources, pathways of exposure and receptors.

The measurements described in the following sections are designed to evaluate the exposure pathways conceptualized above. The sediment quality indicators were selected to provide quantifiable measurement endpoints to determine if these pathways of exposure are sufficient to drive significant ecological or human health risk.

2.3 SEDIMENT QUALITY INDICATORS

Up to four types of sediment quality indicators, as well as sediment characteristics necessary for indicator data interpretation will be measured at each station. Multiple indicators are necessary to increase the likelihood of an accurate determination of the presence or absence of sediment degradation at each site by supporting a weight of evidence approach to the data analysis. Each indicator is complementary to the others with regard to assessing the presence of an impact and determining whether impacts are related to chemical contamination.

Methods equivalent to those used in the BPTCP and Bight'98 regional surveys will be used wherever there is a choice. This will permit directly comparing results of the present study with region-wide values when evaluating impacts and temporal trends.

2.3.1 Sediment Contamination

Sediment chemical measurements will be used to document the extent, spatial pattern, and relative magnitude of sediment contamination at each study site, assess temporal trends through comparisons to prior measurements, and indicate the potential biological availability of sediment-associated trace metals.

The concentrations in surface sediments of the trace metals and organic contaminants measured in the Bight'98 survey (Appendix 1) will be measured at all sampling sites. The chemical analyses will use methods that are comparable to those used in the Bight'98 survey. Surface sediments are defined as those within 5 cm of the sediment-water interface.

2.3.2 Sediment Toxicity

Sediment toxicity tests will be used to document the extent, spatial pattern, and relative magnitude of acute toxicity and sublethal effects in the sediments at each study site.

Acute toxicity will measure survival of the amphipod crustacean, *Eohaustorius estuarius,* after 10 days of exposure to whole sediment (EPA 1994). Porewater and overlying water in the test chambers will be measured for ammonia; water changes will be performed as needed to reduce ammonia effects.

Sublethal sediment toxicity will be assessed by measuring the effects of porewater on sea urchin fertilization (EPA 1995). Porewater will be extracted from samples of surface sediment by centrifugation and diluted with laboratory seawater to obtain concentrations of 100, 50, and 25%. Sea urchin sperm will be exposed to each sample for 20 minutes and then the toxic effects are evaluated by measuring the ability of the sperm to fertilize eggs.

The possibility of toxicity due to unionized ammonia was assessed by comparing concentrations in the toxicity test containers to existing threshold effect and LC_{50} concentrations established for each species. In addition, concurrent unionized ammonia reference toxicant tests will be conducted with each lot of test organisms to verify tolerance to this constituent.

2.3.3 Toxicity Identification evaluations

Causes of toxicity were investigated in selected solid-phase samples using a weight-of-evidence approach based on comparisons of responses to bulk-phase chemical concentrations, evaluation of sediment physical and non-anthropogenic chemical attributes, and U.S. Environmental Protection Agency toxicity identification evaluations (TIEs). Where appropriate Phase I (characterization) and Phase II (identification) TIEs were conducted to determine causes of toxicity. Samples selected for TIEs were from stations demonstrating the greatest magnitude of toxicity in the Phase II studies.

2.3.4 Benthic Community Composition

The numbers and kinds of benthic invertebrates in sediment samples were used to characterize benthic communities at each study site.

Sediment collected using a 0.1m^2 Van Veen grab at each sampling site was sieved through a 1.0 mm-mesh screen onto a 0.5 mm screen. Animals retained on both screens analyzed separately were identified to the lowest possible taxon, and enumerated. Most taxa will be identified to species. These data were used to calculate the Benthic Response Index, as well as other metrics such as macroinvertebrate abundance, Shannon-Wiener Diversity, and species richness.

2.3.5 Sediment Characteristics

Sediment characteristics that influence the bioavailability of contaminants, the response of toxicity test organisms, and the structure of benthic communities were measured to distinguish biological impacts (i.e., toxicity or benthic community alteration) due to contaminants from those due to physical or non-anthropogenic factors.

The sediment grain size distribution and total organic carbon content of surface sediments were measured at each station using methods comparable to those used in the Bight'98 regional survey.

2.3.6 Bioaccumulation

Bioaccumulation tests was used to evaluate the potential for contaminant uptake and subsequent food chain transfer of organic chemicals and metals from the sediment. Samples from the B Street/Broadway Piers, Downtown Anchorage area, and Switzer Creek stations were compared to samples from appropriate reference stations to determine whether they pose a significantly greater potential for bioaccumlation. Bioaccumulation tests were conducted at reference stations and a subset of B Street/Broadway Piers, Downtown Anchorage area, and Switzer Creek stations that span the expected gradient of contamination at the site. Clams (*Macoma nasuta*) were tested using the standard laboratory 28-day exposure protocol (USEPA/USACOE 1991), with sufficient number of organisms to provide ~50-100 g of tissue (wet weight) for chemical analysis. Sediments were obtained from composite grabs from the top 5 cm at each station.

All trace metal and organic constituents to be measured in sediment samples were measured in clam tissues after exposure to study-area sediments for 28-days. The data were lipid normalized (where appropriate) and also compared to concentrations in tissue samples collected at the start of the experiment (t0). The test species is native to and widely distributed in San Diego Bay and actively ingests surface sediments. It is commonly used in dredged sediment studies (USEPA/USACOE 1991) because it provides enough tissue for trace level chemical analysis.

2.4 SEDIMENT SAMPLING

Sediments for Phase II studies were collected in February, August, and October 2004. Sample locations for the Phase II studies were based on the results of the Phase I studies. The three stations sampled in the Switzer Creek study area were SWZ01, SWZ02, and SWZ04. The three stations sampled in the B St./Downtown Piers study area were BST01, BST04, BST07. The three stations sampled in the Downtown Anchorage study area were DAC02, DAC03, and DAC04. Based on the weight-of-evidence from the Phase I studies, these were the most highly impacted stations in each study area, and so, were of greatest interest for temporal and TIE studies for Phase II.

Sampling methods were consistent with procedures used in the BPTCP (Fairey et al. 1996) and the Bight'98 surveys; a 0.1 m^2 Van Veen Grab was used for all sediment sampling. Sediment for chemical, toxicity, or bioaccumulation analyses was obtained from the upper 5 cm of the sediment surface. During each deployment of the grab sampler, sediment for toxicity, chemistry and bioaccumulation were collected from both sides of the grab sample. The entire contents of a separate grab sample from the station was processed for benthic community analysis (August 2004, only).

Approximately 4-7 replicate grab samples were taken at each station in order to provide sufficient sediment for all of the analyses, except at the bioaccumulation replicate stations where an additional 6-8 grabs will be required. Surface sediment from multiple grabs was composited together on board ship, mixed to obtain homogeneity. Samples was transported on ice to the clean facility at the Marine Pollution Studies Laboratory (Moss Landing), where they were re-homogenized and then distributed into separate containers for chemistry, toxicity and bioaccumulation testing.

A sufficient number of grab samples will be collected in each study area to determine temporal patterns of contamination and associated bioeffects. To account for temporal variability, all stations will be sampled three times: once during the wet season (February 2004), and twice during the dry season (August and October 2004). These data were compared to the Phase I data collected in the post-wet-season in May/June 2003. Because the majority of non-point source contaminant loadings in Southern California occur during the wet season (Schiff et al., 2001), it is possible that greater contamination and bioeffects will be observed in wet-season sample. Variability between seasons was compared using the wet and dry season samples collected as part of Phases II studies. Together, the four datasets collected as part of the Phase I and II studies are sufficient to describe temporal variability. Variability was assessed in terms of differences in the contaminant concentrations and the relative magnitude of bioeffects, and bioaccumulation. Toxicity, chemistry, sediment physical factors, and bioaccumulation was measured in all samples collected in Phase II. Because benthic community structure is highly influenced by seasonality, this component was measured only in the August 2004 samples in Phase II for comparison to the spring 2003 samples collected as part of the Phase I studies. May through August was selected as an appropriate index period for characterizing benthic community structure in southern California because the majority of invertebrate species recruitment occurs then (J. Oakden, personal communication).

2.4.1 Switzer Creek

The Switzer Creek study area (Figure 2-4) is located between the north side of the 10th Avenue Marine Terminal and the Campbell Shipyard Piers at the mouth of Switzer Creek. The total sediment surface area is approximately 28,000 m^2. Stations SWZ01, SWZ02, and SWZ04 were sampled 3 times (February, August, and October 2004; Fig. 2-4). The exact locations of Switzer Creek stations are listed in Appendix 2.

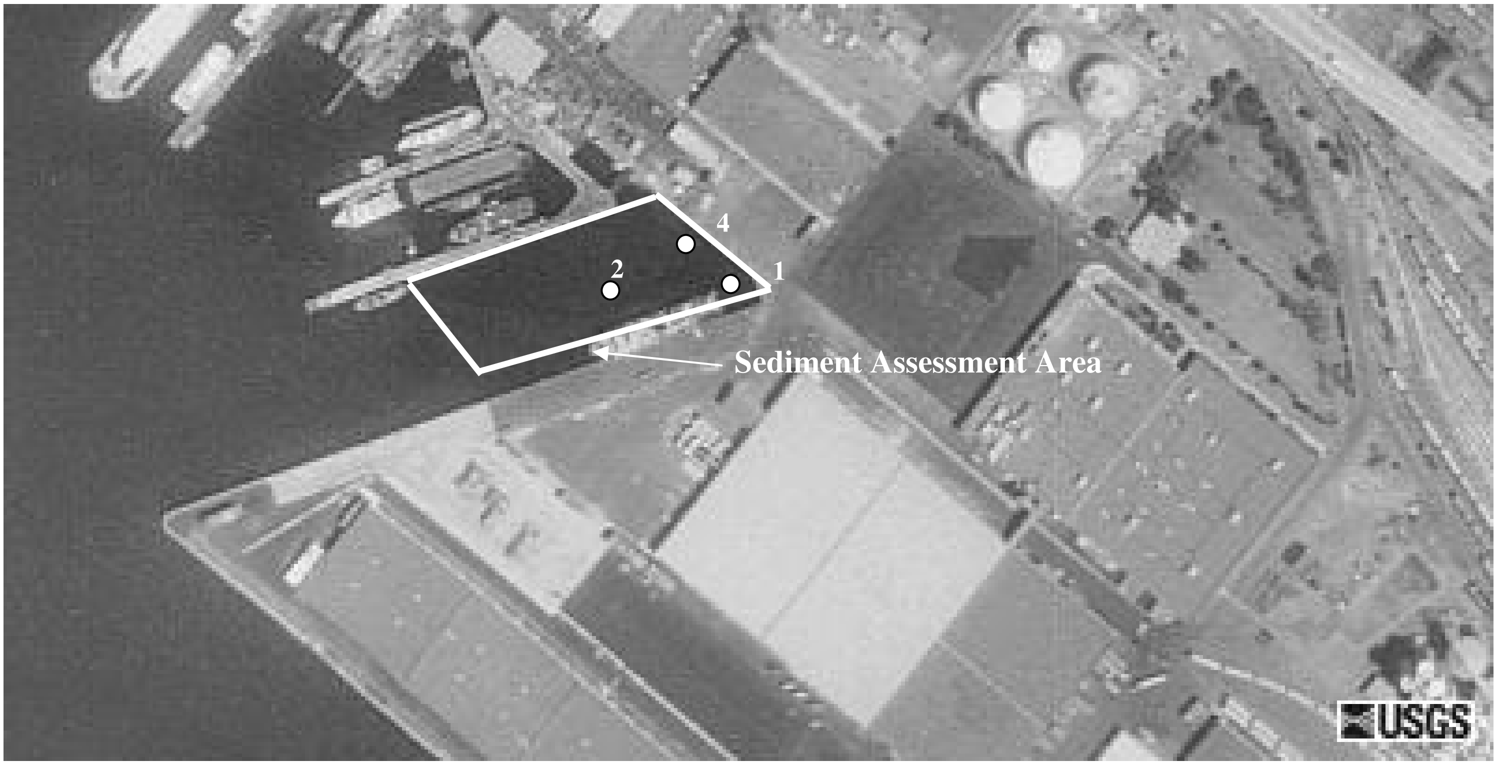

Figure 2-4. Switzer Creek study area with sample locations.

2.4.2 B Street/Broadway Piers

The B Street/Broadway Piers study area is located just south of the Municipal Pier, near the US Navy Reservation, and extends southwest approximately 100 m from the end of the Broadway Pier (Figure 2-5). Total sediment surface area is approximately 48,000 m^2. The 3 sampling stations were selected from those demonstrating the greatest contamination and toxicity based on the Phase I results (BST01. BST04, BST07) Specific locations of the B Street/Broadway Piers stations are summarized in Appendix 2.

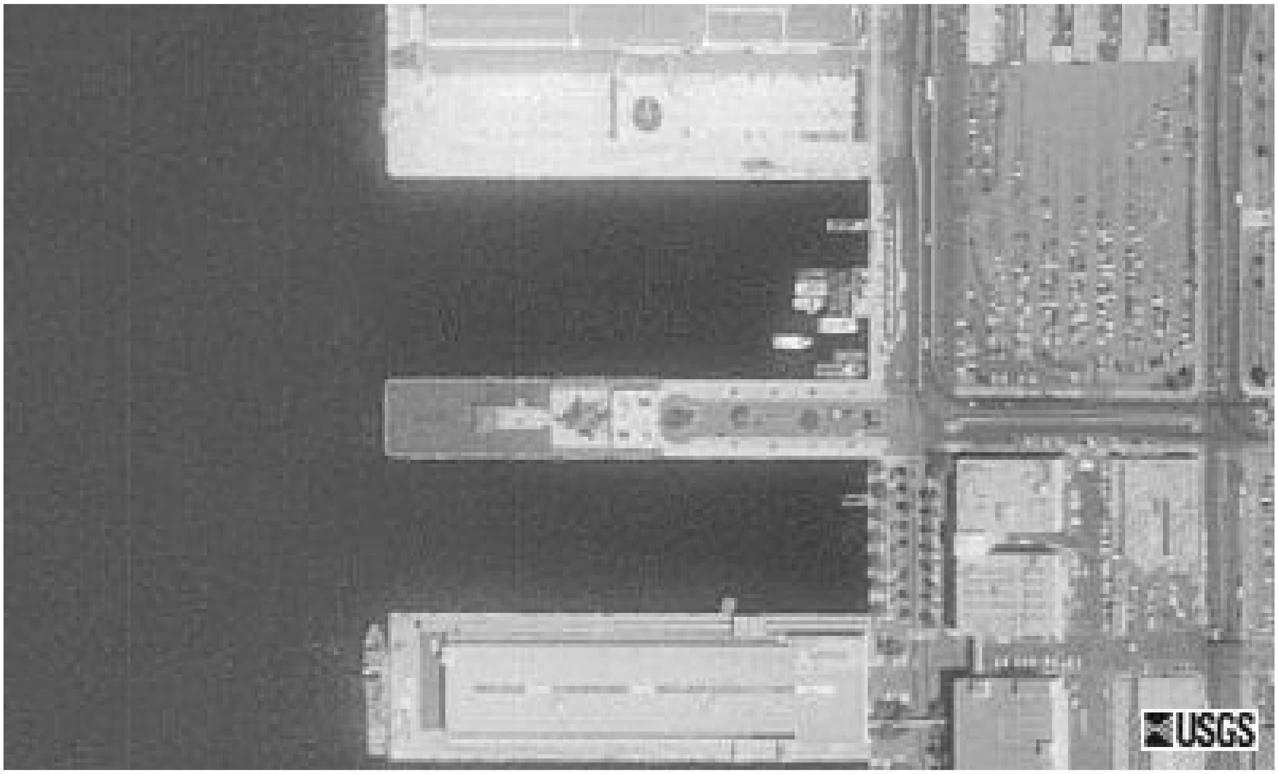

Figure 2-5. B Street/Broadway Piers study area with sample locations.

2.4.3 Downtown Anchorage

The Downtown Anchorage study area is located between Grape Street and Laurel Street in the vicinity of the U.S. Coast Guard Reservation (Figure 2-6). Total sediment surface area is approximately 32,000 m^2. The 3 sampling stations were selected from those demonstrating the greatest contamination and toxicity based on the Phase I results (DAC02, DAC03, DAC04). Specific locations of the Downtown Anchorage area stations are summarized in Appendix 2.

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