TOTAL MAXIMUM DAILY LOADS FOR ORGANOCHLORINE COMPOUNDS

***SAN DIEGO CREEK*:**
TOTAL DDT AND TOXAPHENE

***UPPER AND LOWER NEWPORT BAY*:**
TOTAL DDT, CHLORDANE, TOTAL PCBs

ORANGE COUNTY, CALIFORNIA

SANTA ANA REGIONAL WATER QUALITY CONTROL BOARD

Prepared by:

Kathy L. Rose, Ph.D.
Environmental Scientist

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1.0 INTRODUCTION

On June 14, 2002, the United States Environmental Protection Agency (USEPA) established Total Maximum Daily Loads (TMDLs) for 14 toxic pollutants, including five organochlorine compounds, for San Diego Creek, Upper and Lower Newport Bay, and Rhine Channel. The organochlorine (OC) compounds included four legacy pesticides (1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane [DDT], chlordane, dieldrin and toxaphene) and polychlorinated biphenyl (PCBs). TMDLs were established for chlordane, total DDT, and total PCBs in all waterbodies; dieldrin TMDLs were established for San Diego Creek, Lower Newport Bay, and Rhine Channel; and a TMDL for toxaphene was established only for San Diego Creek (USEPA, 2002). The USEPA TMDLs for the OC compounds were supported by a report prepared by staff of the Santa Ana Regional Water Quality Control Board (SARWQCB, 2000).

This report summarizes the information presented in the USEPA TMDL document (USEPA 2002) and presents additional information and modifications. In particular, impairment was reevaluated in accordance with the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (2004) (the State Listing Policy). The results of this impairment assessment differed from that previously performed by USEPA in that the water body-pollutant combinations requiring TMDLs have been revised, consistent with the new findings of impairment. Also, the loading capacities and existing loads were revised to reflect corrections and modifications to the USEPA technical TMDLs.

1.1 Watershed Background

The Newport Bay watershed covers an area of 154 square miles (98,500 acres) in central Orange County, California. Cities located partly or fully within the watershed include Orange, Tustin, Santa Ana, Irvine, Lake Forest, Laguna Hills, Costa Mesa, and Newport Beach (Figure 1-1); some unincorporated lands within the county are located within the watershed boundaries. The San Diego Creek watershed is part of the larger Newport Bay watershed and occupies about 105 square miles. The remainder of the Newport Bay watershed (about 49 square miles) includes the Santa Ana Delhi Channel, Bonita Creek, Big Canyon Wash, and other small drainages.

The central portion of the watershed is largely occupied by the relatively flat Tustin Plain, bounded to the northeast by the Santiago Hills and by the San Joaquin Hills to the southwest (Figure 1-2). Runoff from the mountains drains across the Tustin Plain and enters Newport Bay primarily via Peters Canyon Wash and San Diego Creek.

Lower Newport Bay is considered to be that portion of the Bay south of the Pacific Coast Highway Bridge (Highway 1). The Lower Bay harbor is important for recreational use and supports nearly 10,000 pleasure boats, as well as many residential and commercial facilities. Upper Newport Bay (north of the Pacific Coast Highway Bridge) includes a 752-acre estuary, where saltwater from the Pacific

Ocean mixes with fresh water derived primarily from San Diego Creek. The Upper Bay supports six threatened or endangered bird species: California least tern, Belding's Savannah sparrow, brown pelican, coastal California gnatcatcher, peregrine falcon, and light-footed clapper rail. In 1992, more than 70 percent of the nation's remaining light-footed clapper rail population occurred here. The Bay is also a major stopping place for birds migrating along the Pacific Flyway, and up to 30,000 birds are present from August to April. At least 78 species of fish occur in the Bay, providing recreational opportunities for anglers (mostly in the Lower Bay) and a source of food for predatory birds. Figure 1-3a shows important habitat areas for federally listed species in proximity to Newport Bay, and Figure 1-3b shows habitat areas throughout the watershed.

1.1.1 Land Use

Land use has changed dramatically in the watershed over the last 150 years. In the late 19th and early 20th centuries, land use changed from ranching and grazing to farming. After World War II, agricultural land use gave way to urbanization. In 1983, agriculture accounted for 22% of the land use in the watershed, while urban land use comprised 48% of the watershed area. By 2002, agriculture accounted for only about 5% of the total land use, while about 75% of the area was urbanized. The watershed still contains large areas of open space, mainly in the foothills and headland areas of the watershed where development has not yet occurred. Table 1-1 provides the latest available land use data for the San Diego Creek drainage and the Newport Bay watershed as a whole.

Table 1-1. Land Use in the Newport Bay Watershed

Land Use	San Diego Creek		Newport Bay Watershed	
	Acres	Percent	Acres	Percent
Vacant	21,910	28.5	23,462	23.9
Residential	11,668	15.2	19,420	19.7
Education/Religion/Recreation	15,811	20.6	17,393	17.7
Roads	10,295	13.4	15,774	16.0
Commercial	6,381	8.3	9,641	9.8
Industrial	3,965	5.2	5,263	5.4
Agriculture	5,092	6.6	5,147	5.2
Transportation	1,177	1.5	1,326	1.3
No code	440	0.6	936	0.9
Total	76,739	100	98,362	99.9

Source: Orange County Public Facilities and Resources Department, provided March 2002

1.1.2 Climate

The watershed experiences a Mediterranean climate, characterized by short, mild winters and dry summers. Average rainfall is about 13 inches per year, with 90 percent of the rainfall occurring between November and April.

1.1.3 Hydrology

The hydrology of the watershed has been substantially altered compared to historic conditions. In the mid-1800s, the Santa Ana River flowed into Newport Bay, while San Diego Creek and the small tributaries that drained the foothills flowed into the Swamp of the Frogs and ultimately to the Santa Ana River. To enable farming in the area, wetlands were drained and vegetation was cleared; drainages were channelized to convey runoff to San Diego Creek. In 1920, the Santa Ana River was permanently channelized to its current configuration for discharge to the ocean. With increasing urbanization, hydraulic capacity was increased in many of the drainages to prevent flooding. Alterations of the area's hydrology and hydraulics culminated with the channelization of San Diego Creek in the early 1960s, such that it discharges directly to Upper Newport Bay. The present estuarine conditions in the Bay developed as a result.

San Diego Creek is the major drainage channel in the Newport Bay watershed and contributes about 85% of the freshwater flow volume into Upper Newport Bay. San Diego Creek is divided into two reaches. Reach 1 is designated as the length from Upper Newport Bay to Jeffrey Road, while Reach 2 is the remaining section from Jeffrey Road to the headwaters of the Creek. The drainage area of San Diego Creek (including its largest tributary, Peters Canyon Channel) accounts for about 77% of the watershed.

Daily flow records for San Diego Creek at the Campus Drive monitoring station reveal a wide range of flow rates. In dry weather, base flow typically ranges from 8 to 15 cubic feet per second (cfs). During wet weather, average daily storm flows in San Diego Creek can range up to about 9,200 cfs, although most storm flows fluctuate between 20 and 815 cfs (Orange County Resources and Development Management Department [RDMD] data).

The second largest drainage in the watershed is that of the Santa Ana Delhi Channel, which accounts for about 11% of the Newport Bay watershed area and provides about 10% of the freshwater flow to Upper Newport Bay. Average dry weather flows in the Santa Ana Delhi channel are typically between 1 and 2 cfs, with storm flows ranging up to 1,370 cfs.

1.1.4 Water Quality

San Diego Creek and Newport Bay are identified on the State's Clean Water Act §303(d) list of impaired waters. Impairment in San Diego Creek Reach 1 has previously been attributed to fecal coliform and pesticides; impairment in San Diego Creek Reach 2 has been attributed to metals and unknown toxicity (2004 §303(d) List). Upper Newport Bay is impaired due to metals and pesticides; and Lower Newport Bay is impaired due to metals, pesticides and priority organics (2004 CWA §303(d) list). Potential sources of these pollutants include urban runoff, contaminated sediments, boatyards, agriculture, and unknown nonpoint sources. In the proposed 2006 §303(d) List of Water Quality Limited Segments (2006 §303(d) List), State Water Resources Control Board (SWRCB) staff has recommended that San Diego Creek Reach 1 be listed specifically for toxaphene; Peters Canyon Channel for DDT and toxaphene; and Upper and Lower Newport Bay for chlordane, DDT, and PCBs.

TMDLs for the San Diego Creek-Newport Bay watershed have been adopted and are currently being implemented for fecal coliform (Newport Bay), sediments and nutrients (San Diego Creek and Newport Bay), diazinon (San Diego Creek) and chlorpyrifos (San Diego Creek and Newport Bay). TMDLs for other toxic pollutants are currently being developed; this document addresses the organochlorine pollutants (DDT, PCBs, chlordane and toxaphene), which were included in the TMDLs for toxic substances promulgated by USEPA in 2002.

2.0 PROBLEM STATEMENT

Section 303(d)(1)(A) of the CWA requires that "Each State shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters." Water bodies that have been identified in accordance with that requirement are placed on the CWA 303(d) list; these waters are not expected to meet water quality standards even after implementation of technology-based control practices. The CWA requires states to establish a priority ranking of waters on the 303(d) list and establish Total Maximum Daily Loads (TMDLs) for such waters.

In the early 1990s, the Regional Board placed Newport Bay and San Diego Creek on the CWA §303(d) list due to violations, or threatened violations, of the Basin Plan narrative objectives for toxic substances. The listings were primarily based on data obtained from the State Mussel Watch Program (SMWP) and Toxic Substances Monitoring Program (TSMP), which showed evidence of declining, but continuing, bioaccumulation of DDT, PCBs and other toxic substances in mussel and fish tissue at levels that could potentially threaten the biota (SARWQCB Final Problem Statement, 2000). Those listings, and subsequent monitoring data supporting those listings, prompted SARWQCB staff to begin development of TMDLs for toxic pollutants.

On October 31, 1997, USEPA entered into a consent decree, Defend the Bay, Inc. v. Marcus, (N.D. Cal. No. C97-3997 MMC), which established a schedule for development of TMDLs in San Diego Creek and Newport Bay. The decree required development of TMDLs for a variety of pollutants by January 15, 2002; this date was subsequently extended to June 15, 2002. Because the SARWQCB was unable to complete development of TMDLs for toxic pollutants by the date specified in the consent decree, USEPA was required to do so. USEPA, therefore, promulgated TMDLs for 14 toxic pollutants on June 14, 2002.

The consent decree included a list of chemicals for which TMDLs would be prepared; however it specifically provided that USEPA was under no obligation to establish TMDLs for any pollutants that USEPA determined were not necessary, consistent with Section 303(d) of the Clean Water Act. USEPA Region 9 evaluated all readily available data for San Diego Creek and Newport Bay, and used a weight of evidence approach to independently determine which chemicals warranted TMDLs. Their determination as to which organochlorine compounds warranted TMDLs is discussed in the Decision Document, Part H of the Technical TMDL (USEPA 2002).

Subsequent to USEPA's promulgation of technical TMDLs, the State Water Resources Control Board (SWRCB) adopted the State Listing Policy in September 2004. This policy specifies methodology for placing a water body on the CWA §303(d) list. The State's methodology differs somewhat from the methodology used by USEPA for developing the toxics TMDLs. Therefore, SARWQCB staff re-assessed impairment for each of the water body-pollutant combinations that had previously been identified as impaired by USEPA, using the methodology identified in the State Listing Policy. That assessment is discussed below.

2.1 Relevant Investigations/Available Data

These TMDLs are based on analysis of data that were collected in the Newport Bay-San Diego Creek watershed during the period 1994-2004; these data sources are listed below. Many of these data sources are also referenced in the Technical Support Document, Part F of the Technical TMDLs (USEPA 2002), but data obtained from investigations that were completed after USEPA's promulgation of technical TMDLs were also evaluated.

1. Orange County Public Facilities and Resources Department (OCPFRD) Storm Water NPDES Permit Monitoring Data. The County of Orange PFRD (now Resources and Development Management Department [RDMD]) acts as the primary permittee under the Municipal Separate Storm Sewer System (MS4) permit that includes the Newport Bay watershed. This permit includes monitoring requirements. The County's monitoring program includes semi-annual sediment sampling and analysis of OC pollutant concentrations. Sediment data were available for three DDT species, two PCB Aroclors, and chlordane; no data were available for dieldrin or toxaphene. Data were available from 1995 to 2004 for San Diego Creek and some freshwater tributaries, as well as for several sites in Upper and Lower Newport Bay.

2. Toxic Substances Monitoring Program (TSMP). The SWRCB's TSMP collected samples of fish from inland surface waters of the State, and occasionally from marine waters, to determine concentrations of toxic substances in fish tissue. The purpose of the program, which terminated in 2002, was to provide a uniform statewide approach to the detection and evaluation of the occurrence of toxic substances in fresh, estuarine, and marine waters of the State; and water bodies with known or suspected impaired water quality were primarily targeted for evaluation. Species-specific fish tissue data were available for OC pollutants for the time period 1995 to 2002. Sampling locations included San Diego Creek at Michelson Drive, Peters Canyon Channel, San Diego Creek at Barranca Parkway, Santa Ana Delhi Channel, and several sites in Upper and Lower Newport Bay.

3. State Mussel Watch Program (SMWP). The SMWP was a SWRCB program conducted in coordination with Regional Boards from 1987-2000. This program monitored the tissue concentrations of toxic pollutants in resident and transplanted mussels in salt water, and resident and transplanted clams in fresh water. While the organochlorine pollutants are not water soluble and usually cannot be detected in the water column by traditional analytical techniques, these pollutants can bioaccumulate in shellfish to levels that are

detected in routine investigations. Data were evaluated to determine spatial distribution of toxic pollutants as well as temporal trends in their concentrations. Detectable pollutant concentrations in tissue relative to a control are evidence of bioaccumulation in the biota. Shellfish tissue concentration data (1995-2000) were available for several sites within Upper and Lower Newport Bay. No data were available for the time period (1995-2004) for San Diego Creek or its tributaries.

4. Bay Protection and Toxic Cleanup Program (BPTCP). This program evolved from the TSMP and SMWP; based on results of those studies, potential toxic hotspots were identified where bioaccumulation could potentially threaten beneficial uses. The BPTCP evaluated sediment chemistry, pore water chemistry, fish tissue chemistry, sediment and pore water toxicity, and the relative benthic index for sites in Upper and Lower Newport Bay in 1994-1998. The results are reported in "Sediment Chemistry, Toxicity, and Benthic Conditions in Selected Water Bodies of the Santa Ana Region, August 1998."

5. Southern California Coastal Water Research Project (SCCWRP) - Newport Bay Sediment Toxicity Studies (2004). This study was undertaken between 2000-2002. It analyzed sediment chemistry at 10 locations in Upper and Lower Bay and Rhine Channel; evaluated sediment toxicity and conducted sediment toxicity evaluations (TIEs); and evaluated water column chemistry and toxicity. Sediment data for PCBs, DDT, chlordane, and dieldrin at selected locations in May 2001 were used to estimate the existing loads for the Bay (see Section 4).

6. SCCWRP – Fish Bioaccumulation Studies (2004). This study was conducted during 2000-2002. Its purpose was to provide data on the distribution and contaminant levels in Newport Bay fishes; identify species that pose a potential health concern to humans or wildlife; identify what fish contaminants may warrant regulatory focus; and identify species or ecological groups of fishes for future study. Data included fish tissue concentrations in muscle fillets from recreationally caught fish, and whole fish tissue concentrations of forage fish in Upper and Lower Newport Bay.

7. SCCWRP – Organochlorine, Trace Elements and Metal Contaminants in the Food Web of the Lightfooted Clapper Rail, Upper Newport Bay, California (2005). This study looked at pollutant concentrations in the food web of the clapper rail to determine the extent of bioaccumulation and biomagnification, and to evaluate contaminant impacts on clapper rail by assessing nonviable eggs.

8. Analysis of Sediment and Fish Tissue obtained from San Diego Creek Unit 2 Basin (2003). SARWQCB staff, along with California Department of Fish and Game staff, collected sediment, shellfish, and finfish from the San Diego Creek Unit 2 basin in 2003, at a time when the basin was drained. The

samples were archived at SCCWRP until analysis by CRG Analytical Lab. Sediment and tissue chemistry data were compared to applicable screening values and were used to assess bioaccumulation.

9. Bight ’98 and ’03 – During Southern California Bight-wide surveys, sediment toxicity and chemistry were examined for Upper and Lower Newport Bay. Available sediment toxicity and chemistry results were evaluated.

10. Masters, P.M. and D.L. Inman (2000). This study examined the fate and transport of organochlorine pollutants discharged from agricultural and urban sources to the salt marsh habitat in Upper Newport Bay. The authors measured concentrations in marsh and channel sediments and salt marsh plants. The data presented included total DDT and chlordane at 11 sites in Upper Newport Bay sediments.

11. Office of Environmental Health Hazard Assessment (OEHHA) Coastal Fish Contamination Program (CFCP). In 1999, OEHHA collected fish samples from Newport Bay and from an offshore site near Newport Beach, and analyzed pollutant concentrations in fillet composites of fish likely to be consumed by humans. Fish species included diamond turbot, shiner surfperch, spotted turbot and yellowfin croaker.

12. Resource Management Associates report (USACE, 1997 – RMA model): Estimates of the sediment distribution for Upper and Lower Newport Bay were made using the results of the sediment transport model developed by RMA. The model simulates wet and dry conditions as well as the largest storm event from 1985 through 1997. Because most sediment entering Upper Bay occurs during storm events, mean daily stream discharge records for San Diego Creek were used to develop a five-day hydrograph and to simulate storm events for the RMA model. Sediment deposition rates that were reported in USEPA’s Technical TMDLs for Newport Bay and that are used in this document were derived from 12-year model simulation results.

2.2 Water Quality Standards

Water quality standards include beneficial uses, water quality objectives (numeric and narrative) and an antidegradation policy.

2.2.1 Beneficial Uses

Beneficial uses of San Diego Creek and Newport Bay are designated in the region’s Water Quality Control Plan (Basin Plan; SARWQCB, 1995), and are listed below in Tables 2-1a and 2-1b. Adverse impacts to these beneficial uses that result from discharges of toxic pollutants are violations of the second narrative objective for toxic substances specified in the Basin Plan (see section 2.2.3).

2.2.2 Numeric Water Quality Objectives

In 2000, USEPA established numeric criteria for priority toxic pollutants for the State of California (40 CFR 131; California Toxics Rule [CTR]). The CTR includes numeric water aquatic life criteria for 23 priority toxic pollutants and numeric human health criteria for 57 priority toxic pollutants. CTR criteria for the OC pollutants covered in these TMDLs are identified in Table 2-2.

2.2.3 Narrative Water Quality Objectives

The Basin Plan specifies two narrative water quality objectives for toxic substances. These are:

(1) Toxic substance shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health, and
(2) The concentration of toxic substances in the water column, sediment or biota shall not adversely affect beneficial uses.

Evidence that toxic substance concentrations in the water column, sediment or biota exceed applicable numeric or narrative objectives indicates that beneficial uses are being impaired or threatened.

2.2.4 Antidegradation Policy

As the organochlorine compounds are man-made chemicals that do not naturally occur in the environment, it can be argued that their presence in surface water constitutes a lowering of the water quality of that surface water. Pursuant to federal and State antidegradation policies, this is permissible only if beneficial uses are protected and it can be demonstrated that the lowering of water quality is consistent with the maximum benefit to the people of the State of California.

Table 2-1a. Designated Beneficial Uses for San Diego Creek and Newport Bay

Water Body	Beneficial Use																			
	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	LWRM	COLD	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST
Lower Newport Bay	+					X		X	X	X					X	X	X	X	X	
Upper Newport Bay	+							X	X	X				X	X	X	X	X	X	X
San Diego Creek Reach 1 – Below Jeffrey Road	+							X[1]	X		X				X					
San Diego Creek Reach 2 – above Jeffrey Road to headwaters	+				I			I	I		I				I					
Other tributaries – Bonita Creek, Serrano Creek, Peters Canyon Wash, Hicks Canyon Wash, Bee Canyon Wash, Borrego Canyon Wash, Agua Chinon Wash, Laguna Canyon Wash, Rattlesnake Canyon Wash, Sand Canyon Wash[2], and other tributaries to these creeks	+				I			I	I		I				I					

[1] Access prohibited in all or part by Orange County Environmental Management Agency (OCEMA)
[2] Sand Canyon Wash also has RARE Beneficial Use
X= present or potential
I= intermittent

Table 2-1b. Beneficial Use Definitions.

MUN – Municipal and domestic supply
AGR – Agricultural supply
IND – Industrial service supply
PROC – Industrial process supply
GWR – Groundwater recharge
NAV - Navigation
POW – Hydropower generation
REC1 – Water contact recreation
REC2 – Non-contact water recreation
COMM – Commercial and sportfishing
WARM – Warm freshwater habitat
LWRM – Limited warm freshwater habitat
COLD – Cold freshwater habitat
BIOL – Preservation of biological habitats of special significance
WILD – Wildlife habitat
RARE – Rare, threatened, or endangered species
SPWN – Spawning, reproduction, and development
MAR – Marine habitat
SHEL – Shellfish harvesting
EST – Estuarine habitat

Table 2-2. CTR Criteria for Organochlorine Compounds. Units represent total recoverable ppb.

Pollutant	Ambient Water Quality (CTR)					
	Freshwater		Saltwater		Human Health (10^{-6} risk for carcinogens) For consumption of:	
	Criterion Maximum Concentration (CMC)	Criterion Continuous Concentration (CCC)	Criterion Maximum Concentration (CMC)	Criterion Continuous Concentration (CCC)	Water & Organisms	Organisms Only
	µg/L					
p,p-DDD					0.00083	0.00084
p,p-DDE					0.00059	0.00059
p,p-DDT	1.1	0.001	0.13	0.001	0.00059	0.00059
Dieldrin	0.24	0.056	0.71	0.0019	0.00014	0.00014
Chlordane	2.4	0.0043	0.09	0.004	0.00057	0.00059
Total PCBs[1]		0.014		0.03	0.00017	0.00017
Toxaphene	0.73	0.0002	0.21	0.0002	0.00073	0.00075

[1] PCBs value based on sum of seven Aroclors: 1242, 1254, 1221, 1232, 1248, 1268, 1016
Blank space indicates no data available.
"Water & Org" and "Org. Only" refer to human health criteria for consuming water and/or organisms from same water body.

2.3 Impairment Assessment

2.3.1 Methodology

USEPA Methodology.
USEPA conducted an impairment assessment when developing technical TMDLs for toxic substances (2002). A two-tiered approach for assessing impairment was applied in USEPA's evaluation of the data: Tier 1 was considered to be met when there was clear evidence of impairment with probable adverse effects; Tier 2 was considered to be met when there was incomplete evidence and/or evidence of possible adverse effects or potential future impairment. Tier 2 required multiple lines of evidence, while Tier 1 could be met using a single line of evidence. This two-tiered approach is summarized in Part H, Decision Document, of the Technical TMDLs (USEPA, 2002).

SARWQCB Methodology.
Because the State Listing Policy was adopted subsequent to USEPA's development of technical TMDLs but prior to adoption of the OCs TMDL Basin Plan Amendment (BPA), staff reassessed impairment to ensure conformance with State policy. The methodology outlined in the State Listing Policy was followed for this impairment assessment. A weight of evidence approach to evaluating impairment is required under the Policy. According to the Final Functional Equivalent Document (FED) (2004),

> The expression "weight of evidence" describes whether the evidence in favor or against some hypothesis is more or less strong (Good, 1985). In general, components of the weight-of-evidence consist of the strength or persuasiveness of each measurement endpoint and concurrence among various endpoints. Confidence in the measurement endpoints can vary depending on the type or quality of the data and information available or the manner in which the data and information is used to determine impairment.
>
> Scientists have used a variety of definitions for "weight of evidence." A scientific conclusion based on the weight of evidence is often assembled from multiple sets of data and information or lines of evidence. Lines of evidence can be chemical measurements, biological measurements (bioassessment), and concentrations of chemicals in aquatic life tissue.

In describing how the SWRCB and RWQCBs are to implement a weight of evidence approach, the FED states:

> The weight of evidence approach would be a narrative process where individual lines of evidence are evaluated separately and combined using the professional judgment of the RWQCBs and SWRCB. The lines of evidence would be combined to make a stronger inference about water quality standards attainment….Using this approach the SWRCB and RWQCBs would use their judgment to weigh the lines of evidence to determine the attainment of standards based on the available data…Using this approach, a single line of evidence, under certain circumstances, could be *sufficient by itself* to demonstrate water quality standards attainment. (Italics were added by staff.)

According to the State Listing Policy, water segments will be deemed impaired if any of the conditions specified in Sections 3.1-3.11 of the Policy are met. Conditions include *Numeric Water Quality Objectives and Criteria for Toxicants in Water; Health Advisories; Bioaccumulation of Pollutants in Aquatic Life Tissue; Water/Sediment Toxicity; Adverse Biological Response; Degradation of Biological Populations and Communities; Trends In Water Quality; Situation-Specific Weight of Evidence Listing Factors*; among others. Each of these factors requires a minimum number of measured exceedances in order to justify a finding of impairment. The minimum number is based on a binomial test, as presented below in Table 2-3. A finding of impairment was made if the number of exceedances was greater than the minimum number required by the State Listing Policy for any one of the above-listed factors. Data quality requirements of the State Listing Policy were followed as much as possible with respect to spatial representation, quality assurance (QA) and quality control (QC).

2.3.2 Data Evaluated in this Impairment Assessment

Concentrations of organochorine pesticides and PCBs have been declining in fish/shellfish tissue and sediments in the Newport Bay watershed over time. Therefore, to reflect environmentally relevant conditions, this assessment evaluates data obtained from 1995 forward. The one exception is that Bay Protection and Toxic Cleanup Program (BPTCP) sediment chemistry data from late 1994 were used in the evaluation because these data were coupled with toxicity and benthic community measurements. Results reported in the comprehensive impairment assessment (Appendix B) are separated into the following groups: 1995-2001; 2001-2004; and 1995-2004. The USEPA's impairment assessment documented in the TMDLs for Toxic Pollutants San Diego Creek and Newport Bay, California (2002) evaluated data obtained between 1995 and June 2001. Therefore, the 1995-2001 grouping should roughly correspond to the same data evaluated by USEPA. The State Water Resources Control Board also conducted an impairment assessment in support of its recommendations for the 2006 303(d) listings (SWRCB, 2005), and they used all available relevant data. This document enables comparisons between this assessment and that performed by USEPA (2002) and the SWRCB in substantiating the 2006 Section 303(d) List.

In some studies (e.g., Orange County sediment monitoring under MS4 permit), method detection limits for analysis of some constituents (e.g., chlordane) were greater than the applicable screening values to which pollutant concentrations were compared. In these cases, any detectable concentration exceeded screening values, but non-detects could not be accurately interpreted (perhaps concentrations in fish tissue or sediment exceeded applicable screening values, or perhaps they did not). For purposes of this impairment assessment, where method detection limits exceeded screening values, data that were above detection limits were used in the assessment, but data showing nondetectable concentrations were considered unusable.

Table 2-3. Minimum Number of Measured Exceedances Needed to Place a Water Segment on the Section 303(d) List for Toxicants. Table is from the State Listing Policy (SWRCB, 2004.)

Null Hypothesis (H_o): Actual exceedance proportion ≤3 percent. Alternate Hypothesis (H_a): Actual exceedance proportion > 18 percent. The minimum effect size is 15 percent.	
Sample Size	List if the number of exceedances equals or is greater than
2-24	2*
25-36	3
37-47	4
48-59	5
60-71	6
72-82	7
83-94	8
95-106	9
107-117	10
118-129	11

*Application of the binomial test requires a minimum sample size of 16. The number of exceedances required using the binomial test at a sample size of 16 is extended to smaller sample sizes. For sample sizes greater than 129, the minimum number of measured exceedances is established where α and $\beta \leq 0.2$ and where $|\alpha-\beta|$ is minimized.

α= Excel® Function BINOMDIST (n-k, n, 1-0.03, TRUE)
β=Excel® Function BINOMDIST (k-1, n, 0.18, TRUE)
where n = number of samples,
k = minimum number of measured exceedances to place a water on the section 303(d) list,
0.03 = acceptable exceedance proportion; and
0.18 = unacceptable exceedance proportion

2.3.3 Assessment of Direct Toxic Effects

Direct toxic effects occur when aquatic organisms are adversely impacted by direct exposure to a toxicant in water and/or sediment. Effects can be measured in terms of mortality or chronic, sublethal effects, such as rate of fertilization. Listing factors evaluated that relate to direct toxic effects are discussed below.

<u>Pollutant Concentrations in Water (Section 3.1 of the Policy).</u>
According to the State Listing Policy, a finding of impairment is made if there is a sufficient number of samples showing exceedances of pollutant concentrations in the water column, compared to the California Toxics Rule (CTR) (Table 2-2). The CTR includes concentrations at which acute toxicity to aquatic life is probable (CMC), as well as levels at which chronic toxic effects are probable (CCC). Additionally, pollutant concentrations in water that are deemed to be protective of human health are identified.

Water/Sediment Toxicity (Section 3.6 of the Policy).
The State Listing Policy provides for placement of a water body on the CWA 303(d) list based on toxicity alone; however, if a specific pollutant causing toxicity has been identified, then the listing should include that pollutant. Use of sediment quality guidelines (SQGs) is recommended to show the association between toxicity and a given pollutant.

Pollutant Concentrations in Sediment. A sediment triad approach was used in this impairment assessment to evaluate direct effects to aquatic life, in keeping with the approach being used by the Sediment Quality Objectives Task Force in developing sediment quality criteria for the State. A sediment triad includes evaluation of sediment chemistry, toxicity, and biological responses. Direct effects are defined as impacts to the aquatic organisms that are directly exposed to sediments, and do not include impacts resulting from food-web bioaccumulation. Effects to wildlife and/or humans due to bioaccumulation of pollutants are considered to be indirect effects. For purposes of this impairment assessment, a finding of impairment was made when exceedances occurred in two of the three triad elements.

Pollutant concentrations in marine and freshwater sediments were compared to the sediment quality guidelines (SQGs) identified in the Final Functional Equivalent Document (FED; 2004) and other applicable SQGs (see Table 2-4). (See Section 3 for a detailed discussion of the derivation and uses of SQGs.) The FED does not endorse the use of SQGs for DDT in marine sediments, and does not identify recommended SQGs for toxaphene in either freshwater or marine sediments; commonly-used SQGs for these compounds are, however, provided for comparison in Table 2-4.

The FED states:

> SQGs should be used with caution because they are not perfect predictors of toxicity and are most useful when accompanied by data from in situ biological analyses, other toxicologic assays, and other interpretive tools…. The predictability of toxicity, using the sediment values reported, is reasonably good and is most useful if accompanied by data from biological analyses, toxicological analyses, and other interpretive tools. These measures are most predictive of toxicity if several values are exceeded. Since these values often are not good predictors of toxicity alone, SQGs that predict toxicity in 50 percent or more samples, should be used in making decisions to place a water body on the Section 303(d) list.

In the Listing Policy, SQGs are used to show association between toxic or other biological effects and a given pollutant. They are only to be used in situations where other biological effects data (e.g., toxicity or benthic community

Table 2-4. Sediment Quality Guidelines Evaluated in Impairment Assessment. Values in bold are those recommended for use in the State Listing Policy.

	Freshwater Sediment				Marine and Estuarine Sediment					
Pollutant	**TEL[1]**	**PEL[1]**	**TEC[2]**	**PEC[2]**	**TEL[3]**	**PEL[3]**	**ERL**	**ERM**	**Other SQG**	**SoCalERM[6]**
	μg/kg dry wt				**μg/kg dry wt**					
p,p-DDD	3.54	8.51			1.22	7.81	2[5]	20[5]		2.5
p,p-DDE	1.42	6.75			2.07	374	2.2[4]	27[4]		12.2
p,p-DDT					1.19	4.77	1[5]	7[5]		1.9
o,p-DDE										
o,p-DDT										
Sum DDD			4.88	**28.0**						
Sum DDE			3.16	**31.3**						
Sum DDT			4.16	**62.9**						
Total DDT	6.98	4450	5.28	**572**	3.89	51.7	1.58[4]	46.1[4]		
Dieldrin	2.85	6.67	1.90	**61.8**	0.72	4.3	0.02[5]	**8[5]**		1.08
Chlordane	4.5	8.9	3.24	**17.6**	2.26	4.79	0.5[5]	**6[5]**		
Total PCBs	34.1	277	59.8	**676**	21.6	189	22.7[4]	180[4]	**400[8]**	77.2
Toxaphene	0.1[7]									

[1] Buchman, M.F. 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pages.

[2] MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

[3] MacDonald, D.D., R.S. Carr, F.D. Calder, E.R. Long, and C.G. Ingersoll. 1996. Development and Evaluation of Sediment Quality Guidelines for Florida Coastal Waters. Ecotoxicology 5: 253-278.

[4] Long, E.R., D.D. MacDonald, S.L. Smith, F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environ. Manage. 19: 81-97.

[5] Long, E.R. and L.G. Morgan. 1990. The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program, Seattle, WA: National Oceanic and Atmospheric Administration.

[6] Vidal, D.E. and S.M. Bay. 2005. Comparative Sediment Quality Guideline Performance for Predicting Sediment Toxicity in Southern California, USA. Environ. Toxicol. Chem. 24: 3173-3182.
ERM values correspond to the 50th percentile of the distribution of sediment concentrations in the toxic dataset (amphipod survival normalized to the control).

[7] from New York Department of Environmental Conservation.

[8] MacDonald,D.D., L.M. Dipinto, J. Fields, C.G. Ingersoll, E.R. Long, and R.C. Swartz. 2000. Development and evaluation of consensus-based sediment effect concentrations for polychlorinated biphenyls. Environ. Toxicol. Chem. 19(5):1403-1413.

degradation) also exist. Therefore, in the absence of toxicity or other biological effects data, sediment chemistry alone was not used as a line of evidence in this assessment. However, when TIE studies identified a particular pollutant (or class of pollutants, e.g., nonpolar organics) as a probable toxicant, statistical tests revealed a correlation between observed toxicity and a particular pollutant, and biological community degradation was statistically linked to a particular pollutant, these data were used in conjunction with sediment chemistry to support a finding of impairment.

2.3.4 Indirect Toxic Effects

Aquatic organisms can bioaccumulate organochlorine pollutants by direct absorption from the dissolved phase in the water column or interstitial water in sediment, or via dietary intake. Bioaccumulation is defined as the net accumulation from all sources (e.g., water and diet), and occurs when the rate of accumulation is greater than the rate of elimination. Indirect adverse effects to human health and/or wildlife may occur when pollutants bioaccumulate and biomagnify within the food web of prey species to levels that are toxic to humans or wildlife predators. The listing factors that are relevant to the evaluation of bioaccumulative effects are discussed below.

<u>Pollutant Concentrations in Fish Tissue (Section 3.5 of the Policy).</u>
A finding of impairment is made for any pollutant-water body combination where bioaccumulation has occurred such that tissue pollutant concentrations exceed an appropriate evaluation guideline and where the minimum number of exceedances is met using a binomial distribution (SWRCB 2004). To assess whether the narrative water quality objective for protection of human health is being achieved, fish fillet concentrations were compared to OEHHA human health risk screening values (Table 2-5). OEHHA screening values (SVs) were calculated for a 10^{-5} cancer risk, and assume consumption of 21 grams per day of fish by a 70 kilogram adult who frequently consumes fish. The screening value approach identifies chemical contaminants in fish that occur at concentrations that may be of concern to human health for frequent consumers of sport fish. These values are not meant to be regulatory criteria, but instead are used by OEHHA to reveal where the need exists for further investigation to determine if a fish advisory may be warranted. In this impairment assessment, and consistent with the State Listing Policy, exceedances of OEHHA SVs are being used as thresholds to indicate that contaminants have bioaccumulated in fish tissue to levels that may be of concern to human health and that threaten to violate the first narrative water quality objective. OEHHA guidelines were not used for evaluating shellfish tissue concentration data, because the guidelines were developed for sport fish and may not be applicable to shellfish. To better evaluate human health risk due to

Table 2-5. Fish Tissue Screening Values (SVs) Used in Impairment Assessment. Values in bold print are those suggested for use by the State (SWRCB, 2004).

Pollutant	Fish Tissue Screening Values				
	Human Protection		**Aquatic Life/Wildlife Protection**		
	OEHHA[1]	**FDA[1]**	**NAS[2]**		**Environment[1] Canada**
			Freshwater	**Marine[4]**	
	µg/kg wet wt		*µg/kg wet wt*		
p,p-DDD					
p,p-DDE					
p,p-DDT					
Total DDT	**100**		**1,000**	**50[5]**	14 µg/kg diet wet wt
Dieldrin	**2**	**300**	**100**	**5[3]**	
Total Chlordane	**30**		**100**	**50[6]**	
Total PCBs	**20**	**2000**	**500**	**500**	*Mammalian*: 0.78 ng TEQ/kg diet ww *Avian*: 2.4 ng TEQ/kg diet ww
Toxaphene	**30**		**100**	**50[6]**	6.3 µg/kg diet wet wt

[1] Applies for freshwater or marine water organisms; OEHHA values do not apply to shellfish
[2] Water Quality Criteria 1972. A report of the Committee on Water Quality Criteria, Environmental Studies Board, National Academy of Sciences, National Academy of Engineering. Washington, D.C., 1972. At the request and funded by the Environmental Protection Agency.
[3] Sum of concentrations of aldrin, dieldrin, endrin, and heptachlor epoxide in a sample consisting of a homogenate of 25 or more whole fish of any species that is consumed by fish-eating birds and mammals, within the size range consumed by any bird or mammal. Applies to pollutants, individually or in combination.
[4] Applies to marine fish but not marine shellfish
[5] Sum of p,p'DDT, p,p'-DD, p,p'-DDE and their ortho-para isomers, in a sample consisting of a homogenate of 25 or more whole fish of any species that is consumed by fish-eating birds and mammals, within the size range consumed by any bird or mammal. Applies to pollutants, individually or in combination.
[6] Samples consist of a homogenate of 25 or more whole fish of any species that is consumed by fish-eating birds and mammals, with the size range that is consumed by any bird or mammal.

presence of the OCs in fish tissue, completion of a site-specific human health risk evaluation will be recommended as an implementation task for these TMDLs.

To assess whether the narrative water quality objective for protection of aquatic life and wildlife beneficial uses is being achieved, whole fish tissue concentrations were compared to NAS guidelines for protection of aquatic organisms and wildlife that feed on those organisms (Table 2-5). The NAS guidelines (1972) provide recommendations for pollutant residues in whole fish tissue (wet weight basis) that are protective of freshwater aquatic life and predators, as well as recommendations for pollutant residues in whole fish composites that are protective of marine aquatic life and wildlife. NAS guidelines for marine organisms apply only to finfish, not shellfish. Staff considered alternative thresholds to use in evaluating impairment for these TMDLs due to criticisms received on the use of NAS guidelines. Concern was raised by some stakeholders that these guidelines are too dated for use and have errors associated with them that should preclude their use. NAS guidelines, however, were ultimately chosen as the preferred thresholds because (1) they are deemed by the SWRCB to be an appropriate translator for narrative water quality objectives (see Functional Equivalent Document for the State Listing Policy, 2004); (2) they link pollutant concentrations in tissues to both the protection of aquatic life and predator organisms; (3) they are scientifically-based and peer reviewed. Therefore, these guidelines are considered by staff to be the most defensible for evaluating direct adverse effects to aquatic life, as well as indirect effects to predator organisms through food web biomagnification.

While findings of impairment are most conclusive when pollutant concentrations in *resident* fish species are evaluated (rather than concentrations in *transient* fish), this assessment evaluated all fish tissue data and did not preclude a finding of impairment based on nonresidency. There is a substantial amount of uncertainty when evaluating concentrations in fish whose home range includes areas outside of the Bay. Pollutant concentrations in transient species captured within embayments could reflect the pollutant concentrations of either in-bay or offshore waters, depending upon the amount of time spent in each area. With some fish species, however, it is not known with certainty whether they are resident or transient. Disregarding certain data because residency cannot be established with certainty could lead to erroneous conclusions. On the other hand, considering fish tissue concentrations from fish known to be migratory and transient within embayments could also lead to erroneous impairment conclusions. In this impairment assessment, staff evaluated tissue data for both resident and transient species. During implementation of these TMDLs, indirect effects due to bioaccumulation and biomagnification will be better evaluated, and the appropriate target species and protective tissue concentrations for those species will be identified.

Indirect Effects Due to Food Web Biomagnification.

The State Listing Policy does not provide specific guidance with which to evaluate water quality impairment related to the effects of food web biomagnification on high trophic level wildlife species (e.g., piscivorous birds). Indirect adverse effects resulting through bioaccumulation and biomagnification of the organochlorine pollutants in the food web of sensitive species (e.g., biomagnification of DDE within the food web of brown pelican, leading to eggshell thinning and reproductive failure) are believed to be more likely to occur than direct effects to aquatic organisms (e.g., mortality or reduced fertilization in benthic organisms). Further study is needed, and will be conducted during TMDL implementation, to adequately assess both direct and indirect adverse effects of the OCs to humans and wildlife.

2.4 Results and Discussion

Figure 2-1 reveals a strong linear relationship between 4,4-DDE concentrations in *Macoma nasuta* (clam) and 4,4-DDE concentrations in sediment from Upper Newport Bay. These data, along with results of other studies that showed bioaccumulation (e.g., SMWP) reveal the OC pollutants are clearly bioavailable in Newport Bay sediments; the degree of bioaccumulation appears to be proportional to the degree of sediment contamination. While the magnitude of bioaccumulation in Newport Bay mussels has declined as pollutant concentrations in sediments have diminished over time (see trends in Figures 2-2, 2-3 and 2-5), sediment-associated contaminants continue to accumulate in the tissues of benthic organisms. Because toxicity to organisms is, by definition, dependent on dose, it must be determined if the contaminant levels currently present in sediments pose a threat to aquatic life, wildlife, or human health, either through a direct toxic response to aquatic organisms or through indirect effects related to bioaccumulation and food web biomagnification.

All existing data were evaluated to determine if the observed bioaccumulation is causing or threatening to cause impacts to human health and/or the biota in San Diego Creek and Newport Bay, and an overall summary of results is shown in Table 2-6. Appendices A1-A3 provide a summary of all fish tissue, water column, and sediment chemistry data that were considered in this assessment. Appendix B contains a more comprehensive evaluation of all data, including toxicity and biological effects data. Data collected between 1995-2004 for the organochlorine pollutants (DDTs, PCBs, chlordane, dieldrin, toxaphene) for San Diego Creek, Peters Canyon Wash, Santa Ana Delhi Channel, Upper Newport Bay, Lower Newport Bay, and Rhine Channel (35 water body-pollutant combinations) were evaluated (Appendix B).

Table 2-6. Summary of Results of Impairment Assessment

Water Body	*Pollutant*	*Line of Evidence*	*Type of Impact*	*Exceedance Frequency*	*Impaired (Y/N)*
San Diego Creek	Total DDT	Fish Tissue (whole)	Aquatic Life/Wildlife	1 of 39 samples>NAS	No
(includes Reach 1,	Chlordane	Fish Tissue (whole)	Aquatic Life/Wildlife	0 of 39 samples>NAS	No
Reach 2, and Peters	Dieldrin	Fish Tissue (whole)	Aquatic Life/Wildlife	0 of 39 samples>NAS	No
Canyon Wash)	Toxaphene	Fish Tissue (whole)	Aquatic Life/Wildlife	9 of 29 samples>NAS	Yes
	Total PCBs	Fish Tissue (whole)	Aquatic Life/Wildlife	0 of 29 samples>NAS	No
	Total DDT	Fish Tissue (fillet)	Human Health	1 of 1 sample>OEHHA	Insufficient Data
	Chlordane	Fish Tissue (fillet)	Human Health	0 of 1 sample>OEHHA	Insufficient Data
	Dieldrin	Fish Tissue (fillet)	Human Health	0 of 1 sample>OEHHA	Insufficient Data
	Toxaphene	Fish Tissue (fillet)	Human Health	No data	Insufficient Data
	Total PCBs	Fish Tissue (fillet)	Human Health	No data	Insufficient Data
	Sum DDD	Sediment Chemistry	Aquatic Life	2 of 127 samples>PEC	Insufficient Data
	Sum DDE	Sediment Chemistry	Aquatic Life	11 of 127 samples>PEC	Sediment triad
	Sum DDT	Sediment Chemistry	Aquatic Life	2 of 127 samples>PEC	requirements
	Total DDT	Sediment Chemistry	Aquatic Life	0 of 127 samples>PEC	not met;
	Chlordane	Sediment Chemistry	Aquatic Life	3 of 22 samples>PEC	Sediment chem.
	Dieldrin	Sediment Chemistry	Aquatic Life	0 of 8 samples>PEC	results are not
	Toxaphene	Sediment Chemistry	Aquatic Life	0 of 8 samples>PEC	validated with
	Total PCBs	Sediment Chemistry	Aquatic Life	0 of 88 samples>PEC	data showing
					sediment
	Total DDT	Sed. Toxicity or	Aquatic Life	No data	toxicity and/or
	Chlordane	Biological Community	Aquatic Life	No data	biological
	Dieldrin	Degradation	Aquatic Life	No data	community
	Toxaphene		Aquatic Life	No data	degradation.
	Total PCBs		Aquatic Life	No data	
Upper Newport Bay	Total DDT	Fish Tissue (whole)	Aquatic Life/Wildlife	8 of 8 samples>NAS All resident fish	Yes
	Chlordane	Fish Tissue (whole)	Aquatic Life/Wildlife	0 of 8 samples>NAS	No
	Dieldrin	Fish Tissue (whole)	Aquatic Life/Wildlife	0 of 8 samples>NAS	No
	Toxaphene	Fish Tissue (whole)	Aquatic Life/Wildlife	No data	Insufficient data
	Total PCBs	Fish Tissue (whole)	Aquatic Life/Wildlife	0 of 8 samples>NAS	No
	Total DDT	Fish Tissue (fillet)	Human Health	7 of 27 samples>OEHHA 4 of 15 resident fish>OEHHA	Yes
	Chlordane	Fish Tissue (fillet)	Human Health	1 of 27 samples>OEHHA	No
	Dieldrin	Fish Tissue (fillet)	Human Health	1 of 27 samples>OEHHA	No
	Toxaphene	Fish Tissue (fillet)	Human Health	0 of 12 samples>OEHHA	No
	Total PCBs	Fish Tissue (fillet)	Human Health	6 of 27 samples>OEHHA 3 of 15 resident fish>OEHHA	Yes
	Total DDT	Sediment Chemistry	Aquatic Life	21 of 98 samples>ERM	N/A for DDT
	Chlordane	Sediment Chemistry	Aquatic Life	27 of 50 samples>ERM	
	Dieldrin	Sediment Chemistry	Aquatic Life	0 of 12 samples>ERM	
	Toxaphene	Sediment Chemistry	Aquatic Life	No data	
	Total PCBs	Sediment Chemistry	Aquatic Life	0 of 72 samples>SQG	

Table 2-6. Summary of Results of Impairment Assessment (continued)

Water Body	*Pollutant*	*Line of Evidence*	*Type of Impact*	*Exceedance Frequency*	*Impaired (Y/N)*
Upper Newport Bay	Total DDT	Sed. Toxicity or	Aquatic Life	SCCWRP (2004) and/or	Yes for DDT and
	Chlordane	Biological Community	Aquatic Life	BPTCP showed correlation	Chlordane
	Dieldrin	Degradation	Aquatic Life	among sediment toxicity,	(Sediment triad
	Toxaphene		Aquatic Life	benthic community degrada-	requirements
	Total PCBs		Aquatic Life	tion, and concentrations of	met)
				DDT and chlordane	
Lower Newport Bay	Total DDT	Fish Tissue (whole)	Aquatic Life/Wildlife	16 of 16 samples>NAS All resident fish	Yes
	Chlordane	Fish Tissue (whole)	Aquatic Life/Wildlife	0 of 16 samples>NAS	No
	Dieldrin	Fish Tissue (whole)	Aquatic Life/Wildlife	0 of 16 samples>NAS	No
	Toxaphene	Fish Tissue (whole)	Aquatic Life/Wildlife	No data	Insufficient data
	Total PCBs	Fish Tissue (whole)	Aquatic Life/Wildlife	0 of 16 samples>NAS	No
	Total DDT	Fish Tissue (fillet)	Human Health	8 of 36 samples>OEHHA 2 of 12 resident fish>OEHHA	Yes
	Chlordane	Fish Tissue (fillet)	Human Health	0 of 35 samples>OEHHA	No
	Dieldrin	Fish Tissue (fillet)	Human Health	0 of 36 samples>OEHHA	No
	Toxaphene	Fish Tissue (fillet)	Human Health	0 of 1 sample>OEHHA	Insufficient data
	Total PCBs	Fish Tissue (fillet)	Human Health	3 of 36 samples>OEHHA 1 of 12 resident fish>OEHHA	Yes
	p,p'-DDD	Sediment Chemistry	Aquatic Life	2 of 45 samples>ERM	
	p,p'-DDE	Sediment Chemistry	Aquatic Life	20 of 45 samples>ERM	
	p,p'-DDT	Sediment Chemistry	Aquatic Life	6 of 45 samples>ERM	
	Total DDT	Sediment Chemistry	Aquatic Life	23 of 56 samples>ERM	N/A for DDT
	Chlordane	Sediment Chemistry	Aquatic Life	13 of 39 samples>ERM	
	Dieldrin	Sediment Chemistry	Aquatic Life	0 of 25 samples>ERM	
	Toxaphene	Sediment Chemistry	Aquatic Life	No data	
	Total PCBs	Sediment Chemistry	Aquatic Life	0 of 53 samples>SQG	No
	Total DDT	Sed. Toxicity or	Aquatic Life	BPTCP TIEs showed	Yes for DDT and
	Chlordane	Biological Community	Aquatic Life	correlation between	chlordane
	Dieldrin	Degradation	Aquatic Life	reduced amphipod	
	Toxaphene		Aquatic Life	survival and urchin	
	Total PCBs		Aquatic Life	development and	
				chlordane, PCBs and	Sediment triad
				DDTs; benthic community	requirements
				degradation significantly	were met
				correlated with DDE.	

2.4.1 San Diego Creek and Tributaries

Freshwater - Aquatic Life/Wildlife Effects.
The concentrations of the OC pollutants in whole fish tissue have declined dramatically over time in San Diego Creek and its tributaries, such that few exceedances of NAS guidelines for protection of freshwater aquatic life are currently observed for any of the contaminants, with the exception of toxaphene (Figure 2-4). Toxaphene concentrations exceeded the freshwater NAS guideline in 30 percent of fish sampled in San Diego Creek Reach 1 and Peters Canyon Wash between 1995 and 2002. The minimum number of samples was met to support a finding of impairment for toxaphene in these water bodies. Note that the SWRCB has adopted the 2006 §303(d) List, and this most recent list of impaired water bodies identifies Peters Canyon Channel as also being impaired due to DDT, based upon fish tissue exceedances that span a longer time frame than was used in this impairment assessment.

While a substantial number of exceedances of the freshwater sediment Probable Effects Concentration (PEC) for sum DDE (31.3 ppb dw) was observed in sediments of San Diego Creek Reaches 1 and 2, and Peters Canyon Wash (Appendix A-2), there were no matched toxicity or other biologic effects data to demonstrate that any adverse effects were caused by DDT or its metabolites. Therefore, in accordance with the State Listing Policy, data were inadequate to use sediment chemistry as a line of evidence in evaluating impairment. Few, if any, exceedances of applicable SQGs were observed for PCBs, dieldrin, toxaphene or chlordane in San Diego Creek or its tributaries, and no toxicity or biologic effects data existed with which to meet the sediment triad requirements.

Trend Analysis.
Turnbull's method for assessing trends in nonparametric data was used to evaluate the observed decline in OCs measured in whole fish tissue over time (Minitab ® 14, Minitab, Inc., State College, PA). TSMP data collected between 1983-2002 were evaluated. Good correlations generally exist between OCs concentrations and time, and declining trends are statistically significant ($p<0.001$) for each of the OCs (Figures 2-5a-d). For PCBs, a weak but statistically significant correlation was observed.

Toxaphene concentrations in fish tissue exceeded the NAS guidelines in 30% of the samples measured between 1995 and 2002. If current fish tissue concentrations are estimated based on the existing trend (see Figure 2-5c), it can be argued that the median concentration would not exceed the impairment threshold. While trend analyses are useful for predictive purposes, where the exceedance frequency is greater than the minimum number of exceedances stipulated in the Listing Policy, a finding of impairment is supported. Nevertheless, the observed trends suggest that as monitoring continues in the watershed, some or all of the OCs may warrant delisting as pollutant levels and numbers of measured exceedances decline. Adopted OCs TMDLs will need to be revisited accordingly.

Freshwater - Human Health Effects.
There were insufficient data with which to evaluate potential threat to human health caused by the OC pollutants in San Diego Creek or its tributaries; however, one single catfish obtained from the Unit 2 in-channel sediment detention basin in San Diego Creek Reach 1, in 2003, contained nearly 1 ppm DDT in a muscle fillet sample (OEHHA SV for DDT is 100 ppb wet weight).

2.4.2 Upper and Lower Newport Bay

Marine Aquatic Life/Wildlife Effects.
Virtually all of the fish species captured in both Upper and Lower Newport Bay between 1996-2002 had whole body residues of total DDT that exceeded the NAS guideline for marine aquatic life/wildlife protection (Allen et al., 2004; Figure 2-6a). A significant number of exceedances of this guideline indicates that fish may bioaccumulate total DDT to levels that could have either a direct adverse effect on aquatic life or an indirect adverse effect on higher trophic level predator species, including birds and mammals, and constitutes an exceedance of the second narrative water quality objective for toxic substances. No exceedances of NAS guidelines in whole fish tissue were observed for dieldrin, PCBs (Figure 2-6b), chlordane, or toxaphene.

Over 50 percent of sediment samples in Upper Newport Bay, and 30 percent of samples in Lower Newport Bay, exceeded ERM values for chlordane (the State-recommended SQG) between 1995-2004 (see Table 2-4 and Appendix A and B). Significant sediment toxicity and/or benthic community degradation were also observed in both Upper and Lower Newport Bay, and the BPTCP study found a significant correlation between chlordane in sediments and amphipod toxicity and purple sea urchin development. Therefore, chlordane exceedances may pose a threat to benthic invertebrates and violate the second narrative water quality objective for toxic substances in the Region's Basin Plan. Applicable SQGs were not exceeded for PCBs, dieldrin or toxaphene; there is no State-endorsed marine SQG for DDT, however a substantial number of samples exceeded the ERM value (see Table 2-4 and Appendix A and B). Sediment toxicity and/or benthic community degradation were also significantly correlated with DDT in sediments (BPTCP and Bay et al. [2004]).

Marine - Human Health Effects.
Between 1995-2004, fish fillet samples were measured in the TSMP, the CFCP, and by SCCWRP (2004). Of a total of 27 samples collected and analyzed, there were 7 exceedances of OEHHA human health SVs for total DDT in fish captured in Upper Newport Bay (see Table 2-5; Figure 2-7a). Fifteen of the fish sampled were resident to the Bay, and 4 of these fish had total DDT concentrations that exceeded OEHHA SVs. There were a total of 8 exceedances for total DDT out of 36 muscle

fillet samples analyzed from fish captured in Lower Newport Bay (Table 2-5; Figure 2-7b). Twelve of these fish were resident to the Bay, and 2 had total DDT concentrations in muscle fillet samples that exceeded OEHHA SVs. The number of exceedances was greater than the minimum required to support a finding of impairment for Upper and Lower Newport Bay based on potential adverse effects to humans. The impairment finding is supported whether or not the evaluation was restricted to resident fish species, or whether it considered both resident and transient species. For PCBs, a significant number of fish fillet tissue exceedances was also observed in resident species in Upper Newport Bay (Figure 2-8a). In Lower Newport Bay, there of 3 exceedances out of a total of 36 fish fillet samples analyzed (1 of 12 resident species) (Figure 2-8b).Very few samples of muscle fillets obtained from both Upper and Lower Newport Bay had detectable concentrations of chlordane or dieldrin, and numbers of fish tissue exceedances did not meet the minimum number required to make a finding of impairment. Interestingly, all fillet tissue exceedances were observed in summer; only one DDT exceedance occurred in the winter (Figure 2-7a,b; Figure 2-8a,b).

<u>Avian Effects due to Food Web Biomagnification</u>.
The many species of birds that nest or feed in Upper Newport Bay are also important receptors for contaminants. Dietary uptake is probably the main source of exposure to bioaccumulative contaminants for these species. These contaminants are passed from the mother to the developing embryo and may cause developmental abnormalities, eggshell thinning and failed hatching.

To estimate the potential for adverse effects in birds due to exposure to these contaminants, concentrations in various components of their diet, in the surrounding environment, and in egg tissue can be measured, and results compared to literature threshold values. The light-footed clapper rail (clapper rail, *Rallus longirostris levipes*) is a federally listed species and a year-round resident of the Upper Newport Bay Ecological Reserve (UNBER). The clapper rail has been identified as one of the species in UNBER that is at risk of immune system or reproductive impairment from dietary uptake of bioaccumulative compounds. Clapper rails nest in the salt marsh and feed in adjacent mudflats, where sediment-associated contaminants are likely to be present.

Non-viable clapper rail eggs, sediment, and food items were evaluated from five nest sites in UNBER over a two-year period by SCCWRP and CH2MHill, and results are reported in Sutula et al. (2005). Only six non-viable eggs were collected, due to limited access to clapper rail nesting areas; therefore, only limited conclusions may be drawn from the study results. DDT (and metabolites) and chlordane were found to be biomagnifying in the food web of the clapper rail. The contaminant of greatest concern was determined to be 4,4'-DDE, as DDE concentrations exceeded screening levels for sediments, bird eggs and embryonic abnormalities. A significant inverse correlation was observed between 4,4'-DDE concentration and eggshell thickness in five eggs (R^2=0.68; p=0.04 at α=0.1). The egg with the highest concentration of DDE also had the thinnest shell, and developmental abnormalities were observed in the embryo. The mean eggshell thickness of the clapper rail eggs collected at UNBER, however, was similar to the mean of pre-DDT era (<1947) eggshell thickness measured from 80 eggs in the collection of the Western Foundation of Vertebrate Zoology, Camarillo, California. While the degree of eggshell thinning documented for one of the six eggs sampled may not be biologically significant at the population level (and, in fact, numbers of breeding pairs of clapper rails in Newport Bay appear to be increasing), evidence of thinning in localized areas at the individual level is of concern when dealing with endangered species.

The potential adverse biologic effects due to biomagnification in the food web of the light-footed clapper rail provide another line of evidence suggesting that the organochlorine pollutants (in particular, DDT species) may be threatening beneficial uses, and that current levels in the environment may violate or threaten to violate the second narrative water quality objective for toxic substances.

2.4.3 Comparison with USEPA (2002) Impairment Findings

Table 2-7 compares staff findings of impairment with those previously made by USEPA (2002).

San Diego Creek.
USEPA's impairment assessment showed that TMDLs were required for total DDT, PCBs, dieldrin, chlordane and toxaphene in San Diego Creek, based on exceedances of the OEHHA SVs in red shiner whole fish tissue (TSMP); in Regional Board staff's assessment, whole fish tissue samples were compared to NAS guidelines for freshwater aquatic life protection, and impairment was demonstrated only for toxaphene.

As stated in the SARWQCB Final Problem Statement, TMDLs for Toxic Substances in Newport Bay and San Diego Creek (2000), whole fish are usually analyzed when fish are small (e.g., red shiner). This may not represent typical human consumption practices, but does reflect what predator species consume. Whole fish concentrations may be 2-10 times the concentration found in fillets, and the fillet is typically the portion of the fish consumed by people. Therefore, pollutant concentrations in fish fillets are appropriately compared to screening values that have been calculated to evaluate human health risk, while pollutant concentrations in whole fish tissue are most appropriately evaluated with respect to ecological risk. Staff concluded that the paucity of data precluded a determination of impairment for San Diego Creek and its tributaries related to human health risk; further monitoring is needed to assess impairment in these water bodies.

Upper and Lower Newport Bay.
Staff's assessment was in agreement with that of USEPA for every water body-pollutant combination except for dieldrin. Findings of impairment for total DDT

Table 2-7. Impairment Summary for all Water Body-Pollutant Combinations & Comparison with Impairment Assessments Performed by USEPA . (+) = Impaired, Requires TMDL; (-) = Not Impaired or Insufficient Data to Make Determination. Note that USEPA did not distinguish between San Diego Creek and its tributaries (Peters Canyon Wash) when evaluating impairment; they also did not include Santa Ana Delhi Channel in their assessment.

Author	Water Body	Total DDT	Total PCBs	Chlordane	Dieldrin	Toxaphene
USEPA	San Diego Creek*	+	+	+	+	+
	Upper Newport Bay	+	+	+	-	-
	Lower Newport Bay	+	+	+	+	-
SARWQCB	San Diego Creek R1	-	-	-	-	+
	Peters Cyn Wash	-	-	-	-	+
	San Diego Creek R2	-	-	-	-	-
	Santa Ana Delhi Ch	-	-	-	-	-
	Upper Newport Bay	+	+	+	-	-
	Lower Newport Bay	+	+	+	-	-

*USEPA's Impairment Assessment did not distinguish between Reach 1 and Reach 2 of San Diego Creek, nor did it distinguish between San Diego Creek and Peters Canyon Wash, its major tributary

and PCBs in the Bay were primarily based on bioaccumulation and fish tissue exceedances in recreational and forage fishes; a finding of impairment due to chlordane, on the other hand, was primarily based on exceedances of applicable SQGs that were coupled with evidence of adverse biological effects. In contrast to USEPA's impairment assessment, Regional Board staff concluded that there was insufficient evidence to make a finding of impairment for Upper and Lower Newport Bay for dieldrin, based on the methodology outlined in the State Listing Policy. Therefore, no TMDLs will be developed for dieldrin for any water body covered in this document.

2.4.4 Conclusions

San Diego Creek.
Impairment was not established by Regional Board staff for any of the OCs pollutants in San Diego Creek, except for toxaphene. SWRCB staff, on the other hand, evaluated a larger data set and (in contrast to staff's assessment) found impairment in Peters Canyon Channel due to DDT exceedances in fish tissue. Peters Canyon Channel, therefore, was listed as impaired for DDT on the SWRCB-approved 2006 303(d) List. These toxaphene and DDT listings must be addressed by development of TMDLs, unless sufficient data exist with which to delist.

Chlordane and PCBs impairment was not established for San Diego Creek or any of its tributaries. For chlordane, data suggest that the existing load of chlordane to San Diego Creek may be greater than the loading capacity. Therefore, the lack of impairment finding may simply reflect a lack of data with which to assess impairment. Staff considered the following alternatives to assure that all applicable water quality standards for both creek and its downstream receiving water (i.e., Newport Bay) will be achieved and protected:

(1) Develop TMDLs for San Diego Creek and tributaries for chlordane and total PCBs, even though Regional Board staff did not make a finding of impairment for these pollutants. Clearly, the largest source of OCs to Newport Bay is via San Diego Creek. Developing TMDLs for the creek would help ensure that water quality standards are achieved, not only within San Diego Creek, but also in Newport Bay. However, some parties may question the legality of proceeding with TMDLs that would necessitate implementation actions on their part absent a finding of impairment.

(2) Develop informational TMDLs for San Diego Creek and tributaries for chlordane and total PCBs. The Clean Water Act provides the legal basis for developing TMDLs, for informational purposes, in situations where impairment has not been established. CWA §303(d)(3) states

"For the specific purpose of developing information, each State shall identify all waters within its boundaries which it has not identified under paragraph (1)(A) and (1)(B) of this subsection and estimate for such waters the total maximum daily load with seasonal variations and margins of safety, for those pollutants which the Administrator identifies under section 1314(a)(2) of this title as suitable for such calculation and for thermal discharges, at a level that would assure protection and propagation of a balanced indigenous population of fish, shellfish, and wildlife."

While such informational TMDLs would have no regulatory effect and would not be implemented at this time, they would facilitate development of a Basin Plan amendment should impairment be established in San Diego Creek for chlordane and PCBs in the future.

Based on the above evaluation of alternatives, staff recommends Alternative 2 as the preferred alternative, in the absence of a finding of impairment for chlordane and PCBs in San Diego Creek. Staff proposes to develop TMDLs for chlordane and PCBs in San Diego Creek for informational purposes only. This information may be used to facilitate adoption of a TMDL Basin Plan amendment for these pollutants in the future. It is anticipated that implementation activities for San Diego Creek will include data collection to better assess impairment, and the informational TMDLs are expected to be revised at a later date. Implementation activities for chlordane and PCBs TMDLs in Newport Bay should result in load reductions from upstream freshwater sources, thereby achieving the same results as would be obtained should TMDLs be developed for San Diego Creek as well.

Upper and Lower Newport Bay.
Staff concludes that development of TMDLs is necessary for total DDT and total PCBs due to a substantial number of fish tissue exceedances that indicates aquatic life, wildlife, and fishing beneficial uses may be threatened. Additionally, chlordane TMDLs are warranted due to elevated concentrations in sediment that have been statistically correlated to biologic effects.

Table 2.8 identifies the waterbody-pollutant combinations for which TMDLs will be developed.

Table 2-8. Waterbody-pollutant combinations for which TMDLs are being developed.

Waterbody	***Pollutant***
San Diego Creek and tributaries	Toxaphene, DDT *Chlordane, PCBs (informational TMDLs)
Upper Newport Bay	DDT, PCBs, Chlordane
Lower Newport Bay	DDT, PCBs, Chlordane

The remainder of this document will discuss the following required TMDL elements:

- *Quantitative Targets*: Identification of specific goals for the TMDL that equate to attainment of water quality standards. When water quality standards are expressed in narrative terms, it is necessary to develop a quantitative interpretation of narrative standards.
- *Source Analysis*: A discussion of all point sources, nonpoint sources, and background sources, including magnitude and location.
- *Existing Loads*: An quantitative estimate of the amount of pollutants entering receiving waters, or the amount of pollutant that is bioavailable based on historic loadings stored in the aquatic environment (USEPA, 2000).
- *Linkage Analysis and Loading Capacity*: The critical linkage between applicable water quality standards (as interpreted through numeric targets) and the TMDL. The loading capacity is the maximum amount of a pollutant that may be delivered to the water body and still achieve water quality standards.
- *TMDLs and Allocations*: The allowed pollutant amount and its components: wasteload allocations for point sources, load allocations for nonpoint sources and natural background.
- *Margin of Safety*: an implicit or explicit margin of safety to provide for uncertainty within the TMDLs.
- *Seasonal Variations and Critical Conditions*: A discussion of how pollutant discharges and impacts to beneficial uses vary in different years or at different times of the year. This discussion is required in order to ensure that the TMDL

will be protective of receiving waters during periods in which they are most sensitive to impacts associated with the pollutant(s) of concern (USEPA, 2000).

- *Implementation Plan*: Specific implementation actions, monitoring plans and a schedule for considering revisions to the TMDLs.

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3.0 NUMERIC TARGETS

Numeric targets identify specific endpoints in sediment, water column, or tissue that equate to attainment of water quality standards. Multiple targets may be appropriate where a single indicator is insufficient to protect all beneficial uses and/or attain all applicable water quality objectives. The water quality objectives and beneficial uses for San Diego Creek and Newport Bay are discussed in Section 2 of this document. The range of beneficial uses identified in the Basin Plan for these waters makes clear that the targets must address the protection of aquatic organisms, wildlife (including federally listed threatened and endangered species) and human consumers of recreationally and commercially caught fish.

Where applicable water quality objectives are numeric, TMDL targets are often set to that value. However, where applicable water quality objectives are in narrative form, it is necessary to develop quantitative target(s) through which narrative water quality objectives can be attained. As described below, this document recommends water column targets based on the numeric criteria in the CTR, and sediment and fish tissue targets intended to assure compliance with the Basin Plan narrative objectives for toxic substances (see Section 2).

3.1 Water Column Targets

The California Toxics Rule (CTR), promulgated by USEPA in 2000, contains the only numeric regulatory water quality criteria for the organochlorine pollutants (see Table 2-2). The CTR criteria are intended to protect aquatic organisms, predator species (e.g., the chronic marine water quality criteria for DDT is protective of brown pelican), and humans. However, because the OC pollutants are hydrophobic and have low water solubility, existing data showing detectable concentrations of these contaminants are limited. Furthermore, the detection limits of many of the analytical methods that have been used in monitoring programs currently being implemented in the watershed are often higher than the CTR concentrations for the OC pollutants. Therefore, CTR water column concentrations were not used as primary targets in these TMDLs. Staff recommends that tasks be included in the Implementation Plan for these TMDLs to ascertain whether CTR criteria are being met for the OCs.

3.2 Sediment Targets

Several approaches to evaluating and selecting the most appropriate sediment targets were considered. Each approach has inherent strengths and weaknesses and these are discussed below.

3.2.1 Selection of sediment targets from literature values that were empirically derived based on statistical evaluation of effects/no effects toxicity data sets.

A number of empirically derived sediment quality guidelines (SQGs) have been identified via statistical evaluation of large, nationwide datasets, and these SQGs predict the probability of adverse aquatic life effects that are associated with different levels of sediment contamination for individual pollutants. Most familiar are the NOAA Screening Quick Reference Tables (SQirRTs) SQGs identified in Buchman (1999). These SQGs provide screening concentrations for freshwater and marine sediments, and are used by NOAA to evaluate potential impacts to coastal resources and habitats from hazardous waste sites. These SQGs are not regulatory criteria and are not endorsed by NOAA as such. However, these SQGs are commonly used by regulatory agencies, research institutions, and environmental organizations to evaluate contaminated sites, characterize sites for disposal of dredged material, and establish goals for cleanup and source control (Vidal and Bay, 2005). Some commonly used SQGs are defined below.

Low-Threshold SQGs.
Low-threshold SQGs include Threshold Effects Levels (TELs) for both freshwater and marine sediments, and Effects Range-Low (ERLs) for marine sediments. The ERL is the lower 10th percentile concentration of the available sediment toxicity data that have been screened for samples that were identified as toxic by the original investigators (Buchman, 1999). TELs are the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effect data set; the TEL represents the concentration below which adverse effects would occur only rarely. TELs and ERLs are, therefore, considered to provide a high level of protection for aquatic organisms (MacDonald et al., 1996).

High-Threshold SQGs.
High-threshold SQGs include Effects Range-Median (ERMs) and Apparent Effect Thresholds (AETs) for marine sediments, and Probable Effects Levels (PELs) for both freshwater and marine sediments. The ERM is the median concentration of the compilation of toxic samples in a dataset. The PEL is the geometric mean of the 50th percentile of toxic samples, and the 85th percentile of non-impacted samples; pollutant concentrations above the PEL would be expected to result in toxicity frequently and, therefore, provide a lower level of protection for aquatic organisms. AETs relate contaminant concentrations of synoptic biological indicators of injury, and represent the concentration above which adverse biological impacts would always be expected to occur due to exposure to that pollutant alone.

Consensus-based SQGs have been developed for freshwater sediments (MacDonald et al., 2000), and include Threshold Effects Concentrations (TECs) and Probable Effect Concentrations (PECs). TECs are low-threshold SQGs, and are intended to identify concentrations below which adverse effects are not expected. PECs, on the other hand, are high-threshold SQGs, and represent concentrations above which harmful effects on benthic organisms are expected to occur frequently.

Figure 3-1 shows a conceptual depiction of ranges of biologic effects that can be predicted by low- and high-threshold SQGs (e.g., TELs and PELs, respectively).

SQGs should be used with caution since individual SQGs are often unreliable indicators of toxicity and do not necessarily identify the correct cause of toxicity (Vidal and Bay, 2005). In particular, use of empirically-derived marine SQGs for DDT and PCBs has been found to be relatively inaccurate in predicting toxicity (Long et al., 1995). Figure 3-2 shows the wide range of DDT concentrations at which adverse effects to benthic organisms as been observed in southern California bays and estuaries. For this reason, the State Listing Policy states that SQGs are not to be used in isolation to arrive at a finding of impairment, but may only be used when coupled with toxicity or other biologic effects data. The State Listing Policy does not endorse the use of any SQG for DDT in marine sediments for purposes of conducting an impairment assessment.

When a finding of impairment has been made, however, and in the absence of sufficient site-specific information that would allow for selection of appropriate sediment targets using other approaches, designating low-threshold SQGs as quantitative targets may be justified in TMDLs for OC pollutants, for the following reasons:

1) SQGs provide a direct link between pollutant concentrations in sediment and demonstrated biologic effects;
2) While high SQGs may be unreliable predictors of toxicity, low SQGs may be more effective predictors of nontoxicity. Low-threshold SQGs may provide an effective quantitative goal, such that if sediment concentrations are reduced accordingly, then beneficial uses should be protected and adverse biologic effects should be reduced or eliminated.
3) SQGs are derived from datasets where multiple contaminants were likely present in sediments and may have contributed to the observed biologic effects; thus, SQGs are conservative targets for individual pollutants.
4) SQGs are commonly used in the scientific and regulatory communities to evaluate contaminated sites, characterize sites for disposal of dredged material, and establish goals for cleanup and source control. Low-threshold SQGs have been used in other regions in the state as sediment targets in TMDLs for organochlorine compounds.

3.2.2 Back-Calculation of Sediment Targets from CTR using Empirically-Derived Water-Sediment Ratios (WSRs)

This approach is documented in the *Ecological Risk Assessment of the Marine Sediments at the United Heckathorn Superfund Site* (Lee et al., 1994). The sediment concentration necessary to achieve a target water column concentration (CTR) can be predicted from:

$$C_s = C_w \div WSR \qquad (1)$$

where, C_s = allowable sediment concentration (μg/kg dw)
C_w = target whole water concentration from CTR (μg/L)
WSR = water-sediment ratio (kg/L) measured at the site

This approach assumes a fairly predictable relationship between pollutant concentrations in water and sediment, but does not assume equilibrium partitioning. Using this approach in the United Heckathorn project, USEPA determined that the range in DDT concentrations in sediments from five different sites should be from 50 to 596 μg/kg dw in order to achieve the CTR human health criterion, and the range was 84 to 1010 μg/kg dw to achieve the CTR chronic water quality criterion. Due to the paucity of site-specific water column chemistry data in the Newport Bay/San Diego Creek watershed, WSR values cannot be calculated and, thus, sediment targets could not be developed using this approach.

3.2.3 Back-Calculation of Sediment Targets from CTR using Equilibrium Partitioning (EqP)

The EqP approach assumes that sediments are in equilibrium with pore water, and that pollutant concentrations in sediments and porewater are related by a partition coefficient (K_{oc}). The relationship is represented as follows:

$$C_s = f_{oc} K_{oc} \times C_w \qquad (2)$$

where, C_s = allowable sediment concentration (μg/kg dw)
f_{oc} = fraction of organic carbon in sediment
K_{oc} = organic carbon/water partition coefficient (L/kg)
C_w = target pore water concentration (assumed to be CTR criterion; μg/L)

To calculate the target sediment concentration for total DDT, for example, if the log K_{oc} values identified in Table F-1 of the USEPA technical TMDLs (2002) are used, and log K_{oc} for total DDT is corrected to reflect the relative abundance of each of the DDT species in Newport Bay (corrected log K_{oc} = 6.67), the sediment concentration required to ensure that the CTR marine chronic water quality criterion would be met is 56 μg/kg dw at 1% carbon; the sediment concentration required to meet the human health criterion would be 28 μg/kg dw. Because Newport Bay and San Diego Creek both have REC1 beneficial uses, the human health criterion would be most appropriately used to back-calculate sediment targets, if this approach were to be followed.

While this approach may be desirable because it uses adopted numeric objectives as a reference point, it also has many disadvantages, and these are discussed below.

(1) The EqP approach assumes equilibrium conditions. Equilibrium conditions may never be reached in Newport Bay and San Diego Creek because of tidal circulation in the bay and flows in the Creek that create fluctuations in pollutant concentrations in sediment and overlying water.

(2) The approach assumes that aquatic organisms accumulate only pollutants derived from porewater. It does not allow for bioaccumulation from ingestion of sediment or other dietary intake.

(3) From Equation 2, it can be seen that sediment targets calculated using this approach are extremely sensitive to the organic carbon fraction in sediment and the choice of partition coefficient. The percent organic carbon in Bay sediments is extremely variable. In Sutula, et al. (2005), percent organic carbon ranged from 3.5% to 12% throughout the study site; in Bay et al. (2004), triplicate same-day sampling at one location in the Bay showed organic carbon in sediments ranging from 1.1 to 2.3%. There is also substantial uncertainty related to K_{oc} values. K_{oc} may be derived from the linear relationship between K_{oc} and K_{ow} (Hoke et al., 1994), as was done in the USEPA promulgated TMDLs, and some degree of uncertainty may exist using this derivation. The choice of K_{ow} values for each of the OC pollutants would be made from the range of K_{ow} values that have been reported in scientific literature, none of which are specific to Newport Bay. Further uncertainty would, thus, be introduced in the selection process. Choice of K_{oc} and K_{ow} have a tremendous influence on the calculated sediment target. For example, USEPA chose literature values for log K_{ow} for each of the DDT species: DDT, DDE, and DDD, and assumed that the log K_{oc} for total DDT would be equal to the arithmetic mean of each of the individual species (log K_{oc} = 6.48). Using this value and assuming 1% total organic carbon (TOC), the calculated sediment target to be protective of human health would be 18 μg/kg dw. Using a weighted average log K_{oc} to reflect the relative abundance of each of the DDT species in Newport Bay sediments (log K_{oc}=6.67), the calculated sediment target would be 28 μg/kg dw. Therefore, even a very small difference in log K_{oc} value can translate into a very large difference in the calculated sediment target. USEPA estimates that calculated sediment targets may vary by a factor of 10-100, depending on assumptions made with respect to TOC and K_{ow} (personal communication, Cindy Lin, USEPA), and this approach may be best suited in instances where substantial site-specific data exist.

Because of the large number of assumptions that are required and amount of uncertainty that is inherent in back-calculating sediment targets, this approach was not followed in arriving at numeric targets.

3.2.4 Calculation of Sediment Targets using BSAFs

The biota-sediment accumulation factor (BSAF) is defined as:

$$BSAF = \frac{C_t}{f_t} \div \frac{C_s}{f_{oc}} \qquad (3)$$

where, C_t = organism tissue concentration (μg/kg ww)
f_t = the lipid fraction in the organism
C_s = pollutant concentration in sediment (μg/kg dw)
f_{oc} = organic carbon fraction of sediment

When a significant relationship has been established between pollutant concentrations in a target organism and in sediment, a “safe” sediment concentration can be calculated by dividing an appropriate tissue endpoint (e.g., NAS guideline) by the BSAF value. This empirical model accounts for pollutant bioavailability, since concentrations are normalized to organic carbon content in sediments and lipid content in tissue.

To measure BSAFs, sediment samples need to be representative of the spatial and temporal history of the organism. That is, sediments should be obtained from the organism’s home range during a time the organism would have been exposed to them. This approach is being pursued by San Francisco Estuary Institute, a research group that is performing empirical and mechanistic modeling, using Newport Bay as a case study, in support of development of sediment quality objectives for the State. This work has not yet been completed; however, results of their efforts may enable refinement of sediment targets, ensuring that the most sensitive wildlife receptors in Newport Bay are protected, in future phases of these TMDLs.

3.3 Fish Tissue Targets

3.3.1 Targets for Human Health Protection

There are no regulatory numeric criteria for fish tissue. The California Office of Environmental Health Hazard Assessment (OEHHA) has developed non-regulatory sport fish tissue screening values (SVs) to assess the need for further investigation to determine if a fish advisory may be warranted. These SVs were derived for the 10^{-5} cancer risk, assuming a 70 year consumption duration for adults weighing 70 kg and eating 21 g of fish per day (see Figure 2-3). In these TMDLs, OEHHA SVs were used to assess water quality impairment, and also serve as fish tissue targets for protection of human health. (Note that CTR human health criteria are based on a 10^{-6} cancer risk factor, while OEHHA SVs are based on a 10^{-5} cancer risk.)

Derivation of Fish Tissue Target Values from CTR Water Quality Criteria**.** As an alternative to using OEHHA SVs, fish tissue endpoints could be back-calculated from CTR human health criteria using bioconcentration factors obtained from the scientific literature, assuming the following relationship:

$$TTRL = C_w \times BCF \qquad (4)$$

where, TTRL = Threshold Tissue Residue Level (μg/kg ww)
C_w = CTR Human Health Water Criterion (μg/L)
BCF = Applicable bioconcentration factors derived from the literature (L/kg)

As an example for DDT, using the BCF published in the USEPA 1980 Ambient Water Quality Criteria for DDT of 53,600, the allowable TTRL in muscle fillet would be 32 μg/kg wet weight, which is less than the OEHHA SV of 100 μg/kg ww. The calculated TTRL for protection of human health would also be protective of aquatic life, since the CTR value for protection of human health is much lower than the acute or chronic criterion for protection of aquatic life.

Derivation of BCF values is performed through controlled laboratory experiments; calculated values differ among laboratories, and therefore selection of any one particular BCF value could be subject to controversy. BCF values are used when the only source of uptake by an organism is via water. If uptake occurs via multiple pathways (e.g., diet), as could reasonably be expected to occur in benthic organisms or bottom-feeding fish in Newport Bay, then TTRLs calculated using BCFs may not be accurate. For these reasons, this approach was not used for arriving at fish tissue target values for these TMDLs.

3.3.2 Targets for Protection of Aquatic Life and Wildlife

The NAS guidelines provide non-regulatory recommendations for whole fish tissue concentrations that are intended to be protective of freshwater aquatic life and predator species, as well as marine aquatic life and fish-eating birds. While these guidelines are dated (1972), they are endorsed by the state for use in assessing impairment related to bioaccumulative pollutants. These guidelines were used as fish tissue targets in development of these TMDLs to ensure that aquatic life and higher trophic level wildlife beneficial uses are adequately protected.

3.4 Conclusions

Sediment targets were prioritized over water column and fish tissue targets, based on the following rationale:

(1) The OC pollutants are directly associated with fine sediment;
(2) The OC pollutants are primarily transported within the watershed via sediment transport;
(3) Limited water column data are currently available;

(4) Impacts to the biota occur through bioaccumulation and biomagnification of the OC pollutants, and these impacts can ultimately be related to concentrations in sediment; and
(5) Attainment of sediment targets should result in attainment of water column criteria and tissue screening values, and thus should offer protection of aquatic life, wildlife, and human health.

Low SQGs (TELs) were chosen as quantitative sediment targets over other methods of deriving sediment targets because:

(1) They directly link sediment concentrations to biologic effects;
(2) They do not have the degree of uncertainty related to TOC and K_{oc}/K_{ow} as in the back-calculation approach;
(3) They do not require substantial site-specific information as in other approaches;
(4) They are conservative values, in that they were derived from datasets with multiple sediment contaminants;
(5) There is precedence for their use in development of OCs TMDLs in southern California;
(6) Their strengths and limitations are well-understood.

The sediment, water column, and fish tissue targets for the OCs TMDLs are provided in Table 3-1. These targets are identical to those selected by USEPA in development of the technical TMDLs (2002); however fish tissue targets for protection of aquatic life and wildlife have also been added.

The linkage between adverse effects in sensitive wildlife species and concentrations of the organochlorine pollutants in sediments, prey organisms and water is not well understood at the present time, although work is underway to better understand ecological risk in Newport Bay, and the State is in the process of developing sediment quality objectives that should provide guidance for assessing adverse effects due to pollutant bioaccumulation. Reducing contaminant loads in the sediment will result in progress toward reducing risk to aquatic life and wildlife. During implementation of these TMDLs, additional wildlife targets will be identified as risk assessment information becomes available.

Table 3-1. Numeric Sediment, Fish Tissue, and Water Column TMDL Targets

Sediment Targets[1]; units are μg/kg dry weight				
	Total DDT	**Chlordane**	**Total PCBs**	**Toxaphene**
San Diego Creek and tributaries	6.98	4.5*	34.1*	0.1
Upper & Lower Newport Bay	3.89	2.26	21.5	
Fish Tissue Targets for Protection of Human Health[2]; units are μg/kg wet weight				
San Diego Creek and tributaries	100	30*	20*	30
Upper & Lower Newport Bay	100	30	20	
Fish Tissue Targets for Protection of Aquatic Life and Wildlife[3]; units are μg/kg wet weight				
San Diego Creek and tributaries	1000	100*	500*	100
Upper & Lower Newport Bay	50	50	500	
Water Column Targets for Protection of Aquatic Life, Wildlife & Human Health[4] (μg/L)				
San Diego Creek and tributaries				
Acute Criterion (CMC)	1.1	2.4*		0.73
Chronic Criterion (CCC)	0.001	0.0043*	0.014*	0.0002
Human Health Criterion	0.00059	0.00059*	0.00017*	0.00075
Upper & Lower Newport Bay				
Acute Criterion (CMC)	0.13	0.09		
Chronic Criterion (CCC)	0.001	0.004	0.03	
Human Health Criterion	0.00059	0.00059	0.00017	

[1]Freshwater and marine sediment targets, except toxaphene, are TELs from Buchman, M.F. 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pp. Toxaphene target is from N.Y. Dept. of Environmental Conservation.

[2]Freshwater and marine fish tissue targets for protection of human health are OEHHA SVs.

[3]Freshwater and marine fish tissue targets for protection of aquatic life and wildlife are from Water Quality Criteria 1972. A report of the Committee on Water Quality Criteria, Environmental Studies Board, National Academy of Sciences, National Academy of Engineering. Washington, D.C., 1972.

[4]Freshwater and marine targets are from California Toxics Rule (2000).

*Note TMDLs for chlordane and PCBs in San Diego Creek are for informational purposes only.

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4.0 SOURCE ANALYSIS AND EXISTING LOADS

This section describes point, nonpoint, and background sources of legacy pesticides and PCBs in the Newport Bay/San Diego Creek watershed. Pollutant reservoirs (sources) and potential pathways by which these contaminants can enter receiving waters are shown below in a conceptual model of the watershed (Figure 4-1).

4.1 Physicochemical Properties and Historic Uses

The physical and chemical properties of the organochlorine pollutants influence their fate and transport in the environment. Some of the properties that are common to all of the OC pollutants include the following:

- They are persistent in the environment and resistant to degradation, with half-lives on the order of decades;
- They have low water solubility (i.e., hydrophobic), with high log K_{ow};
- They are primarily associated with organic matter and fine sediments, and do not tend to migrate into ground water;
- They are semivolatile, with potential for volatilization from soils decreasing with increasing sorption to particulates and mixing in the soil;
- They bioaccumulate in the fatty tissues of biological organisms.

4.1.1 Physical and Chemical Properties

Table 4-1 presents physical and chemical properties for DDT and metabolites, chlordane, toxaphene and PCBs. The following is a description of each of the parameters identified in the table.

Henry's Law Constant (K_H) – Describes equilibrium partitioning of a gaseous species between the liquid and gas phases, where the concentration of the gas in solution is low. The equilibrium condition can be described by a form of Henry's Law: $K_H = [A(aq)] \div P_A$, where K_H has the units mol $m^{-3}atm^{-1}$, [A] is the concentration of gas A in solution (mol m^{-3}), and P_A is the partial pressure of A in air (atm).

K_{ow} – The octanol-water partition coefficient is defined as the ratio of the pollutant concentration in octanol and in water. Octanol is a surrogate for lipids; the log K_{ow} value is a measure of the degree of hydrophobicity of a pollutant, as well as its tendency to be associated with lipids of biological organisms. The higher the log K_{ow}, the greater is the potential for bioaccumulation. For these TMDLs, log K_{ow} values were the same values previously selected by USEPA from the scientific literature (see Table 4-1).

K_{oc} – The partition coefficient is defined as the ratio of the pollutant concentration adsorbed to solids and in solution, normalized for organic carbon content. There is a linear relationship between log K_{oc} and log K_{ow} (Hoke et al., 1994).

Solubility – Describes the tendency of a compound to dissociate in water. The higher the log K_{ow} value, the lower the solubility of a particular pollutant.

Vapor pressure – Defined as the partial pressure of vapor molecules above the surface of a liquid at equilibrium. The vapor pressure describes the degree of volatility of a compound. Compounds with relatively high vapor pressures tend to readily evaporate. For comparison, the vapor pressure of water at 25°C is 23.8 mmHg.

BCF – The Bioconcentration Factor is defined as the ratio of the concentration of a pollutant in the tissues of an organism to the concentration in water, at equilibrium. It describes the potential for an organism to bioaccumulate a pollutant, and is determined from controlled laboratory studies in which water is the sole exposure route for the organism. In contrast, the bioaccumulation factor (BAF) describes the potential for an organism to bioaccumulate a pollutant from all routes of exposure, including absorption from water as well as dietary ingestion.

4.1.2 Historical Uses and Environmental Fate

Because the OC pesticides and PCBs are no longer being actively used in the watershed and there is no record of historic pesticide applications, the following discussion is primarily qualitative. Information for each pollutant was largely obtained from the Toxicological Profiles developed by the U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry (ATSDR).

<u>DDT</u>.
The use of DDT (2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane) began in the 1930s to control disease-causing insects and agricultural pests. Its use peaked in the early 1960s when it was used in over 300 agricultural commodities. In California, DDT uses included agricultural and urban pest control (see Table 4.2; Mischke et al., 1985); specific uses and application rates in the San Diego Creek-Newport Bay watershed are not known. Because of its adverse environmental effects, USEPA banned all uses in 1972, except for control of emergency public health problems. Technical grade DDT is a mixture of isomers: predominantly p,p'-DDT and o,p'-DDT. DDT is persistent in the environment, with a reported half-life of as long as 30 years (ATSDR, 2002). DDT degrades primarily to DDE under aerobic conditions and to dichlorodiphenyldichloroethane (DDD) in anaerobic conditions. Microbial dehydrodechlorination of DDD produces 1-chloro-2,2-bis(4-chlorophenyl)ethylene (DDMU), a key biomarker for in situ biodegradation (Masters and Inman, 2000).

Table 4-1 Physical and Chemical Properties of Organochlorine Pesticides and PCBs.

Pollutant	Molecular Weight	Log K_{ow}	Log K_{oc}[a]	BCF[k]	Solubility	Vapor Pressure	Henry's Law Constant[l] (atm·m^3 mole^{-1})
p,p'-DDT p,p'-DDE p,p'-DDD	354.5 319 321	6.610[c] 6.956[d] 6.217[e]	6.498 6.838 6.111	363,000	<1.2 ppb – 25 ppb (pp'-DDT) 26-85 ppb (op'-DDT)[b]	1.9 x 10^{-7} mmHg[b] at 25° C (pp') 5.5 x 10^{-6} mmHg at 30° C (op')	8.10E-06 2.10E-05 4.00E-06
Chlordane	409.8	6.32[e]	6.21	37,800	1.850 ppm [f]	2.2 x 10^{-5} mgHg (cis; supercooled liquid) 2.9 x 10^{-5}mmHg (trans; super-cooled liquid)[f]	4.86E-05
Toxaphene	414	5.5[h]	5.4	52,000			6.00E-06
PCBs	200.7-453	6.261[i]	6.15	270,000	2.7 – 250 ppb, for various Aroclors[j]	4.06 x 10-4 mmHg to 4.05 x 10-5 mmHg, for various Aroclors[j]	4.0E-04

[a] Log K_{oc} values were calculated from log K_{ow} values, using the equation from Hoke et al. (1994)

$$\text{Log } K_{oc} = 0.00028 - \log K_{ow}(0.983)$$

[b] Solubility and vapor pressure values from Ambient Water Quality Criteria for DDT (USEPA, 1980)

[c] Mean of two values cited in USGS (2001): one value from de Bruijn et al. (1989) and one value from Brooke et al. (1990)

[d] USGS (2001) from de Bruijn et al. (1989)

[e] from de Bruijn et al. (1989)

[f] Solubility and vapor pressure values from Toxicological Profile for Chlordane (U.S. Department of Health and Human Services (1994)

[h] "Southerland" EPA Report

[i] Mean of 20 congener values cited for PCBs in de Bruijn et al. (1989)

[j] Solubility and vapor pressure values from Ambient Water Quality Criteria for Polychlorinated Biphenyls (USEPA, 1980)

[k] BCF value for DDT from EPA Ambient Water Quality Criteria – DDT (Common Shiner – *Notropis cornutus*); for chlordane from EPA Ambient Water Quality Criteria – Chlordane (fat head minnow – *Pimephales promelas*); for PCBs from EPA Ambient Water Quality Criteria – PCB (Aroclor 1260 – fathead minnow [female] – *Pimephales promelas*); for toxaphene from EPA Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment – fathead minnow (*Pimephales promelas*)

[l] from Syracuse Research Corporation, http://www.syrres.com/esc/chemfate.htm; except PCBs from Burkhard et al., 1985

Currently, the primary route of exposure to humans is via dietary intake. Produce contaminated with DDT may originate in countries outside of the U.S. where DDT is still being actively used, or DDT species may be present in fish. DDT concentrations in the atmosphere are not considered to be high enough to pose a substantial human health risk (U.S. Dept. of Health and Human Services, 2002). Human health effects that have been attributed to DDT include nervous system dysfunction, reproductive effects due to the estrogen-like properties of DDT, hepatic effects, developmental toxicity, and cancer.

Adverse biological effects of DDT to plants and wildlife have been well-documented, and are summarized in reports from the National Irrigation and Water Quality Program (NIWQP, 1998) and USEPA (2000). The NIWQP report cites reduced growth and unusual morphology in the green alga, *Chlorella*, at a DDT concentration of 0.3 μg/L in surface water; toxicity to aquatic invertebrates; behavioral changes, hyperactivity, and enzymatic changes in fish; and reproductive impairment, reduced fledging success, and eggshell thinning in birds. According to USEPA (2000), field and laboratory studies suggest that chronic effects to benthic communities may occur at sediment DDT concentrations that exceed 2 μg/kg; and equilibrium partitioning methods predict that chronic effects may occur at sediment DDT concentrations of 0.6 to 1.7 μg/kg. In Bay, et al. (2004), 10-day amphipod survival was not significantly different than the control at total DDT concentrations in Newport Bay sediment of <4 μg/dry kg. At higher sediment DDT concentrations, toxicity was observed; but the toxicant was not identified. Among bird species, brown pelican appears to be the most susceptible to adverse biological effects, with DDE being the primary toxicant responsible for reproductive toxicity. Eggshell thinning and depressed productivity in brown pelican occurs at a DDE concentration of about 3.0 μg/g ww in the egg (USEPA, 2000).

Table 4-2. DDT use in California from 1970-1980 (Mischke et al., 1985)

Year	Pounds Used	Main Use
1970	1,164,699	agricultural
1971	111,058	agricultural
1972	80,800	agricultural
1973[a]	No use reported	--
1974	160	Residential pest control (special local need)
1975-1980	<200 lbs per year	Vector control (special local need)
[a] All uses were banned except for special local needs in 1972		

<u>DDT in Dicofol</u>.
Dicofol is an organochlorine pesticide that has been used in Orange County to control pests on container and field-grown horticultural plants, strawberries, peppers, beans, tomatoes, lemons, and in landscape maintenance. It is manufactured through chlorination of dichlorodiphenyldichloroethylene (DDE, one of the

breakdown products of DDT), and can contain very small amounts (<0.1% since 1985) of total DDT (DDT+DDE+DDD). Because dicofol contains only very small amounts of DDT and because its use has declined dramatically (Figure 4-2), dicofol is considered to be an inconsequential continuing source of DDT in the watershed.

Chlordane.

Chlordane is a broad-spectrum insecticide that was used in the United States from 1948 to 1988. Chlordane was primarily available as a technical grade mixture of about 140 compounds, whose major components were trans-chlordane, cis-chlordane, beta-chlordene, heptachlor, and trans-nonachlor (U.S. Dept. of Health and Human Services, 1994). Its breakdown products include the highly toxic oxychlordane.

Chlordane was extensively used for termite control and for control of insects during the production of crops, such as corn, up until 1983 (U.S. Dept. of Health and Human Services, 1994). In 1983, due to public concern about environmental degradation and potential harm to human health, USEPA restricted chlordane use such that it could only be used for subterranean termite control. In 1988, USEPA banned all uses. Chlordane volatilizes from both soil and water. In soils, volatization rates are greater in coarse textured soils with low organic matter content, compared to clayey soils with high organic matter content. Residual chlordane can remain in soils, however, for as long as 20 years after application. In lakes, streams, and embayments, chlordane will partition to bed sediments or suspended particulates; the extent of partitioning is correlated with organic carbon content.

Like the other OCs, chlordane may be transported long distances in the atmosphere, either in the vapor phase or adsorbed to airborne particulates, and then deposited via wet or dry deposition. In the vapor phase, chlordane degrades by photolysis and hydroxyl radical reaction.

Exposure to chlordane can occur through uptake through skin, inhalation, or dietary ingestion. Most human health effects are linked to ingestion and inhalation. Chronic inhalation exposure to humans whose homes or workplace were treated for termites with chlordane has been associated with various neurological symptoms, including headache, dizziness, vision problems, irritability, excitability, weakness, muscle twitching and convulsions; reproductive effects; immune alterations; anemia; and liver damage. Ingestion can cause similar adverse effects, as well as digestive effects such as nausea, vomiting, and diarrhea (U.S. Dept. of Health and Human Services, 1994).

Chlordane bioaccumulates in freshwater and marine aquatic life, and biomagnifies in predator species. It is taken up from both water and sediment by aquatic vascular plants (U.S. Dept. of Health and Human Services, 1994). It is considered to be moderately to slightly toxic to birds (LD_{50} for bobwhite quail is 83 mg/kg); highly toxic to fresh water invertebrates and fish (96-hour LC_{50} in bluegill is 0.057-0.075 mg/L); and highly toxic to bees and earthworms (EXTOXNET; http://extoxnet.orst.edu/).

Toxaphene.

Toxaphene is a complex mixture of about 670 chlorinated compounds, or congeners (67-69% chlorine by weight), and is produced by reacting chlorine gas with camphene. In 1972, toxaphene was the most heavily manufactured insecticide in the United States, with a production of 23,000 tons (U.S. Dept. of Health and Human Services, 1996). Global use between 1950-1993 has been estimated to be greater than 1.3 million tons. It was one of the most heavily used insecticides in the United States until 1982, when it was banned for most uses. All uses were banned in 1990.

Toxaphene has been used as an insecticide in the production of cotton, corn, fruit, vegetables, and small grains. Because it is not phytotoxic, has low toxicity to bees and is persistent, it was desirable for treating flowering plants. It was also used to control parasites on livestock and to eradicate fish in lakes and streams. Toxaphene was often mixed with other pesticides because toxaphene solutions apparently helped solubilize other hydrophobic insecticides; it was frequently applied with DDT (U.S. Dept. of Health and Human Services, 1996).

Under anaerobic conditions, toxaphene is biotransformed rapidly in soils and sediments, with a half-life on the order of weeks to months (U.S. Dept. of Health and Human Services, 1996). However, under aerobic conditions, toxaphene is relatively resistant to biotransformation, with a half-life on the order of years. Toxaphene strongly sorbs to soils and will persist for long periods of time. Erosion of soils from lands that previously received applications of toxaphene can lead to receiving water inputs of toxaphene (and other pollutants) sorbed to particulates. Toxaphene can volatilize to the atmosphere following releases to water or soil and long-distance atmospheric transport has been documented at a number of locations, including the Great Lakes. Each of its more than 670 components varies in vapor pressure and potential for degradation. Consequently, toxaphene breakdown products found in waters and/or aquatic life may differ dramatically from the technical toxaphene originally applied to soils or waters.

Animal studies show that long-term exposure to toxaphene can result in damage to the liver, kidneys, adrenal glands, and immune system, and may also cause minor changes in fetal development (U.S. Dept. of Health and Human Services, 1996). It is known to bioconcentrate in aquatic organisms and biomagnify in food webs, although food web biomagnification is not as dramatic as with DDT (U.S. Dept. of Health and Human Services, 1996). It has been difficult to evaluate the fate and transport of toxaphene because of its chemical complexity.

PCBs.

Polychlorinated biphenyls (PCBs) are a class of chemical compounds in which between 2 and 10 chlorine atoms are attached to a biphenyl molecule. There are up to 209 possible compounds depending on degree of chlorination, and these compounds are referred to as congeners. PCBs are categorized based on degree of chlorination; all PCB compounds containing the same degree of chlorination are referred to as homologs. Homologs can have varying substitution patterns (e.g., substitutions on meta-, ortho-, and para- positions in the molecule) (U.S. Dept. of Health and Human Services, 2000). The two benzene rings in the PCB structure can rotate about the bond that connects them in two extreme configurations: the two benzene rings can be coplanar; that is, occurring in the same plane. Or, the benzene rings can be non-coplanar; that is, at a 90º angle to each other.

Between 1930 and 1977, the Monsanto Corporation was the major manufacturer of PCBs and marketed various PCB mixtures under the trade name Aroclor. Aroclors can be identified by their 4-digit numbering code. The first two numbers of the code describe the type of mixture, and the last two digits indicate the approximate percentage of chlorine by weight. For example, Aroclor 1242 is a chlorinated biphenyl mixture with varying amounts of mono- through heptachlorinated homologs, with an average chlorine content of 42% (U.S. Dept. of Health and Human Services, 2000).

An important property of PCBs is their general inertness: they resist both acids and alkalis and have thermal stability. This made them useful in a wide variety of applications, including dielectric fluids in transformers and capacitors, heat transfer fluids, and lubricants. In general, PCBs are relatively insoluble in water and the solubility decreases with increasing chlorination. PCBs, however, are readily soluble in nonpolar organic solvents and in biological lipids. Photolysis is the more significant process of degradation than hydrolysis or oxidation. Degradation can occur under both aerobic and anaerobic conditions. The greater the chlorine content of the PCB, the longer the half-life, ranging from days to years.

Although it is now illegal to manufacture, distribute, or use PCBs, these synthetic oils were extensively used for many years as insulating fluids in electrical transformers and in other products, such as cutting oils. In 1976, the manufacture of PCBs was prohibited because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic 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, abandoned facilities, and electrical transformers may still contribute PCBs to the environment.

PCBs can volatilize from both soil and water; in the atmosphere, they can occur in the vapor phase or be sorbed to particulates. Like the other OCs, they are globally redistributed via atmospheric transport. Biphenyls with 1-4 chlorine atoms tend to migrate toward polar latitudes, those with 4-8 chlorine atoms tend remain in mid-latitudes, and higher chlorinated PCBs tend to stay near the contamination source (ATSDR, 2000). From the water column, PCBs may partition to sediments or be volatilized; higher chlorinated PCBs tend to be adsorbed, while lower chlorinated PCBs are more readily volatilized.

Biologic organisms can accumulate PCBs in their lipids and levels of PCBs in organisms can biomagnify within a foodweb, depending on the congener and lipid content of the organism. Consumption of PCB-contaminated fish is a major pathway for human exposure. Human health effects that have been reported due to PCB exposure include liver, thyroid, dermal and ocular changes, immunological alterations, neurodevelopmental changes, reduced birth weight, reproductive toxicity, and cancer (U.S. Dept. of Health and Human Services, 2000).

Of the 209 PCB congeners, about a dozen are considered to be “dioxin-like” because of the fact that PCB toxicity and structural features are similar to those of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2378-TCDD). These PCB congeners have been assigned 2378-TCDD Toxicity Equivalency Factors (TEFs), showing their toxicity relative to 2378-TCDD (which has a TEF of 1.0). The most recent World Health Organization determination of TEFs provided values that are applicable to fish and birds. For example, PCB-126 has a TEF of 0.1 for birds, meaning PCB-126 is 10 times less toxic to birds than 2378-TCDD (USEPA web site, www.epa.gov/toxteam/pcbid/tefs.htm).

4.2 Sources

The organochlorine pollutants are no longer being actively used and all sources are related to historic applications of organochlorine pesticides and releases of PCBs. Therefore, this source analysis will be primarily qualitative. Monitoring data show that a “reservoir” of historically-deposited organochlorine compounds exists in terrestrial soils (e.g., unpublished data for DDT supplied by the Irvine Company for agricultural areas) and that erosion of these soils continues to contribute low levels of contaminants to San Diego Creek and Newport Bay. Once contaminated sediments enter Newport Bay, tidal action influences pollutant spatial distribution.

Historic uses of the organochlorine pesticides were predominantly urban and agricultural (see above discussion). Their high log K_{ow} values predict that they have low water solubility, and, therefore, will be associated predominantly with fine, organic-rich particulates and largely confined to surface soils (i.e., will not migrate to ground water). Soils to which these pollutants were applied in the past and that have been exposed and subjected to erosion in the watershed are believed to be primary sources. Masters and Inman (2000) hypothesized that the source of pesticide-contaminated sediments into San Diego Creek and ultimately Newport Bay was from soils that were eroded from agricultural operations and urban areas. The predominant urban source is most likely active construction sites. Construction activities in the watershed expose soils that were previously associated with agricultural land use, while developed lands have a large percentage of impervious surfaces and landscaping that reduces the potential for erosion and sedimentation. Releases of PCBs in the watershed have occurred on the El Toro and Tustin military bases, and also possibly as the result of industrial activities in proximity to the Rhine Channel. (TMDLs for the Rhine Channel are being developed independently of those for Upper and Lower Newport Bay.)

The following paragraphs describe, in qualitative terms, the relative contribution of point sources, nonpoint sources, and background loading. To further elucidate sources, two studies are being conducted by the County of Orange and the Southern California Water Coastal Research Project (SCCWRP) that should lead to a better understanding of the relative pollutant contributions from different land uses.

4.2.1 Point Sources

Storm Sewer Discharges.
Apart from sewered sanitary waste discharges, all discharges from urbanized areas in the watershed eventually enter the municipal separate storm sewer system (MS4). Discharges from the MS4 are considered to be point source discharges, but they include nonpoint source discharges that originate from urban areas, agricultural operations and open space. A National Pollutant Discharge Elimination System (NPDES) permit (the MS4 Permit) regulates discharges from the MS4; the County of Orange is the primary permittee and the incorporated cities in the watershed are co-permittees under the permit. The MS4 permit currently requires annual monitoring of storm water and semi-annual monitoring of sediments in San Diego Creek (and tributaries) and Newport Bay. OC pollutant concentrations measured in sediments as part of the storm water monitoring program (1995-2004), are shown in Appendix A. Average 4,4-DDE concentrations at about 18 monitoring locations in San Diego Creek and tributaries are shown in Figure 4-3a (1995-2000) and Figure 4-3b (2001-2004). Total DDT concentrations in sediments from San Diego Creek and its tributaries varied by year, ranging from nondetectable concentrations to 480 ppb dry weight (Lane Channel in 1996); chlordane concentrations were as high as 20 ppb dry weight (Agua Chinon Wash in 2002, San Diego Creek at Campus Drive in 2002). These data suggest that substantial discharges of the legacy pollutants may still be occurring into the MS4.

Ground Water Dewatering and Remediation.
Ground water discharges to surface waters that result from dewatering and pollutant remediation operations in the watershed are regulated under waste discharge requirements (WDRs) and NPDES permits. Relevant permits and their requirements for monitoring for OC pollutants are listed in Table 4.3.

No monitoring data for the OC pesticides or PCBs were available from the permitted ground water discharge records. However, other ground water monitoring has shown that OC pesticides are present. For example, results of ground water monitoring performed in January 2006 in support of the City of Irvine's Lane Channel improvement project, showed total DDT concentrations in ground water ranging from nondetectable to 0.021 μg/L, exceeding the CTR chronic criterion for DDT of 0.001 μg/L. None of the other OC pesticides or PCBs were detected in ground water.

Because ground water rising to the surface in San Diego Creek and some tributaries enters the storm drain channels, creeks and channels via leaky pipes, weep holes and other avenues, ground water could potentially be a substantial source of OCs loading to San Diego Creek and Newport Bay, even if the OCs are present in very low concentrations.

Ground water as a potential continuing source of OC pesticides and PCBs will be evaluated during implementation of these TMDLs.

Table 4.3. Permitted Ground Water Discharges in the San Diego Creek-Newport Bay Watershed

Permit Title	Order No.	NPDES No.	OCs Monitoring
General Waste Discharge Requirements for Discharges to Surface Waters that Pose an Insignificant (de minimus) Threat to Water Quality	R8-2003-0061 as amended by R8-2005-0041 and R8-2006-0004	CAG998001	None required
General Waste Discharge Requirements for Short-term Groundwater-Related Dischargers and De Minimus Wastewater Discharges to Surface Waters Within the San Diego Creek/Newport Bay Watershed	R8-2004-0021	CAG998002	Does not specify monitoring requirements for priority pollutants, including OC pesticides
General Groundwater Cleanup Permit for Discharges to Surface Waters of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by Petroleum Hydrocarbons, Solvents and/or Petroleum Hydrocarbons mixed with Lead and/or Solvents	R8-2002-0007, as amended by R8-2003-0085 and R8-2005-0110	CAG918001	Annual monitoring for priority pollutants, including OCs – EPA Method 608 Required PQL = 0.1 ppb; ML = 0.01 ppb for DDT
Waste Discharge Requirements for City of Tustin's 17th Street Desalter	R8-2002-0005	CA8000305	Annual monitoring for priority pollutants, including OCs – EPA Method 608 Required PQL = 0.1 ppb; ML = 0.01 ppb for DDT
Waste Discharge Requirements for City of Irvine, Groundwater Dewatering Facilities, Irvine, Orange County,	R8-2005-0079	CA8000406	Does not specify monitoring requirements for priority pollutants, including OC pesticides

Discharges from Roadways.
Discharges from highways would be expected to be associated primarily with construction activities within Caltrans rights-of-way, if organochlorine pesticides/PCBs were previously applied/spilled to soils in those areas. Storm water and nonstorm water discharges from areas under Caltrans jurisdiction are regulated through a NPDES permit. Data were not available to quantify loading from this source.

Construction Activities.
Construction discharges have the potential to carry sediment-bound, legacy pesticides because most construction activities in the watershed occur on land that was previously in agricultural uses. Erosion and sedimentation from construction sites can be substantial, as grading and other earth-moving activities can expose large areas of soil that are subject to erosion and transport off-site during large storm events. Order No. 99-08-DWQ, NPDES General Permit No. CAS000002, Waste Discharge Requirements (WDRs) for Discharges of Storm Water Runoff Associated with Construction Activity (the General Permit), regulates storm water and non-storm water discharges from construction sites. This statewide general permit requires that best management practices (BMPs) be implemented that use best available technology economically achievable (i.e., BAT/BCT standard) to achieve an effective combination of erosion and sediment control; however, during extremely intense storms or storms of long duration, routine BMPs are not always effective in controlling sediment discharges. For example, in 2005, Regional Board staff issued Notices of Violation (NOVs) for lack of an effective combination of erosion and sediment controls and other violations of the General Permit at two large construction sites in the City of Irvine. The NOVs stated that because of inadequate BMPs, sediment-laden storm water flowed into the storm drain system and adjacent drainages. Because these sites are being developed on lands previously in agricultural land use, it is likely that the transported sediments carried with them a certain amount of adsorbed legacy OC pesticides.

According to the State's database of construction activities covered under the General Permit as of February 2006, there are up to 8185 acres of land currently under construction in the watershed and vicinity (Table 4.3); this number is probably somewhat high since only portions of some cities where construction activities are taking place are in the Newport Bay/San Diego Creek watershed.

Historic Spills/Military Base Cleanup.
PCBs loading to San Diego Creek and Newport Bay may include PCBs originating from spills that occurred on the former Marine Corps Air Station (MCAS) Tustin and MCAS El Toro. Both bases have been closed and re-use plans include residential and commercial development.

Table 4.3. Summary of Permit-Covered Construction Activities in the Vicinity

City	Number of Sites	Total Acres	Primary Developers
Costa Mesa	13	98	Shea Property, RZR Enterprises, Richmond Amer. Homes, Kerry Contractors
Irvine	186	5925	William Lyon Homes, Taylor Woodrow Homes, Standard Pacific Homes, Snyder Langston, Shea Homes, Richmond American Homes, Lennar Homes/Communities, Keith Co., John Laing Homes, Irvine Company, California Pacific Homes, Brookfield Homes
Newport Beach/ Newport Coast	25	684	Irvine Company, WL Homes LLC, Taylor Woodrow Homes, Laing Luxury Homes, Greystone Homes
Orange	28	680	SunCal Co., Orange County Council, Home Depot, Hearthside Homes, Archstone Smith
Santa Ana	20	138	Birtcher Pacific, American Constructors, Orange County Transit, Shea Homes
Tustin	27	570	William Lyon Homes, Vestar Development Co., Tustin Gateway, Lennar Homes/Communities, John Laing Homes
Mission Viejo, Laguna Woods, Laguna Hills, Ladera Ranch, Foothill Ranch	10	90	WL Butler Construction, John Laing Homes, Home Depot, DMB Ladera

MCAS El Toro. This 4,471-acre military base was originally commissioned in 1943 as a Marine Corps pilot fleet operation training facility (Bechtel National, Inc., 1997). It was later a master jet station and center for aviation on the west coast, and supported the operations and combat readiness of Pacific Fleet Marine Forces. Activities on the base included aircraft maintenance and repair. Pollutants generated by these activities included construction debris, municipal waste, batteries, waste oils, hydraulic fluids, paint residues, transformers, and waste solvents. In 1990, the base was listed on the National Priorities List under CERCLA (Superfund), and pollutants of concern included OC pesticides and PCBs. The MCAS El Toro marine base was closed in 1999.

Site assessments identified a total of 1,032 environmental locations of concern (LOCs) on the base, 117 of which required further action. An LOC is any identified location that may be contaminated or is a potential source of contamination, based on activities that are known to have occurred at the site. LOCs are identified during the site assessment/remedial investigation by several means, including but not limited to, anomalies on aerial photographs, records of locations of storage tanks, pesticide and PCB storage areas, and areas with PCB transformers. Directed site investigations identify potential release locations (PRLs) and installation restoration program (IRP) sites. Within the areas of concern on the base, there were 124 PCB transformers, 2 PCB storage areas, and 2 pesticide storage areas. PCB transformers were removed or replaced in 1997. Remediation and achievement of target cleanup goals for PCBs in soils were finalized in 2005. Remediation of PCB-contaminated soil involved soil removal at PCB spill sites and former storage areas. For example, at one site (Site 11) 560 tons of contaminated soil were recently removed and disposed of at the Kettleman Hills Disposal Facility. Prior to remediation, the maximum PCB (Aroclor 1260) concentration in one composite sample of soil was 5.2 ppm (Accord Engineering, Inc. and Earth Tech, Inc., 2005). Two known PCB spill sites were within about 1000 feet of Bee Canyon Wash or Agua Chinon Wash; in the past, the sites may have contributed PCBs to surface waters if erosion of contaminated soils occurred.

It should be noted that remediation goals in soils may be much higher than TMDL sediment targets. For example, the Final Remedial Action Report for IRP Site 11 at the former El Toro military base (2006) states the target cleanup goal was 0.288 mg/kg for Aroclor 1260; 2.95 mg/kg for 4,4'-DDD; 2.09 mg/kg for 4,4'-DDE; 2.09 mg/kg for 4,4'-DDT; and 2.03 mg/kg for alpha-chlordane. These values are all substantially higher than the TMDL sediment targets for San Diego Creek. This implies that if erosion and sediment transport to surface waters from remediated spill sites occur, the residual pollutant concentrations in discharged sediments may be high enough to pose a substantial threat to water quality, even after cleanup goals for particular sites have been met.

MCAS Tustin. The 1600-acre MCAS Tustin was initially established as a Navy Lighter-than-Air (LTA) base to support blimp patrols for submarines off the California

Coast during World War II (Bechtel National, Inc., 1997). Base operations were supported by more than 200 structures, including a 3000-foot long runway, aircraft parking aprons, and aircraft maintenance shops. About 530 acres of land on the base were leased for commercial farming. In 1997, the base supported about 4,000 active duty military and civilian personnel whose responsibilities included maintaining the operation of 12 helicopter squadrons, totaling 170 rotary-wing aircraft.

Six Installation Restoration Program (IRP) sites (i.e., sites with known contamination) were identified on the base during various site investigations. The primary contaminants at the sites were diesel fuel, oils, lubricants, cleaning solvents, gasoline, paint stripper, battery acids. Table 4.4, below, summarizes the magnitude of OC pesticides and PCBs in soil and ground water that were reported by Bechtel National, Inc. (1997) in their Draft Final Remedial Investigation Report.

No further action recommendations, in terms of OC pesticides or PCBs, were made for soils on IRP-3, IRP-5, IRP-12, IRP-13E, and IRP-16; thus, the levels shown in Table 4-4 reflect a reservoir of OC pollutants that likely exists at these sites and that may become mobilized as the sites are developed for urban uses. For example, total DDT concentrations at site IRP-12, a no further action site, are about 1 ppm in some locations. If soils are eroded and discharged to surface waters from this site, adverse impacts to water quality may occur. PCB cleanup at IRP-13W was required since PCB (Aroclor 1260) concentration at a depth of 6 inches was as high as 13 ppm. In 1997, soil in a 220 x 80 foot area was excavated to a depth of 2 feet and disposed of.

Clean-up of all contaminated PCB sites at MCAS Tustin has been completed, target goals achieved, and ownership of the sites transferred. Again, cleanup goals are risk-based concentrations that are developed by conducting site-specific, human health and wildlife risk assessments. The goals do not consider human health or ecological impacts that could occur if soils are eroded and transported to surface waters. No other PCB spills in the San Diego Creek watershed are known to have occurred other than those reported at these military bases. Both former military bases, including former agricultural areas on MCAS Tustin, are currently being developed for commercial and residential urban uses.

Table 4.4 Concentrations of OC Pesticides and PCBs Detected in Soil and Ground Water at MCAS Tustin. Method of analysis was USEPA 8080. Units for Soils and Sediments are μg/kg dw; units for ground water are μg/L. Data from Bechtel National, Inc. (1997). J = concentrations were less than quantitation limit but higher than detection limit and are, thus, an estimate. Range of concentrations given for samples with detectable levels of the chemical.

IRP Site	Site ID	Media: Soil/Ground Water	Detection Frequency	Pollutant	Sample Quantitation Limit (SQL) Range	Concentration (Minimum-Maximum)
IRP-3	Paint Stripper Disposal Area	Soil (1 ft below ground surface (bgs) Ground Water	4/15 1/15 0/15 No OCs detections	4,4'-DDT 4,4'-DDD Arochlors	16.8 – 72.3 16.8 – 72.3	25-100J 32J nd
IRP-5	Drainage Area No. 1	Sediment Ground Water	1/6 1/6 0/6 No OCs detections	4,4'-DDD 4,4'-DDE Aroclors	4-4.3 4-4.3	nd - 6.7 1.7J nd
IRP-12	Drum Storage Area No. 2	Soil (1 ft. bgs) Ground Water	7/10 6/10 2/10 0/10 No OCs detections	4,4'-DDT 4,4'-DDE 4,4'-DDD Aroclors	16.3-18.2 16.3-18.2 16.3-18.2	20-330 23-590 18, 160 nd
IRP-13E	Drum Storage Area No. 3	Soil (2 ft. bgs) Ground Water	4/19 5/23 4/22 6/37 3/23 4/22 No OCs detections	4,4'-DDT 4,4'-DDE 4,4'-DDD Aroclor 1260 Alpha-chlordane Gamma-chlordane	3.5-20.8 3.5-20.8 3.4-20.8 13-208 2-104 1.8-104	17-240J 1.7J- 80 1.3J – 60J 48J-340 1.0J – 1.3J 0.74J-2.1J
IRP-13W	Drum Storage Area No. 3	Soil (1, 2, 7, or 21 ft. bgs) Ground Water	5/34 2/35 2/34 1/35 1/34 1/34 1/34 No OCs detections	4,4'-DDT 4,4'-DDE 4,4'-DDD Aroclor 1260 Alpha-chlordane Gamma-chlordane Toxaphene	3.3-88.96 3.3-88.96 3.3-88.96 13-889.6 1.7-444.8 1.7-444.8 164.8-889.6	3.6J - 82 3.6J– 3.9 0.79J – 1.4 280J 98 200 200
IRP-16	VOC Solvent Contamination Area	Soil Ground Water	No OCs detections No OCs detections			
	Agricultural Area II*	Soil (0-1 ft)	15/31 15/31 2/31 0/17 4/31 5/31 5/31	4,4'-DDT 4,4'-DDE 4,4'-DDD Aroclor 1260 Alpha-chlordane Gamma-chlordane Dieldrin	4-5 4-5 4-5 2-2.6 2-2.6 4-5	2.5 – 130 1.1-73 2.9-5.3 nd 0.54 – 0.88 0.77 – 1.3 0.98-2.1

* Data for Agricultural Area II from Bechtel National, Inc. (1996)

Commercial Nursery Production.

Commercial nursery production is the primary agricultural operation remaining in the watershed. Discharges from four large nurseries in the watershed are regulated by Waste Discharge Requirements (WDRs) and are managed as point source discharges. Implementation of effective best management practices (BMPs) by the nurseries in cooperation with U.C. Cooperative Extension has greatly reduced agricultural discharges of waste. BMPs to reduce non-storm water discharge include water recycling; irrigation management to reduce water use; and use of polyacrylamide monomer (PAM) as a flocculating agent to reduce Total Suspended Solids (TSS) in the discharge stream. BMPs that reduce the total volume discharged and TSS will also reduce discharges of OCs. Monitoring results for El Modeno Gardens, Bordiers, and Hines nurseries are reported in Table 4.5. No detectable concentrations of any of the OC pesticides or PCBs have been reported by any of the nurseries in the watershed. Nondetects need to be verified using other sensitive analytical methods and other sampling strategies. It is possible that no detections occurred because sample size was too small or the analytical methods were not the most suitable for measuring low levels of OCs.

Table 4.5 Concentrations of OC Pesticides and PCBs reported by Commercial Nurseries in the San Diego Creek-Newport Bay Watershed. Method of analysis was USEPA 608; concentration units are μg/L. MDL = Method Detection Limit

Nursery	Date	Nature of Discharge	Dieldrin	Total DDT	Chlordane	Toxaphene	Total PCBs
Bordiers	12/7/03	First storm of season	<MDL	<MDL	<MDL	<MDL	<MDL
	10/17/04	First storm of season	<MDL	<MDL	<MDL	<MDL	<MDL
	10/17/05	First storm of season	<MDL	<MDL	<MDL	<MDL	<MDL
Hines	8/25/04	Water in recycling pond	<MDL	<MDL	<MDL	<MDL	<MDL
	4/21/05	Semi-annual storm sample	<MDL	<MDL	<MDL	<MDL	<MDL
	10/17/05	First storm of season	<MDL	<MDL	<MDL	<MDL	<MDL
	11/7/05	Irrigation runoff	<MDL	<MDL	<MDL	<MDL	<MDL
El Modeno Gardens	No runoff 10/04 – 7/05						

4.2.2 Nonpoint Sources

Agriculture.

Nonpoint source agricultural dischargers include small-scale nurseries and row crop operations. Erosion from agricultural soils has been implicated as a primary source of pesticide-contaminated sediments to Newport Bay in studies and reports dating to the 1970s (Masters and Inman, 2002; County of Orange Human Services Agency, 1978). Agricultural soils are a continuing, but declining, source of the OC legacy pesticides. For example, in 2002, concentrations of total DDT of up to 2 ppm were measured in agricultural soils in localized areas of the San Diego Creek watershed (data provided by the Irvine Company). Many of these areas of concern have now been converted to residential land use, and agricultural land use now occupies only about 3% of the total watershed area. Most agricultural operations in the watershed, including commercial nurseries (except for Nakase Bros.), occur on leased lands. All agricultural leases expire by the year 2010, and these lands are expected to be developed for urban uses after that time, leaving only a very small area in the watershed dedicated to agricultural land use. Figure 4-2 shows the decline of agriculture between the 1970s and the present, on lands owned by The Irvine Company.

Small amounts of DDT may continue to enter the environment through the use of dicofol, another organochlorine pesticide (miticide) that is structurally similar and contains a small amount (less than 0.1%) DDT (USDOI, 1998). Use of dicofol is extremely limited in the watershed, and this continuing source is considered to be inconsequential (see Figure 4-2). For example, in 2002 there were only about 31 pounds of dicofol (equating to less than 1 ounce of DDT) applied in landscaping maintenance and container plant production activities in 15 separate applications over a total of 33 acres in the entire county (2002 Pesticide Use Report for Orange County, http://www.cdpr.ca.gov/docs/pur/purmain.htm).

Upon build-out of the watershed, which is expected in the next 10 years, agriculture will be largely replaced by urban land uses and this source is expected to be substantially reduced, if not eliminated.

<u>Open Space</u>.
Because open space lands may contribute a substantial amount of sediment to San Diego Creek and Newport Bay, they are potential sources of organochlorine pesticides and/or PCBs if pesticides were applied or PCBs were used/spilled in the past. No data were available with which to quantify pollutant loads from this source, and this potential source will be evaluated as an implementation task.

<u>Channel Erosion</u>.
Channel erosion and incisement of unimproved streams could potentially contribute to OCs loading in receiving waters. It is currently not known to what level the OCs occur in soils adjacent to these streams, and, therefore, this potential source cannot be quantified. During TMDL implementation, this source will be evaluated.

4.2.3 Background Sources

Low level background loading of organochlorine pesticides and PCBs may occur in the watershed through wet and dry deposition processes. Studies are underway in the watershed to measure atmospheric concentrations of pesticides, including the OC pesticides (both in the vapor phase and associated with

Table 4.6 Concentrations of OC Pesticides in the Atmosphere. Data are from Gan et al., 2006. nd=not detected.

Date	Location	Phase	p,p'-DDE	p,p'-DDD	p,p'-DDT	trans-chlordane	cis-chlordane	Dieldrin
Dry Season Concentrations in Atmosphere (pg/m^3)								
6/23/05	UNBay	Vapor Particulate	nd nd	nd nd	nd nd	nd nd	nd nd	nd nd
7/21/05	UNBay	Vapor Particulate	11 nd	nd nd	nd nd	8 nd	nd nd	59 5
8/25/05	UNBay	Vapor Particulate	nd nd	nd nd	nd nd	nd nd	nd nd	nd nd
10/13/05	UN Bay	Vapor Particulate	43 nd	nd nd	nd nd	nd nd	nd nd	nd nd
6/23/05	SD Creek	Vapor Particulate	nd nd	nd nd	nd nd	nd nd	nd nd	nd nd
7/20/05	SD Creek	Vapor Particulate	28 nd	5 nd	nd nd	13 nd	nd nd	109 nd
8/24/05	SD Creek	Vapor Particulate	nd nd	nd nd	nd nd	nd nd	nd nd	nd nd
9/29/05	SD Creek	Vapor Particulate	nd 50	nd nd	nd nd	nd 11	nd nd	nd 33
6/22/05	Peters Canyon	Vapor Particulate	nd nd	nd nd	nd nd	nd nd	nd nd	nd nd
7/20/05	Peters Canyon	Vapor Particulate	21 9	6 nd	nd nd	10 nd	nd nd	129 5
8/25/05	Peters Canyon	Vapor Particulate	nd nd	nd nd	nd nd	nd nd	nd nd	nd nd
10/13/05	Peters Canyon	Vapor Particulate	172 nd	nd nd	nd nd	11 nd	nd nd	96 nd
6/22/05	San Joaquin Marsh	Vapor Particulate	nd nd	nd nd	nd nd	nd nd	nd nd	nd nd
7/20/05	San Joaquin Marsh	Vapor Particulate	28 nd	nd nd	nd nd	41 nd	nd nd	137 nd
8/24/05	San Joaquin Marsh	Vapor Particulate	nd nd	nd nd	nd nd	nd nd	nd nd	nd nd
9/29/05	San Joaquin Marsh	Vapor Particulate	nd nd	nd nd	nd nd	nd nd	nd nd	nd nd
Wet Season Concentrations (ng/L)								
12/6/04	Tustin	Rain	0.8	nd	nd	nd	nd	nd
12/6/04	Tustin	Rain	2.8	nd	nd	nd	nd	nd
12/6/04	Irvine	Rain	14.5	6.5	nd	nd	nd	nd
12/29/04	Tustin	Rain	nd	nd	nd	nd	nd	nd
12/6/04	Irvine	Rain	2.2	nd	nd	nd	nd	nd
12/29/04	Tustin	Rain	nd	nd	nd	nd	nd	nd
12/29/04	Irvine	Rain	1.3	nd	nd	nd	nd	nd
12/29/04	Tustin	Rain	4.5	nd	nd	19.5	nd	nd
12/29/04	Irvine	Rain	0.5	nd	nd	nd	nd	nd
12/02/05	Tustin	Rain	nd	nd	nd	nd	nd	nd
4/05	Irvine	Rain	8.3	nd	nd	nd	nd	nd
4/05	Irvine	Rain	nd	nd	nd	nd	nd	nd
12/2/05	Irvine	Rain	0.3	nd	nd	nd	nd	nd
12/2/05	San Joaquin Marsh	Rain	nd	nd	nd	nd	nd	nd
12/2/06	Irvine	Rain	1.9	0.3	nd	0.3	nd	nd
2/2/06	San Joaquin Marsh	Rain	0.1	nd	nd	0.1	nd	nd
2/2/06	San Joaquin Marsh	Rain	0.2	nd	nd	0.2	nd	nd

2/17/06	Irvine	Rain	nd	nd	nd	nd	nd	nd
2/02/06	Tustin	Rain	0.3	nd	nd	nd	nd	nd
2/17/06	Tustin	Rain	nd	nd	nd	0.1	nd	0.5
2/17/06	San Joaquin Marsh	Rain	nd	nd	nd	nd	nd	nd
2/27/06	San Joaquin Marsh	Rain	nd	nd	nd	nd	nd	nd
2/27/06	Tustin	Rain	0.1	nd	nd	nd	nd	nd
2/27/06	Tustin	Rain	0.1	nd	nd	nd	nd	nd
3/28/06	Tustin	Rain	0.1	nd	nd	nd	nd	nd
3/28/06	San Joaquin Marsh	Rain	0.05	nd	nd	nd	nd	nd

particulates). Gan et al. (2006) found none of the OCs in dry deposition (dust). In rain, however, p,p'-DDE was found in 65% of samples. Assuming 15 inches of annual rainfall, about 17 g of p,p'-DDE could be deposited directly to the Bay per year via wet deposition; the overall contribution of DDE to surface waters would likely be higher since runoff from terrestrial surfaces would contribute to the load. DDE, trans-chlordane and dieldrin were frequently detected in air, predominantly in the vapor phase (Table 4.6). In the gas phase, pesticides can partition into or out of surface waters; more information, however, is needed in order to predict the actual exchange flux for the OCs (Gan et al., 2006). It appears that in the San Diego Creek/Newport Bay watershed, atmospheric deposition accounts for only a very minor portion of the OCs loading to surface waters. Studies in nearby geographic areas have also demonstrated that the atmospheric background contribution of OC pollutants was very minor compared to other sources (Larry Walker and Associates, 2005).

4.3 Existing Loads

This section presents calculations of estimated existing loads of the organochlorine compounds to San Diego Creek and Newport Bay. The existing loads were calculated based on knowledge of how each of the OC pollutants partitions in the environment. A conceptual representation of the relationships among pollutant concentrations in organisms, sediment, and water is shown below in Figure 4-5.

4.3.1 San Diego Creek

Existing loads were estimated using the same process as was used by USEPA (2002). That procedure utilized the geometric mean of recently-measured tissue concentrations in *Cyprinella lutrensis* (red shiner) collected June 9, 1998, during monitoring conducted for the TSMP (USEPA 2002), and the bioconcentration factors (BCFs) obtained from scientific literature (Table 4-1). Staff agrees that recently-measured fish tissue concentrations should be used to best represent current conditions. Therefore, the geometric mean of red shiner and fathead minnow tissue concentrations from TSMP samples collected in 2002 (the most recent data) were used in calculations of existing loads. In 2002, the TSMP collected one red shiner and two fathead minnow composite samples. Samples had between 34-49 individuals per composite, and estimated average fish age was 0-3 years. For nondetectable concentrations, one-half the detection limit was used.

Existing loads were calculated for each of three different flow tiers (base, medium and high flows) and then summed to determine the total existing annual load to the Creek for each pollutant (see Table 4-7). Note that by using the most recent TSMP fish tissue data, the calculated existing loads for San Diego Creek are much lower than the loads calculated using the 1998 data (which were used by USEPA). This likely reflects the continued declining trend of OCs concentrations in the environment. The overall equation for calculating existing loads follows, with a complete discussion of the approach below:

$$\textit{Load (g/year)} = \frac{TC}{BCF \times f_d} \times Q \times Q_d \times 28.31 \times 86{,}400 \times 10^{-6} \qquad (5)$$

where TC = tissue concentration (μg/kg wet wt)
BCF = bioconcentration factor (L/kg)
f_d = fraction of pollutant in dissolved phase
Q = flow rate for individual flow tier (cfs)
Q_d = assumed flow duration for individual flow tier (days per year)
28.31 = conversion from cubic feet to liters
86,400 = conversion from seconds to days
10^{-6} = conversion from μg to g

BCFs (L/kg) are determined by performing laboratory experiments in which the only fish tissue uptake of pollutants is from the dissolved phase of the pollutant in water. The relationship is shown below:

$$BCF = \frac{C_{tissue}}{C_{dissolved}} \qquad (6)$$

Tissue concentration (C_{tissue}) is expressed as μg/kg on a wet weight basis, and the dissolved concentration ($C_{dissolved}$) is expressed as μg/L.

Total loading to the creek would include pollutants in both the dissolved (f_d) and particulate fractions (f_p). The relationship between the two fractions is shown below:

$$f_d = \frac{1}{1 + K_d \times C_s} \qquad (7)$$

and

$$f_p = 1 - f_d \qquad (8)$$

where C_s is the suspended sediment concentration in the water column (mg/L), and K_d is the pollutant-specific partition coefficient (m^3/g), describing the ratio of the concentration of pollutant adsorbed to solids to the concentration of the pollutant dissolved in water:

$$K_d = \frac{C_{particulates}}{C_{dissolved}} \quad (9)$$

and,

$$K_d = K_{oc} \times f_{oc} \quad (10)$$

where K_{oc} is the partition coefficient that describes the ratio of pollutant adsorbed to solids versus in solution, but is normalized to organic carbon content (f_{oc}). The organic carbon fraction was assumed to be 1 percent (f_{oc} = 0.01).

Suspended sediment concentrations (C_s) were determined for three different flow tiers within San Diego Creek: low flows, medium flows, and high flows. The selected flow tiers were based upon about 20 years of daily flow records within the Creek at Campus Drive (1977 through 1997) where there is a United States Geological Survey (USGS) stream gaging station. During the past 20 years, flow rates have varied at this site from 8 to 15 cfs during dry weather, to between 800 and 9,000 cfs during wet weather. The flows that were selected to represent low (<181 cfs), medium (181 to 814 cfs), and high flows (>814 cfs) were the median values for those flow ranges. A comprehensive discussion of the freshwater flow analysis is provided in Part B of USEPA's TMDL for Toxic Pollutants (2002).

Flow characteristics at San Diego Creek at Campus Drive are assumed to reflect the cumulative influence of all discharges to San Diego Creek and, ultimately, to Upper Newport Bay. RMA Associates, Inc. used the logarithmic relationship between flows and suspended particulates in the water column at this location to model amounts of sediments entering Newport Bay and their subsequent spatial distribution (RMA, 1997) (see Equation 11). The RMA model was important in the development of the USACOE Upper Newport Bay Ecosystem Restoration Feasibility Study (USACOE, 2000) and is commonly used in other TMDL projects in the watershed as well (e.g., nutrients).

$$\log y = -0.09(\log x)^2 + 2.24(\log x) - 1.96 \quad (11)$$

where y = the sediment yield (tons/day) and
x = flow (cfs)

The selected flow rates corresponding to low, medium, and high flow tiers and the corresponding suspended sediment concentrations expected for these flows are provided in Table 4-7.

Table 4-7. Flow Characteristics and Existing Loads to San Diego Creek*

Pollutant	Fish Tissue Concentration (μg/kg wet)	BCF (L/kg)	Dissolved Concentration (μg/L)	Flow Rate (Q) (cfs)	Flow Duration (Q_d) (days/year)	Suspended Sediment Concentration C_s (mg/L)	Dissolved Fraction (F_d)	K_d (m^3/g)	Existing Load (g/year)
Total DDT	161.5	363,000	0.0004	15	352	88	0.2551	.04677	22.5
				365	10	1569	0.0188		211.3
				1,595	3	4543	0.0066		792.6
Total Load-DDT									**1026.5**
*Chlordane***	9.7	37,800	0.0003	15	352	88	0.3894	.01622	8.5
				365	10	1569	0.0344		66.4
				1,595	3	4543	0.0122		246.3
Total Load-Chlordane									**321.2**
Toxaphene	10.0	52,000	0.0002	15	352	88	0.8046	.00251	3.1
				365	10	1569	0.1872		9.2
				1,595	3	4543	0.0736		30.6
Total Load-Toxaphene									**42.8**
*Total PCBs***	33.7	270,000	0.0001	15	352	88	0.4227	.01413	3.8
				365	10	1569	0.0393		28.4
				1,595	3	4543	0.0139		104.9
Total Load-PCBs									**137.1**

*Values for existing loads differ from the values calculated by USEPA (2002). Differences are due to the following: In converting from sediment yield to sediment concentration, USEPA used a metric ton conversion. Board staff calculated sediment concentration using a short ton conversion, since use of short tons is the local practice. Additionally, the log K_{oc} for total DDT was recalculated using a weighted average as opposed to the arithmetic average used by USEPA. This is because DDE>>DDD and DDT. Data used to determine the relative proportion of DDT and metabolites were obtained from the SCCWRP sediment toxicity study (2003). Fish tissue concentrations reported in the table are the geometric mean of red shiner and fathead minnow TSMP fish tissue concentration data obtained from San Diego Creek and tributaries during 2002 (n=3).

**Note that TMDLs for chlordane and PCBs in San Diego Creek are for informational purposes only.

4.3.2 Upper and Lower Newport Bay

Pollutant loading to Newport Bay was estimated based on the amount and distribution of sediment deposited as modeled by RMA for the USACOE (1997, 1998). The model assumes that sediment is supplied to the Bay primarily during storm events. Then, during dry weather, intertidal flows cause sediments to be resuspended and redistributed throughout the bay. Daily average flows in San Diego Creek at Campus Drive (assumed to provide 85-95% of the flows to the Bay) were used in conjunction with the functional relationship between flows and suspended sediment concentrations (Equation 11) to estimate annual sediment loading to the Bay. Based on their calculations, the average annual sediment load during the model calibration period (1985-1997) was over 100,000 tons of sediment per year. For comparison, the sediment TMDL allowable load for Newport Bay is 62,500 tons of sediment per year.

The RMA model also estimated sediment distribution within the Bay. The quantities of deposited sediment at several critical areas, coupled with the average concentrations of OC pollutants measured by Bay et al. (2004), provide an estimate for existing loading of OC pollutants to the Upper Bay and Lower Bay. Upper Newport Bay is defined as that area of the Bay north of the Pacific Coast Highway Bridge, and Lower Bay is that area between the bridge and the Bay entrance.

The following equation was used to calculate existing loads (g/year) for the Bay:

$$ExistingLoad = C_s \times D_s \times \rho_s \times (1 - P_s) \times 10^{-6} \qquad (12)$$

where C_s = measured concentration of OC pollutant (from Bay et al., 2004)
D_s = sediment deposition (m^3/year)
ρ_s = particle density (2500 kg/m^3)
P_s = porosity (assumed to be 0.65)
10^{-6} = conversion from μg to g

Table 4-8 shows the quantities of sediments deposited at each of the critical areas within the Bay, sediment chemistry results, and estimated annual loads. Where sediment chemistry results showed nondetects, one-half the detection limit was used in the calculations. Loads for each geographic area within Upper and Lower Newport Bay were summed to determine the total existing load.

Table 4-8. Estimated sediment deposition, chemistry, and existing loads to Upper and Lower Newport Bay.

Site Identification	(D_s) Sediment Deposition (m^3/year)	(C_s)[1] Total DDT[2] (μg/kg dw)	Existing Load-DDT (g/year)	(C_s) Chlordane (μg/kg dw)	Existing Load-Chlordane (g/year)	(C_s) Total PCBs (μg/kg dw)	Existing Load-PCBs (g/year)
Unit I Basin (NB10)	31474.17	67.29	1853.16	4.74	130.54	2.54	69.95
Unit II Basin (NB9)	30327.34	12.22	324.28	11.91	316.05	0.5	13.27
South of Unit II Basin (NB7)	11659.46	5.80	59.17	0.5	5.10	0.5	5.10
Downstream to PCH Bridge (NB6)	7772.97	12.06	82.02	0.5	3.40	0.5	3.40
Upper Newport Bay Total	81233.94		**2318.63**		**455.09**		**91.72**
Lower Bay (NB1)	17444.29	3.18	48.54	0.5	7.63	0.5	7.63
Turning Basin (NB4)	6782.52	64.70	383.98	4.32	25.64	37.29	221.31
Newport Channel (NB2)	5697.2	44.92	223.93	0.5	2.49	2.47	12.31
Lower Newport Bay Total	29924.01		**656.44**		**35.76**		**241.25**

[1]In USEPA's calculations (2002) sediment concentration data were used from one sampling date only (Bay et al., 2003 [preliminary report]); USEPA used data from NPDES monitoring as well. SCCWRP data used by USEPA (from 5/21/01) were revised in the Bay et al. Final Report (2004). Staff's approach uses the average pollutant concentration, from all sampling dates for each station, in Bay et al. (2004). Nondetects were assumed to be one half the detection limit.

5.0 LINKAGE ANALYSIS AND LOADING CAPACITY

5.1 Linkage Analysis

This linkage analysis investigates the relationship between OC pollutant loadings, targets, and adverse effects to beneficial uses, in order to calculate the loading capacity of each pollutant in each water body. The loading capacity is defined as the maximum amount of a pollutant that may be received by a water body and still achieve water quality standards (i.e., protect beneficial uses and meet numeric and narrative objectives). It is the critical link between applicable water quality standards (as interpreted through numeric targets) and the TMDL.

A conceptual depiction of the linkages between OCs in fish tissue, sediment and potential adverse effects to water quality standards is shown in Figure 5-1, and Figure 5-2 shows a more comprehensive conceptual food web model for the OCs in Newport Bay. Some of these processes have been discussed in previous sections of this document.

In Figure 5-1, Linkage (1) shows that the potential risk to human health and/or wildlife is proportional to the OC concentration in fish multiplied by the consumption rate. Linkage (2) shows that the OC concentration in the tissue of fish and benthic invertebrates is proportional to the OC concentration in the sediments to which the organisms (or prey organisms) are exposed. This linkage is illustrated in Figure 2.1, which shows a linear relationship between DDE concentration in a benthic organism and in Newport Bay sediments. It is clear that by reducing the OC concentrations in sediment, the concentrations in aquatic food webs should likewise be reduced. The utilization of empirical and mechanistic models by San Francisco Estuary Institute (SFEI), to evaluate risk to humans and wildlife from exposure to OCs in Newport Bay, should further improve our understanding of the relationships between OCs in sediments and in fish and wildlife within a variety of food webs.

San Diego Creek provides 85-95% of the freshwater input to Newport Bay; and a substantial amount of suspended particulates are ultimately discharged from San Diego Creek to the Bay, especially during large storms, where they may be subsequently deposited as bed sediments or flushed out of the Bay into coastal waters. Water column concentrations of the OCs in the Creek or the Bay would include pollutants that are adsorbed to suspended particulates (f_p) as well as pollutants that are in the dissolved phase (f_d). When flows are relatively high in San Diego Creek, almost all of the OCs present in the water column are associated with particulates, and f_d is estimated to be very low (see Table 4.7). Following from this explanation, linkage (3) shows the assumption that the OC pollutant concentration is proportional to the total suspended solids (TSS) concentration in the water column multiplied by the OC concentration of the suspended particulates. There are few data specific to the Newport Bay/San Diego Creek watershed with which to verify the Linkage (3) assumption; however, studies are underway that should provide these data. The linkage, however, has been observed in the Calleguas Creek Watershed in the Los Angeles region (See Figure 5-2, which is specific for DDT. The other OCs are also associated with particulates, and results should be similar).

The relationship between OCs and TSS reveals a potential strategy for attaining the numeric water column targets (i.e., CTR values) and, ultimately, sediment target values. Logically, if the OC concentration in suspended particulates in San Diego Creek is reduced, if the TSS concentration is reduced, or if both the OCs and the TSS concentrations are reduced, then attainment of the CTR criteria and sediment targets may be feasible in both San Diego Creek and Newport Bay.

The OC concentration in sediments is clearly the primary variable dictating whether water quality objectives and beneficial uses can be attained. Linkage (4) shows that OC concentrations in sediment are a function of sediment transport and OC loading; this relationship provides the foundation for calculating the loading capacities for these TMDLs. This assumption can be represented via a one-box mixing model where the OCs, in association with sediments, enter a defined reach of the Creek or the Bay, and are deposited, mixed, and/or resuspended. Likewise, OCs, in association with sediments, leave the stream reach or the Bay through current flow or tidal action (see Figure 5-1).

Sediment TMDLs for San Diego Creek and Newport Bay were adopted in 1998 and are being implemented; these TMDLs allow 62,500 tons per year of sediment to be deposited to San Diego Creek, and 62,500 tons per year of sediment to be discharged to Newport Bay. The loading capacities for the OCs can be calculated by using these allowable sediment loads and the target OCs concentrations in sediment. It is important to note that the OCs loading capacities in the USEPA technical TMDLs (2002) were based on the estimated *current* sediment loading to San Diego Creek and Newport Bay, resulting in much higher loads than would be obtained by using the sediment TMDL allowable loads for these waterbodies as limits. Therefore, Regional Board staff modified the USEPA TMDLs to ensure consistency between the OCs and sediment TMDLs for San Diego Creek and Newport Bay.

5.2 Loading Capacities

5.2.1 San Diego Creek

As shown below in Equation 13, the loading capacity for each pollutant was calculated by multiplying the sediment target concentration by the allowable annual sediment load to San Diego Creek and tributaries, as identified in the sediment TMDLs (allowable load is 62,500 tons per year). This approach is much more simplified than that performed by USEPA (2002); their approach did not take into account sediment TMDL targets, but used a series of calculations to determine loading capacities (g/year).

$$LoadingCapacity = C_s \times D_s \times 907.185 \times 10^{-6} \quad (13)$$

where C_s = sediment target concentration (μg/kg dw)
D_s = Allowable sediment load (tons/year = 62,500)
907.185 = conversion from kg to tons
10^{-6} = conversion from g to μg

5.2.2 Upper and Lower Newport Bay

For Newport Bay, Resource Management Associates (RMA) has modeled the amounts and in-bay distribution of sediment based on the estimated existing sediment discharges to the Bay (RMA, 1997). The fraction of the allowable 62,500 tons of annual sediment loading to the Bay estimated to be deposited within Upper Newport Bay and Lower Newport Bay was extrapolated from modeled sediment loads and in-bay distribution patterns. The RMA model predicted that 72.5 percent of sediment deposition would be to the Upper Bay, and 26.7 percent would be deposited within the Lower Bay. (A smaller fraction [0.8%] was estimated to be deposited within the Rhine Channel; TMDLs for the Rhine Channel are being developed independent of the Upper and Lower Newport Bay OCs TMDLs.) Applying these percentages to the 62,500-ton allowable annual load to the Bay, staff calculated that 45,312 tons of sediment could be deposited to Upper Newport Bay per year, and 16,688 tons per year to Lower Newport Bay. While it is recognized that in order to accurately estimate the deposition patterns within the Bay using the 62,500 tons per year of sediment loading as a constraint, the RMA model would likely need to be re-run, that is not feasible at this time. The present approach is considered to be a reasonable estimate based on best professional judgment. Additional modeling work will be identified in the OCs TMDLs implementation plan.

For each OC pollutant, the marine sediment target value (see Table 3-1) was applied to the estimated allowable sediment load for Upper and Lower Newport Bay to calculate the loading capacity (see Equation 13). Table 5-1 shows the loading capacity for each pollutant in San Diego Creek and Upper and Lower Newport Bay. Note that by ensuring consistency among the OCs and sediment TMDLs, the loading capacities for OCs in both San Diego Creek and Newport Bay are lower than those calculated by USEPA (2002).

Table 5.1. Loading capacities for San Diego Creek and Newport Bay.

Pollutant	Loading Capacity (g/year)		
	San Diego Creek	Upper Newport Bay	Lower Newport Bay
Total DDT	396	160	59
Chlordane	255*	93	34
Toxaphene	5.67		
Total PCBs	1933*	884	326

*Note that TMDLs for chlordane and PCBs in San Diego Creek are for informational purposes only.

6.0 TMDLs, LOAD ALLOCATIONS, AND MARGIN OF SAFETY

A total maximum daily load (TMDL) is defined as the maximum amount of a pollutant that can be received by a water body and still meet water quality standards. The TMDL is expressed as:

$$TMDL = WLA + LA + MOS \qquad (14)$$

where WLA = Waste Load Allocations for Point Sources
LA = Load Allocations for Nonpoint Sources
MOS = Margin of Safety

The allocations distribute the TMDL among all point and nonpoint sources. Various methods may be employed to determine how loads should be allocated, and numerous factors, including cost, technical achievability, and equity, should be considered (SWRCB, 2005).

In a recent D.C. Circuit Court of Appeals decision (*Friends of the Earth, Inc. v. EPA, et al.,* No. 05-5015 [D.C. Cir.2006]), the court held that two TMDLs for the Anacostia River did not comply with the Clean Water Act because they were not expressed as "daily" loads. In light of this decision, these TMDLs are being expressed in mass-based, average daily time increments for each waterbody.

The TMDLs are identified in Table 6-1a, below. Although these TMDLs are identified on an average daily load basis, because of the strong seasonality associated with OCs loadings during storm events, it is more logical for implementation to occur based on long-term average annual loadings (see Section 7). Therefore, the TMDLs are also expressed on an annual basis in Table 6-1b for implementation purposes.

TMDLs were determined by comparing the existing loads with the loading capacities. Where existing loads are greater than loading capacities, the TMDL is set to the loading capacity levels. Note that for all water bodies, existing loads for total PCBs were lower than the loading capacities, therefore, the proposed TMDLs are being set at existing load values. For Newport Bay, existing loads may be underestimated. Deposition rates and loads calculations assumed that San Diego Creek is the primary source of all of the OCs pollutants; however, for PCBs, the Rhine Channel may also be a source. Nevertheless, setting TMDLs at the lower of either existing load or loading capacity levels should ensure the TMDL fish tissue targets are eventually met and that pollutant levels in sediments will decrease over time. During implementation of these TMDLs, tasks will be undertaken to reduce uncertainty and better estimate existing loads for each of the OCs pollutants. The mass reductions that are estimated to be required in order to meet the TMDLs and thereby achieve water quality standards are also shown in Table 6-1a (average daily reductions) and 6-1b (annual reductions).

Table 6-1a. Existing Loads, Loading Capacities, TMDLs and Needed Reductions for San Diego Creek, Upper and Lower Newport Bay (expressed on a "daily" basis to be consistent with the recent D.C. Circuit Court of Appeals decision in *Friends of the Earth, Inc. v. EPA, et al.,* No. 05-5015 [D.C. Cir.2006]).

Water Body	Pollutant	Existing Load	Loading Capacity	TMDL	Needed Reduction
		average grams per day			
San Diego Creek	Total DDT	2.8	1.08	1.08	1.73
and Tributaries	Chlordane*	0.88	0.70	0.70	0.18
	Toxaphene	0.12	0.02	0.02	0.10
	Total PCBs*	0.38	5.30	0.38	Not Required
Upper Newport Bay	Total DDT	6.35	0.44	0.44	5.92
	Chlordane	1.25	0.25	0.25	0.99
	Total PCBs	0.25	2.42	0.25	Not Required
Lower Newport Bay	Total DDT	1.80	0.16	0.16	1.64
	Chlordane	0.10	0.09	0.09	0.01
	Total PCBs	0.66	0.89	0.66	Not Required

Table 6-1b. Existing Loads, Loading Capacities, TMDLs and Needed Reductions for San Diego Creek, Upper and Lower Newport Bay (expressed on an "annual" basis for implementation purposes).

Water Body	Pollutant	Existing Load	Loading Capacity	TMDL	Needed Reduction
		grams per year			
San Diego Creek	Total DDT	1027	396	396	631
and Tributaries	Chlordane*	321	255	255	66
	Toxaphene	42.8	6	6	37
	Total PCBs*	137	1933	137	Not required
Upper Newport Bay	Total DDT	2319	160	160	2159
	Chlordane	455	93	93	362
	Total PCBs	92	884	92	Not required
Lower Newport Bay	Total DDT	656	59	59	597
	Chlordane	36	34	34	2
	Total PCBs	241	326	241	Not required

*Note that TMDLs for chlordane and PCBs in San Diego Creek are being developed for informational purposes only.

The TMDLs for San Diego Creek, Upper Newport Bay, and Lower Newport Bay, including WLAs, LAs and MOS, are shown in Table 6-2a (average daily basis) and Table 6-2b (annual basis). For these TMDLs, loads were allocated based on land use area in the Newport Bay watershed (see Table 1-1), normalized to the estimated relative pollutant source contribution of each land use category (Table 6-3). The qualitative source rankings were assigned based on staff's judgment as well as on the scientific literature (e.g., Masters and Inman, 2000). This approach is consistent with that employed by USEPA in their development of the technical TMDLs (2002), as well as with that of the sediment TMDLs for these waterbodies. At this time, land use source rankings in Table 6-3 for each of the OCs are the same (i.e., urban land uses are ranked 5 for all of the OCs). The reasoning for this approach is as follows:

(1) To staff's knowledge, the highest concentrations of PCBs in the watershed occur in soils on former military bases. These areas are currently being developed or are planned for development. Thus, construction activities are believed to represent the land use most likely to contribute PCBs to San Diego Creek and, ultimately, to Newport Bay.
(2) The legacy OC pesticides were used in both agriculture activities and urban land uses. Because urbanized areas have been landscaped and/or have large percentages of impervious surfaces, agriculture and construction are believed to be the primary sources for all of the OC pesticides.

During TMDL implementation, sources will be better evaluated, and allocations may be revised in the future.

WLAs are defined as that portion of a receiving water's loading capacity that is allocated to its existing or future point sources of pollution (USEPA, 1991), and generally apply to point sources in the watershed regulated under NPDES permits. They include the county and municipalities covered under a Municipal Separate Storm Sewer System (MS4) permit, Caltrans under its NPDES permit, active construction sites covered under the State's General Permit, other NPDES permit holders, and commercial nurseries covered under waste discharge requirements (WDRs).

LAs are defined as the portion of a receiving water's loading capacity that is attributed to its existing or future nonpoint sources of pollution or to natural background sources (USEPA, 1991). They are best estimates of the loading, and can range from reasonably accurate estimates to gross allotments, depending on the availability of data and predictive techniques. The LAs apply to non-point sources, including agriculture (but excluding commercial nurseries covered under

Table 6-2a. Proposed TMDLs and Allocations for San Diego Creek, Upper and Lower Newport Bay (expressed on a "daily" basis to be consistent with the recent D.C. Circuit Court of Appeals decision in *Friends of the Earth, Inc. v. EPA, et al.,* No. 05-5015 [D.C. Cir.2006]).

	Type	Total DDT	Chlordane	Total PCBs	Toxaphene
		(average grams/day)			
San Diego Creek*					
WLA	Urban Runoff – County MS4 (36%)	0.35	0.23	0.12	0.005
	Construction (28%)	0.27	0.18	0.09	0.004
	Commercial Nurseries (4%)	0.04	0.03	0.01	0.001
	Caltrans MS4 (11%)	0.11	0.07	0.04	0.002
	Subtotal – WLA (79%)	**0.77**	**0.50**	**0.27**	**0.01**
LA	Agriculture (5%) (excludes nurseries under WDRs)	0.05	0.03	0.02	0.001
	Open Space (9%)	0.09	0.06	0.03	0.001
	Streams&Channels (2%)	0.02	0.01	0.01	0.0003
	Undefined (5%)	0.05	0.03	0.02	0.001
	Subtotal – LA (21%)	**0.21**	**0.13**	**0.07**	**0.003**
MOS (10% of total TMDL)		**0.11**	**0.07**	**0.04**	**0.002**
Total TMDL		**1.08**	**0.70**	**0.38**	**0.02**
Upper Newport Bay					
WLA	Urban Runoff - County MS4 (36%)	0.14	0.08	0.08	
	Construction (28%)	0.11	0.06	0.06	
	Commercial nurseries (4%)	0.02	0.01	0.01	
	Caltrans MS4 (11%)	0.04	0.03	0.02	
	Subtotal – WLA (79%)	**0.31**	**0.18**	**0.18**	
LA	Agriculture (5%) (excludes nurseries under WDRs)	0.02	0.01	0.01	
	Open Space (9%)	0.04	0.02	0.02	
	Channels & Streams (2%)	0.01	0.005	0.005	
	Undefined (5%)	0.02	0.01	0.01	
	Subtotal – LA (21%)	**0.08**	**0.05**	**0.05**	
MOS (10% of Total TMDL)		**0.04**	**0.03**	**0.03**	
Total TMDL		**0.44**	**0.25**	**0.25**	
Lower Newport Bay					
WLA	Urban Runoff – County MS4 (36%)	0.05	0.03	0.21	
	Construction (28%)	0.04	0.02	0.17	
	Commercial Nurseries (4%)	0.01	0.003	0.02	
	Caltrans MS4 (11%)	0.02	0.01	0.07	
	Subtotal – WLA (79%)	**0.11**	**0.07**	**0.47**	
LA	Agriculture (5%) (excludes nurseries under WDRs)	0.01	0.004	0.03	
	Open Space (9%)	0.01	0.01	0.05	
	Channels & Streams (2%)	0.003	0.002	0.01	
	Undefined (5%)	0.01	0.004	0.03	
	Subtotal – LA (21%)	**0.03**	**0.02**	**0.12**	
MOS (10% of Total TMDL)		**0.02**	**0.01**	**0.07**	
Total TMDL		**0.16**	**0.09**	**0.66**	

*Percent WLA (79%) and LA (21%) is applied to the TMDL, after subtracting the 10% MOS from the Total TMDL. Percent WLA and Percent LA add to 100%.

****Note that TMDLs are being developed for chlordane and PCBs in San Diego Creek for informational purposes only.**

Table 6-2b. Proposed TMDLs and Allocations (Annual) for San Diego Creek, Upper and Lower Newport Bay(expressed on an "annual" basis for implementation purposes).

		Total DDT	Chlordane	Total PCBs	Toxaphene
Category	**Type**	**(grams per year)**			
San Diego Creek*					
WLA	Urban Runoff – County MS4 (36%) Construction (28%) Commercial Nurseries (4%) Caltrans MS4 (11%) **Subtotal – WLA (79%)**	128.3 99.8 14.3 39.2 **281.6**	82.6 64.3 9.2 25.2 **181.3**	44.4 34.5 4.9 13.6 **97.5**	1.9 1.5 0.2 0.6 **4.3**
LA	Agriculture (5%) (excludes nurseries under WDRs)	17.8	11.5	6.2	0.3
	Open Space (9%)	32.1	20.7	11.1	0.5
	Streams & Channels (2%)	7.1	4.6	2.5	0.1
	Undefined (5%)	17.8	11.5	6.2	0.3
	Subtotal – LA (21%)	**74.8**	**48.2**	**25.9**	**1.1**
MOS (10% of Total TMDL)		**40**	**26**	**14**	**0.6**
Total TMDL		**396**	**255**	**137**	**6**
Upper Newport Bay					
WLA	Urban Runoff – County MS4 (36%) Construction (28%) Commercial Nurseries (4%) Caltrans MS4 (11%) **Subtotal – WLA (79%)**	51.8 40.3 5.8 15.8 **113.8**	30.1 23.4 3.3 9.2 **66.1**	29.8 23.2 3.3 9.1 **65.4**	
LA	Agriculture (5%) (excludes nurseries under WDRs)	7.2	8	7	
	Open Space (9%)	13.0	7.6	7.5	
	Streams & Channels (2%)	2.9	1.7	1.7	
	Undefined (5%)	7.2	4.2	4.2	
	Subtotal – LA (21%)	**30.2**	**21.4**	**20.3**	
MOS (10% of Total TMDL)		**16**	**9**	**9**	
Total TMDL		**160**	**93**	**92**	
Lower Newport Bay					
WLA	Urban Runoff – County MS4 (36%) Construction (28%) Commercial Nurseries (4%) Caltrans MS4 (11%) **Subtotal – WLA (79%)**	19.1 14.9 2.1 5.8 **41.9**	11.0 8.6 1.2 3.4 **24.2**	78.1 60.7 8.7 23.9 **171.4**	
LA	Agriculture (5%) (excludes nurseries under WDRs)	2.7	1.5	10.8	
	Open Space (9%)	4.8	2.8	19.5	
	Streams & Channels (2%)	1.1	0.6	4.3	
	Undefined (5%)	2.7	1.5	10.8	
	Subtotal – LA (21%)	**11.2**	**6.4**	**45.5**	
MOS (10% of Total TMDL)		**5.9**	**3.4**	**24**	
Total TMDL		**59**	**34**	**241**	

*Percent WLA (79%) is applied to the TMDL, after subtracting the 10% MOS. Percent WLA and Percent LA add to 100%.

****Note that TMDLs are being developed for chlordane and PCBs in San Diego Creek for informational purposes only.**

Table 6-3. Derivation of Weighted Allocation Percentages for Each Source of OCs in the San Diego Creek/Newport Bay Watershed

Land Use	Year 2002 Percent of Watershed Area	Relative Discharge Source Ranking	Relative Weighting	Weighted Allocation Percentage
Urban - Non-Roads*‡	52.6	5	210.4	36
Urban-Residential	*19.7*			
Urban-Education etc.	*17.7*			
Urban-Commercial	*9.8*			
Urban-Industrial	*5.4*			
Urban-Roads*	16.0	5	64	11
Construction**	8	1	160	28
Agriculture***	5.2	2	52	9
Vacant-Open Space	16	4	80	14
Channels&Streams	2	3	13.33	2
Sums	99.8	20	579.73	100

* Urban land use was subdivided to Urban – Non- Roads and Urban-Roads to provide an allocation (11% to Caltrans (see Table 6-2)); the subdivision was based upon the percentage of the total Urban land use comprised by Urban-Roads (16%).
**Construction land use percentage was based on the assumption that 8000 acres in the Newport Bay watershed are under active construction.
***Agriculture was further subdivided into point source discharges receiving WLAs (i.e., commercial nurseries that are currently covered under WDRs) and nonpoint source discharges receiving LAs (other agriculture, such as row crops). See Table 6-2.
‡Example Calculation for Weighted Allocation Percentage for Urban – Non-roads:
52.6*((20/5)/579.73)*100 = 36%

WDRs), open space, and erosion from natural streams and channels. Agriculture includes row crop growers and small commercial nurseries that are not currently covered under WDRs. An allocation is also provided for “undefined” sources, to account for atmospheric deposition and recirculation of existing bed sediments containing OC pollutants.

A margin of safety (MOS) is required to be incorporated into TMDLs to account for uncertainty in the relationship between pollutant loads and adverse effects to beneficial uses. The MOS may be incorporated implicitly through the use of conservative assumptions to develop the TMDLs, or the MOS can be added to the TMDL as a separate, explicit component. Consistent with the USEPA approach in developing the technical TMDLs (2002), an explicit (10%) MOS is being applied; therefore, the mass-based allocations were calculated as 90% of the TMDL for each constituent (Table 6-2a,b). For example, the TMDL for total DDT in San Diego Creek and tributaries is 1.08 grams per day. The 10% MOS, therefore, is 0.11 gram per day, leaving 90% (or 0.97 gram per day) to be distributed between WLAs and LAs. The percentages specified for WLAs and LAs in Table 6-2a are applied to that remaining 0.97 gram per day (TMDL-MOS) and total 100%.

In addition, a conservative approach was taken in developing these TMDLs, which should provide an added degree of protection to aquatic life, predator organisms, and human health. Some of the conservative assumptions and uncertainties pertaining to the TMDLs are identified below:

Conservative Approaches:

- The loading capacities are linked to the sediment TMDL target values (62,500 tons allowable load per year for San Diego Creek and Newport Bay), which are long-term annual average values with a 10-year compliance period. Periodic fluctuations are not represented, and actual loading may differ in the short term.
- Setting TMDLs at existing load levels when existing loads are less than loading capacities may be viewed as a conservative approach to setting TMDLs. Antidegradation policy precludes establishing allowable loads at levels that are higher than existing loads, and, thus, the approach taken is the most reasonable regulatory approach. It is assumed that if existing loads do not increase over time, but stay at levels that are ≤ existing conditions (i.e. TMDL allowable loads), then TMDL targets will be eventually met and water quality standards will be achieved.
- The RMA model was based a sediment transport curve generated based on flow conditions recorded at a gaging station on San Diego Creek at Campus Drive between 1985-1997 (see Section 4). Since 1997, the watershed has become increasingly urbanized and sediment transport patterns may be changing over time. It is possible that the regression model upon which load calculations were based may now overestimate the amount of sediment being discharged to the Bay. A pending contract with RMA will allow for reassessing sediment transport and in-bay distribution using updated flow data and design bathymetry for the Bay.
- USEPA used a constant sediment porosity value (0.65) to calculate existing OCs loads that are associated with sediment deposited in Newport Bay (USEPA, 2002), and staff used this same methodology (see Equation 12 in Section 4). Calculations of existing OCs loads also included sediment deposition rates that were derived from sediment transport models run by Resource Management Associates (see Section 4.3.2), which assumed a sediment porosity of 0.80. Use of the lower porosity (0.65) reflects the potential for consolidation of sediment following deposition, and results in higher calculated values of existing loads.
- Use of TELs as sediment targets is conservative, in that these low SQGs are associated with sediments with a mixed assemblage of pollutants, each of which may contribute to observed toxic effects.

Additional Uncertainties:

- Long-term sediment deposition patterns were used to calculate the total amount of sediment deposited in each region of Upper and Lower Newport

Bay (USEPA, 2002). These values do not represent short-term or localized fluctuations in sediment deposition rates or spatial distribution. Periodic accumulation or scouring could be substantial during large storm events, resulting in higher or lower deposition rates than the predicted sediment deposition and pollutant concentrations.

- The U.S. Army Corps of Engineers restoration plan for Upper Newport Bay is currently being implemented. This project will change the bathymetry of the Bay, and may affect future sediment deposition patterns and/or spatial redistribution, and effects to future OCs loadings are uncertain.
- Calculations of existing loads for San Diego Creek assumed a total organic carbon (TOC) content of 1 percent. This may be a good estimate of organic carbon content overall, but TOC actually ranges from <1 percent to about 3-4 percent. If the TOC was assumed to be 2 percent, the calculated existing loads would double. During implementation of these TMDLs, organic carbon will be measured in the Creek and existing loads will be directly measured; this will allow refinement of the TMDLs in future phases.
- USEPA calculated existing loads for San Diego Creek using the geometric mean of pollutant concentrations in red shiner that were collected on one date in June 1998 (USEPA), because those data represented the current conditions in 2002. Staff considered using those same data; however, newer data from the TSMP have become available since USEPA promulgated the technical TMDLs (USEPA, 2002), and these data better represent current conditions than older data from the 1990s. Using newer data resulted in calculated existing loads for San Diego Creek that were lower than the existing loads calculated using older data. Because the most recent tissue data are from 2002, even these data may not accurately reflect current conditions. Therefore, there remains some uncertainty as to what existing conditions actually are, although trend analyses can provide useful predictions. The County of Orange is undertaking a project that is aimed at directly measuring OCs loads in San Diego Creek and Newport Bay, and, once completed, it is anticipated that uncertainties associated with existing loads determinations will be reduced.

7.0 SEASONAL VARIATION AND CRITICAL CONDITIONS

These TMDLs analyzed the full range of flow conditions within San Diego Creek to account for seasonal variation in flows and existing pollutant loads. Annual deposition within Newport Bay was also accounted for in the RMA model (1998) that formed the basis of existing loads calculations; this model incorporated various flow regimes over multiple years to produce a sediment budget that represented weather patterns and flow conditions over a period of 12 years.

Sediments to which the OC pollutants adsorb are transported primarily within the watershed during the large storms that are most common during the rainy season, considered to be the months November through April (Figure 7-1). Sediment discharges (and, by virtue of association, OCs discharges) are closely related to rainfall received and flows within San Diego Creek. Thus, sediment discharges can vary both on a daily basis within a given year (Figure 7-2) and on an annual basis depending upon the amount of rain received (Figure 7-3). Because extensive sediment transport primarily occurs only during the extreme storm events that occur in the rainy season (see Figure 7-2), this seasonality can be considered to be the critical condition for OCs loading.

Although short term fluctuations in OCs loading may occur (e.g., within the time scale of wet and dry seasons within a given year), the adverse effects of the OCs are expected to be manifested over longer time periods in response to food web biomagnification. Short-term daily variations in loading should not cause significant variations in beneficial use effects (USEPA, 2002). Of note, however, is the fact that fish fillet tissue exceedances are largely restricted to the spring/summer season, with virtually no exceedances of OEHHA screening values observed during the winter. This may be due, in part, to the fact that fish tissue lipid concentrations are also higher in the summer compared to the winter months (data not shown).

Because of the pronounced seasonal relationship between sediment discharges and rainfall, and because of the long-term nature of adverse OCs effects, it is recommended that compliance with the proposed TMDLs be evaluated based on the average annual loadings, rather than on a daily basis, measured over a relatively long time period (see Table 6-2b). Implementation of the proposed OCs TMDLs would be based on these annual allocations.

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8.0 PROPOSED IMPLEMENTATION PLAN

8.1 Introduction

Federal regulations require states to incorporate TMDLs into water quality management plans (40 CFR 130.6). California's water quality management plan consists of the Regional Water Boards' Basin Plans (see Water Code Section 13240-13247) and statewide water quality control plans. While Section 13360 of the Water Code precludes Regional Boards from specifying method of compliance with WDRs, Section 13242 requires that basin plans include a program of implementation to achieve water quality objectives, including:

(a) a description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private;
(b) a time schedule for the actions to be taken; and
(c) a description of surveillance to be undertaken to determine compliance with objectives.

A TMDL does not establish new water quality standards. A TMDL is a management plan through which existing narrative or numeric water quality objectives and beneficial uses are to be achieved. An implementation plan must be developed to ensure that the TMDL achieves its purpose.

As discussed in previous sections of this report, concentrations of all of the OCs are decreasing in the environment and their use has been banned for many years. As a result, natural attenuation should eventually reduce OCs pollutant levels to concentrations that pose no threat to beneficial uses in San Diego Creek and Newport Bay. This Implementation Plan is aimed at identifying actions to accelerate the decline in OCs concentrations in the watershed, and to augment their natural attenuation.

Staff proposes that the Newport Bay/San Diego Creek OCs TMDLs be adopted as phased TMDLs. A phased TMDL is used when, for scheduling reasons, TMDLs need to be established despite significant data uncertainty and where the State expects that the loading capacity and allocation scheme will be revised in the near future as additional data are collected that will provide for more accurate TMDL calculations (USEPA, 2006). Accordingly, this approach provides time to conduct further monitoring and assessment, including data collection to fill informational gaps; development of site-specific, risk-based models to develop protective sediment and/or fish tissue targets; and assessment of open space and channel erosion as potential OCs sources. The results of these studies are expected to provide the technical basis for future modification of the TMDLs, WLAs, LAs, targets and/or other TMDL elements. Additional monitoring and assessment may also lead to delisting certain water body-pollutant combinations, should a finding of impairment no longer be supported.

Regional Board staff intends to coordinate TMDL implementation with the following agencies, programs, and policies:

- The Regional Board's Watershed Management Initiative (WMI) program for the Newport Bay/San Diego Creek watershed
- The Regional Board's permitting and enforcement sections
- The Regional Board's Storm Water compliance section
- The State Board's Nonpoint Source (NPS) Implementation and Enforcement Policy
- The State Board's Policy for Implementation of Toxic Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California
- The State Board's Sediment Quality Objectives (upon approval)
- The Newport Bay Watershed Management Committee
- U.C. Cooperative Extension and/or the Orange County Farm Bureau
- Other watershed stakeholders
- The U.S. Fish and Wildlife Service, and
- The California Department of Fish and Game

This implementation plan details the activities planned to augment natural attenuation and ensure that the OCs TMDLs are achieved. Implementation tasks include:

- Source control activities to reduce any active sources of OC pesticides and PCBs in the San Diego Creek/Newport Bay watershed;
- Implementation and evaluation of agricultural best management practices (BMPs) in the watershed;
- Implementation and evaluation of construction best management practices (BMPs) in the watershed;
- Special studies to evaluate sediment transport, OCs concentrations and areas where BMP implementation will be most effective in meeting the TMDL goals;
- Monitored natural recovery; this task includes investigation of multiple lines of evidence to evaluate long-term ecological recovery due to natural attenuation of contaminated sediments.

8.2 Relevant Special Studies Currently Underway in the Newport Bay/San Diego Creek Watershed

A number of investigations and monitoring programs have been established to assist with meeting TMDL goals. Some of the studies that are relevant to implementation of these TMDLs are listed below.

(1) <u>SCCWRP - Investigation of bioaccumulative contaminant concentrations in bird eggs, food items and sediment in the San Diego Creek/Newport Bay Watershed</u>

Project Director: Martha Sutula
Subcontractor: CH2MHill (Gary Santolo and Harry Ohlendorf)
Funding Source: State TMDL contract funds
Contract Amount: FY 03-04 $50,000; FY 04-05 $100,000.
Project Deliverable: Final Report due March 31, 2007
Project Purpose: To determine whether bioaccumulative contaminants such as selenium (Se) and organochlorine compounds (OCs) are bioaccumulating in birds and their food items in the San Diego Creek/Newport Bay watershed. Data will be used to structure a biological monitoring program for the Se and OCs TMDLs, to create a conceptual model of contaminant pathways in birds in the watershed, and to identify the most sensitive end receptors for these contaminants to determine appropriate numeric targets that will be protective of all of the beneficial uses in the watershed.

(2) SCCWRP/UCR/CSULB - Assessment of food web transfer of organochlorine compounds, selenium and trace metals in fishes in Newport Bay, California

Project Director: Dr. Jim Allen
Funding Source: Prop 13 CNPS grant
Grant Amount: $253,532.
Project Deliverable: Final Report due March 31, 2007.
Project Purpose: The project will focus on several identifiable trophic pathways leading to birds of concern or to human consumption. Key fish species will be collected and tissue analyzed for organochlorine pesticides, PCBs and trace metal concentrations. Stomach analysis will be conducted on these species to identify prey organisms or food (e.g., detritus, sediment) specific to Newport Bay, and trophic pathways. These food items and sediments will also be collected and analyzed for organochlorine compounds and trace metals. Fish tissue contamination will be evaluated relative to predator-risk guidelines, human health guidelines and TMDL targets; bioaccumulation factors will be calculated; appropriate fish species to use as surrogates for assessing ambient water quality will be identified; locations will be identified in Newport Bay where elevated concentrations in fish tissue and sediment were observed.

(3) County of Orange – San Diego Creek Sediment Pesticide Study

Project Director: Chris Crompton
Funding Source: Prop 13 PRISM grant
Grant Amount: $188,254.
Project Deliverable: Final Technical Report due March 31, 2007.
Project Purpose: The study will evaluate legacy organochlorine pesticide and PCBs mass loadings with respect to geographic location, flow, sediment particle size, and total organic content within the San Diego Creek/Newport Bay watersheds. The information gathered by the study will assist with the quantification of existing loads and identification of active sources and appropriate BMPs.

(4) SCCWRP – Pesticide Source Analysis in the Upper Newport Bay Watershed Using Chiral Properties and Isotopic Fingerprinting

Project Director: Ken Schiff
Funding Source: Prop 13 PRISM grant
Grant Amount: $185,155.
Project Deliverable: Final Project Report due March 1, 2007
Project Purpose: To employ two relatively new analytical methods, chiral gas chromatography (CGC) and compound-specific isotope analysis (CSIA), to identify and apportion sources of pesticides in the San Diego Creek/Newport Bay watershed. Compounds evaluated include chlorinated and organophosphorous pesticides, including chlorpyrifos, diazinon, chlordane, oxychlordane, dieldrin, DDT (six isomers), and toxaphene. Analysis of urban runoff (storm water and dry weather flow), sediments, water column, and air samples will be conducted to determine the sources of the target pesticides and to characterize their distribution in the San Diego Creek/Upper Newport Bay Watershed.

(5) Resource Management Associates (RMA) – Newport Bay Sediment Transport and Macroalgal Modeling (contract not yet executed)

Project Director: John DeGeorge
Funding Source: State TMDL Contract Funds
Contract Amount: $150,000
Project Deliverable: March 31, 2008
Project Purpose: Among other tasks identified in the scope of work, objectives include predicting general sediment deposition rates in Newport Bay under current loading conditions, and using updated or revised bathymetry, storm hydrographs, and sediment-flow regression equation; predicting fine-textured sediment deposition rates in Newport Bay under current sediment loading conditions using the updated/revised model.

(6) San Francisco Estuary Institute – Indicator Development and Framework for Assessing Indirect Effects of Sediment Contaminants.

Work performed under subcontract to Southern California Coastal Water Research Project, as part of the work product provided to the State Water Resources Control Board to aid in development of sediment quality objectives.

Project Director: Steve Bay
Funding Source: SWRCB
Subcontract Amount: $220,178 (a portion of which funds the Newport Bay case study)
Project Deliverable: April 25, 2006 (Draft report is under internal review. Final report is expected late 2006.)
Project Purpose:

The objective of the project is to provide methodology that will assist in evaluating indirect adverse biological effects for bioaccumulative pollutants (e.g. due to food web biomagnification), as part of the overall goal of developing statewide sediment quality objectives. Newport Bay is used as a case study to show how the proposed methodology could be implemented on a screening level. Multiple lines of evidence will be evaluated to determine impacts of organochlorine pesticides and PCBs to humans and wildlife. A conceptual foodweb model will be developed, and sensitive wildlife receptors will be identified. Empirical field data and a steady-state food web model will be used to calculate bioaccumulation factors for the OCs. The bioaccumulation factors will be combined with effects thresholds to identify sediment concentrations that are protective of target wildlife and humans. While the SFEI case study will provide a good foundation for evaluating indirect effects due to bioaccumulation, a more in-depth risk assessment may be necessary.

(7) University of California, Riverside – Reduction of Pesticide Runoff from Nurseries

Project Director: Jan Gan
Funding Source: SWRCB
Contract Amount: $306,758
Project Deliverable: June 30, 2007
Project Purpose: The main objective of the project is to develop various BMPs and to evaluate their effectiveness for reducing pesticide runoff from nurseries. Statewide efforts will also be made to extend the BMPs to nursery growers in other regions throughout California. While the need for the project stemmed from the water quality problems associated with organophosphate pesticides (i.e., diazinon and chlorpyrifos), some of the BMPs that reduce the discharge of OP pesticides may have the added benefit of reducing the discharge of sediment-associated legacy pesticides as well.

(8) County of Orange Resources and Development Management Division, Water Quality Monitoring Program for Santa Ana Region (2003 DAMP).

In 2005, pursuant to specifications in the Monitoring and Reporting Program No. R8-2002-0010, NPDES No. CAS618030, the County revised the stormwater monitoring program that is conducted under the 3rd Term MS4 Permit, to incorporate monitoring elements for the toxics TMDLs (RDMD, 2003 DAMP, Exhibit 11.II). Watershed-specific issues relevant to the toxics TMDLs were identified. Work to address these issues will be managed and funded by a group of permittees within the watershed, and coordination will occur through the NPDES monitoring program. The specific watershed issues identified by the permittees are listed below. Addressing these issues is consistent with the TMDL implementation activities that were identified previously.

- Identification of in-bay sites with substantially elevated pollutant levels;

- An assessment of current understanding of sediment and pollutant movements through the Newport Bay system;
- Long-term monitoring of fish tissue for pollutants above screening values for human and/or wildlife health;
- Assess the need for and design a benthic community monitoring effort;
- The design of future egg tissue and teratogenesis studies.

8.3 Proposed Implementation Tasks

In order to implement the TMDLs, WLAs and LAs, Board staff recommends that the following actions be undertaken. Proposed dates for implementation of these actions are specified in Table 8-1 and in the draft Basin Plan Amendment.

Phase I Implementation

8.3.1 Revise Existing WDRs and NPDES Permits

The Regional Board shall review and revise, as necessary, the existing NPDES permits, including the area's MS4 permit, and WDRs for commercial nurseries, specified in Table 8-2, to incorporate the appropriate TMDL WLAs, compliance schedules, and monitoring program requirements. Provisions will be included in all new and renewed NPDES permits and WDRs to specify that, during Phase I implementation of these TMDLs, permit compliance will be based upon iterative implementation of effective BMPs to manage the discharge of fine sediments containing OCs, along with monitoring to measure BMP effectiveness. Permit revisions shall be accomplished as soon as possible upon approval of the Basin Plan Amendment. Given Regional Board resource constraints and the need to consider other program priorities, permit revisions are likely to be tied to renewal schedules.

For commercial nurseries covered under existing WDRs, revisions of these WDRs shall address the following identified needs:

(1) Evaluation of sites to determine/verify potential storm water and nonstorm water discharge locations;
(2) Evaluation of current monitoring programs and methods of sampling and analysis for consistency with other monitoring efforts in the watershed;
(3) In cooperation with U.C. Cooperative Extension, evaluation of BMPs for adequacy and implementation of the most effective BMPs to reduce/eliminate the discharge of potentially-contaminated fine sediments in both storm water and non-storm water discharges;
(4) Monitoring to better quantify nursery runoff as a potential source of organochlorine compounds and to assure that load reductions are achieved; and

(5) Development of a workplan to be submitted within one month of the effective date of these TMDLs that identifies: (a) the BMPs implemented to date and their effectiveness in reducing fine sediment and organochlorine compound discharges; (b) the adequacy and consistency of monitoring efforts, and proposed improvements; (c) a plan and schedule for implementation of revised BMPs and monitoring protocols, where appropriate. It is recognized that most nursery operations are likely to be of very limited duration due to the expiration of land leases. The workplan shall identify recommendations for BMP and monitoring improvements that are effective, reasonable and practicable, taking this consideration into account. This workplan shall be implemented upon approval by the Regional Board Executive Officer.

The Municipal Separate Storm Sewer System (MS4) permit (R8-2002-0010, NPDES No. CAS618030) and monitoring program shall be revised to address monitoring and BMP-related tasks identified in Table 8-1 and further discussed below. Revisions shall include requirements for evaluation of discharges of the OCs from open space areas; oversight and implementation of construction BMPs; OCs source evaluations; assessment of dredging feasibility and identification of a funding mechanism; and revision of the regional monitoring program.

NPDES permits that regulate discharges of ground water to San Diego Creek shall be reviewed and revised as necessary to require annual (at a minimum) monitoring, using the most sensitive analytical techniques practicable, to analyze for organochlorine compounds in the discharges. If organochlorine compounds are found to be present, the dischargers shall be required to evaluate whether and to what extent the discharges would cause or contribute to an exceedance of the wasteload allocation and to implement appropriate measures to reduce or eliminate organochlorine compounds in the discharges.

Table 8-1. TMDL Tasks and Schedule

Task	Description	Compliance Date – As Soon As But No Later Than
PHASE I IMPLEMENTATION		
1	Revise existing WDRs and NPDES permits: *Commercial Nursery WDRs, MS4 Permit, Other NPDES Permits*	Upon State approval of BPA and permit renewal
2	a. Develop proposed agricultural BMP and monitoring program to assess and control OCs discharges. b. Implement program	a. *(3 months after State approval of BPA)* b. Upon Regional Board approval
3	a. Identify responsible parties for open space areas b. Develop proposed monitoring program to assess OCs inputs from open space areas c. Implement proposed monitoring program	a. *(1 month after State approval of BPA)* b. *(2 months after notification of responsible parties)* c. Upon Regional Board approval
4	Implement effective sediment and erosion control BMPs for management of fine particulates on construction sites: Regional Board: a. Develop SWPPP Improvement Program b. Conduct outreach/training programs MS4 Permittees: c. Revise planning processes as necessary to assure proper communication of SWPPP requirement d. Evaluate/implement BMPs effective in reducing/eliminating organochlorine discharges	a. (*Upon State approval of BPA*) *b. (Two months after State approval of BPA)* c and d: Upon appropriate revision of the MS4 permit
5	Evaluate sources of OCs; develop and implement BMPs accordingly	Upon appropriate revision of MS4 permit
6	Evaluate feasibility and mechanisms to fund future dredging operations within San Diego Creek, Upper and Lower Newport Bay	Submit feasibility/funding report within *(3 years of BPA approval)*
7	Develop workplan to meet TMDL implementation requirements, consistent with an adaptive management approach	Workplan due *(3 months after BPA approval)*
8	Revise regional monitoring program	*(3 months after BPA approval);* Annual Reports due November 15
9	Conduct special studies	As funding allows, and in order of priority identified in task 8.3.7
PHASE II IMPLEMENTATION		
10	Review TMDLs, including numeric targets, WLAs and LAs; delist or revise TMDLs pursuant to established Sediment Quality Objectives, new data, and results of special studies	No later than *(5 years from State approval of BPA)*

Table 8-2. Existing NPDES Permits and WDRs Regulating Discharges in the Newport Bay Watershed.

No.	Permit Title	Order No.	NPDES No.
1	Waste Discharge Requirements for the United States Department of the Navy, Former Marine Corps Air Station Tustin, Discharge to Peters Canyon Wash in the San Diego Creek/Newport Bay Watershed	R8-2006-0017	CA8000404
2	Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the Incorporated Cities of Orange County within the Santa Ana Region - Areawide Urban Storm Water Runoff - Orange County	R8-2002-0010	CAS618030
3	General Waste Discharge Requirements for Discharges to Surface Waters that Pose an Insignificant (de minimus) Threat to Water Quality	R8-2003-0061 as amended by R8-2005-0041 and R8-2006-0004	CAG998001
4	General Waste Discharge Requirements for Short-term Groundwater-Related Dischargers and De Minimus Wastewater Discharges to Surface Waters Within the San Diego Creek/Newport Bay Watershed	R8-2004-0021	CAG998002
5	General Groundwater Cleanup Permit for Discharges to Surface Waters of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by Petroleum Hydrocarbons, Solvents and/or Petroleum Hydrocarbons mixed with Lead and/or Solvents	R8-2002-0007, as amended by R8-2003-0085 and R8-2005-0110	CAG918001
6	Waste Discharge Requirements for City of Tustin's 17th Street Desalter	R8-2002-0005	CA8000305
7	Waste Discharge Requirements for City of Irvine, Groundwater Dewatering Facilities, Irvine, Orange County,	R8-2005-0079	CA8000406
8	Waste Discharge Requirements for Bordiers Nursery, Inc.	R8-2003-0028	
9	Waste Discharge Requirements for Hines Nurseries, Inc.	R8-2004-0060	
10	Waste Discharge Requirements for El Modeno Gardens, Inc., Orange County	R8-2005-0009	
11	Waste Discharge Requirements for Nakase Bros. Wholesale Nursery, Orange County	R8-2005-0006	

8.3.2 Develop and Implement an Agricultural BMP and Monitoring Program

Apart from certain nurseries, agricultural operations in the watershed are not currently regulated pursuant to waste discharge requirements (see Table 8-2). The SWRCB's "Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program" (Nonpoint Source Policy) (2004) requires that all nonpoint source dischargers be regulated under WDRs, waivers of WDRs, Basin Plan prohibitions, or some combination of these three administrative tools. Board staff is developing recommendations for an appropriate regulatory approach to address agricultural discharges. It is expected that the Regional Board will be asked to consider these recommendations and to approve a regulatory approach in late 2007.

In the interim, it is appropriate to require agricultural operators to identify and implement a monitoring program to assess OCs discharges from their facilities, and to identify and implement a BMP program designed to reduce or eliminate those discharges. The proposed monitoring and BMP program shall be submitted as soon as possible, but no later than 3 months from State approval of the BPA. The monitoring and BMP program will be components of the waste discharge requirements or conditional waiver of waste discharge requirements that Board staff will recommend to implement the Nonpoint Source Policy. LAs identified in these TMDLs will also be specified in the WDRs/waiver, along with a schedule of compliance.

It is recognized that most agricultural operations are expected to be of very limited duration due to the expiration of land leases. The monitoring and BMP programs proposed by the agricultural operators should include recommendations that are effective, reasonable and practicable, taking this consideration into account. The BMP and monitoring programs shall be implemented upon approval by the Regional Board. The BMP and monitoring programs could be implemented individually or by a group or groups of agricultural operators. In addition, these BMP/monitoring programs may be coordinated with the development of a watershed-wide workplan (see 8.3.7).

8.3.3 Identify Parties Responsible for Open Space Areas; Develop and Implement an OCs Monitoring Program to Assess Open Space Discharges

Nonpoint source discharges from open space are also subject to State regulation. During Phase I of these TMDLs, sufficient data shall be collected by the responsible parties (e.g., County, private land owners) to determine whether discharges of OCs from designated open space, as well as discharges resulting from erosion in and adjacent to unmodified streams, are causing or contributing to exceedances of water quality objectives and/or impairment of beneficial uses of San Diego Creek and Newport Bay. With the assistance of the stakeholders, Regional Board staff will identify the responsible parties as soon as possible but no later than one month from

State approval of this BPA. Board staff will notify the identified responsible parties of their obligation to propose an organochlorine compound monitoring program within two months of notification. The monitoring program shall be implemented upon Regional Board approval. This program may be coordinated with the development of a watershed-wide workplan (see Task 8.3.7). The Regional Board will consider whether WDRs or a WDR waiver is necessary and appropriate for open-space discharges, based on the monitoring results. These results will also inform future review and revisions of these TMDLs.

8.3.4 Develop and Implement Appropriate BMPs and Sampling Plans for Construction Activities

Currently, all construction activities in the watershed are regulated under the State Water Resource Control Board's (SWRCB) General Permit for Discharge of Storm Water Runoff Associated with Construction Activity (Order No. 99-08-DWQ, NPDES No. CAS000002; the "General Construction Permit"), and/or the MS4 NPDES permit. The requirements of these permits, which require an iterative, adaptive-management BMP approach, coupled with monitoring, are the foundation for meeting the TMDL WLAs for construction.

The General Construction Permit requires the permittees to: develop and implement a site-specific storm water pollution prevention plan (SWPPP); install and maintain appropriate best management practices (BMPs) to prevent erosion, manage sediments, and eliminate unauthorized non-storm water discharges; and conduct periodic inspections to ensure BMPs are adequate and maintained. The General Construction Permit also requires that sampling and analysis be conducted for pollutants that are: a) not visually detectable in storm water discharges; (b) are known or should be known to occur on the construction site; and (c) could cause or contribute to an exceedance of water quality objectives in the receiving water. Pollutants can be considered to be known to occur on the construction site if they were applied to the soil as part of past land use activities. Because the majority of new construction in the San Diego Creek/Newport Bay watershed occurs on sites previously in agricultural land use and on which the organochlorine pesticides may have been applied, sampling and analysis must be conducted of storm water and nonstorm water discharges containing sediments, in accordance with the requirements of the General Construction Permit.

Pursuant to the Phase II MS4 regulations, Orange County and the municipal co-permittees developed a local program to control storm water discharges from construction sites and to manage post-construction urban runoff. Prior to issuance of grading or building permits, a project applicant must demonstrate coverage, if appropriate, under the General Construction Permit and must prepare a project-specific Erosion and Sediment Control Plan (ESCP). Both the SWPPP and ESCP must be implemented once construction begins.

To assure that effective construction BMPs are identified and implemented, program improvements are needed in the following areas: (a) Storm Water Pollution Prevention Plans (SWPPPs) prepared in response to the General Construction Permit must include supporting documentation and assumptions for selection of sediment and erosion control BMPs, and must state why the selected BMPs will meet the Construction WLAs for the organochlorine compounds; (b) SWPPP provisions must be rigorously implemented on construction sites; (c) sampling and analysis for the organochlorine pesticides and PCBs in storm and nonstorm discharges containing sediment from construction sites is necessary to determine the efficacy of BMPs, as well compliance with the construction WLAs; sampling and analysis plans must be included in SWPPPs; (d) additional BMPs, including advanced treatment BMPs, must be evaluated to determine those most appropriate for reducing or eliminating organochlorine compound discharges from construction sites (e.g., BMPs effective in control of fine particulates); (e) outreach and training are necessary to communicate these SWPPP requirements and assure their effective implementation; and (e) enforcement of the SWPPP requirements is necessary.

To address these program improvements, Regional Board staff shall develop a SWPPP Improvement Program that identifies the Regional Board's expectations with respect to the content of SWPPPs, including documentation regarding the selection and implementation of BMPs, and a sampling and analysis plan. The Improvement Program shall include specific guidance regarding the development and implementation of monitoring plans, including the constituents to be monitored, sampling frequency and analytical protocols. Accordingly, the SWPPP Improvement Program shall be completed by the date of State approval of the BPA. No later than two months from completion of the Improvement Program, Board staff shall assure that the requirements of the Program are communicated to interested parties, including dischargers with existing authorizations under the General Construction Permit, and provide training as necessary. Existing, authorized dischargers shall revise their project SWPPPs as needed to address the Program requirements within three months of State approval of these TMDLs. Upon completion of needed outreach and training concerning the requirements of the SWPPP Improvement Program, SWPPPs that do not adequately address the Program requirements shall be considered inadequate and enforcement shall proceed accordingly.

The MS4 permit shall be revised as needed to assure that the permittees communicate the Regional Board's SWPPP expectations, based on the SWPPP Improvement Program, with the Standard Conditions of Approval. The MS4 permittees shall conduct studies to evaluate BMPs that are most appropriate for reducing or eliminating organochlorine compound discharges from construction sites (e.g., fine particulates), including advanced treatment BMPs. MS4 Permittees and Co-permittees shall include these BMPs in the Orange County Stormwater Program Construction Runoff Guidance Manual. Implementation of these MS4 permittee requirements shall commence upon approval of an appropriately revised MS4 permit.

8.3.5 Evaluate sources of OCs to San Diego Creek and Newport Bay; Identify and Implement Effective BMPs to Reduce/Eliminate Sources

Based on the regional monitoring program being implemented by the MS4 permittees and/or on the results of other monitoring and investigations, the MS4 permittees shall conduct source analyses in areas tributary to the MS4 demonstrating elevated concentrations of OCs. Based on mass emissions monitoring (described below) and source analysis, the permittees shall implement additional/enhanced BMPs as necessary to ensure that organochlorine compounds discharges from significant land use sources to surface waters are reduced or eliminated.

The permittees shall develop and implement a collection program for all banned OC pesticides and PCBs. This type of program has had demonstrated success in other geographic areas in collecting and disposing of banned pesticides. Residents and businesses in the watershed may have stored legacy pesticides that could be collected through such a program; if this is the case, this task would prevent future use and improper disposal of these banned pesticides.

Implementation of these requirements shall commence upon approval of an appropriately revised MS4 permit.

8.3.6 Evaluate Feasibility and Mechanisms to Fund Future Dredging Operations

Because large-scale erosion and sedimentation primarily occurs during large storm events, traditional BMPs may have limited success in reducing/eliminating the discharge of potentially-contaminated sediments to receiving waters during wet weather. In such cases, dredging within Newport Bay and/or San Diego Creek may be the most feasible and appropriate method of reducing OCs loads in these waters. However, the feasibility and effectiveness of dredging projects in removing OCs would require careful consideration, since dredging may or may not expose sediments with higher concentrations of OCs. Financing of such projects is also a significant consideration.

Entities discharging potentially contaminated sediment in the watershed shall analyze the feasibility of periodic dredging to achieve water quality standards, and shall identify funding mechanisms for ensuring that future dredging operations can be performed, as necessary, within San Diego Creek, Upper and Lower Newport Bay. A report that presents the results of this effort shall be submitted no later than 3 years from the date of State approval of the BPA. This evaluation may be coordinated with the development of a watershed-wide workplan (see 8.3.7.).

8.3.7 Develop a Workplan to Meet TMDL Implementation Requirements, Consistent with an Adaptive Management Approach

These TMDLs are to be implemented within an adaptive management framework, with compliance monitoring, special studies, and stakeholder interaction guiding the process over time. Information obtained from compliance monitoring will measure progress toward achievement of WLAs and LAs, potentially leading to changes to TMDL allocations; ongoing and recommended special studies, if implemented, may provide information that leads to revisions to the TMDLs, adjustments to the implementation schedule, and/or improved implementation strategies. Thus, implementation of the TMDLs is expected to be an ongoing and dynamic process.

Substantial efforts are now being made by many stakeholders in the watershed to address established permit and/or TMDL requirements for BMP implementation and monitoring and to conduct special investigations to understand and improve water quality conditions in the watershed. For example, the Southern California Coastal Water Research Project (SCCWRP), the University of California, and the County of Orange are all involved in studies aimed at improving the understanding of causes of sediment toxicity, measuring mass emissions, developing sediment quality objectives, analyzing sources, and other relevant projects. The Irvine Company, in conjunction with other watershed stakeholders, is implementing a workplan to gain a better understanding of biologic effects of the OCs, determining appropriate screening values, and determining the cause of sediment toxicity in the watershed. The framework exists for developing a comprehensive watershed plan for addressing water quality, not only as it relates to the OCs, but on a larger scale that encompasses all sources of water quality impairment.

In light of this established framework, many of the preceding implementation tasks may be accomplished most effectively and efficiently through the development and implementation of a watershed-wide workplan, developed by interested stakeholders and approved by the Regional Board. The purpose of the workplan would be to (1) review implementation requirements and integrate TMDL implementation tasks with those already being conducted in response to other programs (e.g., permits, TMDLs); (2) prioritize implementation tasks; (3) develop a framework for implementing the tasks, including a schedule and funding mechanism; (4) implement tasks; and (5) make recommendations regarding needed revisions to the TMDLs. Stakeholders interested in pursuing this approach would be required to commit to their participation in the development and implementation of the workplan within one month of the State approval of these TMDLs. A proposed workplan would be required within 3 months of State approval of these TMDLs. Implementation of the workplan would commence upon approval by the Regional Board. To the extent of any conflicts between the individual tasks and schedules identified above and the prioritized plan and schedule identified in the workplan, the workplan would govern implementation activities with respect to the stakeholders responsible for workplan development and implementation.

8.3.8 Revise Regional Monitoring Program

Section 13242 of the California Water Code specifies that Basin Plan implementation plans must contain a description of the monitoring and surveillance programs to be undertaken to determine compliance with water quality objectives. As part of the incorporation of the proposed San Diego Creek/Newport Bay OCs TMDLs into the Basin Plan, specific monitoring requirements are proposed in order to evaluate the effectiveness of actions and programs implemented pursuant to the TMDL. Since these TMDLs are proposed as phased TMDLs, follow-up monitoring and evaluation are essential to properly validate and revise the TMDLs.

The County of Orange, as Principal Permittee under the County's MS4 permit, oversees the regional monitoring program. Implementation of the monitoring program is supported by funds shared proportionally by each of the Permittees. The program elements are described in the DAMP Section 11, and are in accordance with requirements of the MS4 Permit.

By 3 months from the effective date of these TMDLs, the MS4 permittees shall: (1) document each of the current monitoring program elements that addresses the monitoring requirements identified in the preceding tasks; and, (2) revise the monitoring program as necessary to assure compliance with these monitoring requirements.

Review of/revisions to the monitoring program shall address:

(1) Estimation of mass emissions of chlordane, DDT, PCBs and toxaphene.
(2) Determination of compliance with MS4 wasteload allocations for Upper and Lower Newport Bay, and of status of achievement with the informational wasteload allocations for San Diego Creek for chlordane and PCBs.
(3) Assessment of temporal and spatial trends in organochlorine compound concentrations in water, sediment and tissue samples.
(4) Semi-annual sediment monitoring in San Diego Creek and Newport Bay. Measurements of sediment chemistry in these waters should be evaluated with respect to evidence of biological effects, such as toxicity and benthic community degradation.
(5) Evaluation of organochlorine bioaccumulation and food web biomagnifications.
(6) Assessment of the degree to which natural attenuation is occurring in the watershed.

Staff recognizes that accurately quantifying the very small mass loads that are allowable under these TMDLs will be very challenging, and recommends that analytical strategies for quantifying loads of the OCs be carefully explored.

Revisions to the monitoring program should also take into consideration the following recommendations provided by members of the OCs TMDL Technical Advisory Committee (TAC):

(1) The analytical parameters measured need to be established for each matrix of interest (e.g., sediment, tissue, ambient water). The representative list of compounds to be measured needs to be identified (e.g., what chlordane compounds will be measured and summed to represent "total chlordane;" will PCB congeners be measured and summed or will Aroclors?).
(2) Data quality will need to be consistent with the State's Surface Water Ambient Monitoring Program (SWAMP). Detection limits, accuracy and precision of analytical methods should be adequate to assure the goals of the monitoring efforts can be achieved.
(3) Bioaccumulation/biomagnification in high trophic level predators may not immediately respond to load reductions; appropriate time scales and schedules for monitoring that are supported by empirical data and/or modeling should be established.
(4) Sentinel fish and wildlife species should be selected for monitoring based on home range, life history, size and age.

8.3.9 Conduct Special Studies

Board staff recommends that the following special studies be conducted, in addition to the studies already underway in the watershed and described earlier in this section. These recommendations are based, in part, on recommendations of the technical advisory committee for the OCs TMDLs. These studies will be implemented as resources become available, and the results will be used to review and revise these TMDLs. Stakeholder contributions to these investigations are encouraged and would facilitate review of the TMDLs.

(1) Evaluation of sediment toxicity in San Diego Creek and tributaries, and Upper and Lower Newport Bay.

Previous studies have included Toxicity Identification Evaluations (TIEs) that have yielded inconclusive results as to the cause of toxicity in Newport Bay. Sediment toxicity within San Diego Creek is not well-documented or well-understood. There is evidence that pyrethroid compounds may be a significant contributor. In determining the extent to which nonpolar organic compounds are causing or contributing to sediment toxicity, the differential contribution of both the OCs and pyrethroids should be determined to assure that control actions are properly identified and implemented. Monitoring should be performed year-round and multiple locations within San Diego Creek and Newport Bay (to encompass spatial and temporal variability), and should include various land use types in order to quantify the relative contributions from various sources.

(2) Refinement of sediment and tissue targets.

A study is being conducted by the San Francisco Estuary Institute to develop indicators and a framework for assessing the indirect effects of sediment contaminants. The objective is to provide methodology that will assist in evaluating indirect adverse biological effects for bioaccumulative pollutants (e.g. due to food web biomagnification), as part of the overall goal of developing statewide sediment quality objectives. Newport Bay is being used as a case study to show how the proposed methodology could be implemented on a screening level. Multiple lines of evidence will be evaluated to determine impacts of organochlorine pesticides and PCBs to humans and wildlife. A conceptual foodweb model will be developed, and sensitive wildlife receptors will be identified. Empirical field data and a steady-state food web model will be used to calculate bioaccumulation factors for the organochlorine compounds. The bioaccumulation factors will be combined with effects thresholds to identify sediment concentrations that are protective of target wildlife and humans.

Once completed by SFEI, a thorough evaluation of the Newport Bay case study needs to be initiated, and any additional analyses required for a more in-depth risk analysis should be identified and completed. Protective sediment and tissue targets for indirect effects to humans and wildlife should be developed by the time the TMDLs are re-opened. Furthermore, once TIEs have identified the likely toxicant(s) responsible for sediment toxicity in San Diego Creek and Newport Bay (direct effects), field and laboratory studies should be conducted in order to determine bioavailability and the dose-response relationship between sediment concentrations and biologic effects.

(3) Evaluation of regional BMPs (e.g., constructed wetlands and sediment detention basins) for mitigating potential adverse water quality impacts of sediment-associated pollutants (e.g., OCs, pyrethroids).

Large-scale, centralized BMPs such as constructed wetlands and storm water retention basins may be more effective than project-level BMPs in reducing adverse environmental impacts of sediment-borne pollutants. Regional BMPs are either being planned or are in place within the watershed (e.g., IRWD NTS). Their potential effectiveness for capturing the OCs and mitigating impacts needs to be evaluated.

(4) Improvement in linkage between toxaphene measured in fish tissue and toxaphene in bed sediments.

The toxaphene impairment listing is based on fish tissue exceedances that have no measured linkage with toxaphene in sediments. While sediment is the primary TMDL target for these TMDLs, toxaphene is usually not detected in sediment. Because of its chemical complexity, there is a large degree of analytical uncertainty with measurements of toxaphene in environmental samples that use standard methods (e.g., EPA Method 8081a), especially at low levels. Confirmations of toxaphene in fish and sediment samples in San Diego Creek (and possibly Newport Bay) using other techniques (e.g., GC-ECNI-MS or MS/MS) is recommended.

(5) Evaluation of relative importance of continuing OCs discharges to receiving waters through erosion and sedimentation processes, versus recirculation of existing contaminated bed sediments, in causing beneficial use impairment in San Diego Creek and Newport Bay.

Phase II Implementation

8.3.10 TMDL Reopener

These TMDLs will be reopened no later than five (5) years following their effective date in order to evaluate the effectiveness of Phase I implementation. At that time, all new data will be evaluated and used to reassess impairment, BMP effectiveness, and whether modifications to the TMDLs are warranted. If Phase I BMPs have been shown to be ineffective in reducing OCs loads, then more stringent BMPs may be necessary during Phase II implementation.

It should also be recognized that implementation of these TMDLs and the schedule for implementation are very closely tied with other TMDLs that are currently being implemented in the watershed. The sediment TMDL allowable load for San Diego Creek was the basis for calculating OCs loading capacities. The sediment TMDL is scheduled for revision in 2007; changes to the sediment TMDLs will likely necessitate changes to the OCs TMDLs as well.

8.4 TMDL Compliance Schedule

Regional Board staff proposes that the TMDL targets and allocations for San Diego Creek and Newport Bay specified in Tables 3-1 and 6-2b be met as soon as possible, but no later than December 31, 2015. Schedules for implementation tasks are identified in Table 8-1.

9.0 ECONOMIC CONSIDERATIONS

Regional Boards are required to adopt TMDLs as Basin Plan Amendments. There are three statutory triggers for consideration of economics in basin planning. These are:

(1) Adoption of an agricultural water quality control program (Water Code Section 13141). The Regional Board must estimate costs and identify potential financing sources in the Basin Plan before implementing any agricultural water quality control plan.

(2) Adoption of water quality objectives (Water Code Section 13241). The Regional Board is required to consider a number of factors, including economics, when establishing or revising water quality objectives in the Basin Plan.

(3) Adoption of a treatment requirement or performance standard. The Regional Board must comply with the California Environmental Quality Act (CEQA) when amending the Basin Plan. CEQA requires that the Board consider the environmental effects of reasonably foreseeable methods of compliance with Basin Plan amendments that establish performance standards or treatment requirements, such as TMDLs. The costs of the methods of compliance must be considered in this analysis.

It should be noted that in each of these three cases, there is no statutory requirement for a formal cost-benefit analysis.

The recommended TMDLs rely to a large extent on iterative improvements to BMPs and monitoring and other programs that are already being implemented pursuant to existing waste discharge requirements and/or in response to established TMDLs for the watershed (e.g., the sediment TMDL). Information concerning the estimated costs of implementation of these TMDLs is provided below. However, additional information from the stakeholders is welcomed, especially information regarding the costs of implementation of the TMDLs as distinct from the costs of actions already being taken to address existing permit, TMDL and other requirements or considerations. These considerations would include such actions as reduction of water use, via drip irrigation and/or runoff recycling, for economic reasons.

These TMDLs require that water quality controls be implemented by agricultural operators in the watershed. While commercial nurseries are currently covered by WDRs, and some TMDL implementation measures are already identified as permit requirements, additional BMPs may be necessary to control storm water discharges. Other agricultural activities in the watershed are currently not regulated in the region, although an appropriate administrative tool for complying with the State's Nonpoint Source Enforcement Policy is under development. These TMDLs require that the WDRs for nurseries be revised to require the development and submittal of a proposed plan and schedule for the evaluation of existing BMPs and monitoring protocols, and implementation of recommended improvements. This workplan would be implemented upon the approval of the Regional Board's Executive Officer. Similarly, all agricultural operations in the watershed not currently regulated through WDRs would be required to develop an agricultural nonpoint source management plan, that includes recommendations for BMP implementation to control storm water and nonstorm water discharges of potentially-contaminated sediment, as well as for an appropriate monitoring program to determine compliance with LAs. Again, this plan would be implemented upon the Regional Board Executive Officer's approval. The estimated costs of reasonably foreseeable compliance mechanisms and potential funding sources are identified in Table 9-1. Costs presented in Table 9-1 are from the Natural Resource Conservation Service (NRCS) ProTracts dataset (http://www.programs.tx.nrcs.usda.gov/nationalcosts/), which provides estimates for costs to the state level. It is important to point out that the recommended implementation plan for these TMDLs explicitly recognizes the limited duration of expected agricultural and nursery land uses in the Newport Bay watershed, given the expiration of land leases in the near future. Thus, the proposed implementation plan requires that the workplans to be submitted by nursery/agricultural operators take this consideration into account in making recommendations for BMPs and monitoring that are practicable and reasonable, as well as effective.

For MS4 permittees, these TMDLs would require BMP evaluation and, where necessary, enhancement to address fine sediment transport and deposition of the organochlorine compounds. In addition, the TMDLs would necessitate that the permittees review the efficacy of current monitoring, training and education programs to assure that monitoring and BMPs provisions of the TMDLs are addressed and communicated to those directly responsible for implementing them. Information concerning the costs associated with these efforts, as distinct from those already required pursuant to the MS4 permit would be welcomed.

These TMDLs set a new performance standard and, thus, require analysis of the environmental impacts and costs associated with reasonably foreseeable methods of compliance. Some foreseeable methods of compliance and their associated costs are defined in Table 9-2. These compliance measures include BMPs that are identified in the California Stormwater Quality Association (CASQA) Construction Handbook; individual BMP factsheets are located in Appendix D and may be downloaded from the CASQA website:
http://www.cabmphandbooks.com/Construction.asp. Measures that are identified in Table 9-1 may also be considered. Again, it should be emphasized that requirements for BMP implementation and improvement are generally already included in applicable waste discharge requirements.

Staff is not currently aware of costs associated with some of the implementation measures identified in Table 9-2, and welcomes stakeholder input to determine these costs.

Well over $1 million has been spent on studies supporting the development of these TMDLs (see Section 8 for list of studies). This does not include staff costs incurred by the State for staff time related to TMDL development since 1997. Additional staff costs will be incurred for implementation-related activities when and if these TMDLs are approved.

Table 9-1. Orange County NRCS Programs Cost (from NRCS ProTracts dataset; (http://www.programs.tx.nrcs.usda.gov/nationalcosts/, 8/23/2006)

Practice Code and Name / Description / Component	Unit Cost	Unit
322 Channel Vegetation		
Establish and maintain adapted vegetation to stabilize channel banks, berms, spoils, and associated areas.		
Tree/Shrub Establishment (612)	$1,000.00	acre
Mulching (484)	$600.00	acre
Critical Area Planting (342)	$1,000.00	acre
Channel Vegetation (322)	$1,000.00	acre
327 Conservation Cover		
Establish perennial vegetative cover on land temporarily removed from agriculture		
Competing Veg. Control - chemical treatment (Light)	$100.00	acre
Competing Veg. Control - chemical treatment (Heavy)	$160.00	acre
Competing Veg. Control - hand work	$800.00	acre
Critical Area Planting (342)	$1,000.00	acre
Seed and Seeding (native) - Drill	$500.00	acre
Seed and Seeding (non-native) - Drill & Broadcast	$350.00	acre
Seedbed Preparation (tillage)	$100.00	acre
Seedbed Preparation (tillage, harrow, packer)	$200.00	acre
Tree/Shrub Establishment (612)	$1,000.00	acre
Seedbed Preparation (tillage, harrow, packer, fert.,herb.)	$300.00	acre
Conservation Cover (327)	$1,000.00	acre
348 Dam, Diversion		
Install a structure to divert water from a waterway or stream into another water system.		
Cut and fill	$40.00	acre
Critical Area Planting (342)	$1,000.00	acre
Compacted Fill	$2.50	cu. yd.
Rock, In Place	$100.00	cu. yd.
Rock, In Place D(100)=24"	$100.00	cu. yd.
Rock, Grouted In Place D(100)=24"	$250.00	cu. yd.
Rock & Gravel, In Place	$20.00	cu. yd.
Dam, Diversion (348)	$25,000.00	each
Structure for Water Control (587)	$10,000.00	each
Diversion (362)	$20.00	lin. ft.
350 Sediment Basin		
Construct a basin to collect and store debris or sediment.		
Critical Area Planting (342)	$1,000.00	acre
Rock, In Place D(100)=24"	$100.00	cu. yd.
Cut and filling	$130.00	cu. yd.
Rock & Gravel, In Place	$20.00	cu. yd.
Compacted Fill	$2.50	cu. yd.
Mobilization	$1,250.00	each
Sediment Basin (350)	$5,000.00	each
Pipeline (516)	$15.00	lin. ft.
Fence (382)	$5.00	lin. ft.
356 Dike		
Construct an embankment to protect land against overflow and/or regulate water.		
Critical Area Planting (342)	$1,000.00	acre

Practice Code and Name / Description / Component		Unit Cost	Unit
	Cut and fill	$130.00	cu. yd.
	Concrete Non-Structural Non-Reinforced	$150.00	cu. yd.
	Earthwork excavation normal	$1.50	cu. yd.
	Rock, In Place & Gravel	$100.00	cu. yd.
	Compacted Fill	$2.50	cu. yd.
	Concrete Non-Structural Reinforced	$250.00	cu. yd.
	Concrete, In Place	$350.00	cu. yd.
	Structure for Water Control (587)	$10,000.00	each
	Diversion (362)	$20.00	lin. ft.
	Dike (356)	$10.00	lin. ft.
	Dike, Multipurpose (356)	$0.00	lin. ft.
402	**Dam**		
	Install a dam for temporary water storage and controlled release.		
	Critical Area Planting (342)	$1,000.00	acre
	Cut and fill	$40.00	acre
	Rock, In Place	$100.00	cu. yd.
	Rock, Grouted In Place D(100)=24"	$250.00	cu. yd.
	Rock & Gravel, In Place	$20.00	cu. yd.
	Compacted Fill	$2.50	cu. yd.
	Concrete Non-Structural Reinforced	$250.00	cu. yd.
	Concrete Non-Structural Non-Reinforced	$150.00	cu. yd.
	Rock, In Place D(100)=24"	$100.00	cu. yd.
	Structure for Water Control (587)	$10,000.00	each
	Dam (402)	$25,000.00	each
	Nonreinforced Concrete Pipe 12 inch	$5.75	lin. ft.
	Nonreinforced Concrete Pipe 6 inch	$2.95	lin. ft.
	Nonreinforced Concrete Pipe 10 inch	$3.95	lin. ft.
	Diversion (362)	$20.00	lin. ft.
	Nonreinforced Concrete Pipe 8 inch	$3.25	lin. ft.
410	**Grade Stabilization Structure**		
	Install a structure to control the grade and head cutting.		
	Grading and Shaping	$200.00	acre
	Critical Area Planting (342)	$1,000.00	acre
	Concrete Non-Structural Reinforced	$250.00	cu. yd.
	Rock & Gravel, In Place	$20.00	cu. yd.
	Cut and filling	$130.00	cu. yd.
	Rock, Grouted In Place D(100)=24"	$250.00	cu. yd.
	Concrete Non-Structural Non-Reinforced	$150.00	cu. yd.
	Rock/fill	$50.00	cu. yd.
	Compacted Fill	$2.50	cu. yd.
	Rock, In Place D(100)=24"	$100.00	cu. yd.
	Rock, In Place	$100.00	cu. yd.
	Rock Barrier (555)	$5,000.00	each
	Grade Stabilization Structure (410)	$8,000.00	each
	Diversion (362)	$20.00	lin. ft.
	Underground Outlet (620)	$20.00	lin. ft.
	Wood-building material	$1.25	lin. ft.
	Geotextile Fabric	$1.25	sq. ft.

Practice Code and Name / Description / Component		Unit Cost	
450	**Anionic Polyacrylamide (PAM) Erosion Control**		
	Erosion control through application of water-soluble anionic polyacrylamide (PAM) to minimize or control irrigation-induced soil erosion and to reduce wind and/or precipitation erosion.		
	Anionic Polyacrylamide, PAM (450) Erosion Control	$25.00	acre
555	**Rock Barrier**		
	Construct a rock retaining wall across the slope to form and support a bench terrace that will control water and reduce erosion.		
	Critical Area Planting (342)	$1,000.00	acre
	Rock, In Place	$100.00	cu. yd.
	Rock, In Place D(100)=24"	$100.00	cu. yd.
	Rock/fill	$50.00	cu. yd.
	Rock, Grouted In Place D(100)=24"	$250.00	cu. yd.
	Rock Barrier (555)	$5,000.00	each
	Terrace (600)	$5.00	lin. ft.
558	**Roof Runoff Structure**		
	Construct a facility to collect, control and dispose of runoff water from roofs.		
	Concrete non-Structural Reinforced	$250.00	cu. yd.
	Concrete walls (includes re-bar)	$350.00	cu. yd.
	Concrete Reinforced	$350.00	cu. yd.
	Concrete floors (includes re-bar)	$200.00	cu. yd.
	Concrete non-Reinforced	$100.00	cu. yd.
	Concrete, In Place	$350.00	cu. yd.
	Gravel, In Place	$18.00	cu. yd.
	Earthwork excavation normal	$1.50	cu. yd.
	Concrete non-Structural non-Reinforced	$150.00	cu. yd.
	Roof Runoff Structure (558)	$10,000.00	each
	Mobilization	$1,250.00	each
	Structure for Water Control (587)	$10,000.00	each
	Subsurface Drain (606)	$10.00	lin. ft.
	Corrug., ribbed or profile wall thermoplastic (HDP) 3 -4 in.	$20.00	lin. ft.
	Gutters & Downspouts	$2.75	lin. ft.
	Corrug., ribbed or profile wall thermoplastic (HDP) 6 -8 in.	$6.50	lin. ft.
	Pipeline (516)	$15.00	lin. ft.
	Roofing	$5.00	sq. ft.
	Geotextile Fabric	$1.25	sq. ft.
561	**Heavy Use Area Protection**		
	Protect heavily used areas by providing soil protection with vegetation, surfacing material or mechanical structures.		
	Seed and Seeding (non-native) - Drill & Broadcast	$350.00	acre
	Land Smoothing (466)	$100.00	acre
	Seed and Seeding (native) - Drill	$500.00	acre
	Land Clearing (460)	$200.00	acre
	Heavy Use Area Protection (561)	$500.00	acre
	Land Grading (744)	$500.00	acre
	Concrete Reinforced	$350.00	cu. yd.
	Concrete, In Place	$350.00	cu. yd.
	Earthwork excavation normal	$1.50	cu. yd.
	Concrete non-Structural non-Reinforced	$150.00	cu. yd.

Practice Code and Name			
	Description		
	Component	**Unit Cost**	
	Compacted Fill	$2.50	cu. yd.
	Concrete walls (includes re-bar)	$350.00	cu. yd.
	Concrete non-Reinforced	$100.00	cu. yd.
	Concrete floors (includes re-bar)	$200.00	cu. yd.
	Gravel, In Place	$18.00	cu. yd.
	Concrete non-Structural Reinforced	$250.00	cu. yd.
	Pumping Plant for Water Control (533)	$8,000.00	each
	Structure for Water Control (587)	$10,000.00	each
	Heavy Use Area Protection (561) - Roof Rainfall Diversion	$65,000.00	each
	Concrete	$100,000.00	each
	Below Ground Tank	$3.00	gallon
	Above Ground Tank	$1.75	gallon
	Diversion (362)	$20.00	lin. ft.
	Wood-building material	$1.25	lin. ft.
	Pipeline (516)	$15.00	lin. ft.
	Corrug., ribbed or profile wall thermoplastic (HDP) 3 -4 in.	$20.00	lin. ft.
	Gutters & Downspouts	$2.75	lin. ft.
	Fence (382)	$5.00	lin. ft.
	Corrug., ribbed or profile wall thermoplastic (HDP) 6 -8 in.	$6.50	lin. ft.
	Subsurface Drain (606)	$10.00	lin. ft.
	Animal Trails and Walkways (575)	$5.00	lin. ft.
	Dike (356)	$10.00	lin. ft.
	Access Road (560)	$10,000.00	mile
	Roofing	$5.00	sq. ft.
	Geotextile Fabric	$1.25	sq. ft.
	Geotextile fabric	$1.25	sq. ft.
	Asphalt, In Place	$40.00	ton
587	**Structure for Water Control**		
	Install a structure to control direction, rate and/or level of water in the system.		
	Critical Area Planting (342)	$1,000.00	acre
	Rock, In Place	$100.00	cu. yd.
	Gravel, In Place	$18.00	cu. yd.
	Earthwork excavation normal	$1.50	cu. yd.
	Rock, In Place D(100)=24"	$100.00	cu. yd.
	Diversion Boxes (concrete)	$300.00	each
	Flap Gate36"	$420.00	each
	Flap Gate18"	$130.00	each
	Flashboard Riser 36"x 3'x 24"	$570.00	each
	Flap Gate30"	$355.00	each
	Fish Screen - Small	$10,000.00	each
	Flap Gate24"	$275.00	each
	Diversion Boxes (metal)	$300.00	each
	Flap Gate21"	$205.00	each
	Flow Meters 6 inch	$763.00	each
	Structure for Water Control (587)	$10,000.00	each
	Flow Meters 4 inch	$635.00	each
	Mobilization	$1,250.00	each
	Flashboard Riser 36"x 7'x 24"	$750.00	each
	Flow Meters 2 inch	$578.00	each
	Flashboard RiserHeadwall	$250.00	each

Practice Code and Name / Description / Component	Unit Cost	
Flashboard Riser 36"x 4'x 24"	$615.00	each
Fish Screen - Self Cleaning	$3,000.00	each
Flow Meters 8 inch	$890.00	each
Flow Meters 10 inch	$925.00	each
Flashboard Riser 48"x 7'x 36"	$1,000.00	each
Flashboard Riser 48"x 4'x 36"	$770.00	each
Diversion Boxes (wooden)	$250.00	each
Fish Screen - Large	$40,000.00	each
Fish Screen - Passive	$1,000.00	each
Corrugated pipe Plastic 6-8 in.	$25.00	lin. ft.
Nonreinforced Concrete Pipe10"	$3.25	lin. ft.
Corrugated pipe Metal (CMP) 24-36 in.	$75.00	lin. ft.
Nonreinforced Concrete Pipe8"	$3.25	lin. ft.
Corrugated pipe Plastic 15-18 in.	$60.00	lin. ft.
Nonreinforced Concrete Pipe12"	$3.25	lin. ft.
Corrugated pipe Plastic 24-36 in.	$75.00	lin. ft.
Corrugated pipe Plastic 10-12 in.	$45.00	lin. ft.
Corrugated pipe Metal (CMP) 72-96 in.	$150.00	lin. ft.
Nonreinforced Concrete Pipe6"	$3.25	lin. ft.
Corrugated pipe Metal (CMP) 15-20 in.	$60.00	lin. ft.
Corrugated pipe Metal (CMP) 48-60 in.	$120.00	lin. ft.
Corrugated pipe Metal (CMP) 10-15 in.	$45.00	lin. ft.
Corrugated pipe Metal (CMP) 6-10 in.	$25.00	lin. ft.
638 Water and Sediment Control Basin		
Install a structure(s) across the slope to trap sediment and detain water for safe release.		
Critical Area Planting (342)	$1,000.00	acre
Compacted Fill	$2.50	cu. yd.
Cut and fill	$130.00	cu. yd.
Earthwork excavation normal	$1.50	cu. yd.
Rock & Gravel, In Place	$20.00	cu. yd.
Rock, In Place	$100.00	cu. yd.
Rock, In Place D(100)=24"	$100.00	cu. yd.
Water and Sediment Control Basin (638)	$15,000.00	each
Mobilization	$1,250.00	each
Structure for Water Control (587)	$10,000.00	each
Diversion (362)	$20.00	lin. ft.

Workplan development through third party administrator - Assuming a 6-month development period. Estimated cost = $65,000

Monitoring costs
(Estimated Lab Costs)

Total Suspended Solids:	$15 each
Measurement of Discharge Flow:	???
OCs in Discharge (unfiltered) (EPA Method 625):	$150 each

Potential Funding Sources:
State TMDL funds
State Bond funds
Federal 319(h) funds

Table 9-2. Foreseeable methods of compliance with TMDL and associated costs. Erosion and sediment control best management practices are from CASQA Construction Handbook. (CASQA BMP identification numbers are shown in parentheses and are provided in Appendix D.)

Implementation Action	Estimated Cost
Schedule grading activities to reduce erosion potential during rainy season (EC-1)	No direct costs; however other construction costs may increase (e.g., grading costs would cheaper if site is mass graded one time)
Use polyacrylamide (PAM) (in accordance with EC-13) to increase soil infiltration and flocculation of suspended sediments	Material cost is $1.30 to $5.50 per pound
Preservation of Existing Vegetation (EC-2)	Minimal cost; aesthetic benefits may enhance property values
Earth Dikes and Drainage Swales (EC-9)	Costs range from $15 to $55 per foot for both earthwork and stabilization; small dikes: $2.50-$6.50 per linear foot; large dikes: $2.50 per cubic yard; drainage swale cost increases with drainage area and slope, but are typically inexpensive.
Construction of Sediment Basins (SE-2)	Average annual cost of installation and 2-year maintenance are: Basin < 50,000 cubic feet – average, $0.73 per cubic foot; Basin size > 50,000 cubic feet – average, $0.36 cubic feet
Chemical treatment to reduce turbidity (with advance approval of Regional Board) (SE-11)	May be high, but generally less than 1% of total construction cost
Streambank stabilization (EC-12); may require regulatory permits	Costs varies according to stabilization practice used
Stormwater training program	Development and implementation of a training program is already a requirement under the current MS4 permit; the existing program should be supplemented with BMP training that is relevant to these TMDLs with nominal increase in cost.
Banned pesticide education & collection program	Under the MS4 permit, an urban education program is already being implemented to education the public on use of fertilizers and pesticides. The existing program can be modified to include education related to banned pesticides. The collections program can be incorporated into the existing hazardous waste disposal program with minimal cost.
Sediment Dredging in Newport Bay	Approximately $15 per cubic yard. Design capacity for Unit II and Unit I/III Basins in Newport Bay is about 2.1 million cubic yards. If basins are full in 20 years and dredging is required, the estimated cost (in today's dollars) would be $32 million.
Estimated cost of additional special studies/monitoring:	The costs of these investigations vary

• Evaluation of sediment toxicity, including TIE • Ecological risk assessment for Newport Bay • Human health risk assessment for Newport Bay • Ecological risk assessment for San Diego Creek • Human health risk assessment for San Diego Creek • Laboratory study to determine dose-response relationships • Evaluation of regional BMPs • Toxaphene linkage analysis • Survey of OCs in open space areas • Analysis of channel erosion as potential source of OCs • OCs mass emissions monitoring	depending on the nature of the study and its complexity. Costs are estimated in the range of less than $50,000 to the hundreds of thousands of dollars.
Estimated analytical costs: • OCs in water* • OCs in sediment • OCs in fish tissue • Benthic community evaluation • TSS* • TOC*	 EPA Method 625 - $150 ea. $15 ea. $30 ea.
*These are SARWQCB costs for analysis	

10.0 CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

The California Regional Water Quality Control Board, Santa Ana Region (Regional Board) is the Lead Agency responsible for evaluating potential environmental impacts of the proposed amendment to the Water Quality Control Plan for the Santa Ana River Basin Region (Basin Plan) incorporating the Total Maximum Daily Load (TMDL) and Implementation Plan (IP) for Organochlorine Compounds in San Diego Creek, Upper and Lower Newport Bay, Orange County, California.

The Secretary of Resources has certified the Basin Planning process as “functionally equivalent” to the preparation of an Environmental Impact Report (EIR) or Negative Declaration (ND), pursuant to the California Environmental Quality Act (CEQA). However, in lieu of these documents, the Regional Board is required to prepare the following: the Basin Plan amendment; an Environmental Checklist that identifies potentially significant adverse environmental impacts of the Basin Plan amendment; and a staff report that describes the proposed amendment, reasonable alternatives, and mitigation measures to minimize any significant adverse environmental impacts identified in the CEQA checklist. The Basin Plan amendment, Environmental Checklist, and staff report together serve as substitute environmental documents.

The draft Environmental Checklist (Attachment B to this report) concludes that the proposed project may have a significant effect on the environment. However, there are feasible alternatives and/or mitigation measures available that will substantially lessen any adverse impact to levels that are less than significant. These measures are described in the Environmental Checklist.

This staff report will be followed by another report that will include comments received on the proposed amendment, staff responses to those comments, and a discussion of any changes made to the proposed amendment as the result of the comments or future deliberation by the Board, and/or Board staff. This follow-up report would address any additional CEQA considerations, including economics, which might arise as the result of changes to the proposed amendment.

10.1 Consideration of Alternatives

10.1.1 No Project Alternative

The “No Project” alternative would mean the Regional Board would not adopt OCs TMDLs with implementation measures and a monitoring program. This alternative was recommended by certain stakeholders on the basis that natural attenuation of the OCs would eliminate any water quality standards concerns and/or because there is no clear evidence of beneficial use impairment. However, based on the State Board’s Listing Policy, and the State Board’s recent action to approve the 2006 303(d) List, impairment due to total DDT, total PCBs, chlordane and toxaphene was identified for Upper and Lower Newport Bay and/or San Diego Creek. The “No

Project" alternative would not comply with the requirements of the Clean Water Act, which specify that TMDLs be developed for waters included in the Section 303(d) list of impaired waters. The "No Project" alternative would not meet the purpose of the proposed action, which is to correct violations of Basin Plan narrative objectives for toxic substances, and to prevent adverse impacts to beneficial uses. This alternative would result in continuing violation, or threatened violation, of water quality standards until such time as natural attenuation reduces OCs concentrations in the environment to levels that pose no potential harm to aquatic life, wildlife and/or humans. Furthermore, USEPA has already promulgated TMDLs for toxic substances (including OCs) in compliance with a consent decree deadline; the no project alternative would be inconsistent with that federal action.

10.1.2 Alternatives

The Regional Board could consider alternative approaches to TMDL development and implementation. It should be noted that all alternatives that were considered have inherent uncertainty and/or error associated with them; implementation tasks have been identified to reduce errors and uncertainties and to allow for TMDL refinement in the future. The various alternatives that were considered by staff are summarized below:

<u>Alternative thresholds for evaluating impairment</u>.
Some stakeholders have suggested an alternative marine DDT fish tissue threshold for purposes of evaluating whether narrative objectives are being met; that is, if bioaccumulation of DDT in fish or other aquatic organisms is causing or contributing to adverse impacts to aquatic life or wildlife. Because the stakeholders' suggested threshold tissue value has not been peer-reviewed and published, this value does not meet the requirements specified in section 6.1.3 of the State Listing Policy for selection of evaluation guidelines to be used in assessing water quality impairment. Therefore, the suggested value was not considered when impairment thresholds were selected. Staff proposed the use of impairment thresholds that are recommended for use in the State Listing Policy for bioaccumulative compounds: OEHHA SVs for evaluation of possible human health-related effects, and NAS guidelines for possible effects to aquatic life and wildlife.

<u>Alternatives to TMDL development where there was no finding of impairment (i.e., chlordane and PCBs in San Diego Creek).</u>
The Problem Statement (Section 2) described alternatives that were considered with respect to chlordane and PCBs in San Diego Creek. Staff considered developing TMDLs for these OCs, even in the absence of impairment, to address identified downstream impairment in Newport Bay and to be protective of San Diego Creek, itself. Staff determined that a more defensible approach was to develop chlordane and PCBs TMDLs for San Diego Creek for informational purposes only. Implementation measures for chlordane and PCBs TMDLs in Newport Bay should ensure that upstream sources are identified and controlled, and that water quality standards are achieved in both the Creek and the Bay.

Alternative numeric TMDL targets.

Various alternatives for numeric sediment and fish tissue targets were discussed in detail in Section 3. The proposed numeric targets are, for the most part, those that were used by USEPA in development of technical TMDLs for the OCs. Tissue targets that are protective of aquatic life and wildlife are guidelines recommended by the SWRCB for assessing water quality impairment. Sediment targets are conservative, low-threshold SQGs that, if achieved, will ensure that the OCs do not cause or contribute to direct toxicity to benthic organisms. The assumption is made that by protecting benthic organisms from direct effects, higher trophic level aquatic species, wildlife and humans will also be protected from bioaccumulation effects. These targets are conservative and will assure that water quality standards are achieved. In addition, development of TMDLs require that in the presence of limited data, an adequate margin of safety is incorporated to ensure protection of the water body beneficial uses. The selection of low-threshold SQGs help ensure such protection. Other Regional Boards have adopted TMDLs that used low threshold SQGs as numeric sediment targets, establishing a precedent for their use. These targets may be revised as new, site-specific information becomes available to enable refinement of the TMDLs.

Alternative approach for calculating existing loads in San Diego Creek.

In the absence of direct measurements of existing loads of OCs in the watershed, an indirect method of estimating current loads must be used. USEPA and Regional Board staff's approach to estimating existing loads in San Diego Creek and Newport Bay is presented in Section 4 of this staff report. For San Diego Creek, this approach uses the geometric mean of OCs concentrations in the most recently collected fish (i.e., TSMP data from 2002). More recent data are not available; consequently, some have argued that current tissue concentrations should be estimated from documented trends (see Figure 2-5). Were this alternative approach to be used, in most cases (except for PCBs), estimated existing loads would be smaller than reported herein. Furthermore, using the alternative approach, needed reductions for DDT and toxaphene would also be lower (note that TMDLs for PCBs and chlordane in San Diego Creek are being developed for informational purposes only).

Staff's approach uses the actual (i.e., not predicted) tissue concentrations, with the assumption that the use of "real" data is most appropriate for regulatory purposes. Only the most recent fish tissue data were used, in order to best reflect current conditions. Regardless of which approach is used to estimate current conditions, TMDLs to address impairment in San Diego Creek will still be developed, and implementation measures will be identified to reduce loads and achieve water quality standards. Note that no alternative approaches were identified or considered for estimating existing loads within Newport Bay.

Recommended Alternative

Staff believes that the proposed TMDLs reflect a reasonable approach to the improvement of the beneficial uses of San Diego Creek and Newport Bay. The proposed implementation schedule also provides a realistic timeframe in which to complete the tasks required by the TMDLs.

11.0 PUBLIC PARTICIPATION

Federal TMDL regulations require public participation to give the public an opportunity to review and comment on the TMDLs. A number of opportunities for public participation are afforded throughout the entire TMDL Basin Plan Amendment process and through the CEQA review process.

- Basin Plan amendments require advanced public notice and a public hearing (CWC §13244).
- CEQA requires circulation of a Notice of Filing to the public and interested public agencies.
- Public workshops are held by the Regional Board to consider evidence and testimony related to the proposed TMDLs.
- Regional Board staff must prepare written responses to comments that are received at least 15 days before the Board's scheduled action (public hearing). Staff must respond orally at the public hearing to those late comments for which written responses are not feasible, and to oral comments received at the Board meeting.
- Draft TMDLs, Basin Plan Amendments, Public Notices, Notice of Filing, and CEQA documentation are made available on the Regional Board's website.
- After Regional Board adoption of the Basin Plan Amendment, the SWRCB and the USEPA have their review and approval processes, which afford more opportunities for public participation.
- Documentation of all public participation, including copies of hearing notices, press releases, written public comments and written responses, and tapes or minutes of hearing testimony will be included in the administrative record of the Basin Plan Amendment.
- USEPA promulgated technical OCs TMDLs in June 2002. That TMDL development process afforded opportunities for public participation and comment.

In developing the draft Basin Plan Amendment to incorporate the technical TMDLs, along with an Implementation Plan, into the region's Basin Plan, Board staff conducted two CEQA scoping meetings: one was held in June 2005 and one in August 2006. Following the June 2005 public meeting, staff received comment letters from Tustin Legacy Community Partners, the City of Tustin, Orange County Farm Bureau, the Construction Industry Coalition on Water Quality, and a SCCWRP scientist. Copies of these comments letters are provided in Appendix C. The concerns and issues that were raised in those letters include the following:

1) A Working Group/Work Plan approach (similar to the Nitrogen-Selenium Working Group) was suggested as a means of gathering additional data to gain a better understanding of potential adverse impacts on beneficial uses and provide a consensus-based approach to developing the OCs TMDLs.

2) Concern was raised that the Basin Plan Amendment process for the OCs TMDLs may not be in compliance with the provisions of CEQA. In particular, it was mentioned that the Regional Board must consult with trustee agencies, such as California Department of Fish and Game; baseline environmental conditions need to be fully described; a thorough alternatives analysis needs to be completed, including the no-action alternative.
3) Concern was raised that the June 2005 CEQA scoping meeting was not properly noticed and thus insufficient time was allotted for commenting; staff's presentation was not sufficiently detailed to allow for comment; and additional scoping meetings were requested and recommendations were made for complying with CEQA.
4) Concern was raised that the Regional Board may prohibit construction grading operations during the wet season. Such a prohibition could have negative socioeconomic impacts as well as adverse impacts to agricultural resources, air quality, biological resources, hydrology and water quality, noise, population and housing, recreation, transportation and traffic.
5) It was proposed that because trends in fish tissue concentrations have declined over time, the no project alternative should be considered and TMDLs should not be developed.
6) Concern was raised that staff inappropriately used SQGs and OEHHA SVs as numeric targets; inappropriately considered tissue concentrations in nonresident fish; and it was proposed that the CTR should be used to arrive at defensible targets.
7) Concern was raised that TMDLs are being developed even though there is no clear evidence of beneficial use impairment. One commenter noted that the clapper rail population in Newport Bay has doubled.
8) It was proposed that open space may contribute more sediment, and, thus, OCs, than construction; it was recommended that this be explored further.
9) A phased approach to TMDL implementation was supported.
10) Concern was raised that Regional Board staff proposes to require monitoring for non-visible pollutants in storm water discharges from construction sites (in accordance with provisions in the General Permit).
11) Concern was raised that the proposed TMDLs would have a disproportionate economic burden to agricultural operations, without corresponding benefits to water quality.

These comments and concerns have been considered in the preparation of the proposed TMDLs. It should be noted that a procedural error was made in noticing the June 2005 CEQA Scoping Meeting. While the notice published in a general circulation newspaper advertised the meeting as a CEQA scoping meeting, the notice that was distributed to interested parties failed to indicate that the meeting was a CEQA scoping meeting.

No written comments were received following the August 2006 CEQA scoping meeting. A draft version of the Implementation Plan was not available prior to this meeting, contrary to what was stated in the public notice for the August 2006 CEQA scoping meeting. (The public notice indicated that copies of the staff report, implementation plan and draft Basin Plan Amendment would be made available prior to the meeting; only the staff report was completed in time and made available). Therefore, to allow for more opportunity for public participation, a separate public meeting was held on October 3, 2006, to present the draft Implementation Plan and solicit comments. No written comments were received following that meeting.

Additional comments that are received at the OCs TMDL workshop and prior to the public hearing will be considered in making appropriate revisions to the recommended TMDLs. Staff will prepare written responses to all comments that are received at least 15 days prior to the public hearing at which the Regional Board will consider adoption of the TMDLs.

A Technical Advisory Committee (TAC) was formed to review draft sections of the TMDLs and make comments and suggestions. TAC participants included:

Steve Bay, SCCWRP
Dr. Keith Maruya, SCCWRP
Dr. Jim Allen, SCCWRP
Dr. Tom Meixner, University of Arizona
Dr. Daniel Schlenk, University of California, Riverside
Dr. Jan Gan, University of California, Riverside
Dr. Ron Tjeerdema, University of California, Davis
Dr. Jim Byard
Dr. Robert Brodberg, OEHHA
Dr. Brock Bernstein
Dr. Katie Zeeman, US Fish and Wildlife Service
Drs. Cindy Lin or Peter Kozelka, USEPA
Ben Greenfield, San Francisco Estuary Institute

The TAC met on three occasions during 2006. Comments and suggestions from the meeting participants were used to make modifications and improvements to the TMDLs.

12.0 STAFF RECOMMENDATION

Direct staff to prepare a Basin Plan Amendment and related documentation to incorporate the TMDLs for organochlorine compounds for San Diego Creek, Upper and Lower Newport Bay, shown in Attachment A, for consideration at a future public hearing.

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FIGURES

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APPENDIX A

Data Summary
OCs Concentrations in Fish Tissue, Sediment, Ambient Water
San Diego Creek, Upper and Lower Newport Bay

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APPENDIX B

Staff Impairment Assessment
Submitted to SWRCB
In response to
2006 CWA Section 303(d) List Recommendations

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APPENDIX C

Comments Received following June 2005 CEQA Scoping Meeting

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APPENDIX D

BMP Fact Sheets from CASQA Handbook