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California Regional Water Quality Control Board
San Diego Region

Total Maximum Daily Loads for Toxic Pollutants in Sediment at San Diego Bay Shorelines – Mouths of Paleta, Chollas, and Switzer Creeks

DRAFT TECHNICAL REPORT
June 5, 2013

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Draft Technical Report

Adopted by the
California Regional Water Quality Control Board
San Diego Region
on _____________, 2013

Approved by the
State Water Resources Control Board
on ______________, 200 x
and the
Office of Administrative Law
on ______________,200 x
and the
United States Environmental Protection Agency
on _____________, 200 x.

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STATE OF CALIFORNIA

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Acronyms and Abbreviations

BAP	Benzo(a)pyrene
BASINs	Better Assessment Science Integrating Point and Nonpoint Sources
BMPs	Best Management Practices
BPTCP	Bay Protection Toxic Cleanup Program
BU	Beneficial Use
CA LRM T20	Southern California Logistic Regression Model Approach, Threshold 20%
Caltrans	California Department of Transportation
CAO	Cleanup and Abatement Order
CoC	Chemical of concern
COMM	Commercial and Sport Fishing Beneficial Use
CWA	Clean Water Act
EFDC	Environmental Fluid Dynamic Code
ERL	Effects Range Low
ERM	Effects Range Median
EST	Estuarine Habitat Beneficial Use
HMW PAHs	High Molecular Weight PAHs
IR Program	Installation Restoration Program
JP-5	Jet Propellant Grade 5 Fuel
LA	Load Allocation
LMW PAHs	Low Molecular Weight PAHs
LOE	Line of Evidence
LRM	Logistic Regression Model Approach
LSPC	Loading Simulation Program C^{++}
MAR	Marine Habitat Beneficial Use
MEK	Methyl Ethyl Ketone Solvent
MEP	Maximum Extent Practicable
MLLW	Mean Lower Low Water
MLOE	Multiple Lines of Evidence
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NASSCO	National Steel and Shipbuilding Company
NAVSTA	Naval Base San Diego
NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OAL	Office of Administrative Law
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated biphenyls
PPPAHs	Priority Pollutant Polycyclic Aromatic Hydrocarbons
SANDAG	San Diego Regional Planning Agency
SCCWRP	Southern California Coastal Water Research Project
SDB Work Group	San Diego Bay Sediment TMDLs Work Group
SDRWQCB	Regional Water Quality Control Board, San Diego Region
SDUSD	San Diego Unified School District
SHELL	Shellfish Harvesting Beneficial Use
SQO	Sediment Quality Objective
SVOCs	Semi-Volatile Organic Compounds
SWDS	Storm Water Diversion System
SWMP	Storm Water Management Program
SWRCB	State Water Resources Control Board
TAMT	Tenth Avenue Marine Terminal
THS	Toxic Hot Spot
TIE	Toxicity Identification Evaluation
TMDLs	Total Maximum Daily Loads
TOC	Total Organic Carbon

TPH	Total Petroleum Hydrocarbons
TRPHs	Total Recoverable Petroleum Hydrocarbons
TSS	Total Suspended Solids
USDA	U.S. Department of Agriculture
U.S. EPA	U.S. Environmental Protection Agency
VOCs	Volatile Organic Compounds
WDRs	Waste Discharge Requirements
WILD	Wildlife Habitat Beneficial Use
WLA	Wasteload Allocations
WOE	Weight of Evidence
WQO	Water Quality Objective
WQS	Water Quality Standards
WQBELs	Water Quality Based Effluent Limits

Executive Summary

The purpose of this technical report is to present the development of the Total Maximum Daily Loads (TMDLs) for toxic pollutants in sediment at the mouths of Paleta, Chollas, and Switzer Creeks in San Diego Bay. Concentrations of total chlordane, total polycyclic aromatic hydrocarbons (PAHs), and total polychlorinated biphenyl (PCBs) in sediment at these locations that do not meet the narrative sediment quality objectives for the protection of benthic communities and human health (SQOs) as defined in the State Water Resources Control Board's (State Water Board) *Water Quality Control Plan for Enclosed Bays and Estuaries*. Failure to meet portions of these objectives unreasonably impairs and threatens the beneficial uses of San Diego Bay, including marine habitat (MAR), estuarine habitat (EST), wildlife habitat (WILD), commercial and sport fishing (COMM), and shellfish harvesting (SHELL).

These anthropogenic pollutants have been found to be either toxic to the marine invertebrates that inhabit the sediment in marine waters or bioaccumulate in marine life. As required by Clean Water Act section 303(d), TMDLs for chlordane, total PAHs, and total PCBs in sediment were developed to address toxicity and benthic community degradation impairments at the mouths of Paleta (7th Street Channel), Chollas, and Switzer creeks in San Diego Bay.

A TMDL represents the maximum amount of a pollutant that the waterbody can receive and still attain applicable water quality standards. To attain water quality standards, concentrations of these organic pollutants in the creek mouth sediments need to be reduced and their sources in each of the watersheds controlled. Numeric targets that represent sediment concentrations protective of benthic communities are set as concentration-based TMDLs for creek mouth sediments and used to develop mass-based TMDLs for watershed discharges. By applying the numeric target as the desired condition in the creek mouth areas, mass-based TMDLs and pollutant loads from watershed sources are determined. To protect all designated beneficial uses of San Diego Bay applicable to the creek mouth areas, water quality standards protective of human health are set as concentration-based TMDLs for water column and fish tissue concentrations within the creek mouth areas.

Because these organic pollutants have a tendency to bind to soil and organic particles, they are linked to the transport and deposition of suspended sediment. A comprehensive modeling approach was developed for these waterbodies that includes a watershed model and a receiving water model. The watershed models simulate watershed hydrology and the transport of sediment in the streams and storm drains that flow to the creek mouths. The receiving water models simulate the ability of the impaired waterbody to assimilate pollutant source loading from the watershed and other sources, and consider the dynamic effects of tidal flushing. For the purpose of the TMDL calculations, sediment data were compared to sediment numeric targets to assess the required pollutant load reductions needed to meet the SQO for the protection of benthic communties.

Several pollutant sources have impacted the shoreline areas at the mouths of Paleta, Chollas, and Switzer Creeks in San Diego Bay. These include legacy and active point and nonpoint sources, including municipal and industrial discharges and atmospheric deposition, that contribute toxic pollutants through various mechanisms and complex processes. Point sources include Phase I Municipal Separate Storm Sewer Systems (MS4s), Phase II Small MS4s, Caltrans MS4, Statewide General Industrial and Construction Storm Water discharges, and adjacent shoreline sources with Individual Waste Discharge Requirements (WDRs). Atmospheric Deposition represents the primary nonpoint pollutant source. Other sources include dynamic sediment flux, resuspension of sediment from natural processes and anthropogenic activities, leaching from creosote pier pilings, and various industrial/military activities. Pollutant sources were represented within the modeling framework in order to determine the relative contribution and impact of these sources on the impaired creek mouth areas.

The comprehensive modeling system was used to assess the linkage between pollutant sources and receiving water conditions for the mouths of Paleta, Chollas, and Switzer Creeks. Model development was based on the results of previous studies and available monitoring data, including recent storm water monitoring data collected by the City of San Diego. Watershed models using U.S. EPA's Loading Simulation Program in C++ (LSPC) were used to simulate watershed hydrology and transport of sediment in the streams and storm drains conveying pollutants to the three impaired areas. Receiving water models were developed using the Environmental Fluid Dynamics Code (EFDC) to simulate the fate and transport of suspended sediment and toxic pollutants to determine the assimilative capacity of the impaired areas. Watershed pollutant loads from LSPC were input into the EFDC models to provide dynamic simulation of tidal flushing, sediment deposition/resuspension, and transport of suspended sediment and associated pollutants.

TMDLs were calculated using the model results for the critical high flow year (October 2004 through September 2005). Model assumptions included reducing bed sediment concentrations to numeric target levels, which assumes future remediation of contaminated sediments that may continue to contribute pollutant loads to the impaired creek mouth areas. As a result, the TMDLs and wasteload allocations (WLAs) focus on reducing existing watershed pollutant load contributions, as needed, to meet the TMDL targets. Load allocations (LAs) were calculated for direct atmospheric deposition of total chlordane to the waterbody. Explicit margins of safety of 20 percent for total chlordane and 5 percent for both total PAHs and total PCBs were reserved to account for uncertainty in developing the relationship between pollutant discharges and water quality impacts. The calculated TMDLs, WLAs, LAs, and MOS for each impaired waterbody are summarized in the following table.

Summary of the Mass-Based Toxic Pollutants in Sediment TMDLs for Paleta, Chollas, and Switzer Creeks

Paleta Creek TMDL WLAs, LAs, MOS, and TMDLs

		San Diego WLA	La Mesa WLA	Lemon Grove WLA	SD County WLA	National City WLA	Caltrans WLA	U.S Navy WLA	SD Port District WLA	WLA Total	LA	MOS	TMDL
Chlordane	g/d	0.048	NA	NA	NA	0.023	0.003	0.009	NA	0.083	0.001	0.021	0.105
Total PAHs	g/d	1.75	NA	NA	NA	0.86	0.11	0.32	NA	3.04	0	0.16	3.20
Total PCBs	mg/d	0.240	NA	NA	NA	0.118	0.014	0.044	NA	0.416	0	0.022	0.438

Chollas Creek TMDL WLAs, LAs, MOS, and TMDLs

		San Diego WLA	La Mesa WLA	Lemon Grove WLA	SD County WLA	National City WLA	Caltrans WLA	U.S Navy WLA	SD Port District WLA	WLA Total	LA	MOS	TMDL
Chlordane	g/d	0.340	0.046	0.056	0.002	NA	0.014	0.001	0.001	0.460	0.004	0.118	0.582
Total PAHs	g/d	8.90	1.20	1.48	0.05	NA	0.37	0.03	0.01	12.04	0	0.63	12.67
Total PCBs	mg/d	2.32	0.31	0.39	0.01	NA	0.10	0.01	0.01	3.15	0	0.16	3.31

Switzer Creek TMDL WLAs, LAs, MOS, and TMDLs

		San Diego WLA	La Mesa WLA	Lemon Grove WLA	SD County WLA	National City WLA	Caltrans WLA	U.S Navy WLA	SD Port District WLA	WLA Total	LA	MOS	TMDL
Chlordane	g/d	0.046	NA	NA	NA	NA	0.001	NA	0.001	0.048	0.001	0.012	0.061
Total PAHs	g/d	1.32	NA	NA	NA	NA	0.04	NA	0.02	1.38	0	0.07	1.45
Total PCBs	mg/d	0.49	NA	NA	NA	NA	0.01	NA	0.01	0.51	0	0.03	0.54

Notes: g/d = grams per day, mg/d = milligrams per day, NA = not applicable

Concentration-based TMDLs are required to address the impaired sediment conditions that exist in the three waterbodies. Numeric targets, expressed as sediment, water column, and fish tissue concentrations were the basis for the concentration-based TMDLs. These concentration-based TMDLs will provide protection to benthic communities in the waterbodies from direct effects of these pollutants and protection of human health from pollutants that bioaccumulate.

In order to ensure that the TMDL requirements are met, and as required under state law, an Implementation Plan has been developed that describes the regulatory and enforcement actions that the San Diego Water Board will take to remove legacy pollutants from creek mouth sediments, reduce pollutant loading from the watershed to the creek mouth areas, and require monitoring of effluent and receiving waters. The mass-based TMDLs will be implemented by reissuing or revising the existing NPDES requirements for storm water discharges to include water quality-based effluent limits (WQBELs) and/or TMDL implementation requirements. As part of TMDL implementation, dischargers are required to develop Load Reduction Plans that include a management and source control program that utilizes structural and non-structural best management practices and a monitoring and reporting program. Enforcement actions will be taken to direct contaminated marine sediment remediation and investigate unidentified sources in the tidally-influenced segments of the three watersheds, new or emerging sources of sediment toxicity in the creek mouth areas, and pollutant concentrations in tissue of finfish and lobster in the creek mouth areas. A compliance schedule for meeting the required pollutant reductions and implementation requirements is included in the Implementation Plan. The Implementation Plan also includes a a re-evaluation clause which can be used to refine the TMDLs and required load reductions, and/or modify compliance requirements.

This report includes information related to the technical development of mass-based and concentration based TMDLs for three impaired surface waters located in San Diego Bay at the mouths of Paleta, Chollas, and Switzer Creeks. Mass-based TMDLs for total chlordane, total PAHs, and total PCBs were developed for discharges to the creek mouth areas. Concentration-based TMDLs are established for total chlordane, priority pollutant PAHs, and total PCBs in sediment and total chlordane, benzo(a)pyrene, and total PCBs in water within the creek mouth areas.

1. Introduction

Section 303(d) of the Clean Water Act (CWA) requires states to conduct biennial assessments of waters not meeting water quality standards and to develop lists of "water quality limited segments" for impaired surface waterbodies. The waters identified as not meeting water quality standards, or "impaired waters," are placed on a CWA section 303(d) List of Water Quality Limited Segments (a.k.a. the "303(d) List"). States are further required to establish a priority ranking for listed water quality limited segments and to establish Total Maximum Daily Loads (TMDLs) for these waterbodies. A TMDL establishes the allowable load of a pollutant based on the relationship between pollutant sources and attainment of water quality standards. It provides the scientific basis to establish water quality-based controls to reduce pollution from point and nonpoint sources to attain water quality objectives and restore and protect the beneficial uses of the impaired waterbody.

A TMDL is developed for a specific pollutant and waterbody combination. When developing a "TMDL project," several TMDLs may be developed at once. A TMDL project may include TMDLs that address one waterbody and one specific pollutant, multiple waterbodies and one specific pollutant, one waterbody and multiple pollutants, or multiple waterbodies and multiple pollutants.

For this Project, TMDLs were developed for multiple waterbodies and multiple pollutants. TMDLs have been developed to address three water quality limited shoreline segments located in San Diego Bay. The mouths of Paleta, Chollas, and Switzer Creeks were added to the 303(d) List for non-attainment of their beneficial uses (see Section 2.3.1). Fairey et al. (1996) reported that sediments within these waterbodies were impacted and, therefore, they were deemed "toxic hot spots" by the state of California. The California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) added the creek mouth areas for Paleta and Chollas creeks to the 303(d) List in 1998 and the creek mouth area for Switzer Creek in 2002. The mouths of Paleta and Chollas creeks are listed as impaired by sediment toxicity and benthic community effects, while the mouth of Switzer Creek is listed as impaired from elevated concentrations of chlordane and polycyclic aromatic hydrocarbons (PAHs).

This TMDL Project is developed to address chlordane, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) as the pollutants causing impairment of the beneficial uses in the three creek mouths in San Diego Bay. It includes mass-based TMDLs to control watershed discharges and concentration-based TMDLs for the creek mouths' sediment and waters. In this case, the TMDLs are intended to provide sediment quality that supports for healthy benthic communities and protects human health and aquatic dependent wildlife from bioaccumulation of toxic pollutants in the food web, especially human health from ingestion of contaminated fish from the bay.

The TMDLs are calculated using the analytical procedures and results presented in this technical report including the following 7 components: (1) a **Problem Statement** describing the water quality objectives that are not being attained and beneficial uses that are impaired; (2) identification of **Numeric Targets** that, if met will result in attainment of the water quality objectives and protection of beneficial uses; (3) a **Source Analysis** to identify all of the point and nonpoint sources of the impairing pollutant and to estimate the current pollutant loading for each source; (4) a **Linkage Analysis** to calculate the **Loading Capacity** of the waterbody for the pollutant; i.e., the maximum amount of the pollutant that may be discharged to the waterbody without causing exceedances of water quality objectives and impairment of beneficial uses; (5) a **Margin of Safety** (MOS) to account for uncertainties in the analysis; (6) the division and **Allocation** of the TMDL among each of the contributing sources in the watershed; wasteload allocations (WLA) for point sources and load allocations (LA) for nonpoint and background sources; and (7) a description of how **Seasonal Variation and Critical Conditions** are accounted for in the TMDL determination.

The scientific basis of this technical TMDL analysis has undergone external peer review pursuant to Health and Safety Code section 570004. The San Diego Water Board has considered and responded to all comments submitted by the peer review panel. Based on the peer review commnets, corrections were made to this Technical Report, the modeling reports in Appendices C-2, D, and E, and Appendices F. The peer reviewers' comments and the San Diego Water Board's responses are contained in Appendix A.

This Technical Report also includes an **Implementation Plan** that describes the actions that the San Diego Water Board will take to further address prior and future toxic pollutant discharges to the bay shoreline segments. The dischargers will be responsible for implementing measures to cleanup contaminated sediment, meeting their assigned WLAs in compliance with the TMDLs, and monitoring effluent and/or receiving waters to assess the effectiveness of the implementation measures. The implementation provisions also require the dischargers to report results from studies to fill data gaps, refine the TMDLs and required load reductions, or propose alternative compliance requirements, if determined to be necessary. Public participation is a key element of the TMDL development process; the San Diego Water Board encourages stakeholder involvement for TMDL development.

The final provisions of the TMDLs are incorporated into the *Water Quality Control Plan for the San Diego Basin (9)* or "Basin Plan" (RWQCB 1994). The San Diego Water Board typically initiates a public comment period and hearing process leading to adoption of a resolution amending the Basin Plan to incorporate the TMDLs, allocations, reductions, compliance schedule, and implementation plan. Pursuant to the California Environmental Quality Act (CEQA), most Basin Plan amendments, including TMDL amendments, must undergo an evaluation of the environmental impacts and costs from complying with the amendment.

Basin Plan amendments do not take effect until they have undergone subsequent agency approvals by the State Water Resources Control Board (State Water Board) and the Office of Administrative Law (OAL). In the case of Basin Plan amendments containing TMDLs, the United States Environmental Protection Agency (U.S. EPA) must approve the amendment following approval by OAL. The tentative Resolution and draft Basin Plan amendment associated with this Project are contained in Appendix B.

The technical analyses presented in this document relied on the development and application of computer models of San Diego Bay and the applicable watersheds. The models were used to quantify the connection between pollutant sources and the impaired waterbodies, as described in the Linkage Analysis (Section 6).

In addition to pollutant loading assessments within each watershed, TMDLs were calculated for each selected water quality limited segment located in the bay shoreline areas (i.e., the mouths of the three creeks). TMDL calculations were based on a comprehensive modeling system (described in Appendices C, D and E), which linked watershed hydrology, receiving water hydrodynamics, and their pollutant loading characteristics. The Loading Simulation Program C++ (LSPC) (Shen et al. 2004; U.S. EPA 2003b) was applied to simulate watershed hydrology and pollutant loading. The Environmental Fluid Dynamic Code (EFDC) (Hamrick 1992 and 1996; U.S. EPA 2003a) was used to simulate the complex flow and pollutant transport patterns in the bay.

Model results were used in the calculation of the total allowable pollutant loading to the impaired waterbodies. These TMDLs are reported for each shoreline segment (Table 8-1) and allocated to point and nonpoint source dischargers.

2. Problem Statement

The San Diego Water Board previously identified the Paleta, Chollas, and Switzer Creek mouth areas as three of five priority Toxic Hot Spots in San Diego Bay (SWRCB 1999): specifically, 9 acres located near the mouth of Paleta Creek/7th Street Channel, 15 acres near the mouth of Chollas Creek, and 5.5 acres near the mouth of Switzer Creek in San Diego Bay. The San Diego Water Board identified the areas located near the mouths of Paleta Creek and Chollas Creek as priorities for establishing TMDLs that address toxicity and benthic community degradation in the marine sediment on the 1998 303 (d) List of Water Quality Limited Segments. The area at the mouth of Switzer Creek was identified as a priority for establishing TMDLs that address toxicity impairments due to elevated concentrations[1] of chlordane and PAHs in marine sediment and was originally included on the 2002 303 (d) List of Water Quality Limited Segments.

[1] Lindane was delisted in December 2009 by the San Diego Water Board. See section 2.4 for more detail.

Toxicity is the adverse response of organisms to chemicals or physical agents (RWQCB 1994). To protect aquatic life from toxic pollutants, the Water Quality Control Plan for Enclosed Bays and Estuaries: Part 1 Sediment Quality (Enclosed Bays and Estuaries Plan; SWRCB 2009) contains sediment quality objectives (SQOs) for San Diego Bay. Benthic organisms living in continual contact with sediment and pore water are at greatest risk of adverse effects from direct exposure to contaminated sediment. The aquatic life – benthic community SQO requires the integrated use of sediment chemisty, sediment toxicity, and benthic community condition to assess attainment of the objective.

Several sediment quality studies that included sediment chemistry, sediment toxicity, benthic community analysis, bioaccumulation, and toxicity identification evaluations (TIE) were considered by the San Diego Water Board to evaluate impairment and determine the source of toxicity to organisms in the sediment. The source of toxicity to benthic organisms was identified as non-polar organics, such as pesticides, PAHs, and PCBs, at all three sites in TIE studies. Greenstein et al. (2005) reported that the probable cause of toxicity at Chollas Creek mouth was attributed to concentrations of chlordane and PAHs, and the probable cause of toxicity at Paleta Creek mouth was attributed to concentrations of PAHs. Greenstein et al. (2005) also reported that the results of the study suggest that sediment toxicity may be due to pollutant mixtures at both Chollas and Paleta creek mouths.

While Greenstein et al. (2005) did not conclude that concentrations of PCBs were found at levels likely to cause direct toxicity to amphipods or at levels high enough to affect survival, growth, or development of sea urchin embryos, Southern California Coastal Water Research Project (SCCWRP) and Space and Naval Warfare Systems Center (SPAWAR) (2005) did find that PCBs were found to bioaccumulate in clam tissue exposed to site sediments. SCCWRP and SPAWAR (2005) also reported that benzo(a)pyrene (BAP), a PAH, was found to bioaccumulate in clam tissue at both Chollas and Paleta creek mouth areas. Additionally, PCB-contaminated bay sediments at both Chollas and Paleta creek sites are potential sources contributing to elevated fish tissue concentrations found in San Diego Bay.[2]

For Switzer Creek, Anderson et al. (2005) reported that sediment toxicity was highly correlated with chlordane and PCB concentrations and weakly correlated with pollutant mixtures present in the sediment, including PAHs. Anderson et al. (2005) also reported that clams exposed to site sediments were bioaccumulating BAP, potentially impairing aquatic-dependent wildlife. This site is also considered a potential source contributing to elevated fish tissue PCB concentrations found in San Diego Bay.

[2] San Diego Bay was listed on the 2006 CWA section 303(d) List for impaired waters for PCBs due to elevated fish tissue concentrations.

Sediment pollutant concentrations in the Paleta, Chollas, and Switzer Creek mouths do not meet the Enclosed Bays and Estuaries Plan SQOs for benthic community protection or human health (Bay 2007; SWRCB 2009; SCCWRP and SPAWAR 2005). Elevated levels of pollutants in the sediment unreasonably impair and threaten the designated beneficial uses of San Diego Bay, including estuarine habitat (EST), marine habitat (MAR), wildlife habitat (WILD), commercial and sport fishing (COMM), and shellfish harvesting (SHELL) beneficial uses. The pollutants causing aquatic life beneficial use impairment are chlordane and total PAHs. The pollutant causing human health beneficial use impairment is total PCBs.

For this Project, the San Diego Water Board developed TMDLs and an Implementation Plan for chlordane, priority pollutant PAHs (PPPAHs), and total PCBs to attain the SQOs needed to support the beneficial uses of San Diego Bay. To determine existing wasteloads and assign TMDLs to these impaired waterbodies, the technical approach included modeling to simulate flows and pollutant transport within the local watersheds (i.e., Paleta, Chollas, and Switzer Creeks) that drain to San Diego Bay shoreline areas and linking these models to a receiving water model to estimate the assimilative capacity of the bay's impaired areas.

2.1 Project Area Description

San Diego Bay is a semi-enclosed, crescent-shaped bay opening to the Pacific Ocean in southern California. The bay is approximately 24 kilometers (km) in length and varies from about 0.4 to 5.8 km in width (Fairy et al. 1996). Extensive dredging of channels and near-shore filling over time has significantly altered the bay in terms of depth and width. Depths vary from less than one meter in the southern portion of the bay to 18 meters near the mouth, with an average depth of 12 meters (Fairey et al. 1996).

San Diego Bay's northern, central, and southern areas differ in hydrologic characteristics. High current velocities and rapid tidal flushing characterize the northern reaches of the bay, where tidal currents primarily control surface water mixing. These characteristics decrease into the central and southern reaches of the bay, which are characterized by lower current velocities and longer contaminant residence times (Valkirs et al. 1994). The semi-enclosed marinas and commercial basins located throughout the bay also experience reduced tidal flushing and increased contaminant residence times (Seligman and Zirino 1998).

There is very little freshwater input to the bay and its salinity approaches that of seawater, especially closer to the mouth. During the dry season, the bay may be characterized as hypersaline, particularly in the southern reaches of the bay (Largier 1995). Both temperature and salinity values increase from the mouth to the southern reaches of San Diego Bay (Katz 1998).

The drainage area for San Diego Bay includes the Sweetwater, Otay, and Pueblo San Diego watersheds with a total land area of 1,144 square kilometers (km^2) (282,689 acres). Surface water runoff from these watersheds drains directly to the bay. The impaired waterbody segments addressed in this TMDL report are the shoreline areas located at the mouths of Paleta, Chollas, and Switzer Creeks (Figure 2-1), which are all located in the Pueblo San Diego Watershed. The shoreline impairments are due to toxicity from pollutant sources such as urban runoff/storm water conveyance systems, boatyards, and other point and nonpoint sources of pollution (see Section 5). Sections 2.1.1, 2.1.2, and 2.1.3 provide more detailed descriptions of the impaired shoreline segments at the mouths of Paleta, Chollas, and Switzer Creeks and their respective watersheds.

The climate in the region is generally mild with annual temperatures averaging around 65°F near the coastal regions. Annual average rainfall ranges from 9 to 11 inches along the coast to more than 30 inches in the eastern mountains. There are two distinct climatic periods: a dry period from late April to mid-October and a wet period from mid-October through late April. The wet period provides 85 to 90 percent of the annual rainfall in the region (County of San Diego 2000).

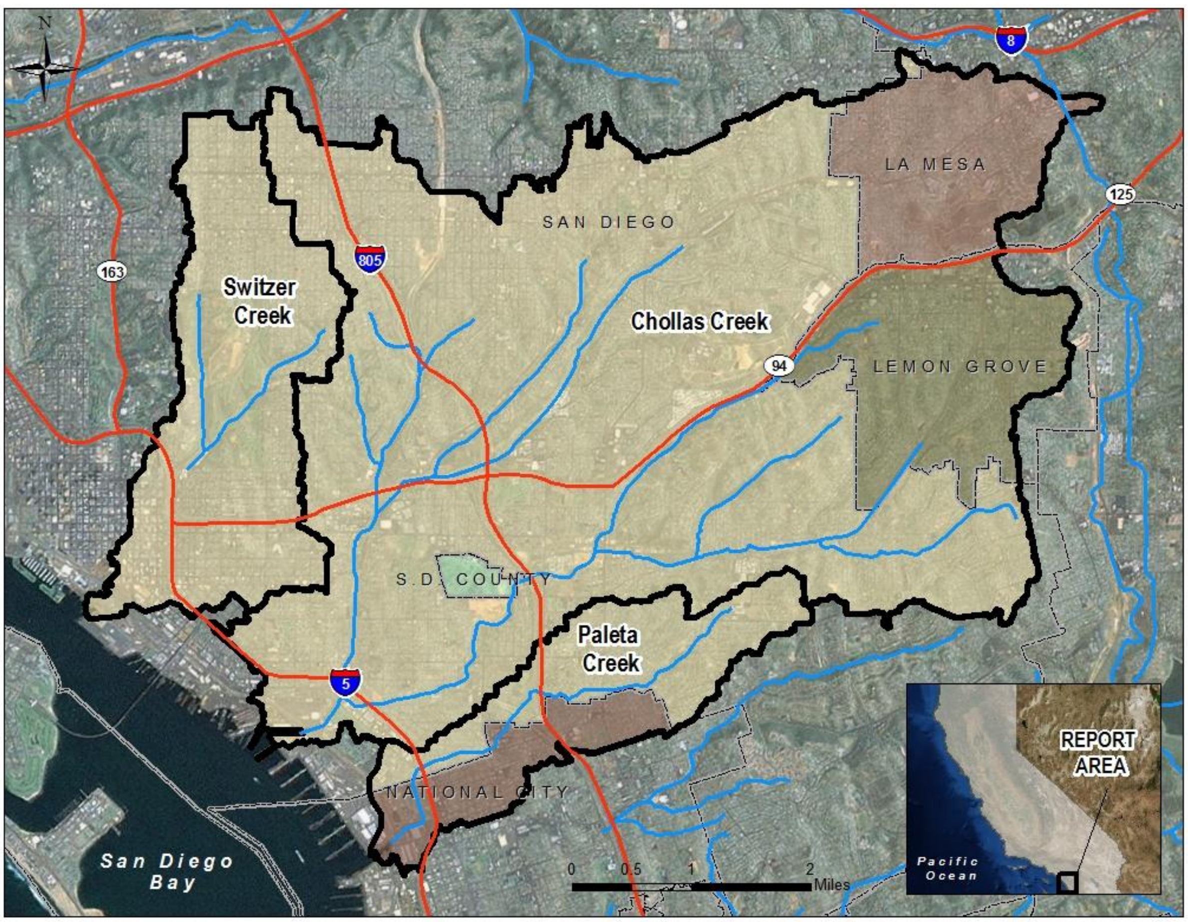

Figure 2-1. Location of San Diego Bay and the Paleta Creek, Chollas Creek, and Switzer Creek watersheds.

The three watersheds are highly urbanized, with commercial and industrial land uses dominating the shoreline around the bay. Much bayside property is owned and operated by the U.S. Navy and the San Diego Unified Port District (Port of San Diego). Industries located along the bay may be divided into three general catagories: maritime, including boatyards and shipyards, aerospace, and various other industries. San Diego Bay is also valued as a wildlife habitat and refuge for migratory and estuarine birds, endangered species, marine mammals, and as a spawning area for near-shore marine fishes. In addition, San Diego Bay supports many recreational uses including swimming, sailing, sport fishing, and recreational boating. See Section 2.3.1 for the bay's designated/beneficial uses.

Table 2-1 lists the areas of each watershed draining to the impaired shoreline segments and the land uses located in those watershed areas based on the SANDAG 2009 land use dataset. The contributing drainage area of each watershed was computed by an aggregation of catchments (subwatersheds) to better evaluate sources contributing to the waterbodies and to represent the spatial variability of these sources. These subdivisions were based on Digital Elevation Model (DEM) data and GIS defining the storm water conveyance system (obtained from SANGIS). Figure 2-2 presents the land use coverage for the three watersheds along with the delineated subwatersheds.[3] The land uses incorporating the largest acreage (and percent of area) in the three watersheds include: low density residential, roads, high density residential, commercial institutional, and open space/recreation. Much of the high density residential is located in the downtown area of Switzer Creek watershed, the northern portions of Switzer Creek watershed, and the north branch of the Chollas Creek watershed. Industrial land uses are mainly concentrated near and along the bay.

[3] Figure 2-2 is a representation of the most up-to-date watershed delineation used in the watershed models as discussed in Section 6, below, and Appendices C, D, and E.

Table 2-1. Watershed and land use areas

Land Use	Paleta Area (acres)	Paleta % Total	Chollas Area (acres)	Chollas % Total	Switzer Area (acres)	Switzer % Total
Agriculture	NA	NA	3.14	0.02%	11.65	0.36%
Commercial	81.58	3.78%	1,066.90	6.19%	133.56	4.15%
Freeway	127.34	5.89%	887.49	5.15%	130.43	4.05%
High Density Residential	182.58	8.45%	2,282.64	13.25%	602.81	18.72%
Industrial	10.70	0.50%	291.80	1.69%	64.64	2.01%
Institutional	85.39	3.95%	725.38	4.21%	186.41	5.79%
Low Density Residential	866.22	40.09%	6,267.84	36.39%	471.81	14.65%
Military	192.17	8.89%	48.45	0.28%	NA	NA
Open Space	52.27	2.42%	708.63	4.11%	48.84	1.52%
Recreation	65.86	3.05%	1,307.56	7.59%	604.93	18.79%
Road	469.91	21.75%	3,480.03	20.21%	828.10	25.72%
Rural Residential	NA	NA	14.87	0.09%	NA	NA
Transportation	19.39	0.90%	115.75	0.67%	131.42	4.08%
Water	7.26	0.34%	22.60	0.13%	5.63	0.17%
Total	**2,160.66**		**17,223.10**		**3,220.22**	

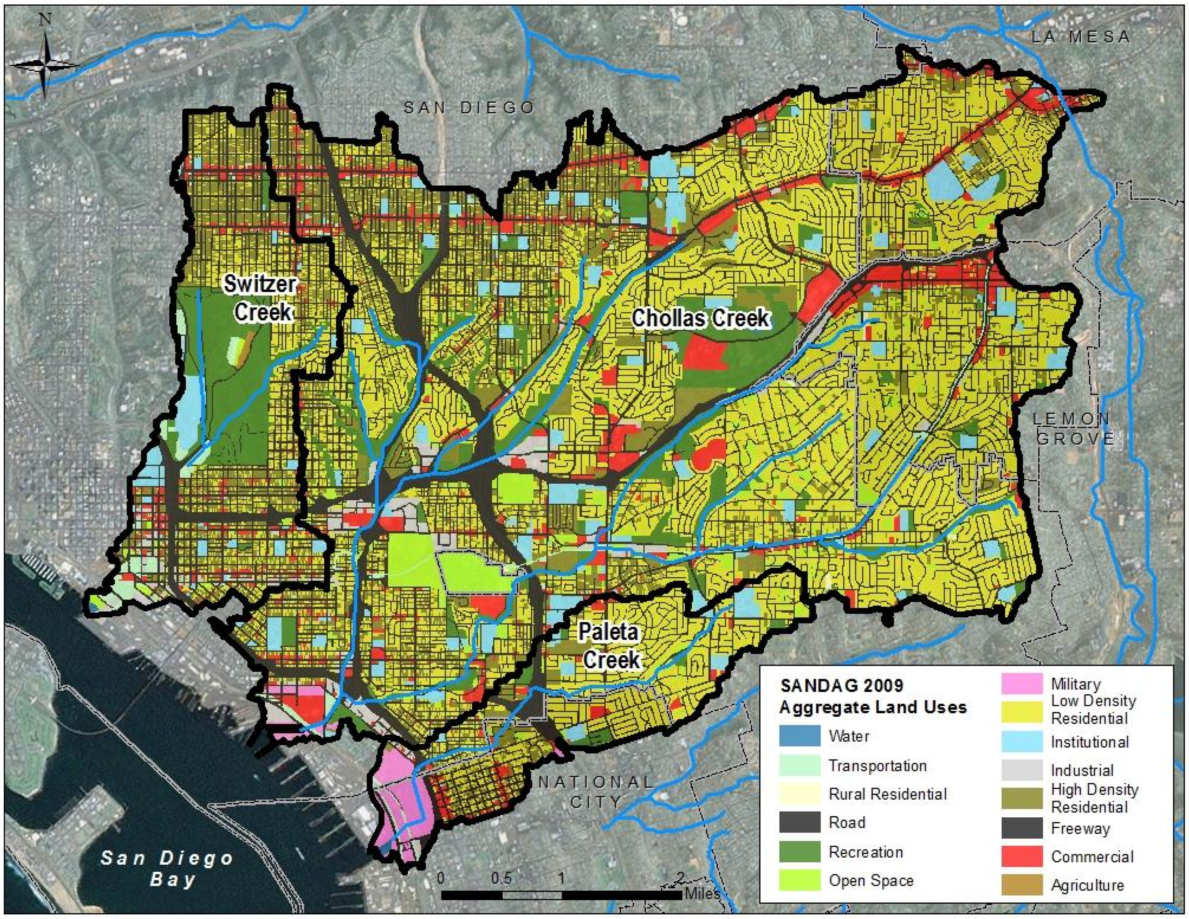

Figure 2-2. Land use coverage

2.1.1 *7th Street Channel/Paleta Creek Estuary and the Paleta Creek Watershed*

Paleta Creek is located on the eastern shoreline in the central portion of San Diego Bay (Figure 2-1). The TMDL project area is located at the mouth of the creek bounded on the east by Cummings Road, bounded on the north by Naval Base San Diego Pier 8, to the south by the Naval Base San Diego Mole Pier, and extending to the end of the piers (as illustrated in Figure 2-3). The impaired area includes 9 acres located at the mouth of the creek, as estimated on the 303(d) List of Water Quality Limited Segments. The final project area, as defined in the Phase I Sediment Assessment Study (SCCWRP and SPAWAR 2005), is approximately 64.5 acres (0.261 km^2).

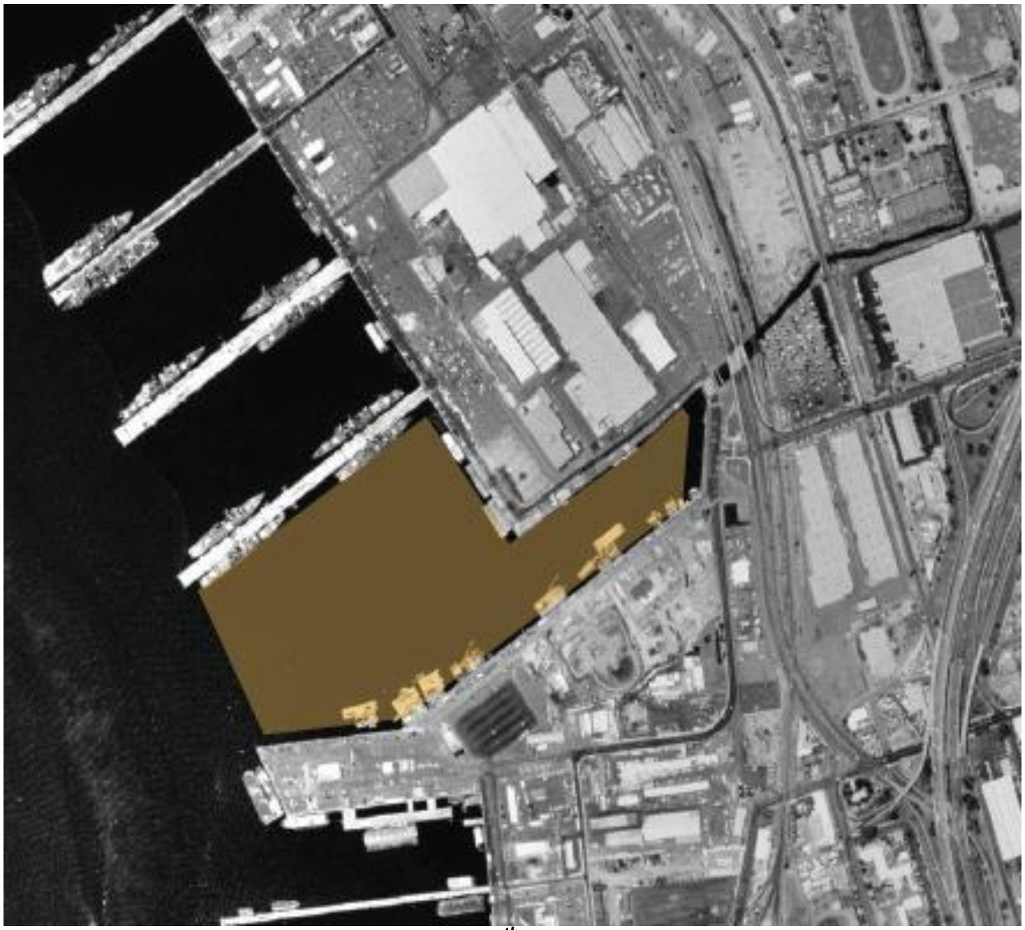

Figure 2-3. TMDL Project Area for 7th Street Channel/Paleta Creek Mouth
Source: Schiff and Carter (2007)

Paleta Creek is a channelized urban creek with the highest flow rates associated with storm events and highly variable flows for the rest of year. Extended periods with no surface flows occur during dry weather, although pools of standing water may be present.

The Paleta Creek watershed encompasses approximately 8.8 square kilometers (km^2) (2,161 acres) in the Pueblo San Diego hydrologic unit. Portions of the cities of San Diego and National City are located in the watershed. A small portion of the watershed consists of "tidelands" immediately adjacent to San Diego Bay under the jurisdiction of the U.S. Navy. The watershed is highly urbanized (Table 2-1 and Figure 2-2). Land uses are predominantly residential, with some commercial and military uses. A significant portion of the remaining watershed area is dominated by roadways.

The State Water Board identified the 7th Street Channel/Paleta Creek as a high priority candidate toxic hot spot due to repeat amphipod sediment toxicity findings and the presence of multiple degraded benthic communities in the Consolidated Toxic Hotspots Cleanup Plan (SWRCB 1999).

2.1.2 *Chollas Creek Estuary and Watershed*

Chollas Creek is located north of Paleta Creek on the eastern shoreline in the central portion of San Diego Bay (Figure 2-1). The project area at the mouth of Chollas Creek is bounded on the east by the weir located downstream of the Belt Street Bridge, on the north by the National Steel and Shipbuilding Company (NASSCO) pier, and to the south by Naval Base San Diego Pier 1 extending to the end of the piers (as illustrated in Figure 2-4). The impaired area includes 15 acres located at the mouth of the creek, as estimated on the 303(d) List of Impaired Water Quality Segments. The final project area, as defined by the Phase I Sediment Assessment Study (SCCWRP and SPAWAR 2005), is approximately 24.9 acres (0.101 km^2).

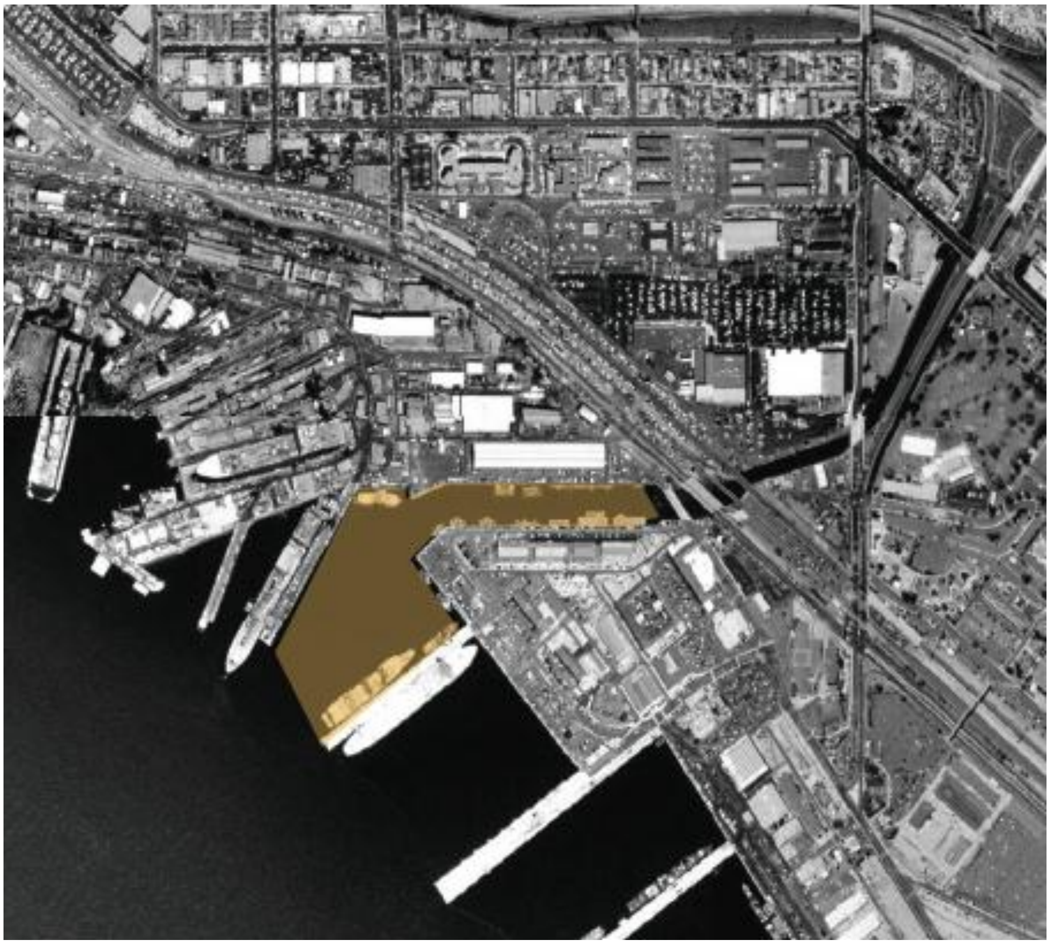

Figure 2-4. TMDL Project Area for Chollas Creek Mouth
Source: Schiff and Carter (2007)

Chollas Creek is an urban creek with the highest flow rates associated with storm events and highly variable flows for the rest of the year. Extended periods with no surface flows occur during dry weather, although pools of standing water may be present. The average annual rainfall in the watershed (from October 1948 through February 2005) measured at La Mesa, California is approximately 12.9 inches (WRCC 2006). Rainfall statistics for the San Diego International Airport (Lindbergh Field, located approximately 4 miles northwest of Chollas Creek, near San Diego Bay) indicate that an average of 18 storms occur each year (Weston 2008).

Much of Chollas Creek has been channelized and concrete lined, but some sections of earthen creek bed remain. The lowest 1.2 miles of the creek are on the 303(d) List of Water Quality Limited Segments for water quality impairments from indicator bacteria, copper, lead, and zinc. The San Diego Water Board has completed several TMDLs to address water quality impairments in the Chollas Creek watershed. Table 2-2 presents the status of the TMDLs adopted for Chollas Creek.

Table 2-2. Adopted TMDLs for Chollas Creek watershed

TMDL(s)	San Diego Water Board TMDL Adoption Date	TMDL Approval Dates
Diazinon	August 2002	OAL approval September 2003 U.S. EPA approval November 2003
Dissolved copper, lead, and zinc	June 2007	OAL approval October 2008; U.S. EPA approval December 2008
Indicator Bacteria	February 2010	OAL approval April 2011; U.S. EPA approval June 2011

Note: Office of Administrative Law (OAL) approval signifies that proposed regulations, including Water Board policies, plans, and guidelines, become effective and incorporated into State of California Law. U.S. EPA approval is required by the Clean Water Act.

The Chollas Creek watershed encompasses approximately 69.7 km^2 (17,223 acres) of the Pueblo San Diego Hydrologic Unit located within the cities of San Diego, Lemon Grove, and La Mesa. A small portion of the watershed includes "tidelands" located immediately adjacent to San Diego Bay under the jurisdiction of the Port of San Diego and the U.S. Navy (Naval Base San Diego). The County of San Diego has jurisdiction over a small portion (<1.0 percent) of the watershed. Land use within the Chollas Creek watershed is predominantly residential with some commercial and military uses. A significant portion of the remaining watershed area is dominated by roadways and freeways.

The presence of multiple degraded benthic communities was the basis for the State Water Board identifying Chollas Creek as a moderate priority candidate toxic hot spot in their Consolidated Toxic Hotspots Cleanup Plan (SWRCB 1999).

2.1.3 *Switzer Creek Estuary and Watershed*

Switzer Creek is located north of Paleta and Chollas creeks on the eastern shoreline in the central portion of San Diego Bay (Figure 2-1). The Switzer Creek project area is located at the mouth of the creek as it enters San Diego Bay, between the north side of the Tenth Avenue Marine Terminal and the southern-most Pier at the former Campbell Shipyard. The impaired area includes 5.5 acres located at the mouth of the creek, as estimated on the 303(d) list. The final project area was defined as approximately 6.9 acres (0.028 km^2) in the Phase I Sediment Quality Assessment Study (Anderson et al. 2004).

The Switzer Creek Watershed encompasses approximately 13.0 km^2 (3,220 acres) in the Pueblo San Diego Hydrologic Unit. Land uses in the watershed are predominantly residential with a significant portion of the remaining area used for parks and recreation, and open space. A significant portion of the remaining watershed area is dominated by roadways.

Repeated amphipod sediment toxicity impairments were the basis for the State Water Board identifying Switzer Creek as a moderate priority candidate toxic hot spot in their Consolidated Toxic Hotspots Cleanup Plan (SWRCB 1999).

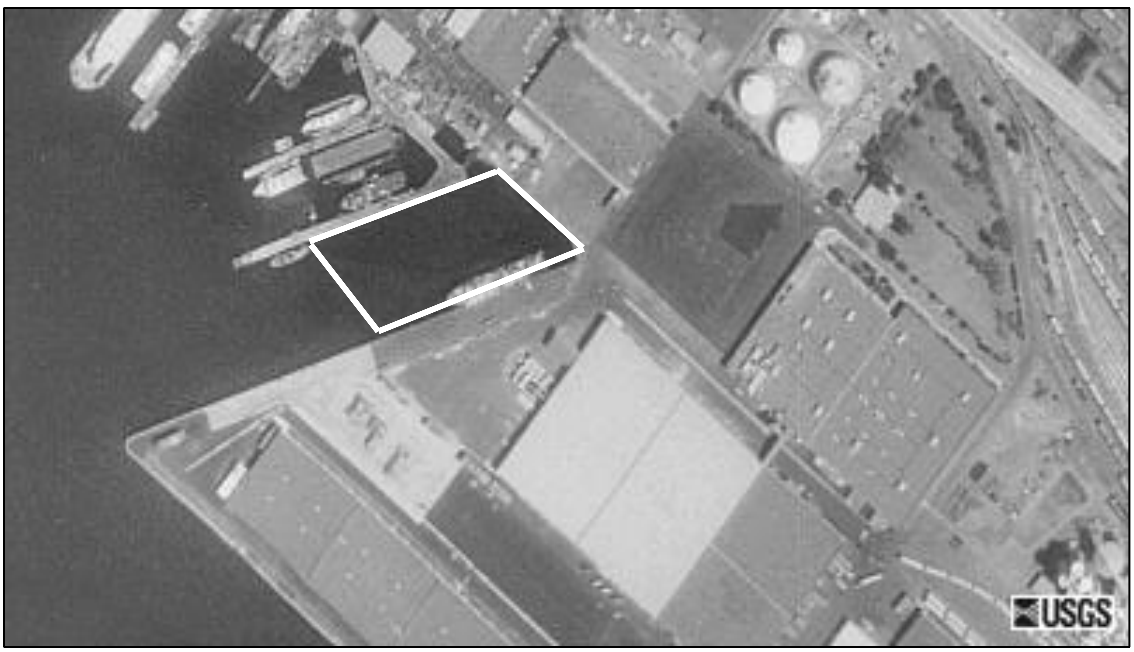

Figure 2-5. TMDL Project Area for Switzer Creek Mouth

2.2 Impairment Overview

The waterbodies included in this Project were originally listed as impaired primarily because of non-attainment of the toxicity water quality objective (WQO) promulgated for the protection of designated beneficial uses in San Diego Bay. Monitoring data collected during the investigation for the Bay Protection and Toxic Cleanup Program (BPTCP) indicated that sediment toxicity, sediment chemistry, and benthic community measurements exceeded the toxicity WQO. The shoreline segments located at the mouths of Paleta and Chollas creeks were listed for toxicity water quality impairments resulting in benthic community degradation. The shoreline segment located at the mouth of Switzer Creek was listed for elevated sediment concentrations of chlordane and PAHs resulting in sediment toxicity and benthic community degradation.

Sediment assessment studies, conducted in 2001 and 2003, characterized the extent of sediment contamination, toxicity, benthic community impacts, and bioaccumulation. These studies confirmed water quality impairments at the mouths of Paleta, Chollas, and Switzer Creeks (SCCWRP and SPAWAR 2005; Brown and Bay 2005; Anderson et al. 2004). The results of toxicity identification evaluation (TIE) studies identified that the probable cause of sediment toxicity was the presence of elevated concentrations of organic chemicals (Greenstein et al. 2005; Anderson et al. 2005). Summaries and data results collected for these investigations and other studies and data sets for the mouths of Paleta, Chollas, and Switzer Creeks are presented in Appendix F.

In 2009, the sediment quality objectives (SQOs) for benthic community protection (Aquatic Life) and human health superseded the toxicity WQO for San Diego Bay. Analysis of the available data for these waterbodies was performed using the Multiple Lines of Evidence (MLOE) Approach to assess attainment of the Aquatic Life SQO. The analysis indicated that a majority of the stations were found to be ‘Possibly Impacted,’ ‘Likely Impacted,’ or ‘Clearly Impacted’ (SWRCB 2008, Appendix D; Bay 2007). In accordance with the narrative Aquatic Life SQO, station assessments with categories of ‘Likely Impacted’ or ‘Clearly Impacted’ are considered to be degraded and not meeting the objective.

Table 2-3 lists the impaired waterbodies addressed in this report.

Table 2-3. Impaired waterbody segments listed on the CWA section 303(d) List

Hydrologic Descriptor	Waterbody (U.S. EPA BASINS 8-digit hydrologic cataloguing unit)	Segment/Area	Pollutant/ Stressor	Extent of Impairment as Noted on List	Year Listed
Pueblo San Diego HU 908.00	San Diego Bay Shoreline (90831000)	at 7th Street Channel (Paleta Creek)	Benthic Community Effects Sediment toxicity	9 acres	1998
	San Diego Bay Shoreline (90822000)	near Chollas Creek	Benthic Community Effects Sediment toxicity	15 acres	1998
	San Diego Bay Shoreline (90821000)	near Switzer Creek	Chlordane PAHs	5.5 acres	2002

2.3 *Applicable California Water Quality Standards*

Water quality standards are comprised of designated beneficial uses, WQOs, and an anti-degradation policy. The Basin Plan (RWQCB 1994) specifies water quality standards for all waters in the San Diego region, including Paleta, Chollas, and Switzer Creeks, and San Diego Bay. The water quality standards that apply to these TMDLs are a combination of the designated and potential beneficial uses in San Diego Bay that could be adversely affected by sediment toxicity associated with the discharges of waste and the State Water Board's SQOs for Aquatic Life and Human Health. The designated beneficial uses for Paleta Creek, Chollas Creek, Switzer Creek, and San Diego Bay are presented in Table 2-4. Paleta Creek, Chollas Creek, and Switzer Creek are also subject to State Water Board Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California*, which establishes a general principle of non-degradation for water quality.

2.3.1 *Beneficial Uses*

Water quality objectives must support the most sensitive beneficial uses of a waterbody. Beneficial uses of San Diego Bay are described in the Basin Plan (RWQCB 1994). The designated beneficial uses for Paleta, Chollas, and Switzer Creeks, and San Diego Bay are presented in Table 2-4. Paleta, Chollas, and Switzer Creeks are included for the purpose of completeness, since these watersheds are directly linked as sources to the receiving water.

Table 2-4. Beneficial uses in the Paleta Creek, Chollas Creek, and Switzer Creek watersheds and San Diego Bay

Beneficial Use	Paleta Creek	Chollas Creek	Switzer Creek	San Diego Bay
Industrial service supply				•
Navigation				•
Contact water recreation				•
Non-contact water recreation	•	•	•	•
Commercial and sport fishing				•
Preservation of biological habitats of special significance				•
Estuarine habitat				•
Warm freshwater habitat	•	•	•	
Wildlife habitat	•	•	•	•
Rare, threatened, or endangered species				•
Marine habitat				•
Migration of aquatic organisms				•
Spawning, reproduction, and/or early development				•
Shellfish harvesting				•

● Existing Beneficial Use

2.3.2 *Sediment Quality Objectives for Enclosed Bays and Estuaries*

The Enclosed Bays and Estuaries Plan was adopted by the State Water Board on September 16, 2008 and approved by the U.S. EPA on August 25, 2009 (SWRCB 2009). The Enclosed Bays and Estuaries Plan's SQOs supersede the Basin Plan's (RWQCB 1994) narrative water quality objectives for toxicity and pesticides as they pertain to protecting benthic communities from direct exposure to toxic pollutants in sediment and protecting human health from toxic pollutants that bioaccumulate.

The Enclosed Bays and Estuaries Plan contains the following applicable narrative SQOs, which protect benthic communities from direct exposure to toxic pollutants in sediment and human health. The SQOs apply to the sediments in the mouths of Paleta, Chollas, and Switzer Creeks:

Aquatic Life – Benthic Community Protection SQO (Aquatic Life SQO)

Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California. This narrative objective shall be implemented using an approach that integrates multiple lines of evidence (MLOE Approach).

- Sediment Toxicity: Sediment toxicity is a measure of the response of invertebrates exposed to surficial sediments under controlled laboratory conditions. The sediment toxicity LOE is used to assess both pollutant related biological effects and exposure. Sediment toxicity tests are of short durations and may not duplicate exposure conditions in natural systems. This LOE provides a measure of exposure to all pollutants present, including non-traditional or unmeasured chemicals.
- Benthic Community Condition: Benthic community condition is a measure of the species composition, abundance and diversity of the sediment-dwelling invertebrates inhabiting surficial sediments. The benthic community LOE is used to assess impacts to the primary receptors targeted for protection of aquatic life. Benthic community composition is a measure of the biological effects of both natural and anthropogenic stressors.
- Sediment Chemistry: Sediment chemistry is the measurement of the concentration of chemicals of concern in surficial sediments. The chemistry LOE is used to assess the potential risk to benthic organisms from toxic pollutants in surficial sediments. The sediment chemistry LOE is intended only to evaluate overall exposure risk from chemical pollutants. This LOE does not establish causality associated with specific chemicals.

Human Health SQO

Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health. This narrative objective shall be implemented on a case-by case basis, based upon a human health risk assessment. In conducting a risk assessment, the Water Boards shall consider any applicable and relevant information, including California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, Cal/EPA's Department of Toxic Substances Control (DTSC) Risk Assessment, and U.S. EPA Human Health Risk Assessment policies.

2.3.3 *Antidegradation*

State Water Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality Water" in California, known as the "Anti-degradation Policy," protects surface and ground waters from degradation (SWRCB 1968). Any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the State, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are subject to the federal Anti-degradation Policy (40 CFR 131.12).

2.4 Lindane at Mouth of Switzer Creek Delisted

During the 2002 Update of the 303(d) List, the State Water Board listed specific pollutants that were assumed to be causing the toxicity and degraded benthic community impairment at the mouth of Switzer Creek (SWRCB 2003). According to the fact sheets prepared for the listings for "San Diego Bay Shoreline, near Switzer Creek," the data used to assess the water quality were from the Bay Protection Toxic Cleanup Program (BPTCP). Three samples were collected and analyzed for lindane at the mouth of Switzer Creek in 1992, 1994, and 1996. The first 2 samples (collected in 1992 and 1994) were reported as having lindane concentrations below detection limits, while the 1996 sample was reported as 8.24 μg/kg (see Table F-5 in Appendix F). The Phase I and Phase II sediment studies for Switzer Creek included collection and analysis of an additional 15 samples without any reported detectable concentrations of lindane. The results from TIEs, performed in 2004, concluded that total chlordane was the most likely cause of the toxicity in sediment samples collected from the mouth of Switzer Creek. Additionally, the site was dredged for maintenance purposes by the Port of San Diego in 2002. On December 16, 2009, the San Diego Water Board adopted the delisting of lindane as a direct cause of impairment at the mouth of Switzer Creek and as a pollutant for Switzer Creek in its 2008 Clean Water Act Sections 305(b) and 303(d) Integrated Report (RWQCB 2009c) that was subsequently approved by the State Water Board on August 4, 2010 and U.S. EPA on November 12, 2010.[4]

3. Data Inventory

Data from numerous sources were used to characterize water quality conditions in the selected waterbody segments of the Paleta, Chollas, and Switzer Creeks, to identify sources of toxicity, and to support the calculation of TMDLs. The analysis of those data provided an understanding of the conditions that result in identified impairments.

[4] Information on the California 2010 Integrated Report (Clean Water Act Section 303(d)/305(b) Report) that includes the San Diego Water Board's 2008 Integrated Report can be found on the following website: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml

The categories of data used to develop these TMDLs included physiographic data that describe the physical conditions of the watershed, and environmental monitoring data that identify past and current conditions and support the identification of potential pollutant sources. Table 3-1 presents the various types and sources of data used to develop the TMDLs. The following sections describe the key data sets used to develop the TMDLs.

Table 3-1. Inventory of data and information used in analysis

Data Set	Type of Information	Data Source(s)
Watershed physiographic data	Stream network	USEPA BASINS (Reach File, Versions 1 and 3); USGS National Hydrogaphy Dataset (NHD) reach file
	Land use	San Diego Regional Planning Agency – 2009 land use coverage for San Diego County (SANDAG)
	Counties	USEPA BASINS
	Cities/populated places	USEPA BASINS, U.S. Census Bureau's Tiger Data
	Soils	USEPA BASINS (USDA-NRCS STATSGO)
	Watershed boundaries	USEPA BASINS (8-digit hydrologic cataloging unit); CALWTR 2.2 (1995)
	Topographic and digital elevation models (DEMs)	USEPA BASINS; USGS
Environmental monitoring data	Sediment quality monitoring data	BPTCP (1992-1994); Ogden (1995); U.S. Navy (1996); Eco-Systems Mgmt, Inc. (1999); Chadwick et al. (1999); SDUPD (1991 and 2002b); SCCWRP and SPAWAR (2005); Anderson et al. (2004); Brown and Bay (2005); Greenstein et al. (2005); Anderson et al. (2005)
	Water quality and storm water monitoring data	SDUPD (2002a, 2003, 2005, and 2006); U.S. Navy (2000); Chadwick et al. (1999); Katz et al. (2003); Schiff and Carter (2007); Katz (1998); City of San Diego (2010a); City of San Diego (2010b)
	Meteorological station locations	National Oceanic and Atmospheric Administration - National Climatic Data Center (NOAA-NCDC); Southern California Coastal Water Research Project (SCCWRP)

3.1 Waterbody Characteristics

The assessment of waterbody characteristics involved the evaluation of physical data such as bathymetry and water surface elevations. This information was used to determine the volume and hydrodynamic features of the waterbodies, which were included in the calculation of the assimilative capacity and identification of the physical processes that affect toxic pollutant loading.

The watershed and receiving water modeling reports contain much of the waterbody characteristic data associated with the TMDLs. Two original watershed modeling reports were produced in support of this Project: *Monitoring and Modeling of Chollas, Paleta, and Switzer Creeks* (Schiff and Carter 2007; see Appendix C-1 of this report) and *Watershed Modeling for Simulation of Loadings to San Diego Bay* (Tetra Tech 2008b; see Appendix C-2 of this report). Section 3.2 of the Tetra Tech (2008b) report is referenced for the Switzer Creek watershed model, as the model for the mouth of Switzer Creek was incorrectly configured by Schiff and Carter (2007). The watershed models were updated based on recent monitoring data collected within Paleta, Chollas, and Switzer Creek watersheds, which included monitoring of specific land use types to improve model accuracy. Land use estimates were also updated based on the current San Diego Regional Planning Agency (SANDAG) land use coverage (SANDAG 2009). Current model configuration and calibration results are presented in the report: *Watershed Modeling for Chollas, Switzer and Paleta Creek Watersheds for Simulation of Loadings to San Diego Bay* (Tetra Tech 2010; see Appendix E of this report). The receiving water model is described in *Receiving Water Model Configuration and Evaluation for the San Diego Bay Toxic Pollutants TMDLs* (Tetra Tech 2008a) (Appendix D). Bathymetry data were based upon the U.S. Navy's original CH3D model of San Diego Bay. Hydraulic data, such as water surface elevations, used for the hydrodynamic model were obtained from the National Oceanic and Atmospheric Administration Center for Operational Oceanographic Products and Services (NOAA-COOPS) for station #9410230, located in La Jolla, California. No changes were made to the receiving water models, except for incorporation of the updated watershed model input data. The TMDL results presented in this report are representative of the updated model results.

3.2 Meteorological Data

Meteorological data are a critical component of the watershed model. LSPC requires appropriate representation of precipitation and potential evapotranspiration. Rainfall-runoff processes for each subwatershed were driven by precipitation data from the closest representative station. These data provide necessary input to LSPC algorithms for hydrologic and water quality representation.

In general, hourly precipitation data are recommended for nonpoint source modeling. Therefore, only weather stations with hourly-recorded data were considered in the climate data selection process. National Climatic Data Center (NCDC) precipitation data were reviewed based on geographic location, period of record, and missing data to determine the most appropriate meteorological stations to represent the watersheds. Lindbergh Field station at the San Diego Airport (COOP ID # 047740) was selected as the most representative weather station for the project watersheds with hourly data. Data from Lindbergh Field were obtained from NCDC for characterization of meteorology of the modeled watersheds. The station also has long-term hourly wind speed, cloud cover, temperature, and dew point data. Evapotranspiration data were obtained from the California Irrigation Management Information System (CIMIS) station 184. To augment the NCDC data with more localized data collected during two sampling efforts, hourly rainfall data were obtained from Southern California Coastal Water Research Project (SCCWRP) for February 16 to May 8, 2006 (Schiff and Carter 2007) and from the City of San Diego for December 5, 2009 to January 12, 2010 (City of San Diego 2010a; City of San Diego 2010b).

3.3 Land Characteristic Data

This study was also supported by available land use data from the SANDAG's 2009 land use dataset covering San Diego County. SANDAG land use data provided the most complete and up-to-date land use representation of the project area.

Soil data were obtained from the U.S. Department of Agriculture, Natural Resources Conservation Service's State Soil Geographic (STATSGO) database, and topographic information was obtained from U.S. EPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) system. See Monitoring and Modeling of Chollas, Paleta, and Switzer Creeks (Schiff and Carter 2007) for greater detail (Appendix C-1).

4. Numeric Targets

The San Diego Bay shoreline segments located near 7th Street Channel/Paleta Creek and Chollas Creek are currently listed on California's 303(d) List for sediment toxicity and benthic community effects that are a result of elevated concentrations of chlordane, PAHs, and PCBs. The shoreline segment located near the mouth of Switzer Creek is on the 2002 303(d) list for elevated concentrations of chlordane and PAHs that have resulted in impairments related to sediment toxicity and benthic community effects.[5] Additionally, Anderson et al. (2005) found that elevated concentrations of PCBs were causing the impairments at Switzer Creek mouth. In order to address these impairments, the Aquatic Life SQO assessment followed by statistical analysis of the data results were used to develop the sediment numeric target. These methods of

[5] Lindane at the mouth of Switzer Creek is also on the 2006 Update of the section 303(d) List. Lindane was delisted in the 2008/2010 Update of 303(d) List by the San Diego Water Board and State Water Board; therefore, a lindane TMDL for Switzer will not be calculated. See section 2.4 for a more detailed discussion.

sediment quality assessment, referred to as the Multiple Lines of Evidence (MLOE) Approach, integrate three lines of evidence: sediment chemistry, sediment toxicity, and benthic community condition (Bay, et al. 2009). In addition, this report considered all relevant sediment quality guidelines in its evaluation of appropriate numeric targets for TMDL development in these three creek mouths.

Numeric targets, developed for concentrations of toxic pollutants in sediment, must be protective of aquatic life beneficial uses of surface waters. As discussed in Section 2, the Enclosed Bays and Estuaries Plan provides narrative objectives that apply to sediment quality. Generally, when applicable Basin Plan objectives are expressed in numeric terms, the numeric targets for a TMDL are set equal to those numeric objectives. When the applicable Basin Plan objectives are narrative, then numeric targets must quantitatively interpret or translate the narrative objectives. For this Project, the applicable narrative objectives were translated to numeric targets, which are the measurable endpoints or goals for each TMDL; these represent the attainment goals of the applicable water quality standards.

Numeric targets for TMDLs set in motion the attainment of SQOs, provide the basis for data analysis, and serve as the standards for TMDL wasteload allocations. These targets are established to ensure that SQOs are met for the protection of aquatic life and human health beneficial uses of surface water resources.

4.1 Numeric Targets for Sediment

The Aquatic Life SQO MLOE Approach was used to develop a dataset that represented “unimpacted” conditions for which a 95 percent confidence limit of the mean could be calculated (see Section 4.1.1, below). The 95 percent confidence limit of the mean became the numeric target. Numeric sediment targets for total chlordane, PPPAHs, and total PCBs are presented in Table 4-1. These numeric targets are reported as mass of pollutants in sediment (µg/kg) because the waterbody segments were identified on the 303(d) List for sediment toxicity and benthic community impairments.

Table 4-1. Numeric targets for sediments

Contaminant of Concern	Units	Numeric Target
Total Chlordane	µg/kg	2.1
PPPAHs	µg/kg	2,965
Total PCBs	µg/kg	168

PPPAHs = PAHs in bold type.
High Molecular Weight PAHs are **Benz(a)anthracene**, **Benzo(a)pyrene**, **Benzo(b)fluoranthene**, **Benzo(k)fluoranthene**, **Benzo(g,h,i)perylene**, Benzo(e)pyrene, **Chrysene**, **Dibenz(a,h)anthracene**, **Fluoranthene**, **Indeno(1,2,3-c,d)pyrene**, Perylene, and **Pyrene**
Low Molecular Weight PAHs are **Acenapthene**, **Acenapthylene**, **Anthracene**, Biphenyl, 2,6-Dimethylnaphthalene, **Fluorene**, 1-Methylnaphthalene, 2-Methylnaphthalene, 1-Methylphenanthrene, **Naphthalene**, **Phenanthrene**, 2,3,5-Trimethylnaphthalene
Total PCBs is the sum of 41 congeners

4.1.1 *95 Percent UCL of San Diego Bay MLOE Unimpacted Stations*

The numeric targets for these TMDLs were developed using a methodology first employed by Thompson et al. (2009) of the San Francisco Estuary Institute Aquatic Science Center. The methodology is to statistically calculate the 95 percent upper confidence limit (UCL) of the mean of a dataset that represents “unimpacted” conditions in San Diego Bay (i.e., data that meets the Aquatic Life SQO). Thompson et al. (2009) describes the methodology and presents the results for these datasets in a report on sediment contamination in San Diego Bay. San Diego Water Board applied the Thompson et al. methodology to the previously analyzed data, and in the full analysis, included other important datasets collected as part of the two Phase I sediment assessment studies for Chollas and Paleta Creek mouths and B Street/Broadway Piers, Downtown Anchorage, and Switzer Creek Mouth (SCCWRP and SPAWAR 2005; Anderson et al. 2004).

<u>MLOE Approach to Interpret the Aquatic Life SQO</u>
The MLOE Approach integrates three lines of evidence condition to determine whether the Aquatic Life SQO has been attained at a station (sediment chemistry, sediment toxicity, and benthic community). The development and composition of each of these three LOEs are discussed in Appendix I-1. The datasets include data collected for use in TMDLs at five locations in San Diego Bay (including Paleta, Chollas, and Switzer Creek mouth areas), the SCCWRP Bight Regional Monitoring Program, the U.S. EPA Western EMAP Program, and for the NASSCO and Southwest Marine sediment investigation (see Appendix I-1).

Data were transcribed into the Data Integration Tool (DIT), which was developed for the State Water Board to assist with conducting the MLOE Approach. The DIT is a Microsoft Excel workbook that contains formulas for calculating the individual LOEs from data entered into the workbook spreadsheets. Once all of the individual LOEs are completed and assessment values are given for each, then the DIT calculates the station level assessment value, which is the integration of the three LOE values into one value.

The MLOE Approach to interpret the narrative SQO produces six possible station level assessment categories of impact: (1) Unimpacted, (2) Likely Unimpacted, (3) Possibly Impacted, (4) Likely Impacted, (5) Clearly Impacted, and (6) Inconclusive (Bay et al. 2009). These categories are the result 64 possible combinations of the LOE category results for sediment chemistry, toxicity, and benthic community condition. Because the numeric target analysis sets goals based on water quality objectives, sediment chemistry data were used from stations that fell into categories representing attainment of the narrative SQO: (1) Unimpacted and (2) Likely Unimpacted.

Numeric Target Calculation Using 95 Percent Upper Confidence Limits

The numeric target development for these TMDLs follows part of the analytical design described by Thompson et al. (2009) of sediment contamination in San Diego Bay. Thompson et al. (2009) used the same data considered in this analysis, with the exception of the data collected for the Switzer Creek Mouth, B Street/ Broadway Piers, and Downtown Anchorage TMDL projects and those sites' associated reference stations.

As discussed above, only the data from unimpacted stations meeting the narrative SQO were used to calculate the targets in this analysis (categories 1 and 2). The data from impacted stations (categories 3, 4, and 5) were considered for comparison purposes during the analysis (see Appendix I-1).

Based on the Student's t-test estimate at the 95 percent Upper Confidence Limit of the mean, the recommended numeric targets are 2,965 µg/kg PPPAHs, 168 µg/kg total PCBs, and 2.1 µg/kg total chlordane (see Table 4-1).

The U.S. EPA's ProUCL statistical program was used to determine the 95 percent UCLs. The data were log transformed before the analysis was run.

4.1.2 *Other Potential Sediment Targets*

Other guidelines and sediment values were considered for use as numeric targets. Table 4-2 provides a summary of all the numeric sediment targets considered for each of the TMDLs including: 1) the California Logistic Regression Model Approach Threshold 20 Percent (CA LRM T20), 2) the National Logistic Regression Model Approach, Threshold 20 Percent (National LRM T20), 3) Effects Range Low (ERL), and 4) Effects Range Median (ERM). San Diego Bay background levels are shown for comparison purposes. This section provides descriptions of each of the sediment target options.

Table 4-2. Available sediment guideline values and San Diego Bay background levels

Contaminant of Concern	Units	95% UCL SDB MLOE[a]	CA LRM T20[b]	National LRM T20[c]	ERL[d]	San Diego Bay Background[e]
HMW PAHs	µg/kg	--	2,500	884	1700	663
Total PAHs	µg/kg	2,861	3,286	1170	4,022	--
PPPAHs	µg/kg	2,965[f]	--	994	--	--
Total PCBs	µg/kg	168	110	35	22.7	84
α-Chlordane	µg/kg	--	2.8	--	0.5	--
Total Chlordane	µg/kg	2.1	2.8	--	--	--

[a] See Appendix I
[b] SWRCB (2006)
[c] U.S. EPA (2005)
[d] Long et al. (1995)
[e] RWQCB (2010)
[f] PPPAHs was chosen as the numeric target rather than Total PAHs because of the need to compare results with the human health risk assessment, which only had PPPAHs and not Total PAHs.

<u>The CA LRM T20 and the National LRM T20</u>

The CA LRM is one of the two indices used to develop the sediment chemistry line of evidence for the MLOE Approach. The CA LRM using the 20 percent threshold (T20) was originally considered as a numeric target because the CA LRM was developed using data from California estuaries and the data used were the same type of data used for the ERLs and ERMs. ERLs and ERMs have been the commonly used and accepted guideline values for sediment chemistry for many years. The CA LRM is superior to ERL and ERM guidelines, see Section 4.1.3 below, which are simply the 10th and 50th percentile of effects data. The CA LRM values are derived using a logistic regression equation of paired toxicity data and sediment chemistry data from estuaries in California. The CA LRM approach develops models that provide users with a tool to predict the probability of observing sediment toxicity that corresponds to the chosen threshold or target value. The equation can also be used to predict the sediment pollutant concentration that will produce a given percent of toxicity in samples (Field et al. 2002). The T20 value was chosen for the numeric target in this TMDL because the T20 was used in the National LRM as an indicator of toxicity based on chemical mixtures. The CA LRM T20 values are listed above in Table 4-2.

Disadvantages of the CA LRM as the approach for the TMDL numeric target include: 1) The CA LRM is only one of the indices used to develop the Sediment Chemistry LOE, whereas the MLOE approach takes into account all indices, tests, and metrics used to determine all three LOEs for the Aquatic Life SQO. 2) The first attempt to develop a numeric target for this TMDL involved using the Sediment Chemistry line of evidence (LOE) of the CA SQO in 2007, when very little information on the CA LRM approach and its development were available. Within the sediment chemistry LOE are two chemical contamination indices based on two types of Sediment Quality Guidelines: the CA Logistic regression model (CA LRM) and the Chemical Score Index. The first numeric target was calculated using the CA LRM. The threshold value of T20 was chosen because it was the same threshold used in the national LRM, where there are significantly more data points used to generate the model results. The San Diego Water Board did not have access much information used to develop the predictive equation in 2007, as most of the reports were still being written on the Aquatic Life SQO. San Diego Water Board was informed by one of the CA LRM developers in 2011 that the data set used to develop the model did not show mortality at or above 20% at the LRM threshold value. Mortality begins to occur around T25 (one point), with the next two occurrences at T33.

While the CA LRM values were determined strictly from California estuarine data, LRM results have also been developed from data throughout the United States. The process is described in detail in the U.S. EPA document *Predicting Toxicity to Amphipods from Sediment Chemistry* (U.S. EPA 2005) and the Environmental Toxicology and Chemistry Journal article *Predicting amphipod toxicity from sediment chemistry using logistic regression models* (Field et al. 2002). The dataset used for the National LRM is quite large (approximately 3,000 samples), while the CA LRM dataset consists of approximately 200 samples.

<u>ERL/ ERM Values</u>

The ERL and ERM values were developed by the National Oceanic and Atmospheric Administration (Long et al. 1995). These values represent sediment quality guidelines values for various metals and organic chemicals. The ERLs and ERMs for each chemical were derived from a database compiled for North America from numerous studies matching chemical and biological data. The data were arranged in ascending order of concentration for each chemical. The ERL represents the 10^{th} percentile of effects data and the ERM represents the 50^{th} percentile of effects data. Note that the "effects data" only represent the data where some level of toxicity was observed, therefore, data from samples not exhibiting a matching toxicity effect were not included in developing these guidelines.

<u>San Diego Bay Background Levels</u>

Background values in San Diego Bay sediments were developed for the purpose of establishing cleanup levels for the Shipyard Sediment Site Cleanup and Abatement Order No. R9-2012-0024. These background values are shown for comparison purposes only and would not be considered as numeric targets because they are specific for the Shipyard Cleanup Site. All of these TMDL sites are located within the same region of the bay as the Shipyard Cleanup Site.

The background values represent the 95 percent upper prediction limit calculated from a pool of reference stations in San Diego Bay. The reference stations were sampled during three independent sediment quality investigations: 1) Southern California Bight 1998 Regional Monitoring Program (Bight 1998), 2) Phase I Sediment Assessment Study for Chollas and Paleta Creek mouths with data collected in 2000-2001 (SCCWRP and SPAWAR 2005), and 3) NASSCO and Southwest Marine Detailed Sediment Investigation with data collected in 2001-2002 (Exponent 2003). Criteria for selecting acceptable reference stations included the presence of low levels of anthropogenic pollutant concentrations, locations remote from pollution sources, similar biological habitat to the Shipyard Sediment Site, sediment total organic carbon (TOC) and grain size profiles similar to the Shipyard Sediment Site, adequate sample size for statistical analysis, and sediment quality data comparability.

4.2 Numeric Targets to Address Human Health

TMDLs should address all identified impairments in a waterbody. According to the CWA, the scope of a TMDL is not limited by impairment reports in statutory lists of waters not attainning water quality standards.[6] Most importantly, the TMDL must address impairments affecting all identified beneficial uses. In the evaluation, there are impairments that are associated with bioaccumulation of PCBs in fish tissue that affect human health. This TMDL Project is addressing that requirement by including numeric targets that must meet the California Toxics Rule (CTR) criteria for water quality and an OEHHA guideline value for fish tissue. This TMDL Project is including these numeric targets to directly address the commercial and sportfishing (COMM) and shellfish harvesting (SHELL) beneficial uses identified in the Basin Plan for these waters.

The CTR promulgates numeric aquatic life and human health water quality criteria for priority toxic pollutants (U.S. EPA 2000b). Human health CTR values representing fish consumption for chlordane, benzo(a)pyrene (which represents the PAHs), and total PCBs are more directly associated with the receptor (humans) as a bioaccumulating pollutant in fish tissue (the food source), and therefore better identified numeric targets in this TMDL Project (Table 4-3). The CTR criteria are water quality standards that must be achieved and included in existing permits statewide. The CTR water quality criteria must be met at all times. In this case, the CTR water column concentrations of bioaccumulating pollutants are translated to sediment levels by linking the relationship between human consumption of fish tissue and the fish consumption of benthic community organisms inhabiting the bottom sediment environment (i.e., the food chain).

[6] CWA section 303(d)

Table 4-3. Numeric Targets for San Diego Bay Water Column

Contaminant of Concern	Units	Numeric Target
Total Chlordane	µg/L	0.00059
Benzo(a)pyrene	µg/L	0.049
Total PCBs	µg/L	0.00017

Source: U.S. EPA (~~1997~~2000b)

A second pathway is included to ensure protection of human health; this is based on the human consumption of fish collected from these waterbodies. OEHHA sets guidelines for an acceptable level of risk when consuming fish tissue (*Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene* (OEHHA 2008). A numeric target of 3.6 µg/kg ww PCBs in fish tissue must be achieved (Tabe 4-4). ~~However, to account for capturing representative aquatic organisms of the impaired waterbodies, the *Macoma nasuta* (a clam) will be the required test organism for the 28-day bioaccumulation analysis (U.S. EPA 1998a; ASTM 2001), rather than fish. A fish species was not chosen because most of the fish in San Diego Bay, and the creek mouths, are highly mobile and not stationary. The method requires analysis of the clam tissue for the bioaccumulants after the organisms have been exposed to the site sediment in a laboratory setting for 28 days.~~

~~In this case, the clam is a preferable test organism to fish because it is sessile, and therefore will appropriately represent only bioaccumulation from sediment at the location of interest. Fish are mobile and the collection of fish tissue samples would not represent bioaccumulation at the location(s) of interest, but instead, to San Diego Bay as a whole. For example, spotted sand bass tissue samples taken for the Shipyard Sediment Site studies showed no significant difference between concentrations in fish caught at the Shipyard site and fish caught at reference sites. There may be fish with high site fidelity in San Diego Bay, such as the goby. In the fish tissue studies for the Shipyard Sediment Site, however, trawls of the study and reference areas failed to produce any gobies for analysis (Exponent 2003). On the other hand, the disadvantage of using *Macoma*, rather than fish, is that it is not a primary food source for humans. However, *Macoma* are a conservative choice for a test organism because of its sessile nature and its direct route of exposure to sediment and the pollutants associated with it (RWQCB 2012, Section 27).~~

Table 4-4. Numeric Targets for PCBs in Fish Tissue

Contaminant of Concern	Units	Numeric Target
Total PCBs	µg/kg wet weight	3.6

Source: OEHHA (2008)

5. Source Assessment

The source assessment identifies the potential sources of chlordane, PAHs, and PCBs discharging to each of the mouths of Paleta, Chollas, and Switzer Creeks. Point and nonpoint sources and their relative significance as contributors to surface waters are also discussed in this section.

5.1 Background on Toxic Pollutants Addressed in this TMDL

The following information is from the *Total Maximum Daily Loads for Toxic Pollutants in Ballona Creek Estuary* (LARWQCB and U.S. EPA 2005) and is relevant for the San Diego Bay TMDLs.

Chlordane was primarily used as a pesticide to control subterranean termites on buildings, insects on agricultural crops, and residential lawns and gardens (ATSDR 1994). In 1988, all chlordane uses, except for fire ant control, were voluntarily suspended in the United States (NPTN 2008). Chlordane can still be legally manufactured in the United States (U.S.) for sale or use by foreign countries. Although it is no longer used in the U.S., chlordane persists in the environment, adhering strongly to soil particles. The most likely route for chlordane to enter the water is from urban and agricultural soils, as its tendency is to adsorb to particulates before entering a body of water (ATSDR 2004). Therefore, the most likely source of chlordane in the watershed is storm water runoff carrying chlordane attached to eroded sediment particles.

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 200 different chemicals. They naturally occur in coal and crude oil and as byproducts in emissions from combustion of fossil fuels, forest fires and volcanoes. Most PAHs entering the environment are formed as byproducts of burning organic material (coal, oil, wood, gasoline, garbage, tobacco, and other organic material) or in certain industrial processes. They are also present in used motor oil, used hydraulic oil, tire particles, asphalt roads, coal, and coal tar. Wild fires and volcanoes are also natural sources of airborne PAHs (ATSDR 1995; NRC 1983). About two-thirds of PAHs in aquatic systems are associated with particles (ATSDR 1995). Important sources of PAHs in surface waters include deposition of airborne PAHs, municipal waste water discharge, urban storm water runoff particularly from roads, runoff from coal storage areas, effluents from wood treatment plants and other industries, oil spills, and petroleum pressing operations (ATSDR 1995). A Southern California study that included San

Diego Bay investigated cross-media transport of PAHs and found that the sediment in San Diego Bay was a source of PAHs to the water column, and the water column was a source to the atmosphere (Sabin et al. 2008). It is assumed that the primary source of PAHs to the San Diego Bay shorelines is urban storm water runoff where most airborne PAHs are deposited on the land (e.g., through precipitation or indirect atmospheric deposition) and are transported to the bay through storm water runoff.

Polychlorinated biphenyls (PCBs) are mixtures of up to 209 individual chlorinated compounds (known as congeners). They were used in a wide variety of applications, including dielectric fluids in transformers and capacitors, heat transfer fluids, and lubricants (ATSDR 2000). PCBs were formerly used in the U.S. as hydraulic fluids, plasticizers, adhesives, fire retardants, way extenders, de-dusting agents, pesticide extenders, inks, lubricants, cutting oils, in heat transfer systems, and in carbonless reproducing paper (U.S. EPA 2009a). The manufacture of PCBs was prohibited in 1976 because of evidence that they were accumulating in the environment and causing harmful health effects. Although it is now illegal to manufacture, distribute, or use PCBs, these synthetic oils were used for many years as insulating fluids in electrical transformers and in other products such as cutting oils. Products made before 1977, which may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, hydraulic oils, and old microscope oils. Historically, PCBs have been introduced into the environment through discharges from point sources, and through spills and accidental releases.

Although point source contributions are now controlled, nonpoint sources may still exist, for example, refuse sites and abandoned facilities may still contribute PCBs to the environment. Once in a waterbody, PCBs become associated with solid particles and typically enter sediments (U.S. EPA 2002). PCBs are also being found in caulking material used in building construction or renovation that occurred between 1950 and 1978 (U.S. EPA 2009b). A case study is the former Teledyne Ryan facility located adjacent to Convair Lagoon in the northern part of San Diego Bay. PCB-impacted surface sediments at the facility were found to be derived from the weathering of building materials including paint, joint compound, and concrete slabs and foundations. The PCB-impacted sediments were transported to Convair Lagoon via the storm water conveyance system draining the former facility.[7]

5.2 Identification of Sources

Storm water data collected in Paleta, Chollas, and Switzer Creeks (above tidal influence) were used to identify potential pollutant sources; whereas sediment data collected near the mouth of Paleta, Chollas, and Switzer Creeks were used to confirm impairment and relate pollutant loading with pollutant deposition and impairment. Dry weather flows to the bay were not measured as these were assumed to be negligible sources for pollutant loading to the impaired waterbodies.

[7] Addendum No. 4 to Cleanup and Abatement Order No. R9-2004-0258, Finding 12

Multiple point and nonpoint sources discharge pollutant loads into the mouths of Paleta, Chollas, and Switzer Creeks. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels. These discharges into surface waters are regulated by the San Diego Water Board or State Water Board through Waste Discharge Requirements (WDRs) that implement federal National Pollutant Discharge Elimination System (NPDES) requirements. Nonpoint sources are diffuse in nature, such as sheet flow or atmospheric deposition that have multiple routes of entry into surface waters.

The pollutants can be deposited either directly to a waterbody or onto land surfaces where the pollutants wash off during storm events. Storm water runoff from urbanized areas flows off of land with a number of different uses, including residential uses, commercial and industrial uses, roads, highways and bridges. Essentially, any surface which does not have the capability to pond and infiltrate water will produce runoff during storm events (U.S. EPA 1999). Sources of pollutants can include storm drain discharges, discharges or spills from permitted industrial facilities, illicit discharges, sewage spills, or other nonpoint sources.

The San Diego Water Board regulates storm water discharges by issuing WDRs that implement federal NPDES requirements. Essentially all sources (point and nonpoint) in the watersheds enter Paleta, Chollas, and Switzer Creek mouths through the storm water conveyance systems that are regulated through the NPDES permits listed in Table 5-1.

Table 5-1. Regulated storm water discharges in Paleta, Chollas, and Switzer Creek watersheds

WDR/Permit	Order No.	Regulated Discharges
Municipal Storm Water NPDES Permit	R9-2007-0001	Storm water runoff in MS4 conveyance system.
NPDES Storm Water from Small MS4s	~~2003-0005~~2013-0001-DWQ	Storm water discharges from small MS4 systems.
NPDES Industrial Storm Water	97-03-DWQ	Discharges of storm water from industrial facilities.
NPDES Construction Storm Water	2009-0009-DWQ	Discharges of storm water from construction sites.
NPDES Storm Water from Caltrans	99-06-DWQ	Discharges of storm water from Caltrans roadways, facilities, and construction sites.

Other likely point and nonpoint source pollutant loads in all three creeks include storm water runoff from adjacent industrial discharges (regulated by individual WDRs), sediment resuspension and flux, leaching from creosote pier pilings, and direct atmospheric deposition of pollutants to the surface of the waterbody. Sources specific to particular creeks include the National Steel and Shipbuilding Company (NASSCO) shipyard located just north of the Chollas Creek mouth, Naval Base San Diego located near Paleta and Chollas creek mouths, and the Tenth Avenue Marine Terminal located near Switzer Creek mouth. Another source is sediment resuspension and migration caused by boat and ship traffic near Paleta, Chollas, and Switzer Creek mouths.

While the wasteloads of PAHs are associated with ongoing activities, such as automobile and truck emissions in the watersheds, the wasteloads of chlordane and PCBs reflect residues accumulated from historical uses, applications, or spills that contaminated soils within the watersheds and sediments in the watersheds, creeks, and storm drains, and act as ongoing sources (City of San Diego 2010a; Westin 2009). In spite of these compounds being banned in the U.S., residual concentrations of these legacy pollutants continue to remain elevated in bay sediments.

5.2.1 *Point Sources*

5.2.1.1 Phase I Municipal Separate Storm Sewer Systems (MS4s)

The U.S. EPA developed rules establishing Phase I of the NPDES MS4 storm water program in 1990. The Phase I storm water program was designed to prevent pollutants from being washed by urban runoff into MS4s, or dumped directly into MS4s, and subsequently discharged into local waterbodies. Phase I of the program required operators of medium and large MS4s (serving populations of 100,000 or more) to implement an urban runoff management program as a means to control polluted discharges from MS4s. Urban runoff management programs for medium and large MS4s are intended to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations and hazardous waste treatment. More specifically, large and medium operators are required to develop and implement Urban Runoff Management Plans that address, at a minimum, the following elements:

- Structural control maintenance;
- Areas of significant development or redevelopment;
- Roadway runoff management;
- Flood control related to water quality issues;
- Municipally owned operations such as landfills, wastewater treatment plants, etc.;
- Hazardous waste treatment, storage, or disposal sites, etc.;
- Application of pesticides, herbicides and fertilizers;
- Illicit discharge detection and elimination;
- Regulation of sites classified as associated with industrial activity;
- Construction site and post-construction site runoff control; and

- Public education and outreach.

Twenty entities (MS4 permittees) are named on the MS4 permit for watersheds in the County of San Diego (RWQCB 2007a).[8] The responsible Phase I Municipal Dischargers (Phase I MS4s) include National City and the City of San Diego in the Paleta Creek watershed; the cities of San Diego, Lemon Grove, and La Mesa, the County of San Diego, and the Port of San Diego in the Chollas Creek watershed; and City of San Diego in the Switzer Creek watershed.

During wet weather events, storm water discharges from lands with various uses provide a significant mechanism for transport of organic pollutants to surface waterbodies. Pollutants from various land uses and associated management practices wash off the surface during rainfall events. The amount of runoff and associated pollutant concentrations are therefore highly dependent on the nearby land uses and management practices.

Sources of pollutants discharged to the MS4 conveyance system, include:

- PAHs from roadways and parking surfaces;
- Creosote telephone/utility pole locations throughout the cities may contain PAH-laden soils that can erode and wash-off into the storm water conveyance system;
- Pesticide-laden soils contaminated from historic treatments of chlordane for termites and ants can also erode and wash-off into the storm water conveyance system; and
- PCB-laden soils contaminated from historic spills or leaks from electrical and hydraulic equipment or from the weathering of building materials can erode and wash-off into the storm water conveyance system.

Additionally, sediments that accumulate within storm drains and creeks during dry periods between storms are considered a source of pollutant-laden sediment to the creek mouth areas in the bay during wet weather events.

[8] Order No. R9-2007-0001 NPDES No. CAS0108758 Waste Discharge Requirements for Discharges of Urban Runoff from The Municipal Separate Storm Sewer Systems (MS4s) Draining The Watersheds of The County of San Diego, The Incorporated Cities of San Diego County, The San Diego Unified Port District, and The San Diego County Regional Airport Authority.

5.2.1.2 Phase II Small Municipal Separate Storm Sewer Systems (MS4s)

In 1999, the U.S. EPA developed rules establishing Phase II of the NPDES storm water program, extending the regulations to storm water discharges from small MS4s located in “urbanized areas” and construction activities that disturb 1 to 5 acres of land. Small MS4 systems are not regulated under the municipal Phase I regulations. They are owned or operated by the United States, a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity.
The General Permit for the Discharge of Storm Water from Small MS4s, Water Quality Order No. ~~2003-0005~~2013-0001-DWQ (Small MS4 General Permit) regulates discharges of storm water from “regulated Small MS4s.” A “regulated Small MS4” is defined as a Small MS4 that discharges to a water of the United States or to another MS4 regulated by an NPDES permit. The General Permit requires that Small MS4 Dischargers develop and implement a Storm Water Management Program (SWMP) that reduces the discharge of pollutants through their MS4s to the Maximum Extent Practicable (MEP). The SWMP must describe the best management practices (BMPs) and measurable goals, include time schedules of implementation and assign responsibility for each task.

Non-traditional Small MS4s may also enroll in and be regulated by the permit. The non-traditional Small MS4s include those located within or that discharge to a permitted MS4, and that pose significant water quality threats. In general, these are storm water systems serving public campuses (including universit~~ies, community~~ and colleges~~, primary schools, and other publicly owned learning institutions with~~ campuses), military bases, and large prison and hospital complexes within or adjacent to other regulated MS4s, or which pose significant water quality threats. The State Water Board considered designating non-traditional small MS4s when adopting the General Permit for them.

Entities that enroll in Order No. ~~2003-0005~~2013-0001-DWQ are responsible for addressing water quality concerns from their small MS4s. In the three watersheds, the non-traditional small MS4~~s~~ that meet the definition in Order No. 2003-0005-DWQ ~~are: the San Diego City Unified School District (SDUSD) and National Elementary School District in the Paleta Creek watershed; the SDUSD, Lemon Grove Elementary School District, and La Mesa-Spring Valley School District in the Chollas Creek watershed; and SDUSD, San Diego City College, and the Naval Medical Hospital, San Diego in the Switzer Creek watershed. Order No. 2003-0005-DWQ does not specifically designate any non-traditional small MS4s as “regulated Small MS4s,” and does not explicitly require these entities to enroll in the permit~~. The Small MS4 General Permit ~~is in the process of being revised and reissued and is expected to~~ designates non-traditional small MS4s, excepting K-12 School Districts, as Regulated Small MS4s.

The urban runoff discharges from Naval Base San Diego’s community facilities are not currently regulated. The San Diego Water Board anticipates that the current permit, Order No. 2002-0169, will be revised and reissued to regulate to include both industrial storm water and the runoff from its community facilities at Naval Base San Diego. The revised permit will be consistent with the requirements of the Statewide general WDRs prescribed for small MS4s in Order No. ~~2003-0005~~2013-0001-DWQ or subsequent order. Runoff from Navy industrial facilities (Naval Base San Diego) discharges into the Paleta Creek and Chollas Creek watersheds and is regulated by WDRs issued as Order No. R9-2002-0169, or subsequent order (discussed in more detail in section 5.2.1.5).

As with MS4s mentioned in section 5.3.1.1, pollutants build up on land surfaces and are washed off during rainfall events. The amount of runoff and associated concentrations are highly dependent on the nearby land uses and management practices. Parking lots contain pollutants such as heavy metals, oil and grease, and PAHs that are deposited on parking lot surfaces by motor-vehicles. Additionally, any pesticide-laden soils contaminated from historic treatments of buildings for termites and ants can also erode and wash-off into the storm water conveyance system. PCBs can accumulate in soil from the weathering of building materials. These pollutants are directly transported to surface waters.

5.2.1.3 California Department of Transportation (Caltrans) MS4

Caltrans is regulated by a Statewide storm water discharge permit that covers all of Caltrans' municipal storm water activities and construction activities (State Water Board Order No. 99-06-DWQ). The Caltrans storm water permit authorizes storm water discharges from Caltrans properties such as the State's highway system, park and ride facilities, and maintenance yards. Storm water discharges from most Caltrans properties and facilities eventually discharge into a city or county storm drain.

Roadway and pavement runoff from Caltrans' highways and facilities contains organic and inorganic pollutants that can impair receiving water quality and disrupt aquatic and benthic ecosystems. Storm water discharges from roadways may contain pollutants, including suspended solids, heavy metals, hydrocarbons, indicator bacteria and pathogens, nutrients, herbicides, and deicing salts (Caltrans 2003; Grant et al. 2003). In recent years, Caltrans has reported measureable amounts of pesticides in storm water discharges, primarily the herbicides diuron and glyphosate (the active ingredient in Roundup®; Caltrans 2003a, 2003b). The principal sources of pollutants from roadways are atmospheric deposition (precipitation and dust fall), automobiles, and the road surfaces themselves (Grant et al. 2003).

5.2.1.4 Statewide General Industrial and Construction Storm Water NPDES

Industrial Storm Water General Permit

The State Water Board issued a Statewide general NPDES permit for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities in 1997 (Industrial Storm Water General Permit)(Order No. 97-03-DWQ). This Order regulates storm water discharges and authorized non-storm water discharges from ten specific categories of industrial facilities, including but not limited to manufacturing facilities, recycling facilities, oil and gas mining facilities, landfills, and transportation facilities. Potential pollutants from an industrial site will depend on the type of facility and operations that take place at that facility. A list of the dischargers enrolled under the Industrial Storm Water General Permit and located within the watersheds draining to Paleta, Chollas, and Switzer Creeks are included in Appendix G.

Potential pollutant loads may be associated with transportation, recycling, and manufacturing facilities. Transportation-related facilities include railway passenger and freight, shipping and delivery services, marine cargo handling, and ambulance and charter bus storage lots. Pollutants related to transportation sources include heavy metals and vehicle fluids, including oils, fuels, and hydraulic fluids in the case of marine cargo handling equipment. Transportation storage yards that store fleet vehicles and school busses are likely sources of PAHs, while the other facility types are likely to have parking lots and/or truck traffic that would contribute PAHs. Automobile recycling yards can be sources for wasteloads including heavy metals (copper, lead, mercury, nickel, and zinc), fluids from the braking, transmission, and cooling systems, motor oil, PCBs from shredded seats and other plastic items, tire waste, and other liquid waste such as fuel, solvents, and battery acid (O'Brien 2000). Automotive and general recycling yards, manufacturing, and storage facilities often use material handling systems (e.g., forklifts) that can be sources of hydraulic fluids, oils, fuels, and metals (O'Brien 2000). Manufacturing facilities that have used cutting oils and lubricants have the potential to be sources of PCBs. Recyclers that handle and process appliances may generate wasteloads including PCBs, oils, lubricants, paint pigments and additives, such as lead and other heavy metals (O'Brien 2000).

Wet weather runoff from industrial sites has the potential to convey pollutant loads to Paleta, Chollas, and Switzer Creeks. Under the Statewide Industrial Storm Water General Permit (Order No. 97-03- DWQ), non-storm water discharges are authorized only when they do not contain significant quantities of pollutants, where BMPs are in place to minimize contact with significant materials and reduce flow, and when the discharges are in compliance with San Diego Water Board and local agency requirements.

Construction Storm Water General Permit

The State Water Board reissued a Statewide NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities in September 2009 (Construction Storm Water General Permit; Order No. 2009-0009-DWQ as amended by 2010-0014-DWQ and 2012-0006-DWQ)[9] that went into effect on July 1, 2010. The Statewide permit covers new construction and redevelopment of existing properties which are the most likely types of eligible construction projects that would be located within the watersheds draining to Paleta, Chollas, and Switzer Creeks. Wet weather runoff from construction sites has the potential to discharge project related wasteloads into the Paleta, Chollas, and Switzer Creeks. Under the Statewide Construction Storm Water Permit, discharges of non-storm water are authorized only where they do not cause or contribute to an exceedance of any water quality standard, do not exceed sediment effluent limitations specified in the permit, and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants. Potential pollutants from construction/redevelopment projects located in highly urbanized watersheds include sediment that may contain residual concentrations of pesticides PCBs, and/or PAHs.

5.2.1.5 Adjacent Sources with Individual Waste Discharge Requirements (WDRs)

In California, discharges of pollutants from point sources to navigable waters of the U.S. are regulated by Waste Discharge Requirements (WDRs). Those WDRs implement federal NPDES regulations, requirements of the Clean Water Act, and serve in lieu of federal NPDES permits. WDRs are issued by the State, pursuant to independent State authority described in California's Porter-Cologne Water Quality Control Act,[10] and may also serve as NPDES permits under authority delegated by the U.S. EPA or derived from the Clean Water Act.

Paleta Creek and Chollas Creek watersheds have facilities with individual NPDES WDRs that are located adjacent to the impaired shoreline areas. Table 5-2 lists the adjacent facilities in each watershed.

Table 5-2. Adjacent Sources with Individual WDRs

Watershed	Permit Holder	Current Order No.
Paleta Creek	U.S. Navy, Naval Base San Diego	R9-2002-0169
Chollas Creek	U.S. Navy, Naval Base San Diego National Steel and Shipbuilding Company (NASSCO)	R9-2002-0169 R9-2009-0099

[9] This permit replaced the original State Water Board construction storm water permit Order No. 99-08-DWQ.

[10] Division 7 of the Water Code, commencing with section 13000

U.S. Navy, Naval Base San Diego

In 1992, Naval Base San Diego enrolled in the State Water Board's General Industrial Storm Water National Pollutant Discharge Elimination System (NPDES) Requirements for the discharge of industrial storm water. The San Diego Water Board issued, in 2002, individual WDRs to Naval Base San Diego as Order No. R9-2002-0169, NPDES Permit No. CA0109169. Those NPDES requirements regulated the following discharges (RWQCB 2012):

- Utility vault & manhole dewatering;
- Steam condensate;
- Salt water system discharge;
- Pier boom, mooring, and fender system cleaning;
- Miscellaneous discharges (landscape watering runoff, potable water & fire system maintenance);
- Ship repair and maintenance activities; and
- Industrial storm water.

Since1921 the U.S. Navy has owned and operated Naval Base San Diego, located at 32nd Street and Harbor Drive on the eastern edge of San Diego Bay, and provides supply and maintenance logistical support to numerous U.S. Navy vessels. The facility is bordered by the City of San Diego to the north and east, National City to the south and east, and San Diego Bay to the west. Chollas Creek discharges into San Diego Bay in the northern portion of Naval Base San Diego, while Paleta Creek discharges into the bay further south (Figure 5-1).

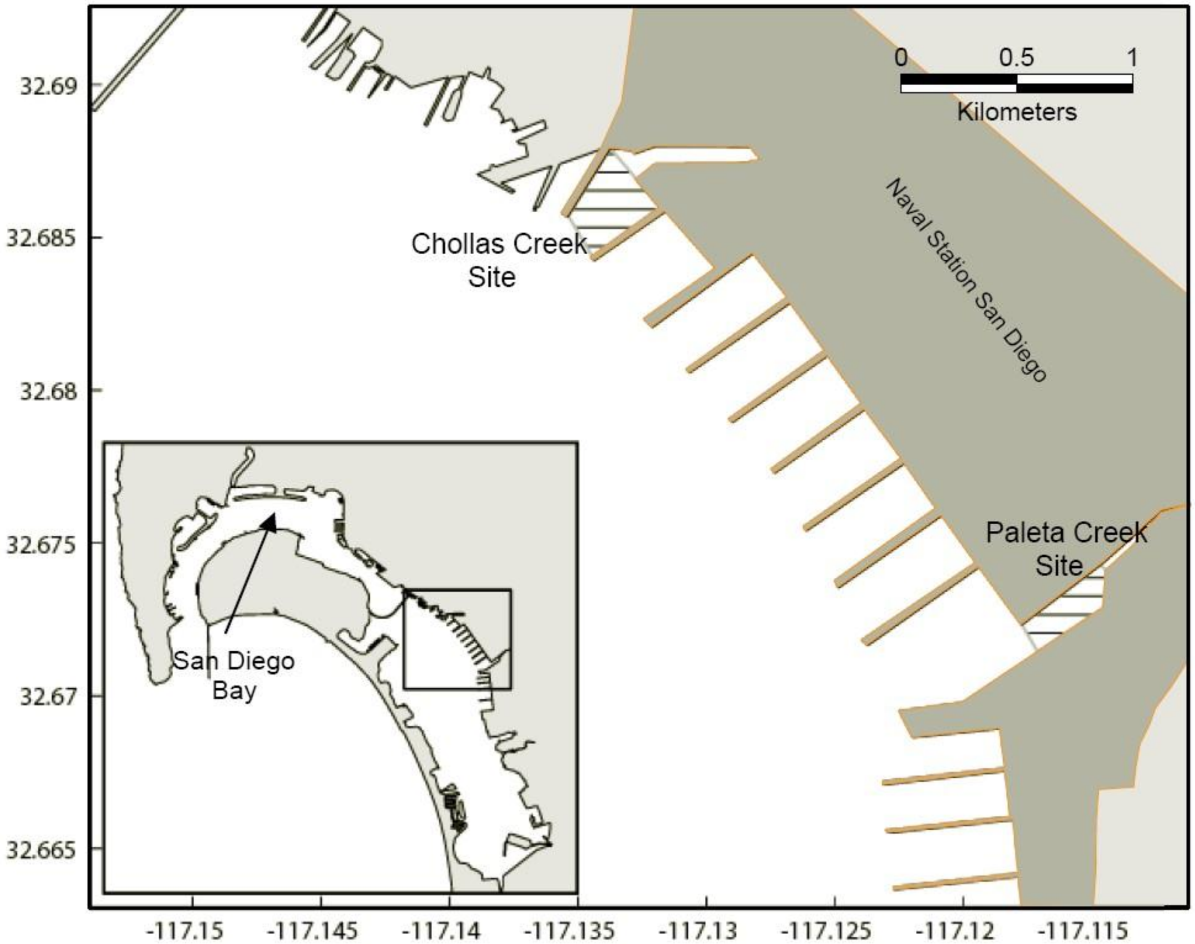

Figure 5-1. Naval Base San Diego
Source: SCCWRP and SPAWAR (2005)

Historically, Naval Base San Diego has served as a docking and fleet repair base. In the 1920s and 1930s, it was extensively used for the repair and maintenance of U.S. Navy Destroyer vessels. The following passage describing this activity is an excerpt from the historical magazine "San Diego's Navy" as quoted in the San Diego Unified Port District's investigative report (SDUPD 2004):

> *"In mid-1923, the destroyer base was caring for eighty-four decommissioned destroyers. During 1924 seventy-seven of these destroyers were decommissioned and seven recommissioned. Destroyers were hauled up on the marine railway, their hulls cleaned of marine growth and rust and painted (many times with an orange-red paint undercoat that led to the public's nickname of "Red Lead Row" for San Diego's Reserve ships). All machinery was opened, dried, and treated with oil or heavy coats of grease. Piping connections were blanked off to prevent flooding and fuel (sic), and the water tanks were drained and cleaned. When the Navy closed its submarine base in San*

Pedro during 1923-25, it transferred repair and upkeep responsibility of fleet submarines to San Diego (SDUPD 2004)."

The base expanded during the late 1930s to the late 1940s. From 1943 to 1945 more than 5,000 ships were sent to the base for conversion, overhaul, battle damage repair, and maintenance; approximately 2,190 of these ships were dry-docked. The base was expanded in 1944 to include approximately 823 acres, over 200 buildings, a 1,700 ton marine railway, a cruiser graving drydock, five large repair piers, quaywall totaling 28,000 feet of berthing space, and extensive industrial repair facilities. Naval Base San Diego remains in operation and is currently homeport for approximately 60 naval vessels and home base to 50 separate commands.

Past facilities and activities that were located in proximity to the impaired waterbody segments at the mouths of Paleta and Chollas creeks are discussed below (RWQCB 2012; SCS Engineers, Inc. 1986; Bechtel Environmental, Inc. 2002).

Mole Pier

The Mole Pier is a 22-acre triangular area bounded by 7th Street and Paleta Creek to the north, Cummings Road to the east, and Mole Road to the south. The area is located near present day Pier 9 adjacent to Paleta Creek and only a few hundred feet from San Diego Bay. Mole Pier was created in 1942 with hydraulic fill material from San Diego Bay. By 1945, Mole Pier was enclosed with earthen berms and designated as a waste disposal area. Wastes such as creosote–coated pier pilings, lumber, refuse concrete, waste paints, gasoline, solvents, oil, and diesel fuel were burned at the site between approximately 1945 and 1972. During the 1970s, trucks and heavy equipment were routinely decontaminated by spraying with diesel fuel and using a crane to dunk the vehicles into Paleta Creek. The U.S. Navy estimates that approximately 75,000 to 360,000 gallons of fuel was sprayed, burned, or buried in this area during its years of operation.

The types of wastes that were burned or buried at the Mole Pier are as follows:

- Motor oils, diesel fuel, gasoline hydraulic fluid;
- Stoddard solvent;
- Mixed solvents (acetone, MEK, toluene, methylene chloride);
- Mineral spirits;
- Carbon remover (phenol, cresol, chlorinated hydrocarbons);
- Methylene chloride;
- Chlorinated solvents; and
- Sandblast grit.

Potential pollutant transport mechanisms to Paleta Creek and San Diego Bay from Mole Pier operations between 1945 and 1972 include direct discharge of wastes, air transport, surface water runoff, and pollutant movement through the highly to moderately permeable (10^{-2} to 10^{-3} cm/sec) fill material underlying the site. Chemical constituents identified from past discharges of wastes at the Mole Pier Site are documented by the U.S. Navy's Installation Restoration Program (IR Program) site investigations (1990's) and include fuels, oils, solvents, paint sludges, metals, total petroleum hydrocarbons (TPH), VOCs, SVOCs, dibutyltin, monobutyltin, tetrabutyltin, and tributyltin. As of 2001, approximately 64,000 cubic yards of impacted soil was removed from the Mole Pier site as part of an initial cleanup action and hauled to a certified off-site landfill for disposal.

Salvage Yard

Between the years 1943 to about 1975, the U.S. Navy operated a salvage yard to receive, sell, donate, and dispose of excess Navy materials. Paleta Creek borders the former salvage yard to the south – southeast and Harbor Drive and Cummings Road border the site to the northeast and southwest, respectively. The U.S. Navy reports that items and materials handled at the site included transformers containing PCBs, mercury, electrolytes from old batteries, drummed petroleum wastes, solvents and thinners, refuse, demolition debris, infectious wastes from medical and dental clinics, and spoiled food items from incoming Navy vessels. The U.S. Navy estimates that between 100 and 200 drums per month of waste lubricating oil, lubricants, solvents, and acid alkaline solutions were transported to the site during its operation for handling. Wastes that could not be sold, reused or donated were incinerated at the site. Liquid waste was typically incinerated, drained onto the ground, or recycled. Wastes that were drained onto the ground included dielectric fluids, mercury, waste oils, solvents, thinners, battery acids, and silver nitrate. Potential pollutant pathways to Paleta Creek and San Diego Bay from the Salvage Yard operation would have included surface water runoff and pollutant movement through the highly to moderately permeable (10^{-2} to 10^{-3} cm/sec) fill material underlying the site. Part of the salvage yard was located adjacent to Paleta Creek, which flows into San Diego Bay approximately 1,200 feet west of the salvage yard site.

The U.S. Navy's IR Program identified waste constituents at the Salvage Yard Site, including PCBs and lead. The U.S. Navy removed approximately 22,000 cubic yards of wastes (and impacted soil) as part of a cleanup action executed between 1996 and 1997. The wastes were hauled to a certified off-site landfill for disposal.

Defense Property Disposal Office (DPDO) Storage Yard

The DPDO Storage Yard, an approximately 180,000 square foot area, operated between the years 1943 and 1981 east of Harbor Dive and north of Paleta Creek. Prior to 1975, the surface of the site was reportedly oiled with an estimated 35,000 to 75,000 gallons of waste petroleum, oils, and lubricants as a dust control measure. In addition, containers of electrical insulating oils were stored at the site during the 1970s. Some of those containers reportedly leaked but no estimated quantities are available. The storage yard was paved with asphalt in 1975 and as of 1986 was used for parking and boat storage.

During the operation of the storage yard, potential pollutant pathways to Paleta Creek and San Diego Bay could have included surface water runoff and pollutant movement through the highly to moderately permeable (10^{-2} to 10^{-3} cm/sec) fill material underlying the site. Paleta Creek channel is located adjacent to the storage yard site and discharges into San Diego Bay approximately 1,400 feet west of the site. The U.S. Navy's 1990s IR Program site investigations identified petroleum, PCBs, and metals in soil at the DPDO Storage Yard.

Firefighting Training Facility
Between the years 1945 through 1995, the U.S. Navy operated a fire-fighting training facility covering a 1,000 feet long by 200 feet wide were located near Pier 8. Approximately 3,500 gallons per week of jet propellant grade 5 fuel (JP-5) and gasoline were used to light training fires, until the training facility was redesigned with pollution control equipment in 1972. Quench water was generated from each firefighting exercise after passing through several oil water separators and discharging into a series of underground concrete tanks located in the southwest portion of the site. The U.S. Navy's IR Program site investigations identified waste constituents in soil and groundwater, including benzene, ethylbenzene, toluene, xylenes, and TPH (primarily JP-5) with lesser amounts of gasoline and bunker fuel (waste petroleum constituents). Petroleum products leaking from underground piping created two waste petroleum plumes in the groundwater beneath the site. Operation of a multiphase extraction system from 1997 to 2001 recovered approximately 15,000 gallons of waste petroleum. The site was paved over and has been used as a parking lot since 1996.

PCB Storage Facility Electrical Storage Yard
Between the years 1981 through 1994, the U.S. Navy operated an Electrical Storage Yard for maintenance and storage of materials containing PCBs at a location approximately 1,200 feet south of Paleta Creek and 1,000 feet east of San Diego Bay. The site is located at the intersection of Cummings Road and Mole Road, and bounded on the south by Civic Center Drive.

The facility was primarily used for maintenance of electrical equipment, including draining of transformer fluids and storage of fluids containing PCBs. Transformers were historically transported, repaired, and stored on soil, gravel, asphalt, and concrete at various locations throughout the yard. Until the late 1980s, no attempt was made to contain fluids or to segregate PCB fluids from other fluids used in the yard. The operation also involved application of waste oil potentially containing PCBs to the ground for dust and weed suppression. The site is currently paved with asphalt and used as a parking lot.

The U.S. Navy's IR Program site investigation reports that Arochlor 1260 was the primary PCB detected in soil and storm drain samples collected from the site. The reported PCB concentrations ranged from below the detection limit to 18,500 mg/kg.

PCB impacted soil was removed from the site and a nearby storm drain inlet in 1994. The Department of Toxic Substances Control certified that the site cleanup was complete, and site closure (i.e. no further remedial action was needed) was achieved. Potential pollutant transport mechanisms to Paleta Creek and San Diego Bay during its years of operation included direct discharge of wastes, air transport, surface runoff, and pollutant movement through the highly to moderately permeable (10^{-2} to 10^{-3} cm/sec) fill material underlying the site.

National Steel and Shipbuilding Company (NASSCO)

First permitted in 1974, the National Steel and Shipbuilding Company (NASSCO) is currently regulated under WDRs issued as Order No. R9-2009-0099, NPDES No. CA 0109134 (RWQCB 2009a). The Order requires NASSCO to limit discharges of pollutants from specific shipyard activities into storm water discharges to San Diego Bay.

NASSCO owns and operates a full service ship construction, modification, repair, and maintenance facility on the waterfront of San Diego Bay and west of the mouth of Chollas Creek. The facility is located on land leased from the San Diego Unified Port District at 28th Street and Harbor Drive in San Diego. NASSCO's primary business has historically been ship repair, construction, and maintenance for the U.S. Navy and commercial customers. The facility includes offices, shops, warehouses, concrete platens for steel fabrication, a floating dry dock, a graving dock, two shipbuilding ways, and five piers, which provide 12 berthing spaces (RWQCB 2001). Figure 5-2 provides an illustration of the facility located adjacent to the mouth of Chollas Creek.

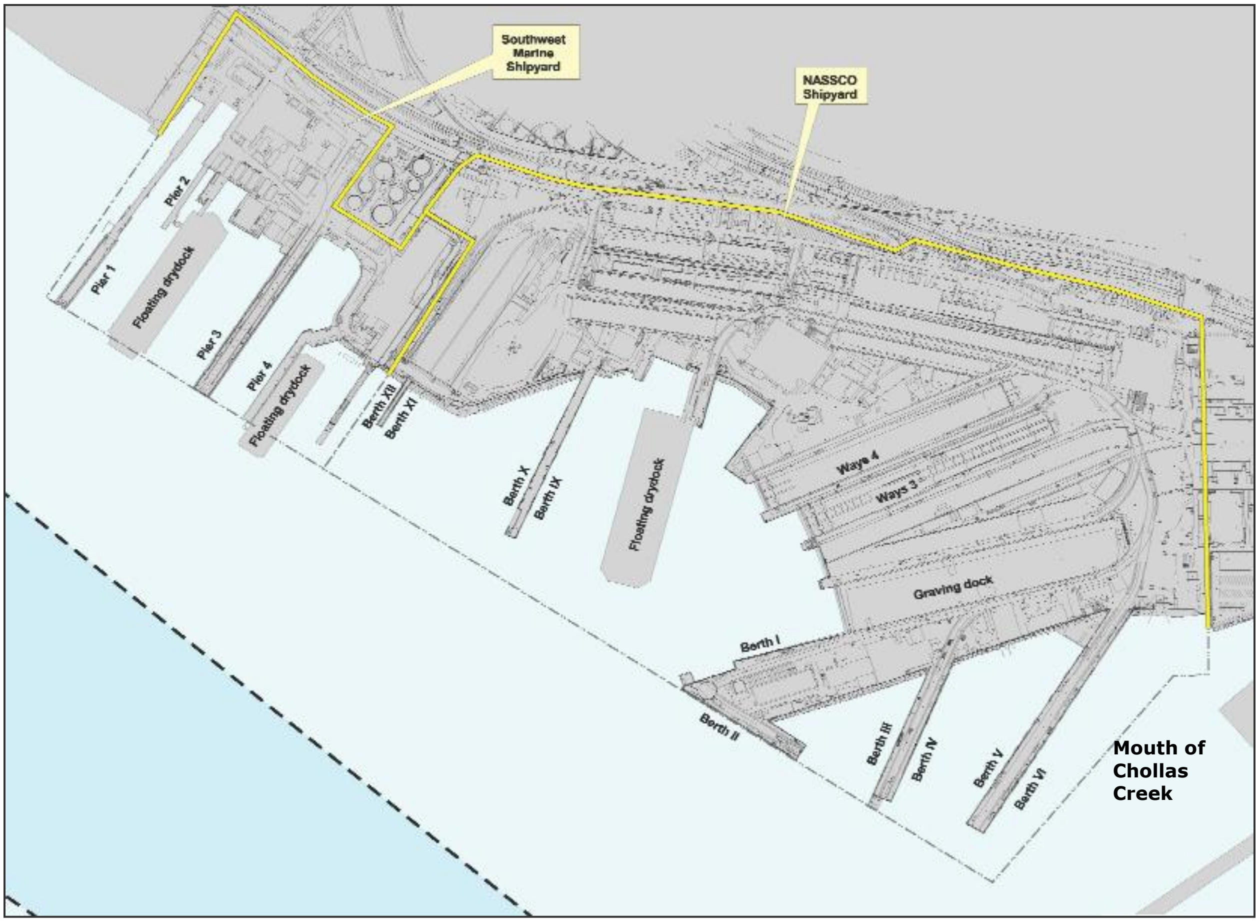

Figure 5-2. NASSCO Shipyard
Source: Exponent (2003)

There are three major types of building/repair facilities at NASSCO, which, together with cranes, enable ships to be assembled, launched, or repaired. These facilities include a floating drydock, a graving dock, and berths/piers. With the exception of berths and piers, the basic purpose of each facility is to separate a vessel from the bay to provide access to parts of the ship normally underwater. The berths and piers are over-water structures where vessels are tied during repair or construction activities. Because drydock space is limited and expensive, many operations are conducted at pier side. For example, after painting the parts of a ship normally underwater, the ship is moved from the drydock to a berth where the remainder of the painting is completed.

NASSCO initiated the capture of first-flush storm water from high-risk areas (dry dock, graving dock, paint and blasting areas) in the early 1990s. Capture of first-flush storm water was extended to additional areas of the facility in 1997. Prior to the early 1990s, all surface water runoff from NASSCO discharged directly into San Diego Bay (Exponent, 2003). Currently, NASSCO discharges storm water from employee parking lots into Chollas Creek, which contain oil and grease and PAHs that are deposited on parking lot surfaces by motor-vehicles.

Categories of wastes commonly generated by NASSCO's industrial processes include the following (RWQCB 2012):

- **Abrasive Blast Waste**: Abrasive blast waste, consisting of spent grit, spent paint, marine organisms, and rust is generated in significant quantities during all dry or wet abrasive blasting procedures. The constituent of greatest concern with regard to toxicity is the spent paint, particularly the copper and tributyltin antifouling components, which are designed to be toxic and to continuously leach into the water. Other pollutants in paints include zinc, chromium, and lead. Abrasive blast waste can be conveyed by water flows, become airborne (especially during dry blasting), or fall directly onto receiving waters.
- **Blast Wastewater**. Hydroblasting generates large quantities of wastewater. In addition to suspended and settleable solids (spent abrasive, paint, rust, marine organisms) and water, blast wastewater also contains rust inhibitors such as diammonium phosphate and sodium nitrite.
- **Bilge Waste/Other Oily Wastewater**. This waste is generated during tank emptying, leaks, and cleaning operations (bilge, ballast, fuel tanks, etc). In addition to petroleum products (fuel, oil), the washwater is generated in large quantities and contains detergents or cleaners.
- **Oils (engine, cutting, and hydraulic)**. In addition to spent products, fresh oils, lubricants, and fuels are released as a result of spills and leaks from ship or drydock equipment, machinery, and tanks (especially during cleaning and refueling).
- **Fresh Paint**. Discharge of paint can occur from spills, drips, and overspray.
- **Waste Paints/Sludges/Solvents/Thinners**. These wastes are generated from cleaning and maintenance of paint equipment.
- **Construction/Repair Solid Wastes**. These wastes include scrap metal, welding rods, slag (from arc welding), wood, rags, plastics, cans, paper, bottles, packaging materials, etc.
- **Miscellaneous Wastes**. These wastes include lubricants, grease, fuels, sewage (black and gray water from vessels or docks), boiler blowdown, condensate discard, acid wastes, caustic wastes, and aqueous wastes (with and without metals).

5.2.2 *Nonpoint Sources*

5.2.2.1 Atmospheric Deposition

Atmospheric deposition can occur as a result of both local and global atmospheric transport. Atmospheric emissions from both stationary point sources (e.g., industrial) and mobile sources, including vehicle emissions, enter waterbodies through direct or indirect deposition. Direct atmospheric deposition occurs when the pollutants deposit directly on the waterbody surface during both wet and dry periods. Indirect atmospheric deposition occurs when pollutants settle and accumulate on the land that drains to Paleta, Chollas, and Switzer Creeks and becomes a component of urban storm water conveyed by the MS4. As such, indirect loading varies depending on the amount of rainfall and size of storms in a given year.

Chlordane is present in the atmosphere, which is likely due to volatilization from soils and water as well as wind erosion. In outdoor air, chlordane exists predominately in the vapor phase and to a lesser extent is adsorbed to air particulates (ATSDR 1994).

PCBs are globally circulated through atmospheric transport and are present in all environmental media. PCBs may be released to the atmosphere from uncontrolled landfills and hazardous waste sites; incomplete incineration of PCB-containing wastes; leakage from older electrical equipment in use; and improper disposal or spills (ATSDR 2000). Hydrophobic PCBs both deposit to and de-gas from waterbodies. As mentioned in Section 5.1 above, the PCBs of concern are no longer in use; therefore, atmospheric deposition rates are declining.

The Southern California Coastal Water Research Project (SCCWRP) has investigated cross-media transport of chlordane and total PCBs between the water column and the atmosphere to understand the role of each compartment as a source or a sink in southern California coastal waters. That research included a sample site at San Diego Bay near the mouth of Chollas Creek. SCCWRP has reported that total chlordane has a net gain to the surface water of San Diego Bay due to dry particle deposition (Schiff 2011). In the case of total PCBs in San Diego Bay, there is a net loss to the atmosphere due to volatilization of the vapor phase components from the water surface (Schiff 2011).

Atmospheric deposition is a potentially significant “nonpoint” source of PAHs discharged into the watershed. PAHs are released to the atmosphere through natural (i.e., wildfires) and synthetic sources of emissions (ATSDR 1995). The largest sources of PAHs discharged into the atmosphere are from synthetic sources, including automobile and truck emissions; hazardous waste sites such as abandoned wood-treatment plants (sources of creosote) and former manufactured-gas sites (sources of coal tar); and wood burning in homes. Because the area of the watershed is much larger than the surface area of the creeks, indirect deposition is assumed to be much more significant than direct deposition.

In the SCCWRP report (Sabin et al. 2010), cross-media transport between both the sediment and the water column, and the water column and the atmosphere were investigated to understand the role of each compartment as sources or sinks of PAHs in San Diego Bay. High water concentrations of PAH compounds were found to result in a net gas exchange to the atmosphere making the impaired waterbody act as a net source of PAH compounds to the atmosphere. The low molecular weight PAHs dominated the fraction of total PAHs that volatilized to the atmosphere and partitioned out of sediment providing a flux of pollutants into the water column. While the high molecular weight PAHs tended towards dry deposition and sedimentation in general, the flux for San Diego Bay indicated a net movement from the water to the atmosphere.

Sabin et al. (2010) also reported that the net gas exchange in San Diego Bay did not change with variations in temperature or wind speed, which indicated that net PAH volatilization is expected to occur throughout the majority of the year.

5.2.3 *Other Sources*

Other potential sources of organic pollutants include the following.

Sediment Flux
Contaminants enter San Diego Bay from various sources, including the watershed areas drained by Paleta, Chollas, and Switzer Creeks, ships, and shoreline facilities. Sediments in the bay are typically considered a sink for these contaminants, but a flux of chemicals may also emanate from the sediments. A study in San Diego Bay evaluated sediment flux of organic compounds, including PCBs and PAHs. PCBs concentrations appeared to be below the detection limit. PAH fluxes were generally from the water column into the sediment and fluxes from the sediment are expected to be minimal (Chadwick et al. 1999).

Resuspension of Sediment
Observed concentrations of waste constituents in marine sediments and the distribution of contaminated sediments within San Diego Bay are generally consistent with source locations (i.e., marine sediment pollutant levels tend to decrease as a function of distance from source locations). Complicating factors and other considerations include the physical, biological, biochemical, and chemical processes that may alter marine sediment and pollutants over time, irrespective of proximity to source locations. In San Diego Bay these processes may include dredging, boat tugging and docking of large vessels, tidal or wind driven currents, bioturbation,[11] biological uptake, and chemical reactions (e.g., dissolution and precipitation).

The redistribution of contaminated marine sediment within San Diego Bay can be caused by both ship movements and natural processes which result in resuspending sediments into the water column and redistributing those sediments via bay currents. Resuspension of marine sediment via ship movements may occur as a result of shear forces generated by the thrust of propellers during boat tugging and docking of large naval or commercial vessels. Natural resuspension of marine sediment is caused by the shear forces induced by bay currents, storm water flushing, and wind-induced wave action. Polluted sediment resuspension and transport by tidal currents is a pathway for pollutants to other portions of the bay.

Sediment Resuspension from Ship Movements:
Chadwick et al. (1999) estimated the loading of resuspended sediment from ship movements at Naval Base San Diego and concluded that it is a significant source of sediment loading to San Diego Bay.

[11] "Bioturbation" refers to the turning and mixing of sediments particles by benthic fauna (animals) or flora (plants). The sediment-water interface increases in area as a result of bioturbation, affecting chemical fluxes and thus exchange between the sediment and water column.

The U.S. Navy estimated that from 16,700 to 71,400 kilograms per day (kg/day), with an average of 41,700 kg/day, of sediment is resuspended due to ship movements in the Naval Base pier area (Chadwick et al. 1999). For comparison purposes, the U.S. Navy reported that:

> *"This daily input represents 29 percent of the background mass of suspended sediment for [Naval Base San Diego] and adjacent shipping channel. In comparison to TSS loading from Chollas and Paleta creeks, which drain into [Naval Base San Diego], the yearly estimated total sediment resuspension from tug-assisted ship movements was roughly 300 percent of the storm estimated total mass coming from the creeks."*

NASSCO has a number of berths and piers where ship movements, propeller wash, and engine testing cause sediment resuspension and transport to and within this impaired site and the surrounding bay. The NASSCO berths and piers are located north of the mouth of Chollas Creek.

Sediment Transport Modeling from Naval Base San Diego:
The U.S. Navy utilized a hydrodynamic model (TRIM-2D) and a sediment transport model (TRIM-SED) to evaluate the transport of resuspended sediment and associated chemicals in the vicinity of Naval Base San Diego (Chadwick et al. 1999). The study concluded that approximately 55 percent of the sediment resuspended within the Naval Base San Diego piers is deposited outside the immediate area of the piers.

The models were also used to simulate the footprint of suspended sediment and chemical levels that have settled on the bay bottom during and after storm events. The model results indicate that fine TSS particles (less than 12 microns) are transported throughout the bay and into creek channels during high tides. Medium-sized particles from 12 to 55 microns are transported to the front and back sections of the bay but are localized along the eastern shoreline. The medium-sized particles settle within 1 to 2 km of the creek outfalls, and the coarse particles settle right at the outfalls (Chadwick et al. 1999). The model considered only tidal currents as the transport mechanism, not ship movements and associated tugboat activity. Although the simulated footprint of suspended sediment deposition was specifically designed to evaluate inputs from the creeks (e.g., Chollas Creek) during storm events, it is reasonable to assume that the tidal currents and movements would also similarly redistribute and deposit sediment resuspended by ship movements in the Naval Base San Diego pier area of San Diego Bay and into creek channels.

<u>Leaching from Creosote Pilings</u>
Creosote, which contains PAHs, has been used to treat wood telephone poles, railroad ties, and pier pilings as a preservative to minimize degradation from exposure of wood structures to natural elements. In June 1995, there were over 13,000 creosote pilings located in San Diego Bay with nearly 9,000 pilings located in the back bay which has

limited net water exchange (Chadwick et al. 1999). "The high degree of similarity in the compositional makeup along with the strong spatial correlation of pilings and seawater PAH concentrations suggests that the creosote pilings are a significant source of PAH to San Diego Bay" (Chadwick et al. 1999). This study estimated that 80.1 percent of PAH loadings to San Diego Bay are associated with creosote pilings (Chadwick et al. 1999). While the current PAH loading has likely decreased as the pilings at Naval Base San Diego have been replaced (Katz 1998), it is not known what proportion of these contaminants may remain within the nearby sediments.

<u>Compensating Fuel Ballast</u>
Intermittent discharges of seawater from tanks, that can hold fuel or ballast water to maintain vessel stability, are known as compensating fuel ballast discharges. Discharges of seawater occur during refueling as the new fuel displaces the seawater in the tanks. The discharged seawater may contain fuel related pollutants, including PAHs. One study estimated that compensated fuel ballast was responsible for 5.1 percent of PAH loadings to San Diego Bay (Chadwick et al. 1999).

<u>Oil and Fuel Spills</u>
Oil and fuel spills usually occur by accidents involving tankers, barges, pipelines, refineries, or other fuel storage or conveyance facilities. Accidents may occur as a result of human error, equipment malfunction, natural disasters, and illegal activities. Oil and fuel contain many pollutants, including PAHs, which can pollute the water or sediment during a spill. Chadwick et al. (1999) estimated that oil spills were responsible for 6.6 percent of PAH loadings to San Diego Bay.

<u>Bilge Water</u>
A bilge is the rounded part of a ship's hull, the transition where the bottom of the ship meets the sides. The bilge receives water and fluids from many parts of the ship and the resulting bilge water may contain oil and fuel, among other pollutants. Bilge pumps are used to remove bilge water from the vessel. Bilge water discharges have been discontinued in the bay (Chadwick et al. 1999); however, it is unknown what proportion of the contaminants historically discharged resides in nearby sediments. It is estimated that historic sources of bilge water contained PAHs, making up 3.6 percent of the loading to San Diego Bay (Chadwick et al. 1999).

5.3 Paleta Creek Sources

Potential organic pollutant loadings and the sources of pollutant discharges into the mouth of Paleta Creek are described in Sections 5.2. The primary sources of toxic pollutant discharges into the mouth of Paleta Creek include the upland Paleta Creek watershed, Naval Base San Diego, and atmospheric deposition. The upland watershed includes residential, commercial, and industrial land uses and roads and highways. Chadwick et al. (1999) estimated that, at the time of the study, a majority of the PAH input to the Naval Base San Diego region, which includes the mouth of Paleta Creek, comes from creosote pier pilings, while the remainder, in lesser amounts, comes from storm water runoff, oil spills, compensating fuel-ballast systems, and atmospheric deposition. Both chlordane and PCBs are banned from use; however, historical applications and contamination continue to wash-off land surfaces in storm water from urbanized and other watershed areas.

5.3.1 *Overview of Conditions at the Mouth of Paleta Creek*

The available sediment quality data for the mouth of Paleta Creek, compiled in Appendix F, was reviewed to provide an overview of the conditions that exist within the impaired site that relate to the assessment of sources.

In 1995 and 1997, Chadwick et al. (1999) performed a detailed physical, chemical, and biological characterization of the sediment at 5 stations within Naval Base San Diego and a reference station, including a station at the mouth of Paleta Creek (see Appendix F, Tables F-14 through F-21). The Paleta Creek station was found to contain one of the highest organic chemical concentrations within Naval Base San Diego.

In 2001, the Phase I Sediment Assessment Study evaluated the spatial distribution of contaminants in the sediments located at the mouth of Paleta Creek (SCCWRP and SPAWAR 2005). SCCWRP and SPAWAR (2005) reported that the area of "likely" impairment for aquatic life, based on sediment chemistry, toxicity and benthic community effects (or the triad), was a subset of four inner creek stations (P11, P15, P16, and P17; see Appendix F, Figure F-12). The increasing gradient of impairment toward the inner creek mouth stations was spatially consistent with a source of pollution entering from Paleta Creek itself, or from the shoreline activities located adjacent to the site where tidal exchange can transport pollutants into creek mouth and channel areas. The high content of fine grained sediments at the inner creek stations indicate that this is a depositional environment containing enriched TOC levels indicating a higher than normal loading of organic matter observed for San Diego Bay. A likely source of the organic matter is the urban runoff conveyed from the upland areas of Paleta Creek.

The Phase I Sediment Assessment (SCCWRP and SPAWAR 2005) reported that the classification of some outer Paleta Creek stations as "possibly" impaired was driven by the co-occurrence of elevated chemistry and benthic community impacts; while sediment toxicity at the outer stations was observed not to be elevated relative to the baseline conditions.

The inner channel of the creek mouth had the highest observed concentrations of chlordane and PAHs, while one station located mid-channel (P05) had the highest concentration of PCBs (SCCWRP and SPAWAR 2005) (Appendix F; Table F-24 and Figure F-12). The inner creek mouth also contains locations high in sediment toxicity and benthic community impacts (Appendix F; Tables F-27 and F-30, and Figure F-11).

Temporal variability in sediment parameters was assessed between July 2001 and October 2002 by Brown and Bay (2005) (Appendix F; Section F1.8.1). This study found that most sediment parameters were consistent over the five sampling periods at the sampling stations, with some variability observed in the chlordane and PCB measurements. However, the variability could not be linked to season or rainfall events. The assessment used a weight of evidence approach on the triad of data evaluated to classify the potential for impairment at the sampling stations. Consistent classifications of potential impairment were found at both reference sites and the station closest to the creek inlet (P17). The station located in the vicinity of a storm water outfall along the northern quay wall, before the corner in the outer channel area (P11), varied from unlikely to likely potential impairment as a result of variations in the parameters used to assess biological impacts (e.g., toxicity or benthic community composition).

The U.S. Navy collected data from the mouth of Paleta Creek on total PAHs concentrations in the water column during dry weather in July and November 1997 (Katz 1998; Appendix F, Table F-44). The highest total PAH concentrations in San Diego Bay were observed at the four stations sampled at Naval Base San Diego, including the Paleta Creek station.

5.3.2 *Paleta Creek Watershed Outflow*

Paleta Creek conveys freshwater flows from urban and storm water runoff. During the majority of the year, the flows in Paleta Creek are insignificant; however, during storm events the creek can provide significant freshwater discharges, including significant chemical pollutants in the suspended sediment load, into San Diego Bay (Chadwick et al. 1999).

Several known sources of organic pollutants are present in the Paleta Creek watershed. Sources contributing urban and storm water flows from the upland watershed areas include the MS4 dischargers (the cities of San Diego and National City, small MS4s, and Caltrans), industrial and construction storm water dischargers, and Naval Base San Diego. Additional information about these sources is provided below. The pollutants are conveyed directly to San Diego Bay or the pollutants runoff into storm drains and Paleta Creek during rainfall events and eventually drain into the bay.

The U.S. Navy funded a project in 2001 (Katz et al. 2003) to quantify storm event mass loading of pollutants, from upstream MS4 creek sources and from near-bay U.S. Navy sources, and to characterize the spatial and temporal impacts from the plumes generated in San Diego Bay. Specific conclusions included that, at the time of the study, upstream storm water sources (i.e., sources upstream of U.S. Navy sources) appeared to dominate the loading of contaminants to the bay via Paleta Creek. Another conclusion is that storm water is a continuing source of excessive levels of chlordane and possibly PCBs in the sediments located at the mouth of Paleta Creek.

In the 2005-06 wet season, storm water flows at a mass emissions station above the tidal prism in Paleta Creek were monitored during three storm events (Schiff and Carter 2007; Appendix C-1). The storm water flows were observed to contain elevated concentrations of chlordane and PAHs transported from the upland watershed area; while PCBs were not detected in the same storm water samples. A separate study conducted during the 2009-10 wet season monitored an additional two storms at the same location (City of San Diego 2010a). This study also reported elevated concentrations of chlordane and PAHs, and no reportable concentrations of PCBs.

The City of San Diego's 2008 storm drain sediment study characterized organic pollutants and metals in several land use areas within the Switzer Creek watershed (Weston Solutions 2009). As previously noted, the land uses in Paleta Creek watershed are similar to those in the study area. The study reported that chlordane was highest and most frequently detected in areas dominated by residential and combined residential/commercial land uses. PAHs were reported in all areas and PCBs were rarely detected.

Interstate Highways 5 and 805 likely contribute petroleum and hydrocarbons from spills and leaks, oil and grease, and vehicle emissions, as well as herbicides in storm water discharges (Grant et al. 2003)(Caltrans 2003a, 2003b). Indirect atmospheric deposition of organic compounds onto impervious surfaces of highway structures would also likely be present in highway runoff from these surfaces.

Permitted industrial facilities in the Paleta Creek watershed include a transportation storage yard, metal works for shipbuilding, and metal galvanizing operations. As discussed in section 5.2.1.4, these types of industrial facilities may be sources of organic pollutants, such as PAHs and PCBs. Housekeeping practices of all industrial sources is important in determining source potential. These industrial facilities are all located within the Cities' MS4 jurisdictional boundaries.

5.3.3 *Naval Base San Diego*

The discharge from Paleta Creek is located at the midpoint of the Naval Base San Diego facility at San Diego Bay. An area of 287 acres at Naval Base San Diego drains to Paleta Creek (U.S. Navy 2000). Section 5.2.1.5 describes the historical operations associated with Naval Base San Diego that affected sediment and water quality at the mouth of Paleta Creek.

Historically, the Navy used 7th Street channel and the surrounding area for a variety of activities (Fairey et al. 1996). Excess materials (solid waste, ships stores, and waste hydraulic fluids) from decommissioned ships were discharged into the ship repair basins for disposal. Overflow from salvage yards, lubricants and hydraulic oil wastes, and paint sludge from nearby Navy repair facilities were often taken to the area's wet docks for disposal. Disposal of large amounts of petroleum based materials at the adjacent mole pier and discharge of diesel fuel used for decontamination purposes directly to the channel occurred during the mid-1940s through the 1970s.

The 7th Street channel is also located near a Navy salvage yard that has storm drains that empty directly into the channel (Fairey et al. 1996). Soil samples retrieved from the salvage yard in 1976 contained high PCB concentrations, which resulted in the upper eight inches of soil being removed as contaminated waste and the entire area being paved.

A large storm water conveyance pipe drains a residential area east of Interstate 5 and Naval Base San Diego adjacent to the 7th Street Channel/Paleta Creek. Paleta Creek discharges into the 7th Street channel with numerous drains located in the immediate area emptying into the creek and bay. Based on high metal, chlordane and PAH concentrations, toxicity, and degraded benthic communities, the BPTCP study (Fairey et al. 1996) gave the Paleta Creek/7th Street Channel site a high priority ranking for cleanup.

Chadwick et al. (1999) reported that creosote pier pilings were a dominant source of PAHs with supporting information from PAH fingerprinting studies of seawater samples that showed a close match to the chemical fingerprint of creosote standards. Naval Base San Diego has removed and replaced creosote pier pilings with plastic or untreated wood as a means to control this source from their facility.

In February 2001, the U.S. Navy collected and analyzed a composite storm water sample collected from three Naval Base San Diego outfalls that drain to Paleta Creek. Katz et al. (2003) reported that the storm water runoff from the Navy facility to the mouth of Paleta Creek contributes low levels of total PAHs, chlordane levels approximately two times that of the CTR value,[12] and total PCBs approximately six times higher than that of the CTR value[13] (see Appendix F, Table F-42).

5.3.4 *Atmospheric Deposition*

Toxic pollutants are dispersed through atmospheric transport and deposition. Pollutants are deposited directly to the waterbody or indirectly through storm and urban runoff to Paleta Creek.

As discussed in Section 5.2.2.1, SCCWRP research observed a net loss to the atmosphere from the water surface as a result of higher volatilization compared to dry particle deposition for both PAHs and total PCBs in San Diego Bay (Sabin et al. 2010; Schiff 2011). However, SCCWRP observed a net gain of total chlordane dry particle deposition or loading to the waterbody (Schiff 2011).

[12] The California Toxics Rule value for Criterion Continuous Concentration for Freshwater is 4.3 ng/L (U.S. EPA 2000b).

[13] The California Toxics Rule value for Criterion Continuous Concentration for Freshwater is 14 ng/L (U.S. EPA 2000b).

5.3.5 *Summary of Sources*

Runoff from urban development and discharges from the industrial uses along the waterfront are the primary sources of ongoing discharges of toxic pollutants to the sediment at the mouth of Paleta Creek. Table 5-3 provides a summary of sources of pollutants discharging to the mouth of Paleta Creek.

Table 5-3. Summary of the primary sources contributing pollutants to the Mouth of Paleta Creek

	Chlordane	PAHs	PCBs
MS4 Dischargers (Phase I MS4s, small MS4s)	◆	◆	◆
Caltrans	◆	◆	◆
General Industrial & Construction Storm Water Dischargers	◆	◆	◆
Naval Base San Diego	◆	◆	◆
Direct Atmospheric Deposition	◆		

5.4 Chollas Creek Sources

Section 5.2 includes general information about the sources of potential organic pollutants and waste loadings for the mouth of Chollas Creek. The primary sources of toxic pollutants to the mouth of Chollas Creek include the Chollas Creek watershed, Naval Base San Diego, NASSCO, and atmospheric deposition. The upland watershed includes residential, commercial, and industrial land uses and roads and highways. Chadwick et al. (1999) reported that, at the time of the study, a majority of the PAH input to the Naval Base area of San Diego Bay, including the mouth of Chollas Creek, comes from creosote pier pilings while the remainder, in lesser amounts, comes from storm water runoff, oil spills, compensating fuel-ballast systems, and atmospheric deposition. Both chlordane and PCBs are banned from use; however, residual concentrations from historical applications of these chemicals could result in pollutants being discharged into surface waters/sediments via storm water runoff from urbanized areas of the watershed and adjacent sites.

5.4.1 *Overview of Conditions at the Mouth of Chollas Creek*

The available sediment quality data for the mouth of Chollas Creek (see Appendix F) was reviewed to obtain an overview of information related to the assessment of potential sources of pollutants and of the spatial and temporal conditions that exist within the impaired area of Chollas Creek.

The U.S. Navy conducted a sediment characterization study, in January 1995, to obtain permits for dredging the channel located at the mouth of Chollas Creek (Appendix F; Section F1.4) and for disposal of bay sediments dredge spoil wastes from that project. The study examined 18 cores, collected throughout the inner channel of the creek, that were separated into one to three 7-foot layers to a depth of -22 feet mean lower low water (MLLW).

The chemical concentrations of pollutants (e.g., chlordane, PAHs, and PCBs) were highest in the deepest layer of the cores collected near the head of the creek mouth (below a depth of -14 feet in the sediment column) and in the surficial sediments located near the outer channel of the creek mouth. Lower pollutant concentrations were observed in the middle and surface layer samples of the cores collected from the area near the head of the creek mouth. Elevated concentrations of chlordane and PCBs were found throughout all core layers, which supports that sediment predominantly originates from the watershed and is deposited in the creek mouth. There is additional evidence that fine-grain surficial sediment deposited in the channel of the creek mouth can be scoured during larger storm events and pushed outward towards the outer channel (U.S. Navy 1996). A significant amount of this material was removed when the U.S. Navy dredged the channel to a depth of approximately -22 feet MLLW in August 1997. Nonetheless, the U.S. Navy's findings suggest the sediment deposition at the creek mouth originates from the watershed and adjacent facilities during storm events where tidal exchange can transport pollutants into creek mouth and channel areas.

NASSCO collected semi-annual surface sediment samples, from 1992 through 1997 and then again in August 1999, from the outer channel of the creek mouth as part of receiving water monitoring for its WDRs (Appendix F; Section F1.2). The monitoring included results for total PAHs and total PCBs. For total PAHs concentrations collected over a seven year period, 10 samples contained positive results ranging from 253 µg/kg to 4,644 µg/kg, with an average total PAHs concentration of 2,723 µg/kg. For total PCBs, only 3 of 12 samples reported positive results: the two semi-annual samples from 1994 and the one sample from 1999. The highest concentration of total PCBs (163 µg/kg) was reported in the 1999 sample (Eco-Systems Mgmt, Inc. 1999). The location of this sample does not appear to be within the 1997 dredge footprint and was not likely removed by the dredging operation. However, its proximity to the dredge footprint makes it possible that the sample location was physically impacted by sloughing or deposition of suspended sediment attributable to the dredging operation.

The Phase I Sediment Assessment Study conducted in 2001 evaluated the spatial distribution of contaminants in the surface sediment of the impaired site (SCCWRP and SPAWAR 2005). SCCWRP and SPAWAR (2005) reported that most stations located within the mouth of Chollas Creek fell into the range of "likely" to "possible" impairment. The evaluation of results from sediment chemistry, toxicity, and benthic community effects (aka triad) indicates that pollutant contamination was substantially greater than the baseline condition and at levels of concern to aquatic life. Biological effects at this site were indicated by results from the sediment toxicity and benthic community analyses. Two stations near the inner/outer creek channel boundary (stations C8 and C11) showed benthic community impacts co-occurring with exceptionally low fines and low contamination levels (Appendix F; Tables F-25, F-28, F-31, and Figure F-13). Recurring sediment physical disturbance associated with ship engine tests performed at NASSCO Shipyard's pier (Berth 6) was identified as potentially contributing to the observed benthic community impacts in this area.

SCCWRP and SPAWAR (2005) reported that the greatest magnitude of "likely" impairment was present at the inner creek mouth stations (stations C12, C13 and C14; see Appendix F, Figure F-13). The increasing gradient of impairment toward the inner creek mouth stations was spatially consistent with a source of pollutants entering the site either from Chollas Creek itself or from the shoreline activities adjacent to the site. The high fines content of the sediments at the inner creek stations indicate that this area is a highly depositional environment, while the enriched TOC levels indicate organic matter loading higher than normal for the bay and most likely related to urban runoff from the creek.

SCCWRP and SPAWAR (2005) reported that the inner creek mouth had the highest concentrations of chlordane and PAHs and the outer channel between the two piers had the highest concentrations of PCBs (Appendix F; Table F-25 and Figure F-13). Additionally, the locations that had high and moderate sediment toxicity are located in the inner creek mouth, in the outer area of the site between the two piers, and along both Naval Base San Diego and NASSCO piers (Appendix F; Table F-28 and Figure F-13).

Temporal variability was assessed by Brown and Bay (2005) in July 2001 through October 2002 (Appendix F; Section F1.8.1). This study found that most sediment parameters were consistent over the five sampling periods at most stations, with some variability in the chlordane and PCB measurements. However, the variability could not be linked to season or rainfall. Brown and Bay (2005) noted that the sampling period was the driest on record, with only 28 percent of the normal total rainfall, and the largest storm event was 0.4 inches.

The temporal assessment included using a weight of evidence approach on the triad of data used to classify the potential for impairment at the stations. Consistent classifications over the time period were found at both reference sites and the station closest to the creek inlet (C14). The station located at the base of Naval Base San Diego's Pier 1 (C10) varied from "unlikely" to "likely" impacted over time as a result of variations in the measures of biological impact (i.e., toxicity or benthic community composition).

The U.S. Navy collected data on total PAHs in the water column at the mouth of Chollas Creek in July and November 1997 (Katz 1998; Appendix F, Table F-44). The highest concentrations in the bay were observed at the 4 stations sampled at Naval Base San Diego, including the Chollas Creek station.

In summary, the available data indicate that pollutants are discharged from the watershed and adjacent facilities; these are deposited in the inner channel of the creek mouth. Fine sediment may be scoured out of the inner channel into the mid-channel between the piers during large storm events, as well as resuspended by and then pushed back into the inner channel and towards the mid-channel between the two piers by NASSCO's engine testing at Berth 6.

5.4.2 *Chollas Creek Watershed Outflow*

Chollas Creek includes freshwater flows from urban and storm water runoff. During the majority of the year, the flows in Chollas Creek are insignificant; however, during storm events in the winter months the creek can provide significant freshwater input with elevated suspended sediment containing significant chemical pollutants into the bay (Chadwick et al. 1999).

There are several known sources of organic pollutants present in the Chollas Creek watershed. The sources that contribute urban and storm water runoff from the watershed include the MS4 dischargers (the cities of La Mesa, Lemon Grove, and San Diego, the Port of San Diego, small MS4s, and Caltrans), industrial and construction storm water dischargers, and adjacent facilities (NASSCO and Naval Base San Diego are discussed separately below). Section 5.2 provides some general information about these point sources. The pollutants are conveyed directly to San Diego Bay or the pollutants are washed into storm drains and Chollas Creek during precipitation events and eventually drain into the bay.

U.S. Navy studies (Katz et al. 2003, Chadwick et al. 1999) support the conclusion that the Chollas Creek outflow (i.e., storm water plume) can introduce pollutants to the adjacent shoreline areas of San Diego Bay. The U.S. Navy funded a project in 2001 (Katz et al. 2003) to quantify storm event mass loading of pollutants from upstream MS4, creek sources, and from near-bay U.S. Navy sources as well as to characterize the spatial and temporal impacts from the plumes generated in the bay. Specific conclusions of this study included that, at the time of the study, upstream storm water sources (i.e., sources upstream of U.S. Navy sources) appeared to dominate the loading of contaminants to the bay by way of Chollas Creek. The study also made the conclusion that storm water discharges were a continuing source of excessive levels of chlordane, PCBs, and possibly total PAHs to the sediment at the mouth of Chollas Creek.

Two subsequent studies identified Chollas Creek (above tidal influence) as a source of chlordane and PAHs, but not PCBs. A 2007 storm water monitoring and modeling study of the creek collected monitoring data during 3 storm events during the 2005-06 wet season at mass emission stations located above the tidal prism on each of the north and south branches of the creek. The study found that large amounts of PAHs and chlordane are transported from the watershed, while PCBs were not detected in storm water samples (Schiff and Carter 2007, Appendix C-1). These monitoring results also reported that the total PAHs and chlordane flow-weighted mean concentrations were 3 times higher in the North Branch than the South Branch. A separate study conducted during the 2009-10 wet season monitored an additional 2 storms at 6 stations upstream of the tidal prism throughout the Chollas Creek Watershed (City of San Diego 2010a). This study also reported elevated concentrations of chlordane and PAHs and very low to no reportable concentrations of PCBs.

The City of San Diego's 2008 storm drain sediment study characterized organic pollutants and metals in several land use areas within the Switzer Creek watershed (Weston Solutions 2009). As previously noted, the land uses in Chollas Creek watershed are similar to those in the study area. The study reported that chlordane was highest and most frequently detected in areas dominated by residential and combined residential/commercial land uses. PAHs were reported to be highest in the Downtown urban area and in Balboa Park (along Pershing Drive). PCBs were rarely detected in these areas.

Interstate Highways 5, 15, and 805, and State Route 94 likely contribute petroleum and hydrocarbons from spills and leaks, oil and grease, and vehicle emissions, as well as herbicides in storm water discharges (Grant et al. 2003; Caltrans 2003a, 2003b). Indirect atmospheric deposition of organic compounds onto impervious surfaces of highway structures would also likely be present in highway runoff from these surfaces.

Permitted industrial facilities in the watershed include automotive dismantlers and recyclers, metal plating, manufacturing, recycled and waste materials processing, and transportation storage yards. As discussed in section 5.2.1.4, these types of industrial facilities may be sources of organic pollutants, such as PAHs and PCBs. These industrial facilities are located within the Cities' MS4 jurisdictional boundaries.

5.4.3 *Naval Base San Diego*

Chollas Creek discharges to San Diego Bay at the northern portion of Naval Base San Diego. The Naval Base San Diego leasehold also includes a 24,653 square foot parcel located north of Chollas Creek and at the south end of 28th Street in the City of San Diego (Figure 5-1). The area of Naval Base San Diego draining to Chollas Creek is approximately 266 acres (U.S. Navy 2000). Section 5.2.1.5 describes the historical operations associated with Naval Base San Diego that have affected sediment and water quality at the mouth of the creek. Naval Base San Diego has contributed pollutants to the mouth area of the creek and adjacent areas of the bay through storm water runoff, leaching of PAHs from creosote pier pilings, sediment resuspension from dredging operations and ship movements, as well as discharges of compensating fuel ballast water and oil spills directly into San Diego Bay (RWQCB 2012).

Chadwick et al. (1999) reported that creosote pier pilings were a dominant source of PAHs. This conclusion was supported by PAH fingerprinting studies from seawater samples that showed a close match to the chemical fingerprint of creosote standards. Naval Base San Diego has removed and replaced all creosote pier pilings with plastic or untreated wood as a means to control this source of pollution from the facility (Kowalczyk 2009).

In February 2001, the U.S. Navy collected and analyzed a composite storm water sample from 3 of the facility's outfalls that drain to Chollas Creek and the creek mouth. Katz et al. (2003) reported that the U.S. Navy contributes low levels of total PAHs and PCBs, and levels of chlordane that are approximately two times the CTR value[14] (see Appendix F, Table F-42). Katz et al. (2003) estimated that the storm water loading from Naval Base San Diego to Chollas Creek was an average of 5 percent of the total loading.

5.4.4 *NASSCO*

The mouth of Chollas Creek is located adjacent to the southern boundary of the NASSCO shipyard. Section 5.2.1.5 describes the historical operations at NASSCO that may have affected sediment and water quality at the mouth of Chollas Creek. NASSCO has contributed pollutants to the mouth of Chollas Creek and adjacent areas of the bay through storm water runoff from its facility, leaching from creosote pier pilings, sediment resuspension from engine testing and ship movements, as well as discharges of compensating fuel ballast water and oil spills directly to the bay's water (RWQCB 2012). Storm water runoff from NASSCO's employee parking lots also discharges into Chollas Creek.

[14] The California Toxics Rule value for Criterion Continuous Concentration for Freshwater is 4.3 ng/L (U.S. EPA 2000b).

Prior to the early 1990s, all surface water runoff from NASSCO discharged directly into San Diego Bay (Exponent, 2003). NASSCO's NPDES permit, Order No. R9-2009-0099, does not allow facility-related wastewater to discharge directly to the impaired waterbody at the mouth of Chollas Creek (RWQCB 2009a). Additionally, NASSCO operates and maintains a Storm Water Diversion System (SWDS). The SWDS is designed to capture all storm water runoff from all industrial areas and eliminate the discharge of industrial storm water to San Diego Bay. The facility has a maximum storm water holding capacity of 33,858,000 gallons (enough to contain 3.5 inches of rain in a 24-hour period). Storm water captured within the facility is discharged to the San Diego Metropolitan Sanitary Sewer System.

A detailed sediment investigation was conducted in 2001 and 2002 at the NASSCO facility (Exponent 2003) and found elevated sediment concentrations of metals, butyl tin species, PCBs, polychlorinated terphenyls, PAHs, and total petroleum hydrocarbons. The majority of the contamination is west of the 28th Street Mole Pier, with the exception of petroleum hydrocarbons, which were also found near the southern boundary of NASSCO's leasehold. Cleanup and Abatement Order No. R9-2012-0024 has been adopted by the San Diego Water Board to remediate the contaminated bay sediments at the facility. However, the area represented by station NA22, which was located within the TMDL project area, was excluded from the Order so that the station NA22 area could be included in any cleanup order issued for the mouth of Chollas Creek as part of the implementation plan for these TMDLs (see Figure 5-3).

Recurring sediment physical disturbance associated with ship engine tests performed at NASSCO Shipyard's Berth VI may contribute to the observed benthic community impacts in this area (SCCWRP and SPAWAR 2005).

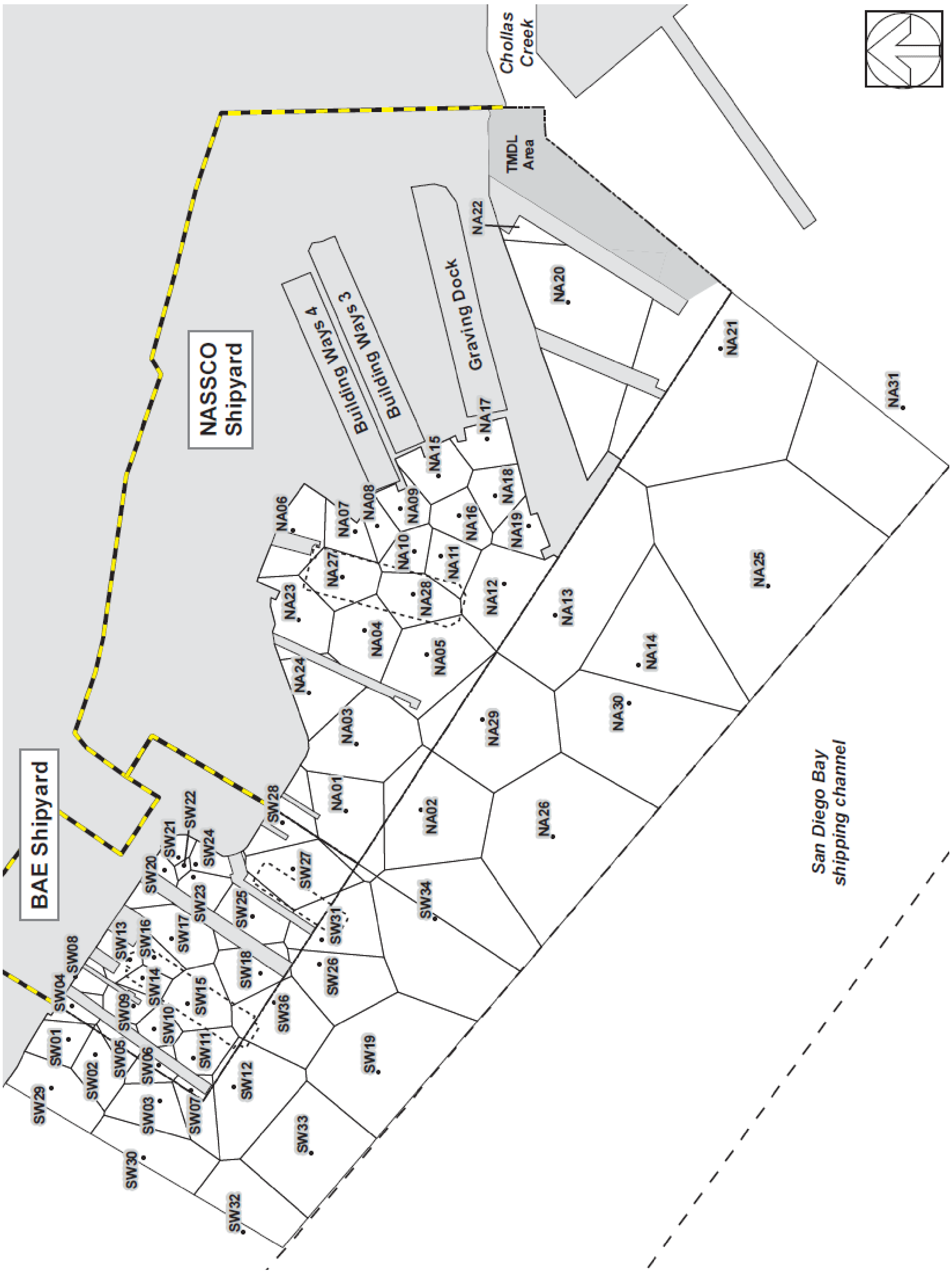

Figure 5-3. Map of Thiessen Polygons at Shipyard Sediment Site Study Area showing TMDL area excluded from CAO No. R9-2011-0001

Source: RWQCB (2010)

5.4.5 *Atmospheric Deposition*

Toxic pollutants are dispersed through atmospheric transport and deposition. Pollutants are deposited directly to the waterbody or indirectly through storm and urban runoff to Chollas Creek.

As discussed in Section 5.2.2.1, SCCWRP research found that there is a net loss to the atmosphere from the water surface as a result of higher volatilization compared to dry particle deposition for both PAHs and total PCBs in San Diego Bay (Sabin et al. 2010; Schiff 2011). However, SCCWRP found that there was a net gain from dry particle deposition for total chlordane to the waterbody (Schiff 2011).

5.4.6 *Summary of Sources*

Runoff from urban development/redevelopment and discharges from the industrial uses along the waterfront are the primary sources of ongoing discharges of toxic pollutants to the sediment at the mouth of Chollas Creek.

Table 5-4. Summary of the primary sources contributing pollutants to the Mouth of Chollas Creek

Sources	Chlordane	PAHs	PCBs
MS4 Dischargers (Phase I MS4s, small MS4s)	◆	◆	◆
Caltrans	◆	◆	◆
General Industrial & Construction Storm Water Dischargers	◆	◆	◆
NASSCO		◆	◆
Naval Base San Diego	◆	◆	◆
Direct Atmospheric Deposition	◆		

5.5 Switzer Creek Sources

Sections 5.2 describe general information about the potential organic pollutant loadings and the sources to the mouth of Switzer Creek. The primary sources of toxic pollutants discharging into the mouth of Switzer Creek include the Switzer Creek watershed, Tenth Avenue Marine Terminal, former Campbell Shipyard site, and atmospheric deposition. The upland watershed includes residential, commercial, and industrial land uses and roads and highways. Chadwick et al. (1999) reported that the majority of the PAH wasteload discharged into the mouth area of Switzer Creek was from creosote treatment of pier pilings while the remainder comes from storm water runoff, oil spills, compensating fuel-ballast systems, and atmospheric deposition. Both chlordane and PCBs are banned from use; however, residual concentrations from historical applications of these chemicals could result in pollutants being transported to surface waters/sediments via storm water runoff from urbanized areas of the watershed and adjacent sites.

5.5.1 *Overview of Conditions at the Mouth of Switzer Creek*

Appendix F contains the available sediment quality data that were reviewed to provide an overview of the conditions that exist within the impaired site and that relate to the assessment of sources.

Fairey et al. (1996; 1998) collected data in 1992, 1994, and 1996, which indicated high concentrations of chlordane, metals, and PAHs, toxicity to amphipods and urchin larvae, and a degraded benthic community in the sediment at the mouth of Switzer Creek (Appendix F; Tables F-5 and F-6).

Sediment chemistry testing was performed for the purpose of maintenance dredging at the Tenth Avenue Marine Terminal in 1991 and 2002 (see Appendix F; Section F1.6). The initial results (1991) of sediment testing (3 to 6 feet deep of core material) found elevated levels of PAHs and PCBs (Aroclor 1254; MEC Analytical Systems, Inc. 1991). Chlordane concentrations in sediment were reported as less than 25 μg/kg. The follow-up testing in 2002 (2.5 to 6 feet deep of core material composites) reported the presence of elevated concentrations of PAHs (AMEC Earth & Environmental, Inc. 2002). Total PAH concentrations ranged from 4,240 to 11,050 μg/kg in core samples. The project area at Berths 10-1 and 10-2 was dredged to -32 feet MLLW with a 1 foot over-dredge allowance.

The Phase I Sediment Assessment Study evaluated the spatial distribution of contaminants in the surface sediment, although the authors qualified the study results as being confounded by the 2002 maintenance dredging (Anderson et al. 2004). The Phase I Study reported elevated levels of chlordane and PCBs; however, the sediment contained lower concentrations of pollutants than reported in previous studies, and marginal toxicity to amphipods. In addition, there was a mix of degraded and transitional benthic community structure in the affected sediments (Appendix F; tables F-26, F-29, and F-33).

5.5.2 *Switzer Creek Watershed Outflow*

There are several known sources of organic pollutants in the Switzer Creek watershed, including: urban and storm water discharges from the MS4s (owned by the City of San Diego, the Port of San Diego, small MS4s, and Caltrans), industrial and construction storm water discharges, and discharges from adjacent facilities that include the Tenth Avenue Marine Terminal and the former Campbell Shipyard site (discussed separately below). These sources provide pollutant loads either directly to San Diego Bay or via erosion and discharge of pollutants into storm drains and Switzer Creek during precipitation events and subsequent transport into the San Diego Bay. The relatively weak currents at the mouth area of Switzer Creek probably ensure that the pollutants entering the site are trapped within the sediments at the site, rather than be transported directly into the bay (Anderson et al. 2005).

Fairey et al. (1996) identified a large storm drain system located directly south of the Trolley Station at 10th and Imperial Avenue. The system drains approximately 11 km^2 of residential (including Balboa Park) and industrial areas before discharging into the bay. Fairey et al. (1998) also reported that one of the original open garbage dumps in the San Diego region was located in this watershed. The dump later accepted an industrial waste stream of PAH wastes from a coal gasification plant operated by San Diego Gas and Electric.

Fairey et al. (1998) concluded that the prevalence of pesticide residues and organic matter in the sediment samples collected during the study indicated a probable link to urban and storm runoff. The 2006 storm water monitoring and modeling study found that large amounts of PAHs and chlordane are transported from the watershed, while PCBs were not detected in storm water samples (Schiff and Carter 2007, Appendix C-1). A separate study conducted during the 2009-10 wet season monitored an additional 2 storms and similarly reported elevated concentrations of chlordane and PAHs, and no reportable concentrations of PCBs (City of San Diego 2010a).

The City of San Diego conducted a study in 2008 to characterize organic pollutants and metals in storm drain sediment in the Switzer Creek watershed (Weston Solutions 2009). The study reported that chlordane was highest and most frequently detected in areas dominated by residential and combined residential/commercial land uses. PAHs were reported to be highest in the Downtown urban area and in Balboa Park (along Pershing Drive). PCBs were rarely detected in these areas.

Interstate Highway 5 and State Route 94 likely contribute petroleum and hydrocarbons from spills and leaks, oil and grease, and vehicle emissions, as well as herbicides in storm water discharges (Grant et al. 2003)(Caltrans 2003a, 2003b). Indirect atmospheric deposition of organic compounds onto impervious surfaces of highway structures would also likely be present in highway runoff from these surfaces.

Industrial facilities located within the watershed include automotive dismantlers and recyclers, manufacturing, fabricating components for ships, and transportation storage and maintenance yards. As discussed in section 5.2.1.4, these types of industrial facilities may be sources of organic pollutants, such as PAHs and PCBs. These industrial facilities are located within the City of San Diego's MS4 boundaries.

The San Diego Convention Center, located on the site previously occupied by Campbell Shipyard, is adjacent to San Diego Bay near the mouth of Switzer Creek. The groundwater in the immediate vicinity of the Convention Center is hydraulically connected to San Diego Bay and is at an elevation of approximately sea level, which is higher than the elevation of the Convention Center underground parking garage floor. A dewatering system was used to prevent groundwater from inundating the basement portions of the facility. The Port of San Diego originally constructed and was responsible for operation of the dewatering system that discharged extracted groundwater into San Diego Bay.

In November 1999, the Port of San Diego officially transferred responsibility to the City of San Diego for the discharge of groundwater to San Diego Bay from the San Diego Convention Center Groundwater Extraction and Treatment System. The discharge was regulated under Order No. R9-2003-0050 *Waste Discharge Requirements for Groundwater Extraction Waste Discharges to San Diego Bay from the San Diego Convention Center*. Pollutants of concern included metals, particularly arsenic, copper, nickel, and hexavalent chromium, chlorinated hydrocarbon compounds, other petroleum products and solvents from past activities and conditions that impacted the groundwater quality in the metropolitan San Diego area. The City of San Diego connected the Groundwater Extraction and Treatment System to the local sanitary sewer system in March 2008, thereby terminating the facility-related permitted discharges of extracted groundwater wastes directly into San Diego Bay.

5.5.3 *Tenth Avenue Marine Terminal*

The Tenth Avenue Marine Terminal (TAMT) opened in 1958 and is owned by the Port of San Diego. TAMT is a 96 acre cargo facility with 1,000,000 square feet of warehouses and transit sheds, and 8 berths. The facility offers dockside storage, breakbulk (products that don't fit into containers), dry/liquid bulk, small scale container operations and warehousing services. Major commodities transported between San Diego and foreign markets include frozen and refrigerated produce, lumber, paper products, steel, fertilizer, cement, machinery, and soda ash. The facility also has a bunker fuel delivery system that provides ship refueling services.

The ships docking at the TAMT, as well as their cargo and refueling activities (including fuel storage tanks), are potential sources of organic pollutants to the bay. In 1993, two BPTCP stations, located in the Switzer Creek mouth area and immediately northwest of and adjacent to the TAMT, had high concentrations of chlordane and PAHs, and moderate concentrations of PCBs. The increased levels of PAHs detected in the sediment at the mouth of Switzer may be related to the TAMT facility (Fairey et al. 1996).

Since 1992, TAMT has been regulated under the Industrial Storm Water General Permit (Order No. 97-03-DWQ). Eight of the facility's 11 storm drain outfalls flow into Switzer Creek (see Figure 5-4). The TAMT discharges industrial storm water to the Switzer Creek storm drain that terminates at the mouth area in San Diego Bay (Appendix F; section F2.1). TAMT routinely samples for oil and grease, total petroleum hydrocarbons (TPHs), and total recoverable petroleum hydrocarbons (TRPHs). Using oil and grease sample results as a surrogate, the results suggest that the facility is likely a minor source of PAHs to the creek mouth area.

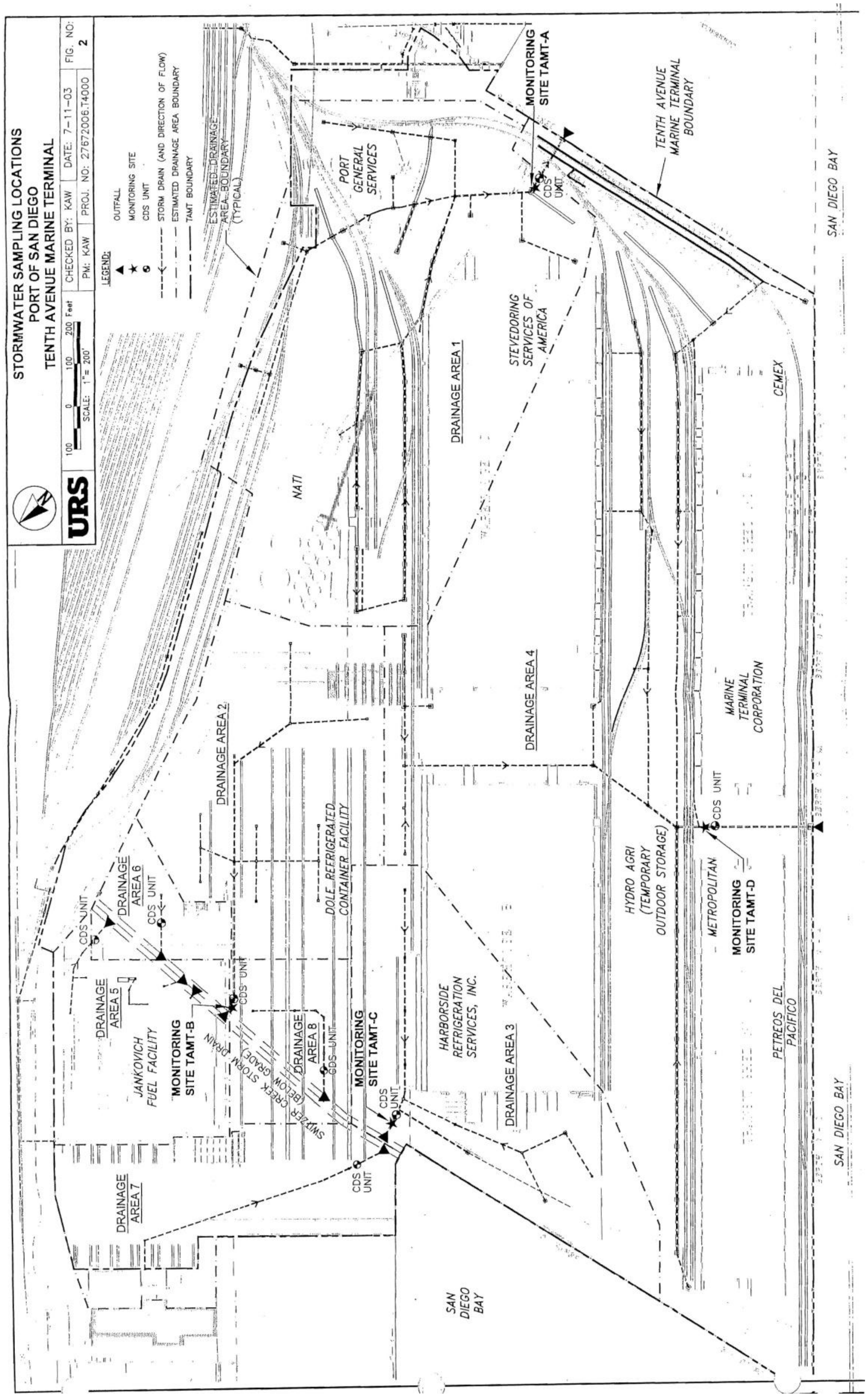

Figure 5-4. Tenth Avenue Marine Terminal
Source: SDUPD (2006)

5.5.4 *Campbell Industries*

Campbell Industries Marine Construction and Design Company (Campbell Industries) was located on San Diego Bay, near Switzer Creek. The company was founded in 1906 and had established shipyard facilities at the site by 1925. They operated five ship repair piers and four dry-docking facilities, a petroleum products tank farm, a municipal refuse incinerator, and a manufactured gas plant. The site was impacted by wastes generated by these industrial operations and on-site contaminants included metals, gasoline and diesel fuels, PAHs, and PCBs.

Cleanup and Abatement Order (CAO) No. 95-21 was issued by the San Diego Water Board in June 1995, requiring remediation of the Campbell Shipyard site including affected areas of San Diego Bay (Ninyo & Moore 2005). To cleanup and abate site-related impacts to San Diego Bay, the Port of San Diego removed contaminated sediments to prescribed concentration limits for specific contaminants of concern (see Table 5-5). Finally, a 9.2-acre engineered cap was constructed over the remaining contaminated sediment, pursuant to waste discharge requirements prescribed by the San Diego Water Board in Order No. R9-2004-0295. Figure 5-5 illustrates the area of remediation for the Campbell Shipyard Cleanup. The surface of the majority of this cap is between depths of approximately -10.0 to -25.0 feet MLLW (mean lower low water). A 1.6 acre section of the cap was designated as eelgrass habitat. This section of the cap was only 3 feet thick. The final surface of the eelgrass habitat after capping is between depths of -4.0 to -6.0 feet MLLW. A protective wave reflector wall and a rock berm were built to protect the eelgrass habitat area from erosion.

Table 5-5. Campbell Industries Sediment Cleanup Levels

Contaminant	Cleanup Levels CAO No. R9-1995-0021 (mg/kg dry weight)	Cleanup Levels WDR Order No. R9-2004-0295 (mg/kg dry weight)
Copper	810	264
Zinc	820	410
Lead	231	88
TPH	4,300	<14
HMW PAHs	44.0	3.47
PCBs	0.95	0.11
TBT	5.75	0.121

A minimum 5-foot-thick cap was installed to keep the remaining contaminated sediments on the Campbell subtidal/intertidal property isolated from the marine environment, and to act as a barrier from deep burrowing marine species. Armoring material was installed on top of the cap in areas where scour from currents, waves, and/ or propeller wash could compromise the cap.

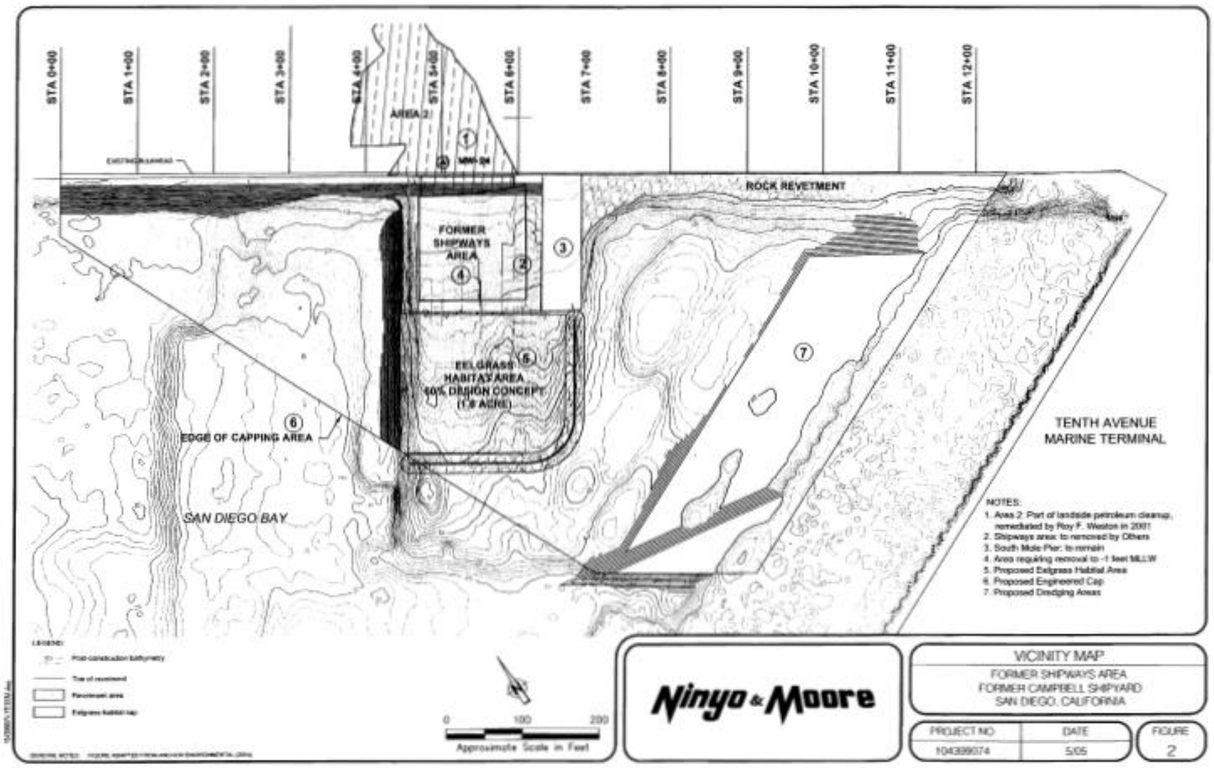

Figure 5-5. Remediation Area for the Campbell Shipyard Site
Source: Gopinath (2005)

The highest levels of sediment contamination extended southward to the Tenth Avenue Marine Terminal (TAMT) and east-west from the bulkhead approximately 137.2 meters offshore, with the chemicals of concern (CoCs) exceeding the cleanup levels required by CAO No. 95-21. South of the launchways, the known vertical extent of contamination ranged from depths of 0.1 to 3.4 meters below mudline. Sediment samples collected in 1999 and 2000 were used to determine the baseline concentrations and assess the lateral/vertical extent of sediment contamination.

For PAH compounds, only high molecular weight PAHs (HMW PAHs) were analyzed in 1999, rather than total PAHs. Eight of 115 sediment samples exceeded the CAO cleanup level of 44 mg/kg (which is actually near the ERM guidance value for total PAHs of 44.792 mg/kg; the ERM for HMW PAHs is 9.60 mg/kg). Samples with the highest HMW PAH concentration of 86.35 mg/kg and other samples with HMW PAHs that exceeded the CAO criteria were collected at sites in the southeast corner of the property, near the old SDG&E facility and adjacent to the mouth of Switzer Creek.

Results for PCBs included analysis of 122 sediment samples with 39 samples exceeding the CAO cleanup level of 0.95 mg/kg. The ERM guidance value by comparison is 0.18 mg/kg. The highest concentration of PCBs collected at the Campbell site was 13.93 mg/kg. These elevated PCB concentrations occurred most often near the southeast corner of the property and the southern property boundary, which is adjacent to the mouth of Switzer Creek. Prior to its remediation in 2005, the Campbell Shipyard site was a likely source of contamination to the sediments located in the mouth of Switzer Creek. Presently, the former Campbell Shipyard facility is not considered to be a continuing source.

5.5.5 *Atmospheric Deposition*

Toxic pollutants are dispersed through atmospheric transport and deposition. Pollutants are deposited directly to the waterbody or indirectly through storm and urban runoff to Switzer Creek.

As discussed in Section 5.2.2.1, SCCWRP research found that there is a net loss to the atmosphere from the water surface as a result of higher volatilization compared to dry particle deposition for both PAHs and total PCBs in San Diego Bay (Sabin et al. 2010; Schiff 2011). However, SCCWRP found that there was a net gain from dry particle deposition for total chlordane to the waterbody (Schiff 2011).

5.5.6 *Summary of Sources*

Runoff from urban development/redevelopment and discharges from the industrial uses in the watershed and along the waterfront are the primary sources of ongoing discharges of toxic pollutants to the sediment at the mouth of Switzer Creek.

Table 5-6. Summary of the primary sources contributing pollutants to the Mouth of Switzer Creek

Sources	Chlordane	PAHs	PCBs
MS4 Dischargers (Phase I MS4s, small MS4s)	◆	◆	◆
Caltrans	◆	◆	◆
General Industrial & Construction Storm Water Dischargers	◆	◆	◆
Tenth Avenue Marine Terminal (Port of San Diego)		◆	
Direct Atmospheric Deposition	◆		

6. Linkage Analysis

The linkage analysis interconnects the pollutant loads to the numeric targets in order to protect the beneficial uses of the waterbody in question. The technical analysis of toxic pollutant loading and the waterbody response to this loading is an integral part of the linkage analysis. The analysis calculates the total allowable pollutant loading to the impaired waterbody and the estimated reductions necessary from current loading by individual controllable sources to meet water quality standards. The total allowable pollutant load is the "TMDL." The existing load and TMDLs were calculated for each of the three watersheds and for each of the three identified organic pollutants. From the existing load and the TMDL, a load reduction is determined.

A linkage also exists between the pollutants and organisms living in the sediment (benthic organisms), because the 303(d) listings are for sediment toxicity and benthic community impairment. These benthic invertebrate organisms are directly exposed to pollutants by ingesting sediment to remove food particles, and they may consume other organisms that live in the sediment. The benthic organisms also expose themselves to pollutants by absorbing or consuming the surrounding pore water or overlying water.

Final numeric targets are set equal to chlordane, PAHs, and PCBs sediment concentrations derived from the Aquatic Life SQO because this TMDL is addressing sediment toxicity and benthic community impairment. Based upon the calculations of allowable loadings to meet the SQO, it is assumed that attainment of the numeric targets, and associated pollutant load reductions, will result in meeting the water quality objectives, and most importantly, beneficial use attainment.

In establishing these TMDLs, a watershed model and a receiving water model are used to link the pollutant sources and the sediment concentration in the impaired waterbody, which are set to meet the sediment numeric targets in Section 4.1. The computer models simulate the physical processes within the impaired receiving waters and their respective watersheds. The models provide an estimation of loadings of the pollutants from the watersheds based on rainfall events, and simulation of the response of the receiving waters to these loadings. The following sections provide a detailed discussion regarding the linkage analyses.

6.1 Watershed Modeling Analysis

The modeling system utilized for this TMDL consists of two main models, and was used to assess the link between watershed sources of sediment and organic pollutants (chlordane, total PAHs, total PCBs) and the receiving waters . The first model simulates land-use based sources of sediment, associated pollutant loads, and the hydrologic processes that affect transport of pollutants. U.S. EPA's Loading Simulation Program in C++ (LSPC) (Shen et al. 2004; U.S. EPA 2003b) was used to simulate watershed hydrology and transport of sediments in the streams and storm drains conveying pollutants to the impaired areas of the San Diego Bay shoreline. The LSPC model is a recoded C++ version of U.S. EPA's Hydrological Simulation Program–FORTRAN (HSPF) that relies on fundamental (and U.S. EPA-endorsed) algorithms.

For a complete discussion of LSPC configuration, validation, and application refer to the modeling reports in Appendices C-1, C-2, and E: "Watershed Monitoring & Modeling Report" (Schiff & Carter, 2007), "Watershed Modeling Report" (Tetra Tech, 2011), "Watershed Modeling for Chollas, Switzer, and Paleta Creek Watershed for Simulation of Loading to San Diego Bay Report" (Tetra Tech, 2011).

Current pollutant loads were estimated using the results of the LSPC watershed model and samples collected above tidal influence at the base of the watershed (see Appendices C-1, C-2, and E). Updates to the LSPC watershed model were performed using additional water quality and land use calibration data at several locations in the San Diego area. Loading analyses were performed for each organic pollutant that requires a mass-based TMDL (chlordane, total PAHs, and total PCBs) for the purpose of calculating the current pollutant loads for input into the receiving water model.

6.1.1 *Watershed Model Configuration*

The watershed model represented the variability of wet-weather runoff source contributions through dynamic representation of hydrology and land practices. The modeling process involves model configuration as well as model calibration and validation. These processes are described below.

Several key components of the watershed modeling are important during model configuration, including: watershed segmentation into subwatersheds, precipitation data, land use type, soil type, stream reach characteristics, point source discharges, hydrology representation (flow and other factors), and runoff pollutant representation.

6.1.1.1 Land Use Type

The watershed model requires a basis for distributing hydrologic and pollutant loading parameters. This is necessary to appropriately represent hydrologic variability throughout the basin, which is influenced by land surface and subsurface characteristics. It is also necessary to represent variability in pollutant loading, which is highly correlated to land practices. The basis for this distribution was provided by land use coverage of the entire modeled area. The source of land use data was the San Diego Association of Governments (SANDAG) 2000 land use data set that covers San Diego County.

6.1.1.2 Hydrology Representation

Watershed hydrology plays an important role in the determination of flow and ultimately loadings to a waterbody. The watershed model must appropriately represent the spatial and temporal variability of hydrologic characteristics within a watershed. Key hydrologic characteristics include interception storage capacities, infiltration properties, evaporation and transpiration rates, and watershed slope and roughness. LSPC's algorithms are identical to those in HSPF. The LSPC/HSPF modules used to represent watershed hydrology for TMDL development included PWATER (water budget simulation for pervious land units) and IWATER (water budget simulation for impervious land units).

Wet-weather watershed modeling and TMDL efforts have led to the development of a regional watershed modeling approach to simulate hydrology, sediment, and pollutant transport for San Diego watersheds. The regional modeling approach assumes that pollutant loadings can be dynamically simulated based on hydrology and sediment transported from land uses in a watershed. Development of the approach resulted from application and testing of models for small-scale land use sites in the San Diego Region (City of San Diego. 2010a). SCCWRP developed watershed models, based on HSPF (Bicknell et al. 2001), of multiple homogeneous land use sites in the region.

6.2 Bay Modeling Analysis

Receiving water model were the second type of models associated with the modeling system for this TMDL. Receiving water models of San Diego Bay were developed to simulate the assimilative capacity of the waterbodies, the transport and fate of suspended sediment loading, and dynamic effects of tidal flushing. These models were based on the Environmental Fluid Dynamics Code (EFDC) (Hamrick 1992 and 1996). Pollutant loads from the watersheds were based on LSPC output for each watershed modeled, and those results were used as boundary conditions for the EFDC models of San Diego Bay receiving waters. The EFDC models also provided dynamic simulation of flushing and resulting transport of suspended sediment and associated organics. A complete discussion of EFDC model development for this TMDL, "Receiving Water Model Configuration and Evaluation for San Diego Bay Toxic Pollutants TMDL" is provided in Appendix D.

The structure of the EFDC model includes four major modules: (1) a hydrodynamic sub-model, (2) a water quality sub-model, (3) a sediment transport sub-model, and (4) a toxics sub-model. The modeling effort for San Diego Bay included the hydrodynamic, sediment transport, and toxic sub-models.

6.2.1 *Model Development*

The hydrodynamic model was developed to simulate water circulation patterns in San Diego Bay. This model was needed to provide accurate boundary conditions for the five localized sediment and toxics models representing the impaired areas. Instead of developing a bay-wide sediment transport and toxics modeling system based on the hydrodynamic model, individual sediment transport and toxic models were developed for the impaired areas.

Configuration of the EFDC model for San Diego Bay involved identifying and processing bathymetric data, developing model grids, defining boundary and initial conditions, and creating a linkage with the existing LSPC watershed model using lateral inputs. Boundary conditions are fixed conditions applied to the modeling system to drive the hydrodynamic simulation. Three types of boundary conditions were applied to the hydrodynamic model: open ocean, lateral flux (representing watershed contributions), and meteorological.

The EFDC modeling domain for San Diego Bay includes the entire bay as well as a portion of the ocean just outside the mouth of the bay. The model grid was generated based on the CH3D grid provided by the U.S. Navy, with minor refinements in the B-street area. The final grid is comprised of 5,796 computational cells (Figure 6.1).

This set of grids, based on the Navy's original CH3D model grid, provided a high resolution representation of the entire San Diego Bay. The average resolution of the grid is approximately 100 meters, with finer resolution at the mouths of Paleta, Chollas, and Switzer creeks in order to resolve the near-shore feature at the areas of concern. The model was configured as a three-dimensional model, with 4 layers along the vertical axis to resolve vertical variability. Since water in San Diego Bay is generally not significantly stratified, a 4-layer representation was considered appropriate. Cell depths range from 2.2 to 20.1 meters.

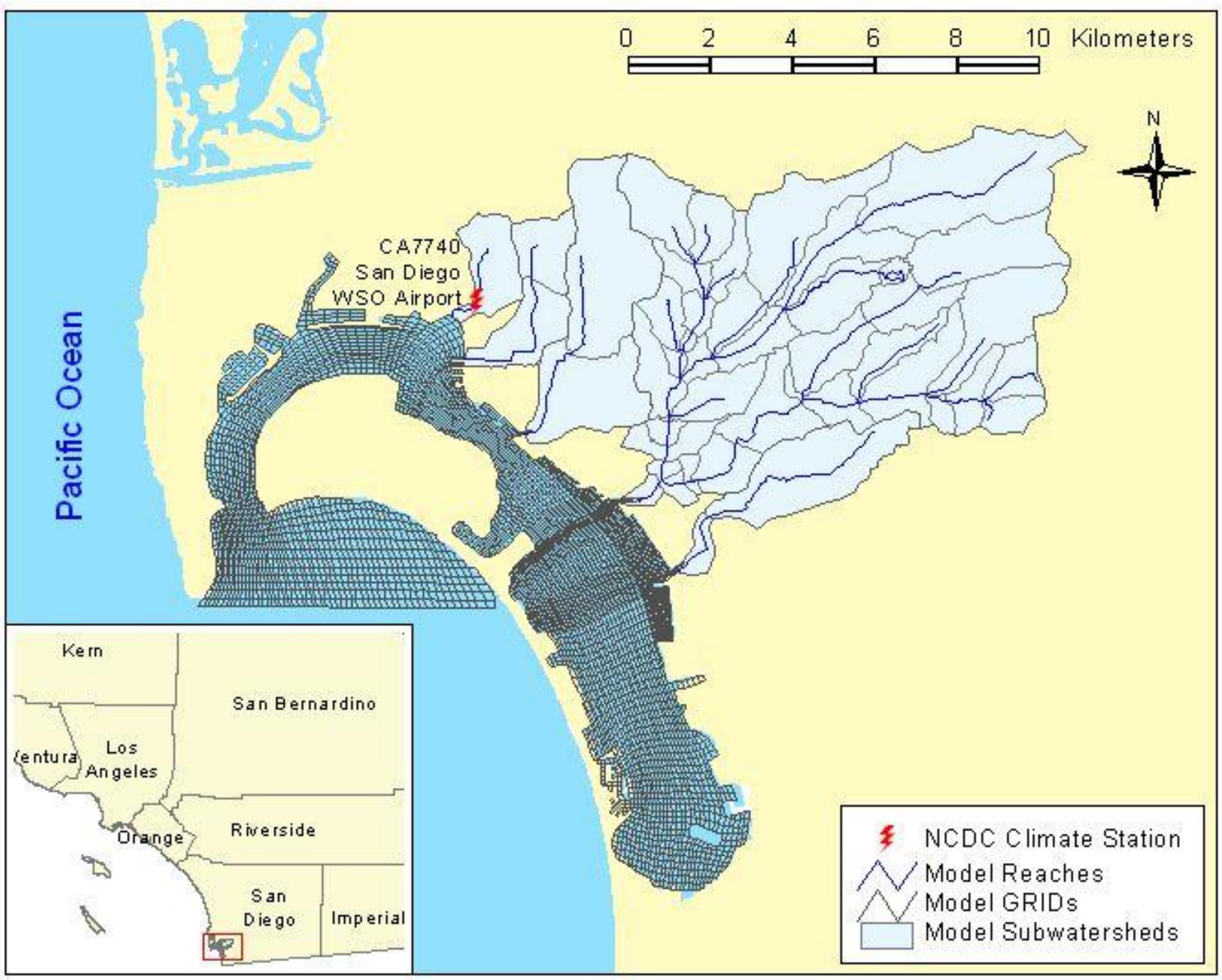

Figure 6.1. Computation grid for San Diego Bay hydroldynamic model.

6.2.2 *Sediment Transport and Toxics Models*

Instead of developing a bay-wide sediment transport and toxics modeling system based on the hydrodynamic model, individual sediment transport and toxic models were developed for the impaired areas. This was done to focus on the five depositional zones at the mouths of the creeks and to reduce computational time. A model was constructed for each of the mouths of Paleta, Chollas, and Switzer Creeks.

Sediment and contaminant transport formulations in the EFDC model are documented by Tetra Tech (2007). Both fine, cohesive sediment and noncohesive sand are simulated within EFDC. Particulate organic material is assumed to be associated with the fine sediment class. Two-phase equilibrium partitioning is used to represent adsorption of the metals and organics to the different sediment classes.

The EFDC model simulates the transport and fate in both the water column and sediment bed. Water column transport includes advection, diffusion, and settling for sediment and sediment adsorbed contaminants. The sediment bed is represented using multiple layers with internal transport of contaminants by pore water advection and diffusion. Sediment and water is exchanged between the water column and bed by deposition and erosion, with corresponding exchange of adsorbed and dissolved contaminants. Dissolved phase contaminants are also exchanged by diffusion between bed pore water and the overlying water column.

6.2.2.1 Grid Generation

The computational grids of the local models were developed based on the bathymetry of the U.S. Navy's CH3D grid (Figure 6.2). For each model, the computational domain was constructed to be significantly larger than the impaired area at the mouth of each inflowing tributary. This ensures that the open boundary for each model is located far enough away from the freshwater inflows to avoid potential boundary errors during storm events. The grids were tested to ensure that during storm events sediment concentrations were low at cells close to the boundaries even though they were very high at the tributary mouths. Model grids were also constructed to align with the bay-wide hydrodynamic model for a seamless linkage.

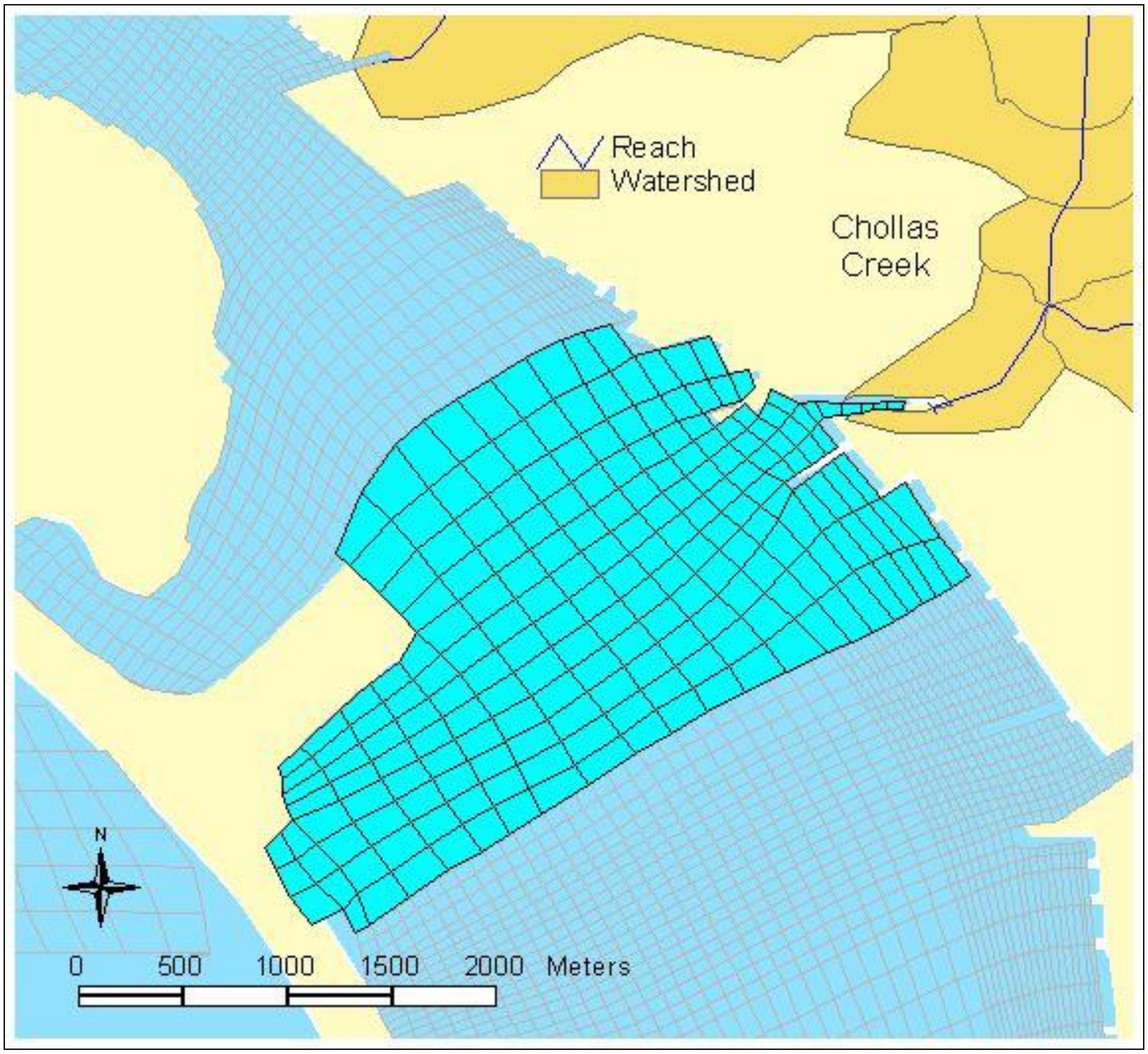

Figure 6.2. EFDC grid for the sediment transport and toxics model for the mouth of Chollas Creek.

6.2.2.2 State Variables

Each of the sediment transport models was configured to simulate two cohesive sediment classes: clay (with a diameter < 3.9 micrometers) and silt (with a diameter > 3.9 micrometers and < 63 micrometers); and one non-cohesive sediment class: sand (with a diameter > 63 micrometers). The sediment bed was configured to have a maximum of six layers, with a maximum layer thickness of 20 centimeters. This allowed the model to represent up to 1.2 meters of active bed, which was deemed sufficient for representing the bed dynamics in San Diego Bay.

The toxic models were each configured to simulate the contaminants identified by the San Diego Water Board to address sediment impairments. The Paleta and Chollas Creek models were configured to simulate total PAHs (TPAH), total PCBs (TPCB), and total chlordane (TCHLOR). The Switzer Creek model was configured to simulate TPAH, TPCB, TCHLOR, and total lindane. The Downtown Anchorage and B-street model was configured to simulate TPAH, TPCB, TCHLOR, and total zinc. The transport of these contaminants is simulated in association with the sediment transport model, because they tend to adsorb to suspended solids, settle into the bed, and re-enter the water column due to resuspension of bed sediment.

6.2.2.3 Initial Conditions

For each of the models, a uniform temperature of 15ºC and a salinity of 33 ppt were included as the initial conditions throughout the water column. The initial velocity was set to 0.0 m/s, and the water surface elevation was set to 0.0 meters above mean low sea level.

The initial sediment concentration in the water column was set to 1.0 mg/L for each of the three classes. For toxics, the water column concentrations were set to be the same as the background concentrations.

Initial bed sediment compositions for the Paleta, Chollas, and Downtown/B-Street models were specified based on data reported in SCCWRP and SPAWAR (2005). Since no data were available to set the initial bed composition at the Switzer Creek mouth for 2001, the data for 2003 collected by the CRG Marine Lab were used. Initial bed toxic concentrations for the Paleta and Chollas models were specified based on data reported in SCCWRP and SPAWAR (2005). Initial conditions for the Switzer and Downtown/B-Street models were specified based on data reported in Anderson et al. (2004, 2005). Since data were available at multiple locations at the mouths of the creeks, the initial bed toxic conditions were specified on a spatially-variable basis. Where data were not available, conditions were set using the minimum values of the data available at the hot spots. The initial bed condition for these cells does not have a significant impact on the simulation results, because these locations are generally outside the area of the incoming tributary mouths and are generally deep. Therefore, resuspension is not expected to occur and contribute significantly to re-distribution of toxics among cells.

6.3 Model Application

6.3.1 *Determination of Baseline Conditions*

After the hydrodynamic, sediment transport, and toxic models were calibrated and evaluated, they were used to conduct a set of baseline analyses to help understand the response of bed sediment toxicity to watershed loading. The first step in configuring the baseline models was to evaluate the loading distribution over an extended recent period predicted by the LSPC models for each watershed (2001 to 2006). The annual toxic loading was summarized by hydrologic year (see Appendix D, Table 6-1). The hydrologic year from October 2004 to September 2005 had significantly higher flow rates as well as TSS and toxics loadings; therefore, this year was used as the baseline condition as it represented the worst case scenarios in terms of watershed loading.

6.3.2 *Configuration of Baseline Models*

Baseline models were configured based on the calibration model for the five shoreline areas of concern, but the flows and loading conditions were replaced based on the October 2004 to September 2005 LSPC model results. The model simulation period was set for one year (October 1, 2004, to September 30, 2005). All parameters were set to be the same as the calibration model. For multiple year simulations, the results at the end of the preceding year were saved as initial conditions for the simulation of the next year.

6.3.3 *Water Column Model Results at the Outer Boundary of the Creek Mouths*

During storm periods, the water column sediment concentration at the outer boundary of the watershed mouths can be impacted by stormwater, which prevents an accurate specification of the open boundary condition in a coarse grid WASP model (see Section 2.2, Appendix D). The simulated fine sediment concentrations at the outer boundary of the Paleta Creek mouth are used as an example to illustrate this condition (Figure 6-1, Appendix D). The fine sediment concentration at the outer boundary of the Paleta Creek mouth can be very high during storm events, reaching values close to 1,000 mg/L. If a coarse grid WASP model was configured to simulate the sediment transport for this area, the prescribed boundary condition must reflect the impact from stormwater, which is not available in a WASP model framework since this information can only be obtained from a sediment transport model driven by a hydrodynamic model. This limitation would be a serious limitation of a coarse grid WASP approach, which would be unreliable as a modeling framework for developing TMDLs at the creek mouths.

6.3.4 *Linkage Analysis Summary*

These models provide the first step in development of tools for a framework to assist in regulatory and management decisions for the bay shorelines and its watersheds. The EFDC models were used to:

1. Estimate the assimilative capacity of the impaired shorelines and the resulting TMDLs based on the numeric targets (section 7.1),
2. Simulate the responses of the receiving waters to various external loading scenarios (section 7.6), and
3. Estimate load allocations from sources not associated with watershed runoff (section 8.1).

Using both the watershed and bay model results (updated to incorporate additional water quality and land use calibration data), annual waste loading values were estimated that will reduce waste loads to the mouths of Paleta Creek, Chollas Creek, and Switzer Creek sediments. Controlling watershed wasteloads is the key to reducing and maintaining sediment concentrations at or below target level within a given number of years.

7. Identification of Load Allocations and Reductions

The calibrated models were used to simulate flow and toxic pollutant concentrations to estimate existing pollutant loads to the impaired waterbodies. Current estimated loads were compared to the calculated TMDLs for identification of necessary load reductions. Methodologies for determining load reductions are described in the following sections, with associated simplifying assumptions and TMDL calculations provided in Appendix D.

7.1 Loading Analysis

The calibrated LSPC model was used to estimate existing PCB, PAH, and chlordane loads to the impaired shorelines, with receiving waters simulated based on the EFDC models (see Appendices C, D, and E). Using the EFDC model, the assimilative capacity of each receiving waterbody was assessed and compared to numeric targets for evaluation of sediment quality. The optimal reduction scenario resulted in reduced toxic loads from the watershed, as needed, based on the modeling analysis.

7.2 Identification of Critical Conditions

Sediment discharges from the watersheds to the San Diego Bay shoreline are highly variable at the mouths of Paleta, Chollas, and Switzer Creeks. This variability is due to the nature of wet weather events that are the critical conditions for sediment deposition.

To ensure protection of the impaired waterbodies during wet periods when a maximum amount of sediment and pollutant transport to the creek mouths is likely, a critical period associated with extreme wet conditions was selected for loading analysis and TMDL calculations. Once the hydrodynamic and sediment models were calibrated and evaluated, they were used to conduct a set of baseline analyses to help understand the response of sediment toxicity to watershed loading. The loading distribution predicted by the LSPC models for each watershed was evaluated over an extended time period (2001 to 2006). The hydrologic year from October 2004 to September 2005 had the highest flow rate with associated TSS and toxics loading; therefore, it was used to represent the critical conditions in terms of watershed loading. The critical period occurs during wet weather when flow generated by rainfall in the watersheds bring in pollutants to the estuary (see Section 7.8). Many of the pollutants are attached to suspended solids that were eroded from the watershed landscape during storm events. Many of these pollutants, and solids with pollutants attached, settle out of the water column and into the bay sediment where they remain for long periods of time.

7.3 Load Estimation

Estimation of current waste loads to the impaired waterbodies required use of the LSPC model to predict flows and pollutant concentrations. The dynamic model-simulated watershed processes, based on observed rainfall data as model input, provided variability in the waste loads used to simulate the critical period. These load estimates were simulated using calibrated, land use-specific processes associated with hydrology and sediment transport, coupled with measured concentrations of organic pollutants in each watershed (see Appendices C-1, C-2, and E). Pollutant concentrations and loads were calculated based on the predicted TSS concentration for each hourly time-step. A land use based consituent, TSS was modeled because the transport of organic pollutants during wet weather events is generally believed to be associated with the detachment and transport of sediment. The relationship between TSS and toxic pollutant concentrations was determined based on a statistical regression of the log-transformed TSS values and available monitoring data for total PAHs and chlordane. The vast majority of PCB monitoring data were reported at detection limit (0.1 ng/L), therefore, the relationship between total PCB concentrations and TSS levels could not be evaluated using the data collected. These regressions are presented in the current watershed modeling report (Appendix E).

7.4 Application of Numeric Targets

Numeric targets are derived from the Aquatic Life SQO for chlordane, PAHs, and PCBs in sediments. A complete discussion of numeric targets is provided in Section 4, with supporting documentation in Appendix I.

7.5 Critical Locations for TMDL Calculation

For TMDL-related calculations, the water quality at a *critical location* in an impaired waterbody was compared to numeric targets for assessment of required reductions of pollutant loads to meet WQOs. This critical location is considered to be conservative for assessment of water quality conditions, and it is therefore selected based on high pollutant levels predicted at that location. Although, this critical location for water quality assessment is utilized for TMDL analysis, compliance to WQOs must be assessed and maintained throughout a waterbody to protect beneficial uses.

For San Diego Bay shorelines, the critical locations for meeting numeric targets include the entire length of impaired shorelines, as described in Section 2.1.1 through 2.1.3. For model development, receiving waters at impaired shorelines were represented in the model with multiple grid cells (see Appendix D). Compliance with the TMDL target for each pollutant was assessed based on the results from the receiving water models for the creek mouth areas. Predicted sediment concentrations from the end of the modeling period were averaged across all grid cells within each creek mouth area to determine if watershed reductions were needed, using an iterative approach as described below. This approach is consistent with the accuracy of the EFDC model results and dynamic changes in pollutant concentrations from sediment deposition and resuspension events. It is also consistent with other TMDL studies of similar areas, such as the Los Angeles Water Board's Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants Total Maximum Daily Loads Project.

7.6 Calculation of TMDLs and Allocation of Loads

Wet-weather flows and toxic pollutant concentrations were estimated for the critical period (October 2004 through September 2005) in each watershed (Paleta, Chollas, and Switzer Creek watersheds). The LSPC watershed model outputs served as boundary condition flows (providing inputs) to EFDC models for receiving waterbody segments of the San Diego Bay near-shore areas. Toxic pollutant concentrations in critical locations of the model were simulated with a sub-minute time step over multiple years. Results were output at daily intervals and compared to numeric sediment targets at each impaired waterbody shoreline segment. The daily interval was used for result output because the change in sediment bed concentration is generally slower than in the water column; therefore, daily frequency was considered to be of sufficient resolution.

As shown in the modeling report in Appendix D, sediment toxic pollutant concentrations in the impaired waterbody shoreline areas are closely related to the watershed loading. When the watershed toxic pollutant concentration is higher than that in the existing bed sediment, the incoming sediment load causes an increase in bed sediment concentration. Thus, reduction of the incoming watershed waste load is an important factor for meeting toxic pollutant concentration targets in the sediment. Although the pollutant concentrations in the watershed runoff and sediment are tied closely together, there are other factors that also impact whether or not sediment concentration targets are met, including the possibility of pollutant inputs or losses to the bay (open boundary loading). In addition, pollutants will adhere to clay and silt size sediments much more readily than to sand or larger size particles (described as the change in adsorption balance with changes in grain size). Pollutants will also adhere better due to carbon content of the sediment.

To calculate the necessary load allocations and TMDL, a series of scenarios were developed for each selected pollutant in each watershed. Scenario 1, detailed below, was first executed. If numeric targets were not met after Scenario 1, then Scenario 2 was conducted. Section 7.7 contains a discussion of the margin of safety for TMDL calculations.

> Scenario 1. Initial sediment pollutant concentrations were set at numeric targets for all local models (at the mouth of each creek). This inherently assumes that contaminated sediment at the mouths of the creeks were dredged or remediated in some manner. Then the model is run using the existing watershed load to the impaired waterbody for a three-year simulation period to allow adequate time for the model to reach equilibrium. The critical high flow year (October 2004 – September 2005) is repeated for the three-year simulation period.
>
> > Outcome 1: In the event that the sediment pollutant concentration at the end of the three-year model run is equal to or lower than the numeric target, then the existing watershed load is sufficient to meet the TMDL (i.e., attain water quality standards) and will be used for TMDL allocation. That is, no further load reduction is required, which may indicate one of the following:

- The pollutant(s) of concern is (are) a legacy pollutant, or
- The pollutant(s) of concern is (are) no longer being loaded to the system at the same rate or concentration as in the past.

BMPs already present in the watershed are controlling loading of the pollutant(s) of concern.

Outcome 2: If the sediment toxicity increases over time and results in a build-up of the sediment pollutant concentration that is higher than the numeric target at the end of the simulation period, then a reduction of the existing watershed load is needed and additional model runs to determine the amount of reduction are performed (see Scenario 2).

Scenario 2. Initial sediment pollutant concentration are set to be the same as Scenario 1. Several additional model scenarios are then run to determine the amount of watershed load reduction that is required to meet the sediment numeric target. Each additional model scenario is run for the three-year simulation period for each load reduction scenario. The exact percent reduction required is determined through an iterative process by making additional watershed load reductions and corresponding model runs until the sediment pollutant concentration is equal to or lower than the numeric target.

Summaries of the TMDL runs for the three impaired waterbody shoreline segments are provided in Sections 7.6.1, 7.6.2, and 7.6.3.

7.6.1 *Paleta Creek Mouth*

Scenario 1: The Paleta Model was run using existing pollutant loading conditions for the watershed, while the open boundary conditions were kept the same as the baseline conditions. According to the model run results, the existing loading of chlordane and total PCBs meet their respective numeric targets; therefore, no additional reduction of chlordane and total PCBs was needed from the watershed. Note that other actions will be required to ensure that pollutant loading from unknown sources does not occur. Total PAH concentrations, however, exceeded the numeric targets; therefore, it was necessary to implement subsequent scenarios.

Scenario 2: Several load reduction scenarios were run to identify the percent reduction required for total PAHs. A 28 percent reduction was found to meet the numeric target for total PAHs in sediment.

In summary, chlordane and total PCBs do not require a reduction in watershed loads from existing conditions. A 28 percent reduction, however, is required for total PAHs to meet the numeric target for sediment. These scenarios also assume the sediment pollutant concentrations are initially set to the numeric target.

7.6.2 *Chollas Creek Mouth*

Scenario 1: The model was run using existing loading conditions for the Chollas Creek watershed, while the open boundary conditions were kept the same as the baseline conditions. Model results suggest that under existing loading, total PCBs meet the numeric target; therefore, no additional reduction of total PCBs is needed from the watershed. Note that other actions will be required to ensure that pollutant loading from unknown sources does not occur. Both total PAHs and chlordane resulted in estimated concentrations exceeding the numeric targets. Therefore, it was necessary to implement subsequent scenarios.

Scenario 2: Several load reduction scenarios were run to identify the percent reduction required for total PAHs and chlordane. A 61 percent reduction was found to meet the numeric target for PAHs. For chlordane, a 15 percent load reduction is needed to meet the numeric target for this pollutant.

In summary, watershed loads of total PCBs do not require a reduction from existing conditions. An 61 percent reduction, however, is required for total PAHs to meet the numeric target for sediment and to reduce the maximum predicted concentration to an acceptable level. A 15 percent reduction in watershed loads is required for chlordane to meet the numeric target. These scenarios also assume the sediment pollutant concentrations are initially set to the numeric target.

7.6.3 *Switzer Creek Mouth*

Scenario 1: The Switzer Model was run using existing pollutant loading conditions for the watershed, while the open boundary conditions were kept the same as the baseline conditions. According to the model run results, the existing loading of chlordane and total PCBs meet their respective numeric targets; therefore, no additional reduction of chlordane and PCBs was needed from the watershed. Note that other actions will be required to ensure that pollutant loading from unknown sources does not occur. Total PAH concentrations, however, exceeded the numeric target, therefore, it was necessary to estimate the load reduction required.

Scenario 2: Several load reduction scenarios were run to identify the percent reduction required for PAHs. A 16 percent reduction was found to meet the numeric target for PAHs in sediment.

In summary, chlordane and total PCBs do not require a reduction in watershed loads from existing conditions. A 16 percent reduction in watershed loads is required for total PAHs to meet the numeric target. This assumes that sediment pollutant concentrations are initially set to the numeric target.

7.7 Margin of Safety

A margin of safety is incorporated into a TMDL to account for uncertainty in developing the relationship between pollutant discharges and water quality impacts (U.S. EPA 1991). The margin of safety can be incorporated in the TMDL either explicitly or implicitly (U.S. EPA 2000a). Reserving a portion of the loading capacity provides an explicit margin of safety. Whereas, making and documenting conservative assumptions used in the TMDL analysis provides an implicit margin of safety. In either case, the purpose of the margin of safety is the same: to ensure that the beneficial uses currently impaired are restored, given the uncertainties in developing the TMDL.

Several conservative assumptions were used in the model analysis and provide some implicit margin of safety to the TMDL analysis. The conservative assumptions are as follows:

1. One of the highest rainfall years on record (October 2004 through September 2005) was used to estimate watershed flows and loads for the TMDL analysis to represent a high mass loading critical condition;
2. The model assumes that historic data values were constant for background values in San Diego Bay (rather than having them fluctuate or change with tides, storms, seasons, or time);
3. The model assumes that there was no loss of pollutants through the bay to the ocean, underestimating reduction of pollutant concentrations over time, if there is a net loss to the bay;
4. Half the PCB detection limit concentration from recent storm water monitoring data (0.05 ng/L) was used in place of a zero value for “non-detectable concentrations” of PCBs in the watershed model; and
5. The model assumes that pollutants are conservative and do not degrade over time, underestimating losses of pollutant concentration in the model.

In order to assure an adequate margin of safety, explicit margins of safety were applied as follows:

1. An explicit margin of safety of 5 percent is applied to the calculated TMDLs for total PAHs and total PCBs in each watershed to account for unknown contributions from other sources, described in Section 5.2.3, either from adjacent sources or from the greater San Diego Bay.
2. For total chlordane, an explicit margin of safety of 20 percent was applied based on the variation in modeled concentrations for this constituent.

These explicit margins of safety are essentially reserved and are not available for wasteload allocation or load allocation, which is more protective of the impaired waterbody because the assumption makes the available load allocations smaller.

Other assumptions made in developing the applicable TMDLs are noted here as follows:

1. The greater bay concentrations cannot be reduced and are considered uncontrollable sources, and
2. The bed sediment toxic pollutant concentrations were reduced to numeric target values. In other words, the model assumes that bed sediments are remediated to levels that meet numeric targets.

7.8 Seasonality

The federal regulations at 40 CFR 130.7 require that TMDLs include seasonal variations. All wet weather flows from the hydrologic year from October 2004 to September 2005 were used for the modeling analyses. Generally, the lowest loadings were observed in the summer, while the highest loadings occurred in February and the early spring, followed by the other winter months. This temporal distribution is expected based on the seasonal variation of rainfall observed in the San Diego region. Seasonal patterns in the sampling data for all pollutants were discussed in Section 3.2.

The numeric targets do not specify values for critical or noncritical conditions. The TMDLs for these pollutants can be developed by reviewing pollutant loads during all flow conditions throughout the year and evaluating the percentage of values exceeding the targets. These TMDLs were developed based on the modeled sediment concentrations for the critical high flow year; therefore, seasonality is taken into account for the entire year. The TMDLs consider seasonal variation in loads and flows, but the results actually occur over a much longer time period of years, in which in-stream processes, estuarine processes, and ecological effects occur.

The contaminant loadings are driven by flow, which are produced by flow events with runoff large enough to transport sediments (carrying pollutants), and are dependent on rainfall. Rainfall that produces flow events and runoff usually occurs in the wet season (from October through April); with higher flows historically occurring in January and February.

8. Total Maximum Daily Loads and Allocations

Federal regulations (40 CFR 130.7) require that TMDLs include load allocations (LAs) and wasteload allocations (WLAs), and that the individual sources for each must be identified and enumerated. The TMDL for a given pollutant and waterbody is the total amount of pollutant that can be assimilated by the receiving water while still achieving water quality standards. Once calculated, the TMDL is equal to the sum of individual WLAs for point sources, and LAs for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water. Conceptually, this definition is represented by the equation:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

In the case of these San Diego Bay shorelines, the applicable SQO relates to the protection of aquatic life beneficial uses. In TMDL development, numeric targets are set equal to the chlordane, PAHs, and PCBs sediment concentrations that were translated using the MLOE Approach in order to address the Aquatic Life SQO (see section 4). Water quality-based controls require that allowable loadings from pollutant sources cumulatively not exceed the TMDL. TMDLs can be expressed on a mass loading basis (e.g., pounds per year) or as a concentration in accordance with 40 CFR 130.2(l).

To control watershed sources, this Project establishes mass-based TMDLs for watershed sources that maintain or reduce the discharge of chlordane, PAHs, and PCBs to the mouths of Paleta, Chollas, and Switzer Creeks (see section 8.1). Concentration-based TMDLs for the water column and bed sediments in the creek mouths are established to assure that water quality standards are restored and maintained in the three creek mouth areas (see section 8.2).

8.1 Mass-Based Total Maximum Daily Loads

The mass-based TMDLs, existing loads, and required wasteload reductions are presented by waterbody in Table 8-1 for chlordane, total PAHs, and total PCBs. Wasteloads and wasteload reductions presented are based on the critical year, October 1, 2004 through September 30, 2005, because this period exhibited a high rainfall record, and therefore, high mass loading.

For the purpose of developing the TMDLs, the assumption was made that the pollutant concentrations from San Diego Bay cannot be reduced and that sediment toxic pollutant concentrations will be reduced to target values. That is, the contaminated sediments are removed or remediated to levels that meet numeric targets or as required by the CAO.

For PCBs, watershed reductions are not required as the existing load produced in the modeled high flow year is within the assimilative capacity of the receiving water (see discussion in section 7.6); however, sediment remediation of legacy pollution is needed at the creek mouths to restore that capacity. However, meeting target levels for chlordane and PAHs requires both reductions in the wasteload discharges from the watersheds and sediment remediation. Note that similar remediation actions would reduce all collocated sediment-associated pollutant concentrations, including PCBs.

Watershed reductions for chlordane are needed for Chollas Creek only, where a load reduction of 15 percent is required. Again, the existing load produced in the modeled high flow year was found to be within the assimilative capacity of Paleta and Switzer Creek mouth areas.

Required load reductions for total PAHs varied in each of the three watersheds. Chollas Creek required the largest reduction of 61 percent of the total PAHs daily load (see Table 8-1). Paleta Creek required a 28 percent reduction for total PAHs, while Switzer Creek required a 16 percent reduction of the daily load for total PAHs. PAHs, which have many uses, are found in greater abundance in the environment when compared to other manufactured organic compounds, such as PCBs, chlordane, and other pesticides.

Table 8-1. TMDLs and Reduction Required for Each Watershed/ Pollutant Combination.

Paleta Creek				
	Total Maximum Daily Load	**Existing load in High Flow Year**	**Reduction required from High Flow Year**	
Pollutant	**g/d**	**g/d**	**g/d**	**%**
Chlordane	**0.105**	0.105	0	0%
Total PAHs	**3.20**	4.44	1.24	28%
Total PCBs	**0.000438**	0.000438	0	0%
Chollas Creek				
	Total Maximum Daily Load	**Existing load in High Flow Year**	**Reduction required from High Flow Year**	
Pollutant	**g/d**	**g/d**	**g/d**	**%**
Chlordane	**0.582**	0.777	0.194	15%
Total PAHs	**12.67**	32.50	19.83	61%
Total PCBs	**0.00331**	0.00331	0	0%
Switzer Creek				
	Total Maximum Daily Load	**Existing load in High Flow Year**	**Reduction required from High Flow Year**	
Pollutant	**g/d**	**g/d**	**g/d**	**%**
Chlordane	**0.061**	0.061	0	0%
Total PAHs	**1.45**	1.73	0.28	16%
Total PCBs	**0.00054**	0.00054	0	0%

Note:

- Acronyms: TMDL = Total Maximum Daily Load; g/d = grams per day
- TMDL allocations in grams per day (g/d) are obtained by dividing the total load for the high flow water year of October 1, 2004 through September 30, 2005 (critical year) by 365 days.
- The TMDL, Existing load, and Reduction required numbers presented above include the assumption that bed sediment pollutant concentrations at the creek mouths have been reduced to target levels. Therefore, loads presented do not explicitly account for these contributions or their reductions. Likewise, potential pollutant loads from the greater San Diego Bay have not been explicitly included as an LA in the tables. No adjustment is required to the greater bay pollutant contributions (boundary conditions).

PCB concentrations in storm water were difficult to determine because the concentrations found were below the detection limit in both the first Watershed Monitoring Study (Appendix C-1) and in recent storm water monitoring studies by the City of San Diego (2010a). As a result, the use of one-half the detection limit (0.05 ng/L) was chosen as the designated event mean concentration (EMC) for PCBs based on the chosen analytical methods for data that were used to determine pollutant concentrations from both the first Watershed Monitoring Study and the recent storm water monitoring studies (City of San Diego 2010a). In a study unrelated to (but applicable to) this TMDL analysis, where data were collected within the tidally-influenced areas of the creek and creek mouth, results above the detection limit were reported for PCBs in two of three of the waterbodies of concern when low detection limit techniques were used. Katz et al. (2003) reported concentrations of PCBs in composited storm water samples at Naval Base San Diego of 37 ng/L for Chollas Creek, and 52 ng/L for Paleta Creek. ~~One important note, the Katz et al. study reported data from the tidal portions of the creek and from the Naval Base only. Whereas, t~~The other two studies focused on flows from above the tidally-influenced portions of the watershed; hence, the portions of the creeks in which loading would be measured to prevent measuring any pollutants that had come from the bay or that had previously been loaded from the watershed. The few storm water concentration data points collected from the Naval Base were determined not to be appropriate for use in the model with the storm water concentration data collected from the watershed ~~would have been helpful in this analysis, but the U.S. Navy did not give permission to use their data for the TMDL analysis~~. Therefore, the same watershed EMC values of 0.05 ng/L were used as the baseline loading concentration in the model instead of the concentrations from the Naval Base.

Because the focus of sampling to determine loading to the creek mouths has only been in the watershed above the tidally-influenced portion of the creeks, there are concerns that the PCB concentrations in the watershed have not been accounted for completely. It is possible that some of the PCBs found in the sediments of these creek mouths are entering from these tidally-influenced portions of the creeks or their watersheds. To address these concerns, additional study of the PCBs sources and pathways, and concentrations of PCBs in sediment discharged to the tidally-influenced portions of the creeks has been added to the TMDLs requirements in Section 10.4 of the Implementation Plan.

For this TMDL Project, reductions below the modeled existing load are not required for PCBs to meet target levels in any of the three designated watersheds or for chlordane in Paleta and Switzer Creek watersheds (see Table 8-1). While additional management practices may not be necessary to meet these TMDLs in these watershed, monitoring will be needed to demonstrate attainment of TMDLs in the future and that the PCB load does not increase over time.

8.1.1 *Wasteload Allocations*

TMDLs are required to include individual WLAs for each point source discharge regulated by a discharge permit. The Paleta, Chollas, and Switzer Creek watersheds are under the control of permittees identified in the San Diego County MS4 permit, as noted in section 5.2.1. Therefore, the wasteload contributions are presented as WLAs.

The responsible Municipal Dischargers are:

Paleta Creek Watershed	**Chollas Creek Watershed**	**Switzer Creek Watershed**
National City	City of San Diego	City of San Diego
City of San Diego	City of Lemon Grove	Port of San Diego
Caltrans	City of La Mesa	Caltrans
	County of San Diego	
	Port of San Diego	
	Caltrans	

The Navy also has runoff from Naval Base San Diego in the Chollas Creek and Paleta Creek watersheds regulated under its industrial discharge WDRs prescribed in Order No. R9-2002-0169. Order No. R9-2002-0169 does not regulate urban runoff discharges from MS4 areas. The facility is not currently regulated under any MS4 WDRs. The San Diego Water Board anticipates that Order No. R9-2002-0169 will be revised and reissued to regulate discharges of industrial process water, industrial storm water, and municipal storm water from its community facilities at Naval Base San Diego.

NASSCO is not permitted to discharge facility-related wastewater directly to the mouth of Chollas Creek (RWQCB 2009a); however, storm water runoff from the facility's employee parking lots discharges into Chollas Creek and is considered negligible for TMDL allocation. No other individual NPDES permits for point sources have been issued in these watersheds for total PCBs, total PAHs, or chlordane.

Additionally, an allocation was not given to bay sources (see Section 5.2.3) because the bay source would be impracticable to manage and the concentrations within the open bay are much lower than at the TMDL sites. Instead, the legacy sediment contamination at the TMDL sites will be addressed through remediation as part of the implementation plan.

For this TMDL study, only wet-weather point sources (WLAs) were identified, which were MS4s (city and county municipalities, the U.S. Navy, Caltrans, and/or the Port of San Diego) from Paleta, Chollas, and Switzer Creek watersheds. Allocations were calculated based on the modeled runoff (flow) for each subwatershed (i.e. total flow during the critical period) and the jurisdictional boundaries. Flow was used to estimate the WLA for each jurisdiction based on the relationship between flow, anthropogenic activities, and pollutant loading/transport. Specifically, the watershed model simulates the flow from each landuse type within a subwatershed. This information was used along with the landuse distribution for each jurisdiction within a subwatershed to derive the total estimated flow contributed by each jurisdiction within the watershed. The total allowable WLA for a particular watershed was allocated to the various jurisdictions based on the estimated flows. Loads associated with the explicit MOS and LAs (direct deposition) were subtracted from the allowable WLA. In this way, the watershed model assigned the total load (TMDL) from each watershed into separate WLAs for each of the municipalities, the U.S. Navy, and Caltrans, that includes four WLAs for Paleta Creek, six WLAs for Chollas Creek, and three for Switzer Creek. These WLAs have been included in Table 8-2 in columns for each specific jurisdiction or right-of-way (for Caltrans).

The WLAs in Table 8-2 are the values that each responsible entity is assigned for each of the TMDLs in this TMDL Project. The WLAs by percentage for each specific jurisdiction or right-of-way are provided in Table 8-3 to make comparisons among the responsible entities. The loadings of these three organics should be a concern on a long-term basis for these TMDLs rather than on a day-to-day basis given that the loading results are based on a sediment concentration value and not an immediate water column concentration.

Explicit margins of safety of 20 percent of each TMDL for chlordane and 5 percent of each TMDL for total PAHs and total PCBs were reserved for each pollutant. The calculated margins of safety for each TMDL is as follows:

Waterbody	**Paleta Creek**	**Chollas Creek**	**Switzer Creek**
Chlordane (g/d)	0.021	0.118	0.012
Total PAHs (g/d)	0.16	0.63	0.07
Total PCBs (mg/d)	0.022	0.160	0.030

In addition, load allocations (LAs) for direct atmospheric deposition of chlordane were calculated and accounted for in these allocations (see Section 8.1.2). After deducting the margins of safety and LA (chlordane only) from each TMDL, the remaining load is allocated to the point sources.

Table 8-2. TMDL Wasteload Allocations by Jurisdiction or Right-of-Way.

Paleta Creek TMDL WLAs										
		San Diego	**La Mesa**	**Lemon Grove**	**SD County**	**National City**	**Caltrans**	**U.S Navy**	**SD Port District**	Total WLA[1]
Chlordane	g/d	0.048	NA	NA	NA	0.023	0.003	0.009	NA	0.083
Total PAHs	g/d	1.75	NA	NA	NA	0.86	0.11	0.32	NA	3.04
Total PCBs	mg/d	0.240	NA	NA	NA	0.118	0.014	0.044	NA	0.416

Chollas Creek TMDL WLAs										
		San Diego	**La Mesa**	**Lemon Grove**	**SD County**	**National City**	**Caltrans**	**U.S Navy**	**SD Port District**	Total WLA[1]
Chlordane	g/d	0.340	0.046	0.056	0.002	NA	0.014	0.001	0.001	0.460
Total PAHs	g/d	8.90	1.20	1.50	0.05	NA	0.37	0.03	0.01	12.06
Total PCBs	mg/d	2.33	0.31	0.39	0.01	NA	0.10	0.01	0.003	3.15

Switzer Creek TMDL WLAs										
		San Diego	**La Mesa**	**Lemon Grove**	**SD County**	**National City**	**Caltrans**	**U.S Navy**	**SD Port District**	Total WLA[1]
Chlordane	g/d	0.0463	NA	NA	NA	NA	0.0013	NA	0.0008	0.0484
Total PAHs	g/d	1.32	NA	NA	NA	NA	0.04	NA	0.02	1.38
Total PCBs	mg/d	0.49	NA	NA	NA	NA	0.01	NA	0.01	0.51

NA – Jurisdiction is not applicable in this watershed.
[1] The WLAs were calculated by subtracting the percent explicit MOS and the percent atmospheric deposition load allocation from the total TMDL value.

Table 8-3. Percent of Wasteload Allocations by Jurisdiction or Right-of-Way.

Paleta Creek TMDL Percent of the Total WLAs								
	San Diego	**La Mesa**	**Lemon Grove**	**SD County**	**National City**	**Caltrans**	**U.S. Navy**	**SD Port District**
Chlordane	57.7	NA	NA	NA	28.3	3.5	10.5	NA
Total PAHs	57.7	NA	NA	NA	28.3	3.5	10.5	NA
Total PCBs	57.7	NA	NA	NA	28.3	3.5	10.5	NA
Chollas Creek TMDL Percent of the Total WLAs								
	San Diego	**La Mesa**	**Lemon Grove**	**SD County**	**National City**	**Caltrans**	**U.S. Navy**	**SD Port District**
Chlordane	73.9	9.9	12.3	0.4	NA	3.1	0.2	0.1
Total PAHs	73.9	9.9	12.3	0.4	NA	3.1	0.2	0.1
Total PCBs	73.9	9.9	12.3	0.4	NA	3.1	0.2	0.1
Switzer Creek TMDL Percent of the Total WLAs								
	San Diego	**La Mesa**	**Lemon Grove**	**SD County**	**National City**	**Caltrans**	**U.S. Navy**	**SD Port District**
Chlordane	95.5	NA	NA	NA	NA	2.7	NA	1.8
Total PAHs	95.5	NA	NA	NA	NA	2.7	NA	1.8
Total PCBs	95.5	NA	NA	NA	NA	2.7	NA	1.8

NA – Jurisdiction is not applicable in this watershed.

8.1.2 *Load Allocations*

According to federal regulations (40 CFR 130.2(g)), load allocations are best estimates of pollutant loads associated with nonpoint or background sources. Atmospheric emissions from both stationary point sources (e.g., industrial) and mobile sources, including vehicle emissions, enter waterbodies through direct or indirect deposition; therefore, it is important to quantify the effect atmospheric deposition has on impaired waterbodies and assign an appropriate load allocation. Atmospheric deposition is considered a significant nonpoint source of toxic pollutants, primarily through indirect deposit to land surfaces within the contributing watersheds. Indirect deposition and other nonpoint source discharges that are discharged through storm water conveyances are included in the WLAs for point sources, rather than as separate LAs.

As discussed in Section 5 Source Analysis, results from a study conducted by SCCWRP suggest that there is a net loss to the atmosphere for both total PAHs and total PCBs, but a net gain for total chlordane in San Diego Bay (Sabin et al. 2010; Schiff 2011). Considering the net loss to the atmosphere for total PAHs and total PCBs, the load to each waterbody is zero. The net gain to the waterbody from aerial deposition of total chlordane was estimated at 25 ng/m^2/day (Schiff 2011).

Total chlordane loads for atmospheric deposition were calculated and a load allocation was assigned based on direct precipitation to the surface area of each impaired waterbody and its corresponding watershed modeled reaches (stream channels). A default five-foot buffer was applied to the reaches (giving them a uniform width of ten feet) in order to estimate the total surface area and therefore calculate the atmospheric deposition load. The estimated direct atmospheric deposition loads are set as LAs and are presented below.

Waterbody	Area (m^2)	LAs for Direct Atm. Dep. (g/day)
7th Street Channel/Paleta Creek	24,021.22	0.001
Chollas Creek/Creek Mouth Area	165,540.78	0.004
Switzer Creek/Creek Mouth Area	33,385.91	0.001

The LAs for direct atmospheric deposition are assigned as uncontrollable sources; therefore, no load reductions are required. Because there is no direct load of total PAHs and total PCBs, the LAs for each waterbody is zero.

8.1.3 *Summary of Mass-Based TMDLs*

Table 8-4 provides an overall summary of the TMDL, including TMDL, WLA, LA and MOS values for each pollutant in each waterbody.

Table 8-4. Summary of the Mass-Based TMDLs for Toxic Pollutants in Sediment for Paleta, Chollas, and Switzer Creeks

Paleta Creek				
	WLA	**LA**	**MOS**	**Total Maximum Daily Load**
Pollutant	**g/d**	**g/d**	**g/d**	**g/d**
Chlordane	0.083	0.001	0.021	0.105
Total PAHs	3.04	0	0.16	3.20
Total PCBs	0.000416	0	0.000022	0.000438
Chollas Creek				
	WLA	**LA**	**MOS**	**Total Maximum Daily Load**
Pollutant	**g/d**	**g/d**	**g/d**	**g/d**
Chlordane	0.460	0.004	0.118	0.582
Total PAHs	12.04	0	0.63	12.67
Total PCBs	0.00315	0	0.00016	0.00331
Switzer Creek				
	WLA	**LA**	**MOS**	**Total Maximum Daily Loa**
Pollutant	**g/d**	**g/d**	**g/d**	**g/d**
Chlordane	0.048	0.001	0.012	0.061
Total PAHs	1.38	0	0.07	1.45
Total PCBs	0.00051	0	0.00003	0.00054

8.2 Concentration-Based Total Maximum Daily Loads

The impairments at the creek mouth areas are due to historic loads of chlordane, PAHs, and PCBs that have accumulated in the bed sediments. This impairment is not amenable to a direct calculation of loading capacity expressed as mass per unit time. Instead, the loading capacity is set on a concentration basis to the sediment concentration that will be protective of direct effects to benthic communities. The loading capacity of each pollutant is set equal to the numeric targets in the receiving water bed sediments.

The numeric targets are sediment concentrations that are derived from Aquatic Life SQO analysis. Table 8-5 summarizes the bed sediment loading capacity for the three impaired waterbodies.

Table 8-5. Bed Sediment Loading Capacity at the Mouths of Paleta, Chollas, and Switzer Creeks

Pollutant	Units	Bed Sediment Loading Capacity
Total Chlordane	µg/kg	2.1
Priority Pollutant PAHs	µg/kg	2,965
Total PCBs	µg/kg	168

Attainment of the Aquatic Life SQO will occur through demonstrating that the bed sediments have achieved the loading capacity, i.e., if the ambient sediment chemistry levels within a waterbody are equal to or less than the numeric targets.

Additionally, these organic pollutants are known to be hazardous to human health due to the potential to bioaccumulate up the food chain. To protect human health in San Diego Bay, concentration-based TMDLs for water column concentrations in the receiving water and fish tissue concentration are set equal to the numeric targets described in Section 4.2. The water column concentrations in the receiving water are set equal to the CTR human health targets for consumption of organisms. Total PCBs in fish tissue are set to the Fish Contaminant Goals developed by OEHHA (2008).

Table 8-6. Water Column and Fish Tissue Concentration Targets at the Mouths of Paleta, Chollas, and Switzer Creeks

Pollutant	Units	Receiving Water Loading Capacity
Water Column		
Total Chlordane	µg/L	0.00059
Benzo(a)pyrene	µg/L	0.049
Total PCBs	µg/L	0.00017
Fish Tissue		
Total PCBs	µg/kg wet weight	3.6

9. Legal Authority for Regulating Pollutant Sources

This section presents the legal authority and regulatory framework used as a basis for assigning responsibilities to dischargers to implement and monitor compliance with the requirements set forth in these TMDLs. The laws and policies governing point source[15] and nonpoint source discharges are described below. The pollutant loads generated in the watersheds and discharged to the creek mouth areas come from anthropogenic sources. Nonpoint sources, primarily direct atmospheric deposition to the waterbody, are considered largely uncontrollable at this time, and therefore cannot be regulated with a TMDL implementation plan. The regulatory framework for nonpoint sources is provided for completeness.

Discharger accountability for attaining wasteload allocations is established in this section. The legal authority and regulatory framework is described in terms of the following:

- Controllable water quality factors;
- Regulatory framework; and
- Persons accountable for point source discharges

[15] The term ''point source'' is defined in CWA section 502(6) to mean any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

9.1 Controllable Water Quality Factors

The source analysis (section 5) found that toxic pollutants are transported to impaired creek mouth areas through wet weather runoff generated from urban and industrial areas. These discharges result from controllable water quality factors which are defined as those actions, conditions, or circumstances resulting from human actions that may influence the quality of the waters of the state and that may be reasonably controlled. These TMDLs establish WLAs for point sources for these controllable discharges.

9.2 Regulatory Framework

The regulatory framework for point sources of pollution differs from the regulatory framework for nonpoint sources. The different regulatory frameworks are described in the subsections below.

9.2.1 *Point Sources*

Clean Water Act section 402 establishes the National Pollutant Discharge Elimination System (NPDES) program to regulate the ''discharge of a pollutant,'' other than dredged or fill materials, from a ''point source'' into ''waters of the U.S." Under section 402, discharges of pollutants to waters of the U.S. are authorized by obtaining and complying with NPDES permits.

In California, Waste Discharge Requirements (WDRs) for discharges of pollutants from point sources to navigable waters of the United States that implement federal NPDES regulations and CWA requirements serve in lieu of federal NPDES permits. These are referred to as NPDES requirements. Such requirements are issued by the State pursuant to independent state authority described in California's Porter Cologne Water Quality Control Act[16].

Because point sources identified as discharging toxic pollutants were largely determined to be associated with storm water runoff discharged from MS4s (Cities, County, Port of San Diego, Caltrans, and U.S. Navy) and industrial facilities, the primary mechanism for TMDL attainment will be regulation of these discharges with WDRs that implement NPDES requirements. Mechanisms to impose regulations on these discharges are discussed in the Implementation Plan, section 10.

9.2.2 *Nonpoint Sources*

While laws mandating control of point source discharges are contained in the federal CWA's NPDES regulations, direct control of nonpoint source pollution is left to state programs developed under state law. LAs for nonpoint sources are not directly enforceable under the Clean Water Act and are only enforceable to the extent they are made so by state laws and regulations. The Porter-Cologne Water Quality Control Act applies to both point and nonpoint sources of pollution and serves as the principal legal

[16] Division 7 of the California Water Code (Water Code), commencing with section 13000.

authority in California for the regulation of discharges from controllable nonpoint sources.

Nonpoint source discharges from direct atmospheric deposition are considered to be largely uncontrollable, and are usually excluded from regulation. The State policy pertaining to regulation of nonpoint sources of pollution in California is provided in the Plan for California's Nonpoint Source Pollution Control Plan (NPS Program Plan; State Water Board, 2000) and the Policy for the Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Implementation and Enforcement Policy; State Water Board, 2004).

The primary objective of the NPS Program Plan is to reduce and prevent nonpoint source pollution so that the waters of California support a diversity of biological, educational, recreational, and other beneficial uses. Towards this end, the NPS Program Plan focuses on implementation of 61 management measures[17] (MMs) and related management practices[18] (MPs) in six land use categories by the year 2013.[19]

The success of the NPS Program Plan depends upon individual discharger implementation of MPs. Pollutants can be effectively reduced in nonpoint source discharges by the application of a combination of pollution prevention,[20] source control, and treatment control MPs. Source control MPs (both structural and non-structural) minimize the contact between pollutants and flows (e.g., rerouting run-off around pollutant sources or keeping pollutants on-site and out of receiving waters). Treatment control (or structural) MPs remove pollutants from NPS discharges. MPs can be applied before, during, and after pollution producing activities to reduce or eliminate the introduction of pollutants into receiving waters.

The NPS Implementation and Enforcement Policy provides guidance on the statutory and regulatory authorities of the State Water Board and the San Diego Water Board to prevent and control nonpoint source pollution.

[17] MMs serve as general goals for the control and prevention of nonpoint source polluted runoff.
[18] MPs are the implementation actions taken by nonpoint source dischargers to achieve the management measure goals.
[19] MMs are identified in Volume II of the Plan for California's Nonpoint Source Pollution Control Program (NPS Program Plan) 1999 Program Plan: California's Management Measures for Polluted Runoff (CAMMPR) (http://www.waterboards.ca.gov/nps/cammpr.html).
[20] Pollution prevention, the initial reduction/elimination of pollutant generation at its source should be used in conjunction with source control and treatment control MPs. Pollutants that are never generated do not have to be controlled or treated.

9.3 Parties Responsible for Point Source Discharges

Parties identified as responsible for point source discharges of toxic pollutants (i.e., chlordane, total PAHs, and/or total PCBs) include the following: (Parties receiving WLAs have solid bullets. Parties receiving LAs have clear bullets.)

Paleta Creek Watershed

- City of San Diego (Phase I MS4)
- National City (Phase I MS4)
- Caltrans
- U.S. Navy
- ○ Enrollees of the Industrial Storm Water General Permit
- ○ Enrollees of the Construction Storm Water General Permit
- ○ Regulated Small MS4s (Statewide General Permit)

Chollas Creek Watershed

- City of San Diego (Phase I MS4)
- City of La Mesa (Phase I MS4)
- City of Lemon Grove (Phase I MS4)
- Port of San Diego (Phase I MS4)
- County of San Diego (Phase I MS4)
- Caltrans
- U.S. Navy
- ○ Enrollees of the Industrial Storm Water General Permit
- ○ Enrollees of the Construction Storm Water General Permit
- ○ Regulated Small MS4s (Statewide General Permit)
- ○ NASSCO[21]

Switzer Creek Watershed

- City of San Diego (Phase I MS4)
- Port of San Diego (Phase I MS4)
- Caltrans
- ○ Enrollees of the Industrial Storm Water General Permit
- ○ Enrollees of the Construction Storm Water General Permit
- ○ Regulated Small MS4s (Statewide General Permit)

The Phase I MS4s, Caltrans, and the U.S. Navy have been assigned WLAs, as shown in Table 8-2. These point sources are regulated under WDRs that implement NPDES requirements. Enrollees of general permits and regulated small MS4s are located within the Phase I MS4s. Pursuant to each general permit, enrollees of general permits are already required to reduce and prevent pollutants in storm water and authorized non-storm water discharges through the use of BMPs, comply with water quality

[21] NASSCO's WDRs, Order No. R9-2009-0099, do not allow for storm water discharge to any receiving water; therefore, receives no WLA for Chollas Creek Mouth. NASSCO is considered a responsible party for sediment remediation of Chollas Creek mouth sediment.

standards, and implement additional BMPs or other measures if receiving water quality standards are exceeded. Additionally, sufficient data is not available to determine and assign WLAs to enrollees of the Phase II MS4s, industrial, and construction general permits. Any other point source that has not been specifically assigned a WLA effectively has a WLA of zero and is not allowed to discharge a pollutant load as part of the TMDL.

Under this TMDL, the responsible parties that are assigned WLAs are responsible for meeting their WLAs and must take actions to reduce their pollutant loads to the three creek mouth areas in San Diego Bay. To reduce their pollutant loads, the owners and operators of each individual point and non-point source must individually reduce their own sediment load attributable to their discharge.

The San Diego Water Board encourages cooperation among all the responsible parties. While it is the responsibility of all the responsible parties to manage their discharge, the Phase I MS4s collect and drain virtually the entirety of each watershed. As such, the Phase I MS4s become the ultimate point source conveyor of pollutants to San Diego Bay. Therefore, it is the expectation and responsibility of the Phase I MS4s to assume the lead role in coordinating and carrying out the necessary actions, compliance monitoring requirements, and successful implementation of the adaptive management framework required as part of this TMDL Project.

Individual industrial facilities, construction sites, and small MS4s are subject to dual (state and local) storm water regulation. Under this dual system, the San Diego Water Board is responsible for enforcing the Statewide Industrial, Construction, and Small MS4 Storm Water General NPDES Permits within its jurisdiction and each municipal permittee is responsible for enforcing its local permits, plans, and ordinances, which may require the implementation of additional BMPs beyond that required under the Statewide general permits. The San Diego Water Board relies upon the municipality to enforce its ordinances/permits and then works with the municipality to coordinate information and actions to compel compliance at the local and state level.

All responsible parties must undertake actions to manage and reduce pollutant loads in accordance with the Implementation Plan in section 10.

10. Implementation Plan

This section describes the actions necessary to implement the TMDLs to restore the beneficial uses in the impaired creek mouths in San Diego Bay. The goal of the Implementation Plan is to restore beneficial uses of the waterbodies addressed by these TMDLs. Restoring the impaired beneficial uses will be accomplished by achieving the TMDLs in the receiving waters, achieving the wasteload allocations (WLAs) for point sources and the load allocations (LAs) for nonpoint sources, demonstrating attainment of the Aquatic Life and Human Health SQOs, and cleanup of contaminated sediments in the areas at the mouths of Paleta, Chollas, and Switzer Creeks.

TMDLs are not self-implementing or directly enforceable against pollutant sources located in the watershed. Other San Diego Water Board regulatory tools, programs, and authorities must be used to implement the TMDL pollutant reductions required to achieve water quality standards. The most effective authorities and programs used to implement the TMDLs depends on the type of point source(s) of pollutants to be controlled in the watershed. This section describes the actions necessary to implement the TMDLs in order to attain the SQOs for protection of benthic communities and human health in the sediment of the mouths of Paleta, Chollas, and Switzer Creeks.

The implementation framework includes a phased TMDL implementation approach and the requirement to implement actions. The TMDLs will be implemented over a 20 year period with interim reductions being required in years 5, 10, and 15, and the final TMDLs met by year 20. Implementation actions include completion of a special study to investigate the tidally-influenced portion of each of the three creeks and completion of sediment remediation in the creek mouth areas (which will be addressed through a separate CAO). Monitoring and sediment quality assessments will be required to demonstrate compliance with WLAs and SQO attainment and restoration of beneficial uses. This plan includes a schedule for implementing the required actions.

10.1 Regulatory Requirements for Implementation Plans

State law requires that a TMDL include an implementation plan since a TMDL supplements, interprets, and/or refines existing water quality objectives. The TMDLs, LAs, and WLAs must be incorporated into the Basin Plan.[22] Basin plans must have a program of implementation to achieve WQOs,[23] and Basin Plan amendments including TMDLs are not exempted from this requirement. At a minimum, implementation plans must include a description of actions that are necessary to achieve the objectives, a time schedule for implementation of the actions, and a description of surveillance to determine compliance with the WQOs.[24]

10.2 Implementation Framework

The San Diego Water Board's Implementation Framework for attaining and maintaining SQOs for chlordane, total PAHs, and total PCBs in the impaired creek mouths of Paleta, Chollas, and Switzer Creeks is described as follows.

The TMDLs will be phased in over a 20 year period from the effective date of this Basin Plan amendment in accordance with the schedule presented in Table 10-1. Attainment of the TMDLs is based on achieving the WLAs for watershed discharges, maintaining

[22] See CWA section 303(e).
[23] See Water Code section 13050(j). A "Water Quality Control Plan" or "Basin Plan" consists of a designation or establishment for the waters within a specified area of all of the following: (1) Beneficial uses to be protected, (2) Water quality objectives and (3) A program of implementation needed for achieving water quality objectives.
[24] See Water Code section 13242

the creek mouth sediment concentrations at or below the concentration-based TMDLs, and attaining the SQOs for benthic community protection and human health in the creek mouth areas of San Diego Bay. SQO attainment demonstrates that the aquatic life beneficial use has been restored and provides the data needed for delisting from the 303(d) List.

Watershed discharges are subject to the phased load reductions listed in Table 10-1. The table also contains milestones for meeting concentration-based TMDLs and attaining the narrative SQO for benthic community protection. These milestones coincide with the completion of sediment remediation activities and allow for adequate time for the recolonization of the benthic communities (Guerra-Garcia et al. 2003; Ceia et al. 2011).

Table 10-1. Phased Load Reduction of Mass-Based TMDLs and Sediment Quality Improvement Milestones

	Attainment Date[1]	**Phased Load Reductions for Achievement of WLAs[2] (Mass-Based TMDLs)**	**Attainment Milestones for Creek Mouth Areas (Concentration-Based TMDLs)**
Interim Goal 1	Year 5	40%	--
Interim Goal 2	Year 8	--	Complete Sediment Remediation. Meet Sediment and Water Column Targets.
Interim Goal 3	Year 10	80%	Begin monitoring to demonstrate attainment of Aquatic Life SQO.
Interim Goal 4	Year 15	90%	--
Final Goal	Year 20	100% = Meet WLAs	Meet Fish Tissue Concentration Target. Attain Aquatic Life and Human Health SQOs.

[1] Compliance is to be completed by the end of the calendar year noted, following the effective date of the Basin Plan Amendment.
[2] Percent reduction required from existing loads in high flow year to meet WLAs.

The TMDL implementation requirements needed to ensure attainment of water quality standards and restoration of beneficial uses are as follows.

1. **Source Control and Pollutant Load Reduction**. The following actions will be implemented to address pollutant loading:
   a. **Pollutant Load Reduction**. Responsible parties will implement measures to manage and control sources of pollutants, reduce pollutant loading, and develop a comprehensive monitoring program to show compliance with WLAs and beneficial uses restoration. Responsible parties in each watershed will develop a Load Reduction Plan or a Storm Water Pollution Prevention Plan (SWPPP) that demonstrates how they will comply with TMDL implementation. Plans should be developed collaboratively, when possible, by all responsible parties within each watershed and incorporate an adaptive management approach. Section 10.3.1 provides additional detail.
   b. **Water Board Regulatory Actions**. In order to be enforceable, TMDL requirements, such as WLAs and monitoring and reporting requirements, must be incorporated into existing or new permits or enforcement orders.

      The regulatory mechanisms to implement the requirements of this Implementation Plan include, but are not limited to, individual NPDES permits, the Statewide Storm Water Permit for Caltrans Activities, the Small MS4s General Permit, the Industrial Storm Water General Permit, the Construction Activity Storm Water General Permit, and the authorities contained in sections 13243, 13263, 13269, 13300, 13301, 13267, 13328, 13377, and 13383 of the Water Code.

      Implementing regulatory authorities, including revision of waste discharge requirements to incorporate requirements consistent with these TMDLs into NPDES permits, are discussed in Section 10.3.2.
2. **Special Studies**. Special studies are needed to (1) investigate contributing sources and pathways for, and loads and sediment concentrations of chlordane, PAHs, and PCBs in the sediments of the tidally-influenced portion of each of the three watersheds and (2) assess the human health threat from post-remediation creek mouth sediments by testing for PCBs bioaccumulation in ~~clam (*Macoma nasuta*)~~ tissue of the relevant species. The San Diego Water Board shall issue one or more investigative orders, pursuant to Water Code section 13267, to initiate needed special studies and will use the results to determine if additional enforcement actions and/or revisions to load reduction plans are necessary. Additional actions (e.g., enforcement order) will be considered following the results of the studies. Other special studies may be proposed and conducted as needed by the responsible parties. Section 10.4 provides additional information.
3. **Sediment Remediation**. Remediation of contaminated sediment in the three creek mouth areas is needed to achieve a sediment quality that supports the beneficial uses. The San Diego Water Board will issue one or more cleanup and abatement orders (CAOs), pursuant to Water Code section 13304, directing responsible parties to remediate sediment in the three TMDL project areas.

Enforcement actions will be informed by results of investigative orders issued for characterization of the tidally-influenced portion of each creek. Section 10.5 provides additional information.

4. **Monitoring and Assessment**. Monitoring and assessment of water and sediment quality conditions are needed to inform decision-making, demonstrate attainment with TMDLs and the SQO for benthic community protection, and restore the beneficial uses. Section 10.6 provides additional information.

   Monitoring will be required for the city and county municipalities of each watershed, Caltrans, the U.S. Navy, and the Port of San Diego where monitoring of storm water, receiving water, and sediment will be necessary to ensure that WLAs and concentration-based TMDLs are met. Assessment of sediment quality conditions in each creek mouth will also be required to determine the status of beneficial use restoration.

   An adaptive management strategy will be used to manage and control the loads from each watershed and the condition of the sediment receiving water as necessary.

5. **Re-evaluation of TMDLs and/or Allocations**. The San Diego Water Board may re-evaluate the TMDLs and/or WLAs and LAs if new information or data indicates that a re-evaluation is needed for the purpose of restoring beneficial uses.

Dischargers must comply with the San Diego Region Basin Plan and Encloded Bays and Estuaries Plan, and applicable Waste Discharge Requirements, and Conditional Waiver requirements. The Phase I and small ~~Municipal~~ MS4s, Caltrans MS4 (Caltrans), and U.S. Navy must meet WLAs. Compliance will be based not only on a measurement of the amount of pollutant entering the receiving water from each source (load-based), but also concentration of the pollutant in the sediment and water column of the receiving water (concentration-based).

Atmospheric deposition was the only nonpoint source identified in the Paleta, Chollas, and Switzer creek watersheds. Atmospheric deposition is considered an uncontrollable nonpoint source. The Water Boards, the California Air Resources Board (CARB), and some of the Air Districts have identified the need to (1) expand monitoring of larger particulates in atmospheric deposition to better gauge the impact to water quality and (2) investigate the sources of these pollutants in order to design a control strategy. The San Diego Water Board will submit a letter to the California Air Resources Board and/or the San Diego County Air Pollution Control District requesting that they address issues relating to air deposition of toxic organic pollutants in the San Diego Bay airshed.

The San Diego Water Board will use its authorities to take actions, as necessary, to direct any other discharger that is identified by the San Diego Water Board or other parties as a significant source causing or contributing to the impairments in the waterbodies addressed in these TMDLs.

10.3 Pollutant Load Reduction Requirements

10.3.1 *Load Reduction Actions by Responsible Parties*

The parties identified in Section 9.3 are responsible for taking actions to manage and reduce pollutant loads in accordance with the phased load reduction milestones in Table 10-1 and the compliance schedule in Section 10.7.

Urban development and inadequate management of runoff from impervious areas have contributed to the development of toxic hot spots in San Diego Bay. To minimize the effects of runoff, management and source control of organic pollutants can be achieved through the execution of implementation actions such as BMPs. All responsible parties are required to develop load reduction plans that identify specific implementation actions that will be used to comply with the required wasteload reductions and meet the TMDLs.

Implementation actions can be grouped into the following categories: management and source control, education and outreach, and monitoring. Each is summarized below.

- **Management and Source Control**: The source assessment identified land development (MS4 and adjacent land use contribution) as the primary source of organic pollutant contributions. Urban activities associated with industrial, commercial, and residential land uses introduce organic pollutants into the environment. Additionally, re-development activity in these areas can expose contaminated sediment. Runoff carries these pollutants, often with sediment, into the waterways and, ultimately, into the bay. Appropriate runoff management and source control can partially or fully mitigate the effects of urban land use.

  Storm water BMPs can be implemented to reduce the effects of pollutant loading from urban development. Structural BMPs, including the incorporation of low impact development (LID), can be utilized in new development as well as for retrofitting existing sites to reduce or eliminate pollutant runoff. Structural BMPs can also be applied as regional MS4 BMPs to treat pollutants and/or flows prior to discharge into receiving waters.

- **Education & Outreach**: As a source control technique, education and outreach can function as pollution prevention to reduce or eliminate the amount of sediment generated at its source. Education and outreach can be targeted at specific land user groups and/or staff involved with site maintenance. As an example, implementation actions such as municipal incentives can be used to encourage proper irrigation and landscaping and can significantly reduce volumes of runoff.

- **Monitoring**: A coordinated monitoring plan is recommended to establish existing watershed conditions (baseline conditions) from which future changes and anticipated improvement in water quality can be measured. Additional monitoring could focus on BMP effectiveness and/or reduction in impervious coverage. Additionally, monitoring is crucial in the assessment of implementation actions to gain an understanding of performance for future adaptive management actions.

10.3.1.1 Develop and Submit Load Reduction Plan

The Phase I MS4s in each of the three watersheds (see Section 9.3), Caltrans, and the U.S. Navy (in Paleta and Chollas creek watersheds) are required to prepare load reduction plans that demonstrate how they will comply with the interim and final TMDLs in each watershed. The San Diego Water Board expects that load reduction plans will be developed collaboratively by the responsible parties within each watershed. Additionally, the plans should integrate with existing runoff management or storm water management programs. Load reduction plans shall be submitted to the San Diego Water Board within 12 months of incorporation of required language into the relevant permit, and reviewed by the San Diego Water Board Executive Officer within 6 months of submittal (this period will likely include a round of revisions by the responsible parties based on San Diego Water Board staff comments).

Load reduction plans will utilize an adaptive management approach and include a detailed description of implementation actions, as identified and planned by the responsible parties, to meet the requirements of this TMDL. Implementation actions identified in the plan may include source control techniques, structural and/or non-structural storm water BMPs, and/or special studies that refine the understanding of pollutant sources within the watershed. The plan shall include a description and objective of each implementation action; it will also detail potential BMP locations, a timeline for project or BMP completion, and a monitoring plan to measure the effectiveness of implementation actions.

Storm Water Pollution Prevention Plans (SWPPPs) prepared by industrial, construction, and regulated small MS4s permittees pursuant to their respective individual or Statewide general NPDES permits can serve as the Load Reduction Plans for these entities. All such permittees within the Paleta, Chollas, and Switzer creek watersheds shall update their SWPPPs within 6 months of incorporation of required language into the relevant permit with any additional BMPs, monitoring, etc. to account for their site's potential to impact the receiving waterbody with respect to total chlordane, priority pollutant PAHs, and total PCBs. Alternatively, existing permittees may update their SWPPPs within 12 months if they enter into a Memorandum of Understanding (MOU), or a similar formal joint effort with the Phase I MS4s in the applicable watershed to collaboratively and more successfully implement the adaptive management framework.

Sites identified through monitoring data or site inspections as posing an increased risk to the receiving waterbody may be directed to perform additional monitoring by the San Diego Water Board Executive Officer to quantify total chlordane, priority pollutant PAHs, and total PCBs load contributions to the receiving waterbody.

Adaptive Management Approach

An adaptive management approach will be utilized in the Load Reduction Plans. An adaptive management approach offers the flexibility for responsible parties to monitor implementation actions, determine the success of such actions and ultimately, base future management decisions upon the measured results of completed implementation actions and the current state of the system. This process enhances the understanding and estimation of predicted outcomes and ensures refinement of necessary activities to better guarantee desirable results.

Adaptive management entails applying the scientific method to TMDL implementation. A National Research Council review of U.S. EPA's TMDL program strongly suggests that the key to improving the application of science in the TMDL program is to apply the scientific method to TMDL implementation (NRC 2001). In TMDL implementation, applying the scientific method involves 1) taking immediate actions commensurate with available information, 2) defining and implementing a program for refining the information on which the immediate actions are based, and 3) modifying actions as necessary based on new information. This approach allows the impaired waterbody to make progress toward attaining water quality standards while regulators and stakeholders improve the understanding of the system through research and by observing how it responds to the immediate actions.

Implementation actions to achieve WLA and LA will be implemented via an iterative process, whereby existing and new information can be used to inform the implementation of subsequent activities. Load Reduction Plans can be adjusted as necessary based on information gained as implementation progresses.

10.3.1.2 Load Reduction Plan Implementation

The Load Reduction Plans for parties assigned waste load allocations must be implemented within 90 days upon receipt of San Diego Water Board's Executive Officer's comments and recommendations, but no later than 6 months after submittal. Other responsible parties (e.g., general enrollees that do not enter into MOUs with Phase I MS4s) must implement their plans as soon as they are developed.

10.3.2 *Water Board Regulatory Actions*

The San Diego Water Board uses its authorities and programs to regulate discharges from the controllable sources in the Region. The controllable sources that are subject to regulation are, in turn, responsible for complying with the requirements issued by the San Diego Water Board. Ultimately, the dischargers subject to regulation are responsible for reducing their pollutant loads in order for the TMDLs and WLAs to be achieved.

The authorities that are available to the San Diego Water Board to regulate dischargers are given under the Porter-Cologne Water Quality Control Act.[25] The available regulatory authorities include incorporating discharge prohibitions in to the Basin Plan,[26]

[25] Division 7 of the Water Code
[26] Water Code section 13243

issuing individual or general WDRs,[27] or issuing individual or general conditional waivers of WDRs.[28] The San Diego Water Board has the authority to enforce Basin Plan prohibitions, WDRs, or conditional waivers of WDRs through the issuance of enforcements actions (e.g., time schedule orders, cleanup and abatement orders, cease and desist orders, administrative civil liabilities).[29] The San Diego Water Board also has the authority to require monitoring and/or technical reports from dischargers,[30] which may be used to support the development, refinement, and/or implementation of TMDLs, WLAs, and/or LAs. The actions taken by the San Diego Water Board depends on the regulatory authority and the source.

TMDLs are enforced when TMDL requirements are incorporated into existing permits. Recommended permit requirements are provided, below, to serve as guidance for permit revision. The following permits will be revised to incorporate TMDL requirements:

- Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, the San Diego Unified Port District, and the San Diego County Regional Airport Authority, Order No. R9-2007-0001, or subsequent order (Phase I MS4 Permit);
- NPDES Permit, Statewide Storm Water Permit, and Waste Discharge Requirements for the State of California, Department of Transportation (Caltrans), State Water Board Order No. 99-06-DWQ, or subsequent order (Caltrans General Permit);
- Waste Discharge Requirements for U.S. Navy, Naval Base San Diego, San Diego County, Order No. R9-2002-0169, or subsequent order (Naval Base San Diego Individual Permit);
- NPDES General Permit, Waste Discharge Requirements for Discharges of Storm Water Associated with Industrial Activities, Order No. 1997-0003-DWQ, or subsequent order (Industrial General Permit);
- NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ, or subsequent order (Construction General Permit); and
- NPDES General Permit for the Discharge of Storm Water from Small MS4s, Water Quality Order No. ~~2003-0005~~2013-0001-DWQ, or subsequent order (Small MS4 General Permit).
- Waste Discharge Requirements for General Dynamics National Steel and Shipbuilding Company (NASSCO), Discharge to San Diego Bay, Order No. R9-2009-0099, NPDES Permit No. CA 0109134, or subsequent order.

[27] Water Code section 13263 and 13264
[28] Water Code section 13269
[29] Water Code sections 13301-13304, 13308, 13350, 13385 and/or 13399
[30] Water Code sections 13225, 13267, and/or 13383

10.3.2.1 Phase I MS4 Permit

The source assessment identified Phase I MS4s as sources needing load reductions to achieve and meet the interim and final WLAs in the watershed and concentration-based TMDLs in creek mouth sediment, and to demonstrate attainment of the SQO in the creek mouth sediment. The linkage analysis identified urban land uses, primarily associated with Phase I MS4s, as the most significant controllable point source causing or contributing to the impairments during wet weather conditions in the three watersheds addressed in these TMDLs.

The TMDLs and Phase I MS4 WLAs, with respect to discharges from Phase I MS4s, will be implemented primarily by revising and re-issuing the existing NPDES requirements that have been issued for Phase I MS4 discharges.

The San Diego Water Board will revise and re-issue the WDRs and NPDES requirements for Phase I MS4s to incorporate the applicable elements of this implementation plan and the following requirements in a manner that is consistent with the permit. Appendix J contains the permit conditions that will be added to Order No. R9-2007-0001, or subsequent order.

10.3.2.2 Naval Base San Diego Individual Permit

The military facility, Naval Base San Diego, in Chollas Creek and Paleta Creek watersheds was identified in the source assessment as requiring load reductions from their industrial activities and MS4 to achieve and meet the WLAs. The linkage analysis identified urban land uses, primarily associated with storm water conveyance, as the most significant controllable point source causing or contributing to the organic pollution impairments in watersheds addressed in these TMDLs. Runoff from Navy industrial facilities discharges into the Chollas and Paleta Creek watersheds and creek mouth areas and is regulated by WDRs issued as Order No. R9-2002-0169. The urban runoff discharges from Naval Base San Diego's community facilities are not currently regulated by the San Diego Municipal MS4 Permit. The San Diego Water Board anticipates that Order No. R9-2002-0169 will be revised and reissued to regulate both industrial storm water and the runoff from its community facilities at Naval Base San Diego. The revised permit would be consistent with the requirements of the Statewide general WDRs prescribed for small MS4s in Order No. ~~2003-0005~~2013-0001-DWQ or subsequent order.

The San Diego Water Board will revise and reissue the WDRs and NPDES requirements to incorporate the applicable elements of this implementation plan and the following requirements in a manner that is consistent with the permit. Appendix K contains the permit conditions that will be added to the subsequent order of Order No. R9-2002-0169.

10.3.2.3 Caltrans General Permit

Caltrans was identified in the source assessment as requiring load reductions to achieve and meet its WLAs. The TMDLs and Caltrans WLAs will be implemented primarily by revising and re-issuing the existing NPDES requirements that have been issued for Caltrans discharges.

The San Diego Water Board will request the State Water Board to revise and reissue the WDRs and NPDES requirements to incorporate the applicable elements of this implementation plan and the following requirements in a manner that is consistent with the permit. Appendix L contains the permit conditions that will be added to Order No. 99-06-DWQ, or subsequent order.

10.3.2.4 General Permits for Industrial, Construction, and Small MS4s

The San Diego Water Board will request the State Water Board to revise and reissue the WDRs and NPDES requirements to incorporate requirements consistent with the following for industrial, construction, and small MS4s discharges in the San Diego Region.

Storm water discharge from identified industrial facilities (see below), construction sites, and small MS4s within the watersheds subject to this TMDL and identified by the San Diego Water Board will be subject to the following applicable TMDL requirements, which will be incorporated into the applicable Statewide general permit: [31]

1. **Storm Water Pollution Prevention Plan/Storm Water Management Program**. Identified permittees within the Paleta, Chollas, and Switzer Creek watersheds must update their SWPPPs/SWMP within 6 months of incorporation of required language into the relevant permit with any additional BMPs, monitoring, or other actions that will be performed to account for their site's potential to impact the receiving waterbody with respect to total chlordane, priority pollutant PAHs, and total PCBs. Sites identified through monitoring data or site inspections as posing an increased risk to the receiving waterbody may be directed to perform additional monitoring by the San Diego Water Board Executive Officer to quantify total chlordane, priority pollutant PAHs, and total PCBs load contributions to the receiving waterbody.

   Existing permittees may update their SWPPPs/SWMP within 12 months if they enter into a Memorandum of Understanding (MOU), or a similar formal joint effort with the Phase 1 MS4s in the applicable watershed to collaboratively and more successfully implement the adaptive management framework. Permittees must implement their plans as soon as they are developed.

[31] State Water Board Order Nos. 97-03-DWQ (Industrial), 2009-0009-DWQ (Construction), 2003-0005-DWQ (Small MS4s), or subsequent orders.

2. **Best Management Practices**. Permittees must implement BMPs capable of reducing organic pollutant loading, sediment, and erosion to a level which maintains the WQS. All facility storm drain inlets, including those in employee parking areas, must be protected. If monitoring demonstrates applied BMPs are not protective of WQS, then additional BMPs must be implemented in accordance with the iterative, or adaptive, approach of the SWPPP or load reduction plan.
3. **Monitoring and Reporting Requirements**. Permittees must monitor effluent from outfalls for the purpose of creating a baseline of facility water and sediment quality and to assess and verify the effectiveness of BMPs.

   The results of monitoring conducted during the reporting period shall be reported to both the San Diego Water Board and the appropriate Phase I MS4 copermittee(s). The report must include an analysis of the data relative to BMP effectiveness and protection of water quality standards.

The San Diego Water Board has authority to direct individual enrollees under the General Permits for Industrial, Construction, or Small MS4s to obtain an Individual NPDES permit for their storm water discharges. Direction by the San Diego Water Board to obtain an individual NPDES permit may occur based upon program audits, State or local compliance inspections, and/or Permittee monitoring.

Industrial Facilities
The NPDES requirements regulating industrial facilities include discharge prohibitions and receiving water limitations that are applicable to the implementation of these TMDLs, as summarized below:

- Discharges of materials other than storm water (non-storm water discharges) that discharge either directly or indirectly to waters of the United States are prohibited.
- Storm water discharges and authorized non-storm water discharges shall not cause or threaten to cause pollution, contamination, or nuisance.
- Storm water discharges and authorized non-storm water discharges to any surface or groundwater shall not adversely impact human health or the environment.
- Storm water discharges and authorized non-storm water discharges shall not cause or contribute to an exceedance of any applicable water quality standard contained in a statewide Water Quality Control Plan or the San Diego Basin Plan.

The San Diego Water Board identified the following types of industrial facilities as likely sources of pollutants discharging storm water either directly to surface waters or indirectly through a Phase I MS4 in the Paleta, Chollas, and Switzer Creek watersheds

(Hydrologic Subareas 8.22, 8.31, and a portion of 8.21 that drains to the Switzer Creek underground storm drain):

- Recycling Facilities (SICs 5015 and 5093) that have metal scrap yards, battery declaimers, salvage yards, motor vehicle dismantlers and wreckers, or recycling facilities that are engaged in assembling, breaking up, sorting, and wholesale distribution of scrap and waste material such as bottles, wastepaper, textile wastes, oil waste, etc.;
- Transportation Facilities (SICs 3731, 3732, 4011, 4111 – 4173, 4212 – 4231, 4512-4581, and 5171) that have fueling, vehicle washing and maintenance, outdoor vehicle and equipment storage and parking, or liquid storage in above ground storage, or petroleum loading/unloading;
- Fabricated Metal Products Manufacturing Facilities (SICs 3411 – 3499) that have heavy equipment use and storage, metal surface cleaning and treatment, or equipment/vehicle maintenance; and
- Marine Cargo Handling Facilities (SICs 4412, 4424, 4491, 4492) that have material handling (fueling, liquid storage in above ground storage, or waste material storage and disposal), or shipboard processes (process and cooling water, sanitary waste, bilge and ballast water).

Construction Sites

Storm water dischargers from construction sites within these watersheds are identified by the San Diego Water Board as likely sources of pollutants. Storm water that discharges directly to surface waters or indirectly through a Phase I MS4 from these sites are subject to the TMDL requirements of this implementation plan. TMDL requirements will be incorporated into Order No. 2009-0009-DWQ, or subsequent order.

The San Diego Water Board may direct individual enrollees under the Construction General Permit to obtain an Individual NPDES permit for their storm water discharges. Direction by the San Diego Water Board to obtain an individual NPDES permit may occur based upon program audits, State or local compliance inspections, and/or Permittee monitoring.

Small MS4s

Phase I MS4s were identified as requiring load reductions to achieve and meet their WLAs. The linkage analysis identified urban land uses, associated with storm water conveyance systems, as the most significant controllable point sources causing or contributing to the toxic pollutant impairments during wet weather conditions in all three watersheds addressed by these TMDLs. Some urban land uses within the Phase I MS4 are associated with non-traditional small MS4s, which are governmental facilities such as military bases, public campuses, ~~and~~ prison and hospital complexes, and State parks.

Under these general WDRs and NPDES requirements, Small MS4s are required to develop and implement a Storm Water Management Plan/Program (SWMP). The SWMPs specify what BMPs will be used to address certain program areas. The program areas include public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping for municipal operations.

~~The State Water Board general WDRs for Small MS4s identify the facilities in the San Diego Region subject to regulation under the NPDES requirements. The non-traditional small MS4s subject to Order No. 2003-0005-DWQ are identified as follows:~~

~~Paleta Creek Watershed~~

- ~~San Diego City Unified School District (SDUSD)~~
- ~~National Elementary School District~~

~~Chollas Creek Watershed~~

- ~~SDUSD~~
- ~~Lemon Grove Elementary School District~~
- ~~La Mesa-Spring Valley School District~~

~~Switzer Creek Watershed~~

- ~~SDUSD~~
- ~~San Diego City College~~

The San Diego Water Board may direct individual enrollees under the Small MS4 General Permit to obtain an Individual NPDES permit for their storm water discharges. Direction by the San Diego Water Board to obtain an individual NPDES permit may occur based upon program audits, State or local compliance inspections, and/or Permittee monitoring.

When and where possible, the San Diego Water Board will require the Load Reduction Plans to be developed on a watershed or region-wide scale and have the Small MS4 BMP programs coordinate with the BMPs programs for Phase I MS4s and Caltrans.

10.3.2.5 NASSCO Individual Permit

As described in the source assessment, past activities at the NASSCO facility have contributed to the impairment condition in the Chollas Creek mouth. While NASSCO no longer discharges storm water from its industrial areas, it continues to discharge storm water from employee parking lots into Chollas Creek. The San Diego Water Board will revise and reissue the WDRs and NPDES requirements to incorporate requirements consistent with the following into Order No. R9-2009-0099, or subsequent order:

1. **Storm Water Pollution Prevention Plan**. NASSCO will update its SWPPP within 6 months of incorporation of the required language into the permit with any additional BMPs, monitoring, or other actions that will be performed to account for its site's potential to impact the receiving waterbody with respect to total chlordane, priority pollutant PAHs, and total PCBs. The San Diego Water Board Executive Officer may require additional monitoring for sites identified through monitoring data or site inspections as posing an increased risk to the receiving waterbody.

2. **Best Management Practices**. NASSCO must implement BMPs capable of reducing organic pollutant loading, sediment, and erosion to a level which maintains the WQS. All facility storm drain inlets, including those in employee parking areas, must have BMPs to prevent excessive organic pollutant and sediment loading to the mouth of Chollas Creek.

3. **Monitoring and Reporting Requirements**. NASSCO must monitor any effluent from the facility which discharges to Chollas Creek or the Phase I MS4 for the purpose of creating a baseline of facility water and sediment quality and to demonstrate the effectiveness of BMPs.

   The results of monitoring conducted during the reporting period shall be reported to both the San Diego Water Board and the appropriate Phase I MS4 copermittee(s).

   NASSCO must implement the monitoring, assessment, and reporting requirements as directed in any applicable Investigation Order(s) issued for investigation of PCB concentrations in fish tissue in the creek mouth area~~s~~ of ~~Paleta,~~ Chollas~~, and/or Switzer~~ ~~c~~Creek~~s~~, and or for tidal zone influence assessment, issued consistent with this TMDL Implementation Plan. The monitoring reports required under the Investigation Order(s) must be submitted as part of the Annual Reports required under this NPDES permit.

10.4 Special Studies

The San Diego Water Board has the authority to require any State or local agency to investigate and report on any technical factors involved in water quality control or to obtain and submit analyses of water.[32] The San Diego Water Board has the authority to require technical or monitoring program reports from persons who have discharged or are discharging waste that could affect the quality of the waters in the San Diego Region.[33] The San Diego Water Board also has the authority to establish monitoring and recordkeeping requirements for discharges regulated under NPDES requirements.[34]

[32] Water Code section 13225
[33] Water Code section 13267
[34] Water Code section 13383

The San Diego Water Board will issue two investigative orders to Responsible Parties to conduct the following special studies:

- Characterization of the tidally-influenced segments of Paleta, Chollas, and Switzer creeks; and
- Investigate PCB concentrations in tissue of *Macoma nasuta* exposed to sediment from the Paleta, Chollas, and Switzer creek mouth areas to determine if the fish tissue target is being met.

Additionally, the San Diego Water Board will encourage and support additional special studies proposed and undertaken by the dischargers or other entities that will provide information to refine and improve the implementation of these TMDLs. The San Diego Water Board may develop agreements (e.g., Memoranda of Understanding) with one or more entities to support and use the findings from any special studies that may be conducted. Proposing additional special study projects and initiating agreements with the San Diego Water Board to use the results of the study to modify this TMDL Implementation Plan is the responsibility of the project proponent(s).

Intertidal Segments Study(ies)
A special study(ies) is needed to characterize contributing loads and sediment concentrations of total chlordane, PPPAHs, and total PCBs from the tidally-influenced portions of each of the three watersheds at the sub-watershed level. The study(ies) must be designed to answer the following questions:

1. Are contaminated sediments in storm drains and/or creek beds in the tidally-influenced portions of the watersheds sources of pollutants to the impaired creek mouth areas?
2. From where is the contaminated sediment originating, and what are the pathways for transport of the contaminated sediment into the storm drain and/or creek bed?
3. If storm drain sediments and/or the creek bed sediments are found to be sources of a pollutant(s) to the creek mouth areas, what are their relative contributions of the pollutant(s) to the impaired waterbodies
4. What is the lateral and vertical extent of contaminated sediments in the creek mouth areas?
5. Do sediment concentrations in storm drains and/or creek beds exceed the concentration-based TMDLs for bed sediment?

The Investigative Order requiring the Intertidal Special Study work plan and study report will be issued to Responsible Parties that own and operate storm drains within the tidally-influenced portions of the watersheds. The study(ies) must be completed within 3 years of the effective date of this Basin Plan Amendment. This study(ies) shall include monitoring of storm drains and creek bed sediments and be designed to complement the City of San Diego's storm drain studies of the Paleta, Chollas, and

Switzer Creek watersheds (City of San Diego 2010a, 2010b). Monitoring in storm drains and creeks must include water quality and sediment quality sampling. The water quality monitoring must include 2 wet weather and 2 dry weather sampling events. One sediment quality sample set shall be collected during the summer season. Sampling locations shall be representative of the land uses within the tidal portion of each watershed. The Joint Storm Water Agency Project Report to Study Urban Sources of Mercury, PCBs, and Organochlorine Pesticides in San Francisco Bay should be used to provide insight into sediment sampling protocol (Kinnetic Laboratories, Inc. 2002).

If necessary, based on the findings and proposed responses or lack thereof from responsible parties, the San Diego Water Board may require remediation action via permit requirements or enforcement actions.

~~*Macoma* Tissue~~Bioaccumulation Monitoring Study

The San Diego Water Board will issue an investigative order to monitor for PCBs in ~~*Macoma*~~ tissue within 6 years of the effective date of this Basin Plan Amendment. The purpose of the study is to determine if the sediment at these three discrete locations within San Diego Bay continue to cause an impairment to human health-related beneficial uses after sediment remediation, without influence from sediment contamination from other locations in San Diego Bay. The investigative order will identify and direct Responsible Parties to submit a work plan and study report for the monitoring of PCB concentrations in the tissue of the most relevant species~~test organism, *Macoma nasuta* (commonly called the bent-nosed clam),~~ after exposure to sediments from the impaired areas, using appropriate scientific testing methods, to determine if the Fish Tissue Concentration Target has been exceeded (see Section 4.2).

The ~~*Macoma* Tissue~~Bioaccumulation Monitoring Study should be designed to answer the following question:

- What is the pre-remediation, or baseline, concentration of PCBs in fish tissue ingested by humans~~, using *Macoma* as a surrogate~~?
- Have concentrations of PCBs in ~~fish~~ tissue~~, using *Macoma* as a surrogate,~~ decreasing, increased, or not changed in the creek mouth areas following sediment remediation?
- Has sediment remediation in the creek mouth areas over time been successful in achieving the fish tissue numeric target~~ using *Macoma* as a surrogate~~?

The proposal shall, at a minimum, consider the following information when selecting a test method and species:

1. U.S. EPA recommends five species for conducting sediment bioaccumulation tests (U.S. EPA 1993). The five species are bivalves Macoma nasuta, Macoma balthica, and Yoldia limatula and polychaetes Nereis diversicolor and Neanthes (Nereis) virens.

2. Dr. Catherine Zeeman raised several points to the San Diego Water Board (Zeeman 2013):
    a. Collecting resident species in the creek mouths are preferred over conducting laboratory bioaccumulation tests. Resident species better reflect the accumulation of contaminants that occur over long term exposure.
    b. Collecting resident fish with high site fidelity (e.g., gobies) are preferred when comparing tissue concentrations to the OEHHA fish tissue target. Fish are taxonomically and physiologically different from invertebrates, and as such may (or may not) accumulate contaminants that are (or are not) accumulated by an invertebrate species.
    c. Fish, crabs, and lobsters include species that occupy high trophic levels, while bivalves and polychaetes are generally lower trophic level species.
3. The California SQO indirect effects assessment selected the following indicator fish species (SWRCB 2010):

Dietary Guild	**Description**	**Indicator Species**
Piscivore	The majority of the diet is fish, large predatory invertebrates are also consumed to some degree	California halibut
Benthic diet with piscivory	Diet regularly includes a mixture of benthic invertebrates and forage fish	Spotted sand bass White catfish
Benthic and pelagic diet with piscivory	Diet includes a combination of benthic invertebrates, pelagic invertebrates, and forage fish	Queenfish
Benthic diet without piscivory	Diet largely composed of small benthic invertebrates	White croaker
Benthic and pelagic diet without piscivory	Diet includes a mixture of epibenthic and pelagic invertebrates	Shiner perch
Benthic and pelagic diet with herbivory	Largely consumes benthic invertebrates, benthic algae, and aquatic plants	Common carp
Benthic and pelagic diet with herbivory	Diet consists of benthic and pelagic invertebrates and plant material, including benthic algae and phytoplankton	Top smelt
Pelagic diet with benthic herbivory	Diet includes largely pelagic invertebrates and benthic algae	Striped mullet

4. The California SQO database shows that Macoma nasuta has the greatest number of samples with matching sediment data (SFEI 2005):

Species	**Number of Samples with Matching Sediment Data**
Macoma nasuta	410
Nephtys caecoides	159*
Neanthes virens	88*

* Almost all samples were non-detect.

The investigation must include a baseline monitoring event prior to sediment remediation in the creek mouth areas and must be conducted every 2 to 3 years following remediation of sediment and continue until ~~*Macoma*~~ tissue concentrations meet the Fish Tissue Concentration Target, but no later than by the end of year twenty after the effective date of this Basin Plan amendment. ~~*Macoma* tissue~~ Bioaccumulation monitoring should coincide with Aquatic Life SQO attainment monitoring in the 5 year periods that Aquatic Life SQO monitoring occurs.

Those Parties who are responsible for discharging or having discharged PCB pollutants to the sediment in the three creek mouth areas will be responsible for conducting the ~~*Macoma* tissue~~ bioaccumulation monitoring to measure compliance with the TMDL requirements. The San Diego Water Board will consider issuing this Investigative Order to the U.S. Navy and NASSCO, who are dischargers in the tidal portion of the Chollas Creek watershed, and the U.S. Navy for Paleta Creek watershed.

Analysis for the study may be used in conjunction with any human health risk analysis associated with the enforcement order to conduct sediment remediation. ~~Macoma tissue~~ Bioaccumulation monitoring may be replaced with participation in studies to be developed to address the 303(d) listing of San Diego Bay for PCBs in fish tissue.[35] Adoption of a San Diego Bay PCBs in Fish Tissue TMDL would negate these TMDL requirements for ~~*Macoma* tissue~~bioaccumulation monitoring as those requirements would address the bay-wide PCB impairment.

10.5 Sediment Remediation

The San Diego Water Board will issue a Cleanup and Abatement Order (CAO) to Responsible Parties within 6 years of the effective date of this Basin Plan Amendment that requires ~~removal~~ remediation of contaminated sediment to levels that meet sediment quality objectives and support the aquatic life, aquatic dependent wildlife, and

[35] The San Diego Water Board is expected to consider a Resolution supporting a San Diego Bay Strategy for Healthy Waters at its December 2012 meeting. The San Diego Water Board expects to initiate a bay-wide PCB TMDL Project by 2018.

human-health related beneficial uses of San Diego Bay at each of the three TMDL site footprints. Required cleanup levels will be established in compliance with State Water Board Resolution No. 92-49.[36] Sediment remediation will be required to be completed no later than by the end of year eight after the effective date of this Basin Plan amendment. The combination of load reductions from the watersheds and removal of contaminated sediment that does not meet SQOs will ensure that beneficial uses are supported in San Diego Bay.

Resolution No. 92-49 directs the San Diego Water Boards to "[e]nsure that dischargers are required to clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible…"[37] Cleanup levels need not be set at the TMDL numeric targets as long as the sediment quality that results from sediment load reductions and remediation results in sediment quality that meets sediment quality objectives.

10.6 Monitoring for TMDL Compliance and Compliance Assessment

Water and sediment quality monitoring are essential components of implementation. Monitoring is performed to evaluate the progress toward attainment of the TMDLs and restoration of beneficial uses in the receiving waters. The San Diego Water Board will require monitoring, assessment, and reporting from each Responsible Party in each step of the implementation plan (e.g., permits, Investigative Orders, and enforcement actions). The information presented in this section is intended to be a brief overview of the monitoring required for this TMDL Project. The goals of the implementation monitoring are to:

- Determine compliance with the assigned wasteload allocations and concentration-based TMDLs;
- Evaluate the effect of implementation actions conducted by Responsible Parties;
- Determine if additional implementation actions are necessary to restore and protect beneficial uses;
- Avoid duplication with other TMDL implementation plans and regulatory actions within watersheds where there are TMDLs; and
- Provide sufficient data to support the removal of these waterbodies from the CWA section 303(d) List.

[36] Resolution No. 92-49, Policy and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code section 13304.
[37] 23 CCR section 2550.4

The monitoring must include the following requirements:

- Storm Water Effluent Monitoring.
  Watershed monitoring of storm water effluent concentrations and flow at a subset of MS4 outfalls within each jurisdiction of each watershed will be required to demonstrate attainment of the WLAs. The subset of outfalls must be representative of storm water flows from areas consisting primarily of residential, commercial, and industrial land uses. Responsible Parties will use the data to calculate or estimate their individual and collective annual loads. Samples shall be collected during at least two wet weather events occurring in the rainy season, October 1st through April 30th.

  Storm water samples will be analyzed and reported for total chlordane, PCB congeners[38] and total PCBs, total PAHs and PPPAHs, and total suspended solids. Sampling shall be designed in a way to collect sufficient volumes of suspended solids to allow for analysis of the listed pollutants in the bulk sediment.

  In addition to TMDL constituents, general water chemistry (temperature, dissolved oxygen, pH, and electrical conductivity) and a flow measurement will be required at each sampling event. General chemistry measurements may be taken in the laboratory immediately following sample collection, if auto samplers are used for sample collection or if weather conditions are unsuitable for field measurements. The sample must not be influenced by sea water.

  If exceedances of the concentration-based TMDLs are observed in the monitoring data, additional monitoring locations and/or other source identification methods must be implemented to identify the sources causing the exceedances. The additional monitoring locations and/or other source identification methods must also be used to demonstrate that organic pollutant loads from the identified sources have been addressed and are no longer causing exceedances in the receiving waters.

[38] PCB congeners should include those listed in Attachment A in the Water Quality Control Plan for Enclosed Bays and Stuaries – Part 1 Sediment Quality (SWRCB 2009).

- Receiving Water Monitoring: Sediment and Water Column
  Bed sediment and water column monitoring of the creek mouth areas are required to demonstrate attainment of concentration-based TMDLs. Monitoring locations must spatially represent each creek mouth area and be selected based on the Phase I Studies' stations for these creek mouths (Anderson, et al., 2004; SCCWRP and SPAWAR, 2005) or justified otherwise as meeting the objectives above. Collection of creek mouth sediment and water column samples must occur in the summer months. Sediment and water chemistry monitoring shall be required annually.

  Sediment chemistry variables sampled must include, at a minimum, total chlordane, PCB congeners and total PCBs, and PPPAHs.

  Receiving water chemistry variables sampled must include, at a minimum, total chlordane, Benzo[a]pyrene, total PCBs. In addition to TMDL constituents, general water chemistry (temperature, dissolved oxygen, pH, and electrical conductivity) will be required at each sampling event.

  If exceedances of the concentration-based TMDLs begin to occur in the creek mouth sediments after ~~dredging~~ remediation has occurred, additional investigation, analysis, and/or monitoring will be required for the purpose of identifying pollutant sources. Such monitoring will likely include stations representing the tidally-influenced portion of the watershed.

- Attainment of Aquatic Life SQO
  Sediment quality objective evaluation as detailed in the Aquatic Life SQO (MLOE Approach) shall be performed at least once every 5 years and, if possible, in coordination with the Biological Baseline and Bight regional monitoring programs, if possible. Sampling and analysis for the full chemical suite, two toxicity tests and four benthic indices as specified in Aquatic Life SQO shall be conducted and evaluated. If moderate toxicity as defined in the Aquatic Life SQO is observed, results shall be highlighted in annual reports and further analysis and evaluation to determine causes and remedies shall be required in accordance with the monitoring plan. Locations for sediment triad assessment and the methodology for combining results from sampling locations to determine sediment conditions shall be specified in the MRP to be approved by the Executive Officer. The sampling design shall be in compliance with the Enclosed Bays and Estuaries Plan Part 1 Sediment Monitoring section (VII.E).

The Responsible Parties identified in Section 9.3 are responsible for conducting water and sediment quality monitoring to measure compliance with the TMDL requirements. Phase I MS4s, Caltrans, and the U.S. Navy have primary responsibility for demonstrating that storm water discharges meet the interim and final WLAs.

Monitoring shall be conducted under technically appropriate Monitoring and Reporting Plans (MRPs) and Quality Assurance Project Plans (QAPPs). The MRPs will include a requirement that the Responsible Parties report compliance and non-compliance with waste load and load allocations as part of annual reports submitted to the San Diego Water Board. The QAPPs shall include protocols for sample collection, standard analytical procedures, and laboratory certification and be comparable with the requirements of the Surface Water Ambient Monitoirng Program (SWAMP). Annual reporting shall be submitted electronically using the State Water Board's California Environmental Data Exhange Network (CEDEN).

Responsible Parties are encouraged to collaborate or coordinate their efforts to avoid duplication and reduce associated costs. Storm water dischargers may coordinate compliance with the TMDL monitoring, assessment, and reporting requirements.

10.7 TMDL Compliance Schedule

The purpose of these TMDLs is to restore the impaired beneficial uses of the waterbodies addressed through mandated reductions of chlordane, total PAHs, and total PCBs in sediment from controllable point and nonpoint sources discharging to impaired waters. The requirements of these TMDLs mandate that the San Diego Water Board require dischargers to improve water quality conditions in impaired waters by achieving the assigned WLAs and concentration-based TMDLs. After the controllable sources achieve their assigned WLAs and legacy pollutants are remediated, the TMDLs in the receiving waters will be met and beneficial uses restored.

Until the dischargers achieve their assigned WLAs, the beneficial uses of the waterbodies addressed by this Project will remain impaired, and the dischargers will continue violating one or more Basin Plan waste discharge prohibitions. The San Diego Water Board recognizes that restoring the beneficial uses of the waterbodies impaired by elevated toxic pollutant levels will require time and multiple approaches to implement. Therefore, the TMDLs are expected to be implemented in a phased approach with a monitoring component to identify pollutant sources, determine the effectiveness of each phase, and guide the selection of BMPs, as outlined in the BMP programs proposed in the Load Reduction Plans that are accepted by the San Diego Water Board.

Accomplishing the goals of the implementation plan will be achieved by cooperative participation from all responsible parties, including the San Diego Water Board. Major milestones are described in Table 10-2.

Table 10-2. Implementation Action Schedule

	Task Description	Responsible Party	Compliance Date
1.	Issue, reissue, or revise WDRs/NPDES requirements for Phase 1 MS4 Permit and Naval Base San Diego individual permit to incorporate	San Diego Water Board	Completed during NPDES permit renewal (within 5 years of applicable permit adoption date) or sooner dependant upon resources

	Task Description	Responsible Party	Compliance Date
	requirements for complying with TMDL, WLAs, and TMDL implementation requirements		
2.	Issue, reissue, or revise WDRs/NPDES requirements for individual and Statewide general permits to incorporate requirements for complying with TMDL, WLAs, and/or TMDL implementation requirements	San Diego Water Board and State Water Board	Completed during NPDES permit renewal – within 5 years of applicable permit date, and every 5 years thereafter
3.	Prepare and submit Load Reduction Plans for San Diego Water Board review, for each watershed	Phase I MS4s, U.S. Navy, and Caltrans	Plan submittal by the end of the 12th month after incorporation of required language into the relevant permits. Plan must begin implementation no later than 6 months after submittal Annual reporting of implementation and monitoring program consistent with permit reporting requirements
4.	Prepare and submit updated Storm Water Pollution Prevention Plan	Enrollees of the Industrial, Construction, and Regulated Small MS4 General Permit and NASSCO	Plan submittal within 6 months of incorporation of required language into the relevant permits. Permittees entering into agreements with Phase I MS4s may submit in accordance with the Phase I MS4 submittal date. Plan must be implemented no later than 6 months after submittal Annual reporting of implementation and monitoring program consistent with permit reporting requirements
5.	Issue Investigative Order(s) to direct special study on intertidal segments of Paleta, Chollas, and/or Switzer creeks	San Diego Water Board	Within 6 months to 1 year of effective date of this Basin Plan amendment
6.	Submit report on special study on intertidal segments of Paleta, Chollas, and/or Switzer creeks	Responsible Parties named in Investigative Order	In accordance with the Investigative Order(s) to direct special study on tidally-influenced segments of Paleta, Chollas, and/or Switzer creeks
7.	Issue Investigative Order(s) to	San Diego Water Board	Within 6 years of effective date of

	Task Description	Responsible Party	Compliance Date
	direct special study on ~~pollutant concentrations in *Macoma* tissue of a relevant species~~bioaccumulation in Paleta, Chollas, and Switzer Creek mouth areas		this Basin Plan amendment or in accordance with the San Diego Bay Strategy
8.	Issue Cleanup and Abatement Order(s) to remediate sediment in Paleta, Chollas, and Switzer Creek mouth areas	San Diego Water Board	Within 6 years of effective date of this Basin Plan amendment
9.	Completion of sediment remediation in Paleta, Chollas, and Switzer Creek mouth areas	Responsible Parties named in Cleanup and Abatement Order	In accordance with the Cleanup and Abatement Order(s) to remediate sediment in Paleta, Chollas, and Switzer Creek mouth areas
10.	Demonstrate attainment of TMDL Interim Goal 1: attain 40% of required reduction in waste loads	Phase I MS4s, U.S. Navy, and Caltrans	5 years after effective date of this Basin Plan amendment
11.	Demonstrate attainment of TMDL Interim Goal 2: attain concentration-based TMDLs for sediment and water column in Paleta, Chollas, and Switzer Creek mouth areas	Phase I MS4s, U.S. Navy, and Caltrans	8 years after effective date of this Basin Plan amendment
12.	Demonstrate attainment of TMDL Interim Goal 3: attain 80% of required reduction in waste loads and begin monitoring to demonstrate attainment Aquatic Life SQO	Phase I MS4s, U.S. Navy, and Caltrans	10 years after effective date of this Basin Plan amendment
13.	Demonstrate attainment of TMDL Interim Goal 4: attain 90% of required reduction in waste loads	Phase I MS4s, U.S. Navy, and Caltrans	15 years after effective date of this Basin Plan amendment
14.	~~Demonstrate attainment of~~ Meet Final Goals: attain ~~100% of required reduction in waste loads~~WLAs and LAs, meet Fish Tissue Concentration Target, and attain Aquatic Life and Human Health SQOs	Phase I MS4s, U.S. Navy, and Caltrans	20 years after effective date of this Basin Plan amendment

11. Environmental Analysis

The San Diego Water Board must comply with the California Environmental Quality Act (CEQA) when amending the Basin Plan as proposed in this Project to adopt these TMDLs for toxic pollutants in sediment in San Diego Bay. Under CEQA, the San Diego Water Board is the Lead Agency for evaluating the environmental impacts of the reasonably foreseeable methods of compliance with the proposed TMDLs. This Technical Report and its appendices, including Appendix B containing the Basin Plan amendment and Appendix H Environmental Analysis and Checklist, are the substitute environmental documentation that fulfills the requirements of CEQA.[39]

12. Necessity of Regulatory Provisions

The Office of Administrative Law (OAL) is responsible for reviewing administrative regulations proposed by State agencies for compliance with standards set forth in California's Administrative Procedure Act[40] for transmitting these regulations to the Secretary of State and for publishing regulations in the California Code of Regulations. Following State Water Board approval of this Basin Plan amendment establishing TMDLs, any regulatory portions of the amendment must be approved by the OAL.[41] The State Water Board must include in its submittal to the OAL a summary of the necessity[42] for the regulatory provision.

This Basin Plan amendment for Toxic Pollutants in Sediment TMDLs in the mouths of Paleta, Chollas, and Switzer Creeks meets the "necessity standard" required in the State Water Board special procedures for Administrative Regulations and Rulemaking.[43] Amendment of the Basin Plan to establish and implement toxic pollutants in sediment TMDLs in affected watersheds in the San Diego Region is necessary because the existing water quality does not meet applicable SQOs for benthic community protection and human health. Applicable state and federal laws require the adoption of this Basin Plan amendment and regulations as provided below.

The State Water Board and Regional Water Boards are delegated the responsibility for implementing California's Porter Cologne Water Quality Control Act and the federal CWA. Pursuant to relevant provisions of both of those acts the State Water Board and San Diego Water Board establish water quality standards, including designated (beneficial) uses and criteria or objectives to protect those uses.

[39] 23 CCR section 3777
[40] Government Code section 11340 et seq.
[41] Government Code section 11352
[42] "Necessity" means the record of the rulemaking proceeding demonstrates by substantial evidence the need for a regulation to effectuate the purpose of the statute, court decision, provision of law that the regulation implements, interprets, or makes, taking into account the totality of the record. For purposes of this standard, evidence includes, but is not limited to, facts, studies, and expert opinion. [Government Code section 11349(a)].
[43] Government Code section 11353(b)

CWA Section 303(d)[44] requires the states to identify certain waters within their borders that are not attaining WQSs and to establish TMDLs for certain pollutants impairing those waters. U.S. EPA regulations provide that a TMDL is a numerical calculation of the amount of a pollutant that a waterbody can assimilate and still meet standards.[45] A TMDL includes one or more numeric targets that represent attainment of the applicable standards, considering seasonal variations and a MOS, in addition to the allocation of the target or load among the various sources of the pollutant. These include WLAs for point sources, LAs for nonpoint sources, and natural background. TMDLs established for impaired waters must be submitted to the U.S. EPA for approval.

CWA section 303(e) requires that TMDLs, upon U.S. EPA approval, be incorporated into the state's Water Quality Management Plans, along with adequate measures to implement all aspects of the TMDL. In California, these are the basin plans for the nine regions. The California Water Code requires that basin plans have a program of implementation to achieve WQOs.[46] The implementation program must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the objectives. State law requires that a TMDL project include an implementation plan because TMDLs normally are, in essence, interpretations or refinements of existing WQOs. The TMDLs have to be incorporated into the Basin Plan, and, because the TMDLs supplement, interpret, or refine existing objectives, State law requires a program of implementation.

[44] U.S. Code Title 33, section 1313(d)
[45] Code of Federal Regulations Title 40, section 130.2
[46] Water Code sections 13050(j) and 13242

13. Public Participation

Public participation is an important component of TMDL development. The federal regulations[47] require that TMDL projects be subject to public review. All public hearings and public meetings have been conducted as stipulated in the regulations,[48] for all programs under the CWA. Public participation was provided during TMDL development, including site characterization and model development, through the formation and participation of stakeholder work groups: the Toxic Hot Spot Work Group and San Diego Bay Sediment TMDLs Work Group. In addition, staff contact information was provided on the San Diego Water Board's website, along with periodically updated drafts of the TMDL project documents. Public participation also took place through the San Diego Water Board's Basin Plan amendment process, which included an additional public workshop, a hearing, and a formal public comment period. A chronology of public participation and major milestones is provided in Table 12-1. Appendix M contains public comments received to date and the San Diego Water Board's responses. Appendix M includes comments received during the public comment period, orally during the stakeholder and public meetings noted in Table 12-1, and in writing via email or letter submitted during TMDL development. Public comments submitted during the public comment period will be added after the close of the comment period.

Table 12-1. Public Participation Milestones

Date	Event
May 5, 2000	Public Workshop introducing TMDL projects for the Mouth of Chollas Creek and 7th Street Channel
February 5, 2001	Toxic Hot Spot Work Group Meeting – Update on phased hot spot cleanup approach, TMDL development, and discussion about conducting toxicity identification evaluations at Chollas and Paleta Creek Mouth Areas
August 3, 2001	Public Workshop to discuss Toxic Hot Spot Cleanup and TMDL development at the Mouth of Chollas Creek and 7th Street Channel
April 17, 2002	Stakeholder Meeting (U.S. Navy): Toxic Hot Spot/TMDL Study for Chollas and Paleta Creek Mouths
May 15, 2002	Stakeholder Meeting (Port of San Diego and City of San Diego) to discuss TMDL projects for San Diego Bay at B Street/Broadway Piers, Grape Street (Downtown Anchorage), and Switzer Creek Mouth
June 18, 2002	San Diego Water Board Public Workshop for San Diego Bay Contaminated Marine Sediments Assessment and Remediation

[47] Code of Federal Regulations Title 40, section 130.7
[48] Code of Federal Regulations Title 40, sections 25.5 and 25.6

Date	Event
July 24, 2002	Stakeholder Meeting (Port of San Diego and City of San Diego) to discuss Sampling and Analysis Plan for B Street/Broadway Piers, Grape Street (Downtown Anchorage), and Switzer Creek Mouth projects
April 21, 2003	Public Workshop and CEQA Scoping Meeting for TMDL projects at Switzer Creek, Downtown Anchorage, and B Street/Broadway Piers in San Diego Bay
January 13, 2004	Stakeholder Meeting to present Phase I sediment characterization study results for Switzer Creek, Downtown Anchorage, and B Street/Broadway Piers TMDL projects
May 13, 2004	Public Workshop to present Phase I sediment assessment study results for Switzer Creek, Downtown Anchorage, and B Street/Broadway Piers TMDL projects
November 15, 2004	Electronic List Server Notice. Notification of availability of the Phase I sediment assessment study report for the Chollas and Paleta Creek Mouth TMDL projects
January 18, 2005	Public Workshop to present the draft findings of the Phase I and II sediment assessment studies for Chollas and Paleta Creek Mouth TMDL projects
January 24, 2005	Electronic List Server Notice. Solicitation for public comment on draft Phase I and Temporal Assessment of Chemistry, Toxicity and Benthic Communities in Sediments
September 27, 2005	Stakeholder Meeting to initiate San Diego Bay Sediment TMDLs Work Group and the Watershed Monitoring and Modeling Study for Chollas, Paleta, and Switzer Creek TMDL Project
October 11, 2005	San Diego Bay Sediment TMDLs Work Group Meeting - Watershed Monitoring and Modeling Study
October 26, 2005	San Diego Bay Sediment TMDLs Work Group Meeting - Watershed Monitoring and Modeling Study
December 19, 2005	San Diego Bay Sediment TMDLs Work Group Meeting - Watershed Monitoring and Modeling Study
January 30, 2007	San Diego Bay Sediment TMDLs Work Group Meeting - Watershed Monitoring and Modeling Study
April 26, 2007	San Diego Bay Sediment TMDLs Work Group Meeting - Watershed Monitoring and Modeling Study and Numeric Targets
September 18, 2007	San Diego Bay Sediment TMDLs Work Group Meeting – Estuary Model Results and Numeric Targets

Date	Event
September 15, 2008	San Diego Bay Sediment TMDLs Work Group Meeting – Receiving Water Model/Results, Overview of Sediment TMDLs, and implementation strategies/options. Stakeholder comments received during this meeting, See Appendix M, section IV for comments and responses.
October 14, 2008	Public Workshop and CEQA Scoping Meeting for Toxic Pollutants in Sediment TMDLs for Paleta, Chollas, and Switzer Creeks. Public comments received during this meeting, See Appendix M, section II for comments and responses.
March 29, 2011	Solicitation for primary stakeholder informal, preliminary review and comment of the draft Technical Report (not including the implementation plan). Received informal comments from Caltrans, Port of San Diego, and U.S. Navy.
June 19, 2012	San Diego Bay Sediment TMDLs Work Group Meeting – Presentation of Numeric Targets calculated using MLOE Approach of Sediment Quality Objective

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