Total Maximum Daily Loads
For Toxic Pollutants
San Diego Creek and Newport Bay, California

U.S. Environmental Protection Agency
Region 9

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Table of Contents

Summary TMDL Document

Technical Support Documents

I. Introduction

What Is the Purpose of This Action?

This document describes Total Maximum Daily Loads (TMDLs) being established for several toxic pollutants by U.S. Environmental Protection Agency (EPA) to help protect and restore the water quality of Newport Bay, San Diego Creek, and their tributaries. A TMDL identifies the maximum amount of a pollutant that may be discharged to a water body without causing exceedences of water quality standards and impairment of the uses made of these waters. The federal Clean Water Act requires development of TMDLs for polluted waters to assist in identifying pollutant control needs and opportunities. EPA is establishing these TMDLs pursuant to a 1997 consent decree in which EPA committed to ensure that these TMDLs would be established in 2002. EPA has worked closely with the California Regional Water Quality Control Board, Santa Ana Region (Regional Board) in the development of these TMDLs. Although the State has primary responsibility for developing TMDLs under the Clean Water Act, the State was unable to complete its formal adoption of these TMDLs by the consent decree deadline; hence EPA is required to establish the TMDLs at this time.

What Is A TMDL?

Section 303(d)(1)(A) of the Clean Water Act (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." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish Total Maximum Daily Loads (TMDLs) for such waters. As part of California's 1996 and 1998 Section 303(d) lists, the Regional Board identified Newport Bay and San Diego Creek as water quality limited due to several toxic pollutants (in addition to other pollutants not addressed in these TMDLs) and designated this watershed as a high priority for TMDL development.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in EPA guidance documents (e.g., EPA 1991 and EPA 2001). A TMDL is defined as "the sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the water body to assimilate pollutant loadings (the Loading Capacity) is not exceeded. A TMDL is also required to be developed with seasonal variations and include a margin of safety to address uncertainty in the analysis. In addition, pursuant to the regulations at 40 CFR 130.6, states must develop water quality management plans which incorporate approved TMDLs and implementation measures necessary to implement the TMDLs.

Upon establishment of TMDLs by EPA or the State, the State is required to incorporate the TMDLs along with appropriate implementation measures into the State Water Quality Management Plan (40 CFR 130.6(c)(1), 130.7). The Regional Board Basin Plan, and applicable state-wide plans, serve as the State Water Quality Management Plan governing the Newport Bay watershed. If the State subsequently adopts and submits for EPA approval TMDLs which are different from the TMDLs established by EPA, EPA will review the State-submitted TMDLs to determine if they meet all TMDL requirements. If EPA approves the State TMDLs, they will supercede the TMDLs being established now by EPA.

Why Is EPA Establishing These TMDLs?

The Environmental Protection Agency (EPA) has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. If the EPA disapproves a TMDL submitted by a state, the EPA is required to establish a TMDL for that water body.

On October 31, 1997, EPA entered into a consent decree (decree), Defend the Bay, Inc. v. Marcus, (N.D. Cal. No. C 97-3997 MMC), which established a schedule for development of TMDLs in San Diego Creek and Newport Bay. The decree required development of TMDLs for several toxic pollutants by January 15, 2002. The agreement also provided that EPA would establish the required TMDLs within ninety (90) days, if the State failed to establish an approved TMDL by the deadline. In early April 2002, the decree was modified to extend the deadline for EPA establishment of these TMDLs to June 15, 2002.

Pursuant to the decree, EPA Region 9 and the Regional Board have already established sediment and nutrient TMDLs for San Diego Creek and Newport Bay. EPA has also approved state-adopted TMDLs for fecal coliform in Newport Bay.

The RWQCB has conducted extensive analysis in support of these toxic pollutant TMDLs and has proposed to adopt TMDLs and associated implementation plans for two pesticides and selenium. However, the State of California has not yet adopted TMDLs for any of the toxic pollutants covered by the decree. Therefore, in compliance with the terms of the decree, EPA is establishing the TMDLs for these toxic pollutants in order to meet the requirements of the decree. On April 12, 2002, EPA published a public notice seeking comment on the proposed toxic pollutant TMDLs for San Diego Creek and Newport Bay. EPA carefully considered comments received during the comment period and made some changes in the final TMDL decisions. EPA also completed a responsiveness summary that describes how EPA considered each comment received.

What TMDLs Are Being Established?

EPA is establishing TMDLs for several toxic pollutants which are exceeding applicable State water quality standards: selenium; several heavy metals; and several organic chemicals including modern pesticides (i.e., diazinon and chlorpyrifos) and legacy pesticides (DDT, Chlordane etc.) and polychlorinated biphenyls (PCBs). The pesticide diazinon is being addressed by these TMDLs because the State found that it is associated with significant water toxicity in San Diego Creek and concluded that it should be addressed by EPA concurrent with the similar pesticide chlorpyrifos, which is addressed by the consent decree. These TMDLs are being developed for specific water bodies in the Newport Bay watershed for which available data indicate that water quality is impaired. Table 1-1 lists the specific water bodies and associated pollutants for which TMDLs are being established.

Table 1-1. Toxic Pollutants per waterbody requiring TMDL Development

WaterBody (Type)	Element/ Metal	Organic compound
San Diego Creek (freshwater)	Cd, Cu, Pb, Se, Zn	Chlorpyrifos, Diazinon, Chlordane, Dieldrin, DDT, PCBs,Toxaphene
Upper Newport Bay (saltwater)	Cd, Cu, Pb, Se, Zn	Chlorpyrifos, Chlordane, DDT, PCBs
Lower Newport Bay (saltwater)	Cu, Pb, Se, Zn	Chlordane, Dieldrin, DDT, PCBs
Rhine Channel, within Lower Newport Bay (saltwater)	Cu, Pb, Se, Zn, Cr, Hg	Chlordane, Dieldrin, DDT, PCBs

Table 1-1 Toxic pollutants per waterbody requiring TMDL development.

California's Section 303(d) list of impaired waters does not specifically name each of these water body-pollutant combinations. The 1996 Section 303(d) list identified Newport Bay and San Diego Creek as impaired due to metals, pesticides and priority organics. The 1998 Section 303 (d) list added "unknown toxicity" to one specific part of San Diego Creek—Reach 2. During the negotiation of the consent decree, Regional Board staff provided a more specific list of pollutants covered by these general pollutant categories used in the listing decisions, and the consent decree refers to this more specific pollutant list. In 2001-02, EPA and Regional Board staff carefully evaluated more recent water quality data to help determine whether TMDLs were needed for each of the toxic pollutants identified in the decree. As described in EPA Region 9's assessment of water quality in San Diego Creek and Newport Bay (*Decision Document* 2002), and in this summary TMDL document below, EPA and the State determined that the list of water body-pollutant combinations warranting TMDL development should be fine-tuned to reflect the best current information concerning water body impairment. Based on our assessment of the most current local data and national EPA guidance concerning arsenic, EPA has concluded that TMDLs are not needed for arsenic for waters in the Newport Bay watershed.

Why Are These Pollutants Of Concern to EPA and the State?

By definition, toxic substances are poisonous through chemical action that may result in adverse impacts to humans or other living organisms. Adverse impacts may include, but are not limited to, cellular injury, mutagenic impairment, reduced reproductive success, and carcinogenic responses. The impacts of greatest potential concern in these water bodies are: a) chemical bioaccumulation through the aquatic food chain at levels which could harm human health when we consume fish or shellfish and b) chemical concentrations in water, sediment or biota that cause adverse effects in aquatic life or aquatic-dependent species. Available data indicate that the pollutants addressed in these TMDLs were found in water column, bottom sediments, or fish tissue at potentially unsafe levels which exceed applicable water quality standards. There is no current evidence of adverse effects on human health due to consumption of contaminated fish or direct exposure to toxic pollutants. Evidence of adverse impacts to aquatic life as a result of direct or indirect exposures to these toxic pollutants is limited. However, because the pollutants addressed in these TMDLs have the potential to cause short term adverse impacts to aquatic life or long term human health and aquatic life impacts due to pollutant bioaccumulation, actions to reduce discharges of these pollutants to the aquatic environment are warranted. The TMDLs are designed to assist in targeting pollutant reduction activities.

How Are the TMDL Documents Organized?

This document provides summary information about the Toxic Pollutant TMDLs, including a description of the environmental problems, water body goals, source analysis, loading capacity (i.e., TMDL), and loading allocations for each toxic pollutant TMDL. The document also describes how other federally-required TMDL components (i.e., margin of safety to account of analytical uncertainty, and critical conditions and seasonal variations associated with water body flow and pollutant loadings) are addressed. Individual pollutants have been grouped together based on chemical characteristics as follows:

Organophosphate (OP) Pesticides—diazinon and chlorpyrifos are two organophosphate pesticides with similar sources and impairment primarily limited to San Diego Creek.
Selenium—is a toxic bioaccumulative metal, with significant groundwater sources
Metals—cadmium, copper, lead and zinc have similar aqueous behavior and affect nearly all water bodies
Organochlorinated compounds—PCBs, DDT, chlordane, dieldrin and toxaphene have similar fate (bioaccumulation) and transport mechanisms (primarily from watershed soils to freshwater and saltwater sediments) for all waterbodies.
Mercury and Chromium—are two metals with very small geographical areas of impairment.

The State and EPA initially found that arsenic was present at levels of concern in Upper and Lower Newport Bay; however, based on more recent data and new information concerning arsenic risk in saltwater bodies, EPA has now concluded that Newport Bay and its tributaries are not impaired due to arsenic pollution. This summary document includes a section describing the basis for this conclusion in greater detail. The consent decree governing development of these TMDLs contains provisions that authorize EPA to make a determination that TMDLs are not needed for individual waters and/or pollutants if available data and information support those determinations. Pursuant to these decree provisions, EPA is making the determination that arsenic TMDLs are not needed for waters in the Newport Bay watershed.

EPA has prepared several Technical Support Documents (TSDs) to accompany this summary TMDL document. The TSDs provide considerably more detailed information relevant to each pollutant (grouped together as described above). The TSDs describe chemical characteristics of each toxicant, the basis for numeric targets, a complete source analysis, an explanation of how we calculated the loading capacity and TMDLs, and related information. A TSD is also provided that discusses EPA's analysis of freshwater flows in San Diego Creek, which was used to identify the appropriate numeric targets for certain pollutants, address seasonal variations and critical conditions in flows and pollutant loads, and evaluate the best approaches for calculating pollutant loading capacities and allocations. Another TSD provides more maps of the San Diego Creek, Santa Ana-Delhi Channel and Newport Bay watersheds and analysis concerning water residence times in Upper and Lower Bay. A summary of public comments and EPA's responses to those comments is provided in another TSD.

What Happens After The TMDLs Are Established?

TMDLs are not self-implementing – they must be implemented by the State and the entities that are discharging pollutants of concern. Federal regulations require states to adopt TMDLs and associated implementation measures in the State Water Quality Management Plan (i.e., the Basin Plan) (40 CFR 130.6). The State of California's procedure for adopting TMDLs and associated implementation measures is through amendments to the Basin Plans. These amendments are developed by the Regional Board staff, then approved by the Regional Board, State Water Resources Control Board, and State Office of Administrative Law. The amendments are then submitted to EPA for approval. (If the TMDLs adopted by the State are different from the TMDLs established by EPA then the TMDLs must be resubmitted to EPA for approval.)

EPA does not establish implementation plans as part of TMDLs under currently applicable federal regulations. However, we have included several implementation recommendations (see Section IX) which are intended to assist the State and local stakeholders in devising appropriate pollutant control and monitoring plans to address these toxic pollutants.

Three general categories of pollutant sources are identified in these TMDLs:

- <u>Nonpoint sources</u>, which discharge pollutants through diffuse runoff from the land, primarily in response to rainfall runoff, and which are addressed by the State through a combination of voluntary and regulatory measures outlined in California's State Nonpoint Source Management Plan.
- <u>Point sources</u>, which discharge pollutants through discrete pipes or conveyances and which are addressed through regulatory provisions of the National Pollutant Discharge Elimination System (NPDES) permit program. Several sources of pollutant runoff from roads and urban areas in the Newport Bay watershed are addressed through NPDES stormwater permits. There are a small number of additional permitted point source discharges in the watershed which are addressed in the TMDLs, including several groundwater dewatering operations.
- <u>Pollutants already in water body sediments</u>, which are usually associated with contaminated sediments discharged to water bodies in the past, but which retain and release significant quantities of pollutants to the ecosystem. These contaminated sediments may be concentrated to the point where remediation or removal action is warranted to remove the contaminated material, or they may be so diffuse that remedial action would be ineffective.

The federal Clean Water Act creates federal regulatory jurisdiction only over point sources. When NPDES permits for point source discharges addressed in the TMDLs are revised, their provisions must be consistent with the requirements and assumptions of any wasteload allocations contained in these TMDLs (see 40 CFR 122.44(d)(1)(vii)(B)). Permit modification may occur when the permits are reopened or reissued. The State has some discretion in determining the appropriate permit provisions to ensure consistency.

Although the TMDLs include allocations which address nonpoint source and contaminated sediments, implementation of these allocations is usually based on the TMDL implementation plan developed by the State as part of its Basin Plan amendment process described above. The State of California has broad authority under State law to apply voluntary or regulatory approaches to addressing these source categories. Past TMDL implementation plans in California have provided for State-issued "Waste Discharge Requirements" for some nonpoint sources, remedial action plans to address contaminated sediment sites, and opportunities for voluntary action to comply with load allocations. The Regional Board is currently in the process of developing implementation plans for several of the toxic pollutant TMDLs and will address the remaining toxic pollutant TMDLs in the near future.

Environmental Setting

(see Figure 1-1 in TSD--Part A)

The Newport Bay/San Diego Creek watershed is located in Central Orange County in the southwest corner of the Santa Ana River Basin, about 35 miles southeast of Los Angeles and 70 miles north of San Diego (see Figure 1-1 in TSD—Part A). The watershed encompasses 154 square miles and includes portions of the Cities of Newport Beach, Irvine, Laguna Hills, Lake Forest, Tustin, Orange, Santa Ana, and Costa Mesa. Mountains on three sides encircle the watershed; runoff from these mountains drains across the Tustin Plain and enters Upper Newport Bay via San Diego Creek. Newport Bay is a combination of two distinct water bodies - Lower and Upper Newport Bay, divided by the Pacific Coast Highway (PCH) Bridge. The Lower Bay, where the majority of commerce and recreational boating exists, is highly developed. The Upper Bay contains both a diverse mix of development in its lower reach and an undeveloped ecological reserve to the north.

San Diego Creek flows into Upper Newport Bay and is divided into two reaches. Reach 1 is located downstream of Jeffrey Road and Reach 2 lies upstream of Jeffrey Road to the headwaters. The San Diego Creek watershed (ca. 105 square miles) is divided into two main tributaries:

- Peters Canyon Wash, which drains Peters Canyon, Rattlesnake Canyon, and Hicks Canyon Washes that have their headwaters in the foothills of the Santa Ana Mountains, and
- San Diego Creek itself, which receives flows from Peters Canyon Wash in Reach 1 and includes Bee Canyon, Round Canyon, Marshburn Channel, Agua Chinon Wash, Borrego Canyon Wash and Serrano Creek

Important freshwater drainages to Upper Newport Bay, together covering 49 square miles, include the San Diego Creek, Santa Ana-Delhi Channel, Big Canyon Wash, Costa Mesa Channel and other local drainages.

San Diego Creek is the largest contributor (95%) of freshwater flow into Upper Newport Bay, followed by Santa Ana-Delhi Channel (~5%) (ACOE 2000). Table 1-2 summarizes the drainage areas of the major tributaries.

Table 1-2 Drainage Areas of the Newport Bay Watershed

Tributary	Drainage Area (acres)	Drainage Area (%)
San Diego Creek	47,300	48
Peters Canyon Wash	28,200	29
Santa Ana-Delhi	11,000	11
Other Drainage Areas	12,000	12
Total	98,500	100

Upper Newport Bay contains one of the highest quality remaining wetland areas in Southern California. The Upper Bay estuary contains a State Ecological reserve in the upper half with habitat designated for sensitive species. Sediment capture basins exist in the Upper Bay and have been dredged periodically by Army Corps of Engineers (ACOE). Another sediment removal/ecological restoration project has been proposed and is currently being evaluated (ACOE 2000). Newport Dunes Recreation area—a small public beach—is in the lower portion of Upper Bay (outside of the Ecological Reserve) along with more small boat marinas down near Pacific Coast Highway Bridge. Historical water uses for Upper Bay included water skiing, commercial and sport fishing although it is now used mainly for wildlife habitat, preservation of rare species, marine habitat, recreation and shellfish harvesting. In Lower Bay, surrounding shores and two islands are highly urbanized with nine boatyards and many (~10,000) small boats. Rhine Channel, a dead-end reach in western side of Lower Bay, is an isolated area with poor tidal flushing and minimal storm drain input. The Regional Board has identified Rhine Channel as a toxic hotspot based on previous investigations (BPTCP 1997). The entire Newport Bay up to the mouth of San Diego Creek is subject to tidal influence.

Climate is characterized by short, mild winters, and warm dry summers. Average rainfall is approximately 13 inches per year. Ninety percent of annual rainfall occurs between November and April, with minor precipitation during summer months. In the past six years, San Diego Creek has a mean base flow rate of approximately 12 cubic feet per second (cfs) (for all flows <20 cfs). Storm events, depending on their magnitude, intensity, and antecedent conditions, can increase this daily mean flow to over 9000 cfs (Dec. 7, 1997). San Diego Creek is freshwater with wide range of hardness and small influences by the slightly saline water table (less than 1 or 2% salinity). Upper Bay is an estuary with saline water conditions during dry weather and yet there is heavy freshwater influx (from San Diego Creek and Santa Ana-Delhi Channel) during major storms. Lower Bay waters are dominated by twice-daily ocean tides via the jetty entrance, thus saline waters exist at 30 to 35 parts per thousand (ppt).

Watershed History

The description below is taken largely from Regional Board staff report prepared for its draft Newport Bay TMDLs (RWQCB 2000).

The nature of the Newport Bay watershed has changed dramatically over the last 150 years, both in terms of land use and drainage patterns. In the late 19th and early 20th centuries, land use changed from ranching and grazing to open farming. During this time the Santa Ana River flowed into Newport Bay, while San Diego Creek and the small tributaries from the

Santiago Hills drained into an ephemeral lake and the neighboring area called "La Cienega de las Ranas" (Swamp of the Frogs) and then into the River. To accommodate rural farming, the ephemeral lake and Swamp of the Frogs were drained and vegetation cleared. Channels were constructed (but often did not follow natural drainage patterns) to convey runoff to San Diego Creek and then Newport Bay. After a major flood event in 1920's, the Santa Ana River was permanently diverted into the current flood control channel which now discharges to the Pacific Ocean. As a result of these land use and drainage changes, surface and groundwater hydrology have been substantially altered from natural conditions. Following World War II, land use again began to change from grazing and open farming to residential and commercial development. As urban development in the watershed proceeded (and continues), drainages were further modified through removal of riparian vegetation and lining of stream banks to expand their capacity and to provide flood protection. These changes culminated in the channelization of San Diego Creek in the early 1960s by the Orange County Flood Control Department. The channelization isolated the San Joaquin Marsh, the last remaining portions of the historic marsh upstream of Upper Newport Bay, from San Diego Creek (Trimble 1987).

Conversion of rural farmland to residential, commercial and light industrial use has been constant in the watershed. Land use statistics supplied by Orange County demonstrate this urban development (ACOE 2000). In 1983, agriculture accounted for 22% and urban uses for 48% of the Newport Bay watershed. In 1993, agricultural uses accounted for 12% and urban uses for over 64% of the area. As of 2000, agriculture had dropped to approximately 7% (<7,500 acres), including row crops (primarily strawberries and green beans), lemons, avocados and commercial nurseries. Currently, San Diego Creek watershed is greater than 90% urbanized whereas Santa Ana-Delhi is approximately 95% urbanized. Projected land use suggests 81% urban land use, 11% open, 8% rural and no agriculture (ACOE 2000).

Land use and drainage modifications changed the nature and magnitude of toxic substance discharges to the Bay. Converting from grazing type agriculture to orchards and row crops has increased the amount of pesticide use in the watershed, resulting in discharges of pesticides from these areas. The commercial nurseries drain to Peters Canyon Wash via Central Irvine Channel and to San Diego Creek via Marshburn Channel and Serrano Creek. Tustin and El Toro military bases exist within the watershed and have historically used various toxic substances during operations. Both military sites are involved with base closure procedures and may ultimately be converted to more urban/suburban areas. Urban development introduced new sources of toxic substances, including different pesticides and metals associated with human habitation (e.g., buildings, landscaping, and motor vehicles). In addition, land use activities which cause erosion may contribute to the delivery of pesticides and other pollutants that adhere to sediments or normally remain in solid form.

Table 1-3 Land Use types in watersheds of Newport Bay

Land use type	**San Diego Creek**		**Santa Ana Delhi**		**Newport Bay**	
	Acres	**% total**	**Acres**	**% total**	**Acres**	**% total**
Agricultural/	5092	6.6	0	0	5147	5.2
Residential	11,668	15.2	5285	18.2	19420	19.7
Commercial	6381	8.3	2397	8.3	9641	9.8
Industrial	3965	5.2	1102	3.8	5263	5.4
Education/Religion/ Recreation	15,811	20.6	825	2.8	17,393	17.7
Roads	10,295	13.4	3446	11.9	15,774	16.0
Transportation	1177	1.5	99	0.3	1326	1.3
No assigned land code	440	0.6	339	1.1	936	0.9
Vacant	21,910	28.5	1060	3.7	23,462	23.9
Total	**76,739**	**99.9**	**29003**	**100**	**98,362**	**99.9**

Source: OCPFRD land use data defined by sub-watersheds to compose each watershed. (see TSD Part A) Most accurate and recent land use data provided by OCPFRD GIS Dept., March 1, 2002.

Public Participation

The State and EPA have provided for public participation through several mechanisms. The Regional Board staff has conducted numerous technical workshops (e.g., quarterly meetings since April 2000) on its assessment of toxic pollutant TMDL needs and the specific toxic pollutant TMDLs being developed by the State. The Regional Board held several public workshops as part of their regular meetings to discuss staff TMDL proposals (January 15, September 26, and October 26, 2001). EPA staff provided updates on its TMDL development activities at several of these Regional Board meetings. On October 26, 2001, the State's draft organophosphate (OP) pesticide and Selenium TMDLs were presented before the public as part of a Regional Board meeting. These draft State TMDLs were also available via the Regional Board website after that date.

On April 12, 2002, EPA publicly noticed the availability of the proposed Toxic Pollutant TMDLs and gave the public until May 28, 2002, to provide written comments. The EPA notice of availability was published in the Orange County Register, mailed to the Basin Plan distribution list provided by the Regional Board, and posted on the EPA Region 9 TMDL website. Two public meetings were held during the public comment period – a meeting to discuss the TMDLs in general in Newport Beach on April 16, 2002, and a meeting to discuss specific technical issues in Irvine on May 9, 2002. Copies of the TMDLs and TSDs were available at the public meetings, in EPA and Regional Board offices, and on the EPA Region 9 TMDL website.

Changes in the Final TMDL Documents

Several changes were made in the final TMDLs in response to comments received during the comment period:

- The numeric targets for some pollutants were modified to follow California screening guidelines or to reflect the most recent screening value studies. The organophosphate pesticide TMDL targets are based on values calculated by the California Department of Fish and Game. The California Office of Environmental Health Hazard Assessment guidelines were applied for organochlorine pollutant fish tissue targets. More recent literature values were applied for the freshwater organochlorine sediment targets.

- The flow records used to calculate flow tiers for several pollutant TMDLs were changed to reflect a longer period of record and to incorporate more recent flow data.

- The selenium TMDLs for the highest flow tier are based on acute water quality standards because, based on analysis of the longer flow record, flow patterns necessary to apply chronic standards were not expected to occur under the highest flow tier.

- The metals TMDLs for San Diego Creek are concentration-based; the metals TMDLs for Newport Bay are both concentration-based and mass-based.

- The organochlorine pollutant TMDLs were revised based on additional modeling analysis and consideration of more recent data. The flow tier approach applied for San Diego Creek organochlorine pollutant TMDLs was slightly modified. The description of analytical methods used for the organochlorine pollutant, chromium, and mercury TMDLs was revised to more clearly explain the analytical methods.

- The allocation methods used for each TMDL were clarified.

- A new section of implementation and monitoring recommendations was added to assist the State in preparing to adopt and implement TMDLs for these pollutants.

II. Overview of TMDLs and Available Data

TMDL Components

This section describes the components of a TMDL and discusses the analytical approaches used in the Newport Bay watershed TMDLs to address each component.

The goal of the TMDL process is to attain water quality standards and protect the beneficial uses of water bodies, including aquatic habitat, fishing, and recreation. A TMDL is a written, quantitative assessment of water quality problems and contributing pollutant sources. It identifies one or more numeric targets (endpoints) based on applicable water quality standards, specifies the maximum amount of a pollutant that can be discharged (or the amount of a pollutant that needs to be reduced) to meet water quality standards, allocates pollutant loads among sources in the watershed, and provides a basis for taking actions needed to meet the numeric target(s) and implement water quality standards.

For federally established TMDLs, seven components are included:

- **Problem Statement**—a description of the water body setting, beneficial use impairment of concern, and pollutants causing the impairment.
- **Numeric Targets—**for each pollutant addressed in the TMDL, appropriate measurable indicators and associated numeric target(s) based on numeric and/or narrative water quality standards which express the target or desired condition for the water body which will result in protection of the designated beneficial uses of water.
- **Source Analysis**—an assessment of relative contributions of pollutant sources or causes to the use impairment.
- **Loading Capacity/Linkage Analysis**—a connection between the numeric targets and pollutant sources which yields calculations of the assimilative capacity of the water body for each pollutant.
- **TMDL and Allocations**— an expression of the total allowable pollutant loads as divided between pollutant sources through load allocations for nonpoint sources and wasteload allocations for point sources. The TMDL is defined as the sum of the allocations and cannot exceed the loading capacity for each pollutant.
- **Margin of Safety**—an explicit and/or implicit margin of safety must be specified to account for technical uncertainties in the TMDL analysis.
- **Seasonal Variation/Critical Conditions—**an account of how the TMDL addresses various flows and/or seasonal variations in pollutant loads and effects.

Problem Statement

EPA includes problems statements in TMDL documents to assist readers in understanding the context for TMDL development and describe the water quality standards issue(s) which prompted development of the TMDL. The problem statements identify:

- name(s) and location(s) of waterbody segments for which the TMDL is being developed,
- the pollutant(s) for which the TMDL is being developed and information about why the pollutant(s) are being addressed,

- a description of the water quality impairment or threat which necessitated TMDL development, and
- adequate background information about the watershed setting for the TMDL to help the reader understand the key water quality, pollutant discharge, land use, and resource protection issues in the watershed.

As discussed above, California's Section 303(d) listing decisions only identified general pollutant categories for toxic pollutants impairing waters in the Newport Bay watershed. The consent decree identified suspected individual pollutants of concern, but the decree provides that TMDLs need not be established for individual pollutants and/or waters if subsequent analysis indicates TMDLs are not necessary at this time. To help define the scope of these TMDL studies, EPA Region 9, with assistance from the Regional Board, completed an assessment of available monitoring data for San Diego Creek and Newport Bay to determine which chemicals warrant TMDL development. In our assessment, we reviewed available toxicity and chemical data in three critical water quality categories: water column quality, sediment quality, and fish and shellfish tissue levels. We applied a two-tiered approach whereby all available data were analyzed to determine whether there is clear evidence of impairment with probable adverse effects (Tier 1) or incomplete evidence and/or evidence of possible adverse effects (Tier 2) (EPA Region 9, 2002). If a chemical exceeded the screening criteria in Tier 1 with respect to any *one* of the water quality categories, then it was determined a TMDL is necessary. If a chemical exceeded the screening criteria in Tier 2 with respect to *two or more* categories then a TMDL is necessary. EPA also considered whether TMDLs might be necessary based on evaluation of water quality trends and conditions in water segments adjacent to a segment in question. We examined monitoring data for the past fifteen years; however, to maximize the relevance of our assessment to present-day water quality, we focused on the most recent results (since 1995). Our assessment evaluated each chemical identified in the decree for four separate water bodies: San Diego Creek, Upper Newport Bay, Lower Newport Bay and Rhine Channel. The water body-pollutant combinations for which EPA determined TMDLs are needed at this time are listed in Table 1-1.

The introduction to this document provides a basic discussion of the problems associated with exposures to toxic pollutants addressed in these TMDLs and background information on the watershed setting.

Numeric Targets and Applicable Water Quality Standards

Numeric targets identify the specific water column, sediment, and/or tissue goals or endpoints for the TMDL which equate to attainment of the water quality standards (see EPA Region 9, 2000). In some cases, multiple indicators and associated numeric target values may be needed to interpret applicable water quality standards (e.g. where there is uncertainty that a single indicator is sufficient to measure protection of designated uses). In addition, some TMDLs may incorporate multiple numeric targets to account for differences in acceptable pollutant levels in a particular water body at different time scales (e.g., short term acute toxicity effects versus long term chronic exposure effects).

Water quality standards are comprised of the designated beneficial uses made of water bodies, narrative and numeric water quality criteria (known as "water quality objectives" in California), and anti-degradation policies. Applicable standards of concern for these toxic pollutant TMDLs include the designated uses and both narrative and numeric water quality criteria, which are applied in a manner which is expected to result in protection of the designated beneficial uses.

The Regional Board Basin Plan (1995) designates the beneficial uses for Newport Bay, San Diego Creek and its tributaries. All water bodies are designated as wildlife habitat, with San Diego Creek identified as warm freshwater habitat and Upper and Lower Bay identified as estuarine and marine habitat, respectively. The recreation beneficial uses are designated for all of Newport Bay and San Diego Creek. Upper and Lower Bay are also designated for commercial and sport fishing, preservation of biological habitats—spawning, reproduction, development, rare, threatened and endangered species, recreation, and shellfish harvesting. The specific beneficial uses of San Diego Creek and Newport Bay are identified in Appendix A-1 at the end of this summary document.

These toxic pollutant TMDLs focus on two of the most sensitive designated aquatic life and wildlife beneficial uses of concern in the watershed—RARE and WILD. One primary objective is to protect the special biological and wildlife habitat of the Newport Bay Nature Preserve and Ecological Reserve, in the upper part of Upper Newport Bay. The Nature Preserve is considered a critical estuary of Southern California. The Upper Newport Bay Nature Preserve consists of approximately 1,000 acres of open space and is home to seven rare or endangered bird species: Light-footed clapper rail, Belding's savannah sparrow, least tern, brown pelican, peregrine falcon, black rail, and California gnatcatcher. Two endangered plants, the salt marsh birds-beak and the rare Laguna live-forever, are also found at the reserve. The second objective is to reduce build up of toxicants in fish and shellfish within all water bodies, thereby minimizing the potential for adverse impacts associated with wildlife and human consumption of contaminated food. Seventy-eight species of fish inhabit the Upper Newport Bay waters, including the California halibut and barred sand bass—two popular sport fishes.

Narrative water quality objectives considered for each TMDL are specified by the 1995 Regional Board Basin Plan:

- Toxic substances shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health;
- The concentrations of toxic substances in the water column, sediments or biota shall not adversely affect beneficial uses.

Numeric water quality objectives for several pollutants addressed in these TMDLs were promulgated by EPA in 2000 in the California Toxics Rule (CTR). Pollutants covered by CTR objectives include selenium, cadmium, copper, lead, zinc, chromium, chlordane, dieldrin, DDT, toxaphene and PCBs. Chlorpyrifos and diazinon are not listed as toxic pollutants pursuant to Section 307(a)(1) of the Clean Water Act (see 40 CFR 401.15), and the CTR did not establish numeric objectives for those pollutants. Additionally, the CTR did not establish aquatic life objectives for mercury and the selenium and cadmium objectives were established contingent on an EPA commitment to revise the objectives promptly to better protect wildlife.

In many cases where applicable standards are expressed in numeric terms, it is appropriate to set the numeric target equal to the numeric water quality standard. For most metals addressed in these TMDLs, the numeric targets are equal to the numeric objectives in the CTR. For selenium (Se) the freshwater and saltwater water quality standards are defined by

CTR. However, EPA acknowledged in its consultations with the U.S. Fish and Wildlife Service (USFWS) that the freshwater standards for Se may not be fully protective of wildlife, and EPA committed to revisit and, if necessary, revise the Se criteria in the near future. In its draft TMDL for Se, the Regional Board proposed to apply more protective Se targets based on USFWS recommendations. In the draft TMDL document, EPA proposed TMDLs based on the promulgated CTR standards, but invited comment on the alternative approach of basing the Se TMDLs on the more protective targets proposed by the Regional Board. The final TMDLs are based on the promulgated CTR standards. (See section IV—Se TMDL for further discussion.)

In some cases, it is necessary to interpret a numeric standard in terms other than the method through which the standard is expressed as long as the target(s) can be shown to relate back to achieving the water quality standard(s). For some pollutants (e.g., bioaccumulative toxins) or receiving water settings (e.g. embayments), it often makes more sense from the standpoint of source control and impact assessment to focus the TMDL on reductions of pollutant mass loads than solely on avoidance of exceedences of concentration-based standards. Moreover, use of sediment and/or fish tissue endpoints may provide more discriminating indicators of the beneficial use impacts of concern in a TMDL (e.g., pollutant bioaccumulation in the food chain and resultant human health or aquatic life impacts from consumption of contaminated organisms). Moreover, selection of targets based on these media enabled EPA to more completely utilize site specific data for several pollutants for which water column data were limited, consistent with the provisions of 40 CFR 130.7(c)(1)(i).

For several pollutants addressed in these TMDLs for which numeric objectives are in place (mercury, chromium, chlordane, dieldrin, DDT, toxaphene, and PCBs), the numeric targets are expressed in terms of protective sediment or fish/shellfish tissue levels. EPA's analysis of the relationship between the levels of these pollutants found in the water column, sediment, and fish/shellfish tissue found that attainment of the sediment and fish/shellfish tissue numeric targets will result in attainment of the water column numeric objectives. The sediment and tissue numeric targets are probably more protective than the numeric objectives for these pollutants. The use of sediment and tissue targets is appropriate in these cases in order to provide an implicit margin of safety to account for uncertainties in the relationship between pollutant loadings and beneficial use effects, and to ensure that both numeric and narrative standards are attained as required by 40 CFR 130.7(c)(1). In addition, EPA's decision to use sediment quality and fish tissue values as numeric targets for these pollutants is based in part on the fact that these substances are much more likely to be associated with particulate matter than to remain in the dissolved phase; that is, these compounds are either sorbed to bottom sediments or associated with extremely fine suspended sediments. Also, there are technological challenges accompanied with sampling and accurately detecting these compounds in water column samples. Therefore, these pollutants are unlikely to be detected in the water column in dissolved form even in waters where they may be present at levels of concern.

In situations where applicable water quality standards are expressed in narrative terms, it is necessary to develop a quantitative interpretation of narrative standards (EPA Region 9 2000). Since a TMDL is an inherently quantitative analysis, it is necessary to determine appropriate quantitative indicators of the water quality problem of concern in order to calculate a TMDL. It is sometimes possible to supplement water column indicators (i.e., pollutant concentrations in water) with measures in sediment or tissue media since these alternative indicators are more directly associated with the pollutant effects of concern.

Where sediment indicators are used in these TMDLs, they are based on sediment quality guidelines developed by several studies (Long et al. 1995, Smith et al.1996, MacDonald et al. 1996) and compiled by Long and MacDonald in the biological effects database system (BEDS) synthesizing many, many samples throughout North America. These sediment quality guidelines (equivalent to threshold effect levels) have been endorsed by NOAA in the screening quick reference tables (SQuiRTs) for contaminants in sediments (Buchman 1999). Where fish or shellfish tissue indicators are used, they are based on tissue screening values established by the California Office of Environmental Health Hazard Assessment (OEHHA 1999). The specific basis for these target indicators is discussed in the individual TMDL descriptions.

For the organophosphate (OP) pesticides, chlorpyrifos and diazinon, there are no promulgated water quality criteria established by EPA or the State of California. Several entities including EPA (USEPA 1986 and 2000c) and California Department of Fish and Game (CDFG 2000a) have recommended criteria values for these pollutants. To be protective of aquatic resources and to meet beneficial uses, EPA has selected the CDFG values for chlorpyrifos and diazinon at the recommendation of the Regional Board.

Source Analysis

An understanding of pollutant loading sources and the amounts and timing of pollutant discharges is vital to the development of effective TMDLs. These TMDLs provide estimates of the amounts of pollutants entering the receiving water of concern or, in some cases, the amount of pollutant that is bioavailable based on historic loadings stored in the aquatic environment. These pollutant source estimates are documented based on data analysis and modeling studies described in the individual TMDLs and associated TSDs. Source loading estimates can be categorized in many ways, including but not limited to discharge source, land use category, ownership, pollutant production process (e.g. sedimentation processes), and/or tributary watershed areas.

The source analysis for these TMDLs indicated that historical discharges of PCBs and chlorinated pesticides, all of which are no longer authorized to be used, are believed to be primarily responsible for the pollutant levels measured in Newport Bay. Metals loading is associated with historical and ongoing discharges of urban runoff. Selenium loadings are estimated to come primarily from erosion and runoff, and discharges of shallow groundwater. Discharges of OP pesticides are associated with past and ongoing uses of these pesticides for household and agriculture pest control. Some pollutant loads are also estimated to come from seawater and atmospheric deposition.

The individually permitted point sources listed below discharge into waters in the Newport Bay watershed. These TMDLs include wasteload allocations for some of these facilities. A general permit is in place to regulate discharges associated with groundwater cleanup, which affects 21 permittees and focuses principally upon total suspended sediment, petroleum hydrocarbons and chlorinated solvents. Another general permit is in place which regulates groundwater dewatering operations of 12 permittees and focuses principally on suspended sediment discharges. Finally, the statewide general permit for industrial stormwater discharges covers several facilities that may discharge in the Newport Bay watershed, including John Wayne Airport. Runoff from state highways is regulated through the statewide CalTrans NPDES permit.

Six boatyards are located around Newport Bay; all are regulated for indirect metals discharges to the sewer system. Discharges from these boatyards do not flow to the Bay. Instead, wastewater flows into sumps or into connections to the Orange County Sanitation District pre-treatment system.

Table 2-1: NPDES Permits In San Diego Creek/Newport Bay Watershed

NPDES permits in San Diego Creek watershed	**Comments**
Orange County Stormwater	MS4 Permit; Includes many cities as co-permittees
Tustin Marine Base/GW general	At present this is general permit, although RWQCB is currently drafting an individual permit
Silverado Constructors/GW cleanup	General permit, discharges under emergency conditions only
Irvine Ranch Water District	Individual permit, discharges tertiary treated water into Sand Canyon Reservoir and permit regulates stormwater overflows from Sand Canyon Reservior
Serrano Water Treatment Plant	Individual permit for a drinking water filtering plant
City of Tustin groundwater desalter	Individual permit, irregular discharges
Great Lakes Chemical/GW cleanup	Individual permit, no longer discharges
CalTrans Stormwater	Statewide permit for CalTrans facilities
Industrial Stormwater	Statewide general permit for industrial stormwater discharges

The Regional Board currently regulates three commercial nurseries through waste discharge requirements (WDRs): Bordier's, Hines and El Modeno Gardens. These nurseries are located in the upper reaches of the watershed, and their discharge (normally only during storm events) flows into Peter's Canyon Wash (for Hines and El Modeno) and Marshburn Channel (for Bordier's) before reaching the main stem of San Diego Creek. The Regional Board is currently evaluating whether WDRs are needed for two other nurseries (Nakase Nursery and AKI nursery). There are some unpermitted nurseries that are smaller in size than the permitted nurseries. Runoff from other agricultural operations in the watershed, including row crops, orchards, and vineyards, is not currently regulated.

Loading Capacity/ Linkage Analysis

The loading capacity is the critical quantitative link between the applicable water quality standards (as interpreted through numeric targets) and the TMDL. The loading capacity reflects the maximum amount of a pollutant that may be delivered to the water body and still achieve water quality standards. The linkage analysis investigates the relationship between pollutant loadings and water quality effects in order to calculate loading capacities for each pollutant and water body. The loading capacity sections discuss the methods and data used to estimate loading capacity. A range of methods were used to derive the loading capacities for the various pollutants, including predictive water quality models and linkage methods based principally on data analysis. The individual TMDLs and associated TSDs describe the linkage analysis in detail.

TMDLs and Allocations

For each pollutant and water body, this document identifies the necessary TMDL (total allowed pollutant amount) and its components: appropriate wasteload allocations for point sources and load allocations for nonpoint sources and natural background. The TMDLs and associated wasteload and load allocations are expressed in quantitative terms as required by federal regulations.

TMDL calculation methods are summarized in this document and described in greater detail in the TSDs. Separate wasteload and load allocations are identified for point and nonpoint sources, respectively. In cases where it is feasible, individual wasteload allocations are established for each existing point source discharge, including permitted stormwater discharges. For several pollutants, insufficient information was available to support delineation of individual WLAs for each NPDES-permitted discharge. Therefore, the TMDLs include wasteload allocations for a category of “other NPDES permittees.” This wasteload allocation category covers discharges under the following permits:

- Tustin Marine Base groundwater
- Silverado Constructors
- Irvine Ranch Water District
- Serrano Water Treatment Plant
- City of Tustin desalter
- Great Lakes Chemical
- Statewide Industrial Stormwater
- Statewide Construction Stormwater

EPA is establishing the grouped allocations for the “other NPDES permittees” category based on the following assumptions, which are discussed here to provide information to assist in implementing the allocations through the NPDES permitting process. The State, in consultation with the permittee(s) where appropriate, should gather data and information necessary to characterize the discharge flows and, if feasible, the loads of the specific pollutants for which allocations are established. The State should consider this new data and information when it considers adoption of the TMDLs and associated implementation plans for these toxic pollutants. If this categorical wasteload allocation is not subdivided when the State adopts the TMDLs, we assume that when any permit in this category is considered for revision or reissuance, the State should prepare an analysis as part of the permit fact sheet that (1) identifies the specific proportion or amount of the categorical wasteload allocation that can be discharged by the individual discharger, and (2) shows that the sum of all discharges covered by these permits will not exceed the total categorical wasteload allocation and is otherwise consistent with the TMDLs. Several alternative approaches are available to the State to apportion available loading amounts among the facilities covered in this wasteload allocation category (see *Technical Support Document for Water Based Toxics Control*, (EPA-505-2-9-001), March, 1991, pp. 68-69 for guidance on allocation criteria).

In the absence of additional analysis by the State in support of individual permitting actions consistent with the assumptions discussed above, we assume that available loading capacity identified in the categorical wasteload allocation is to be divided equally among the 8 permitted discharges. We expect that the followup State analysis in support of TMDL adoption or permit reissuance may result in different divisions of allocation capacity depending upon the combination of discharge flows, loads, and timing associated with each permitted discharge.

Load allocations for nonpoint sources may be expressed as specific allocations for specific dischargers or as "gross allotments" to nonpoint source discharger categories (40 CFR 130.2). TMDLs usually provide separate load allocations for natural background loads. Separate load allocations for background loads are calculated for the Newport Bay metals TMDLs; however, insufficient information is available to support a conclusion that these loads are completely natural. Separate natural background allocations are inappropriate for pesticides and organochlorine compounds because they of anthropogenic origin and because all known loading sources are accounted for in the TMDL analysis. Separate background allocations could not be calculated for selenium, chromium and mercury because insufficient information was available to support these calculations. Background levels of selenium associated with groundwater inputs to surface water may be significant; however, the physical and hydrological structure of the watershed has been highly altered as a result of hydrologic modifications, groundwater pumping, irrigation practices, and water imports to the watershed. As a result, it would be very difficult to estimate "naturally occurring" selenium discharge levels. Background levels of chromium and mercury are not expected to be substantial.

Allocations may be based on a variety factors. Federal regulations do not establish specific criteria which must be considered in dividing and allocating any available loading capacity between contributing sources. Criteria applied to determine the division of available pollutant loading capacity include:

- Organophosphate Pesticides: All allocations are concentration-based and are applied equally to all discharge sources.
- Selenium: Allocations were divided in proportion to land use areas of the different allocation categories for nonpoint sources and in proportion to discharge flow rates for point source categories. Consideration of flow rates in freshwater bodies, directly linked to precipitation events, is included.
- Metals: Load allocations and the stormwater wasteload allocation for San Diego Creek were generally divided in proportion to land areas associated with each source category. In defining the wasteload allocations for San Diego Creek, we considered the relative discharge flows associated with the different dischargers. We also included an undefined sources load allocation as a gross allotment to account for apparent loadings that could not be associated with other source categories.
- Organochlorine Compounds: Allocations to terrestrial watershed sources were generally divided in proportion to land use areas of different allocation categories, with some consideration of the feasibility of reducing loads for DDT. Newport Bay allocations are expressed as net available loads, taking into account as background loads loadings already allocated for "upstream" segments. For this reason, the allowable loads as expressed in the allocation tables in the TMDL document do not increase cumulatively in a downstream direction. The division of available loading capacity between terrestrial and in-Bay sediment sources was done in proportion to the percentage of total loads associated with watershed versus in-Bay sediment sources.
- Mercury and Chromium: Allocations to watershed sources were generally divided in proportion to land use areas of different allocation categories. Allocations between

watershed sources and in-Bay sediment sources were divided in proportion to the percentage of estimated contributions from new sources and resuspended sediments.

TMDLs (and thus, load allocations and wasteload allocations) can be expressed as *"mass per time, toxicity, or other appropriate measure"*, depending on the type of waterbody and the sources that contribute to impairment. The TMDLs for all pollutants except diazinon and chlorpyrifos are expressed in terms of mass loads per time, and the TMDLs for the pesticides diazinon and chlorpyrifos are expressed in terms of water column concentrations. It is appropriate to express these pesticide TMDLs in terms of water column concentrations because these pollutants cause adverse effects on aquatic life through relatively short term exposures. These pollutants are relatively short-lived in the environment before they break down into less toxic forms, and they do not bioaccumulate through the food chain in the same way several of the other pollutants addressed in these TMDLs do. Therefore, the water column concentrations of these pesticides are of greatest concern in preventing adverse ecosystem effects.

Margin of Safety

A margin of safety is incorporated in each TMDL analysis in order to account for uncertainty in the relationship between pollutant loads and water quality effects.

The margin of safety can be implicit (i.e., incorporated into the TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings) or a combination of both. The TMDLs described in this document include a margin of safety discussion for each pollutant that describes the basis for the provided margin of safety and shows why it is adequate to account for uncertainty in the TMDL. The document discusses sources of uncertainty in the analysis and how individual analytical assumptions or other provisions adequately account for these specific sources of uncertainty.

For all pollutants except metals, a 10% explicit margin of safety was applied to account for uncertainties in the analysis. An explicit margin of safety is appropriate for each TMDL because there is significant uncertainty in the analysis of pollutant effects, loads, fate (i.e. chemical transformations and degradation following discharge), and transport in the watershed. The data supporting the TMDLs were somewhat limited. For metals, a 20% explicit margin of safety was applied to account for (1) these analytical uncertainties and (2) the consideration that the metals TMDLs are expressed in terms of dissolved metals although it is likely that total metals loading levels are somewhat higher than dissolved metals loads, and that total metals loads may be of concern as a cause of sediment toxicity.

For all pollutants, the TMDLs also incorporate an implicit margin of safety because numerous conservative assumptions were made to ensure that the analytical methods applied are environmentally protective. Each TMDL section describes sources of uncertainty in the analysis and the assumptions made which provide an implicit margin of safety.

Seasonal Variations and Critical Conditions

TMDL must describe the methods used to account for seasonal variations and critical conditions (e.g., stream flows, pollutant loadings, and other water quality parameters) in the TMDL(s) [40 CFR 130.7 (c)]. In the semi-arid climate of Southern California there are two seasons—dry weather during most of the year and intermittent wet weather events typically between November and March. This two-season climate creates significant differences in flow through the creeks and streams. In general, 90% of the water flow occurs during less than 10% of the time; that is, most significant storm events and associated high flows usually occur during the months of December, January and February.

EPA has utilized two different approaches to seasonal variations and critical conditions in developing these TMDLs. One approach varies TMDLs on a seasonal basis. For example, the OP pesticide TMDLs (chlorpyrifos and diazinon) show there is considerable increase in pesticides applied during the dry season (when pests grow and create problems); however, aquatic impairment occurs during wet weather events as surface runoff pollutes the freshwater tributaries. OP pesticide critical conditions are explained more in section III below.

The other approach to addressing seasonal variations and critical conditions is to define critical conditions solely based on freshwater flow rates due to precipitation regardless of season. This flow based approach is applied to freshwater loading to metals, Se, and organochlorine (OC) compounds. Unlike the OP pesticides, the water quality effects associated with these pollutants are not expected to vary on a seasonal basis. In this flow-based approach, the continuous range of stream flows (measured as daily flow rates) that occur in San Diego Creek is broken down into several flow tiers. The loading capacity for each breakpoint in the flow tiers is established, and the sum of allowable loads under all tiers equals the total annual loading capacity for freshwater bodies. Thus the applicable allocation for a given source does not depend on the time of year, but on the actual stream flow (or associated sediment deposition rate for OC compounds) at the time of discharge. This flow approach is partially used for chromium and mercury TMDLs for Rhine Channel, where freshwater has little influence (6%) on deposition within that dead-end reach of Newport Bay.

To estimate the loading capacity of freshwater systems, EPA has utilized daily flow records at San Diego Creek at Campus Drive which were collected by USGS from 1977 - 79 and 1983 – 85 and Orange County Public Facilities and Resource Division (OCPFRD) from 1985 to present. EPA and Regional Board staff reviewed the entire daily mean flow record set from USGS and OCPFRD. The analysis was performed on a water year basis (e.g., July 1977 to June 1978). Incomplete USGS data for the period 1979/80 to 1982/83 were not used because only partial records were available for each year. Thus, the USGS and OCPFRD records yielded 19 water years of daily mean flow records for San Diego Creek. This time span covered water years: 1977-78, 1984/85 – 2000/01. EPA used these records for calculating the flow based approach to Se, dissolved metals, organochlorine, mercury and chromium TMDLs. EPA used annual flow records for water year 1996, 1997, 1998, 1999, 2000, 2001 to determine flow inputs from Santa Ana Delhi Channel. This time span covers a reasonable diversity of rainfall conditions based on precipitation measurements from 1958 to 2001. It includes the exceptionally wet El Nino year, 1998, as well as relatively drier years, 1999 and 2000. Table 2-2 shows rainfall recorded at Tustin/Irvine Ranch gage station for each year within the time span utilized by EPA, as well as historical high and low rainfall records. These data illustrate that the data years used by EPA for this approach are reasonably representative of the entire time period. Technical Support Document—Part B gives more explanation of freshwater flows and seasonal variations.

Table 2-2. Annual Precipitation Records at Tustin-Irvine Ranch Station

Water Year *	Rainfall (inches)	Water Year	Rainfall (inches)	Water Year	Rainfall (inches)	Water Year	Rainfall (inches)
1958-59	5.03	1971-72	5.02	1983-84	10.47	1995-96	11.17
1959-60	9.6	1972-73	14.9	1984-85	10.25	1996-97	16.19
1960-61	4.13	1973-74	9.81	1985-86	14.42	1997-98	34.72
1961-62	13.07	1974-75	12.36	1986-87	8.79	1998-99	8.6
1962-63	5.76	1975-76	5.11	1987-88	11.14	1999-00	8.8
1963-64	9.38	1976-77	10.2	1988-89	8.17	2000-01	14.6
1964-65	10.28	1977-78	27.96	1989-90	5.93	Summary	
1965-66	12.68	1978-79	18.59	1990-91	11.23	Min:	4.13
1966-67	14.22	1979-80	20.75	1991-92	17.18	Max:	34.7
1967-68	8.58	1980-81	8.47	1992-93	27.09	Mean:	13.03
1968-69	19.91	1981-82	13.22	1993-94	10.23	Median:	10.8
1969-70	8.48	1982-83	25.92	1994-95	24.65	Count:	42

*Source: OCPFRD; *Water years run from July 1 to June 30 of the following year.*

Rainfall data for water year 1970-71 not available

Available Data

Monitoring data used in these TMDLs came from numerous sources. Much of the analysis has been summarized in a Regional Board staff report describing the monitoring results in relation to water quality objectives, sediment guidelines and fish tissue screening values (SARWQCB 2000). EPA has included data from a few more recent studies and focused on monitoring results compiled over the past five years to assess present day water quality conditions. EPA has also reviewed ten years of sediment data and nearly twenty years of fish tissue results to determine long-term trends. Finally, the Regional Board has several projects currently in progress with the Southern California Coastal Research Water Project (SCCWRP). The studies relevant to these toxics pollutant TMDLs address sediment toxicity in Newport Bay (2001a), fish bioaccumulation in Newport Bay (2001b) and freshwater toxicity in San Diego Creek at Campus Dr. (2001c). Preliminary results for two studies (2001a, 2001b) were available as of Dec 1, 2001 and (where feasible) some data were included in these TMDLs. A summary of all monitoring data, the waterbodies sampled, measured parameters and citation/abbreviation is provided in Table 2-3.

Table 2-3 Overview of monitoring data

Organization	Period of record	Geographic Scope	Measured Features	Measured Parameters and comments
Lee & Taylor (2001a) 319(h) report (for SA RWQCB)	Winters 1999; 2000	San Diego Creek Watershed	stormwater runoff	Se; metals and OP pesticides in watershed, Draft report provided May 2001

Hibbs & Lee Se Study	1999	San Diego Creek; Groundwater	Surface and groundwater	Se in groundwater and SDCreek
Lee & Taylor (2001b) 205(j) report (for SA RWQCB)	1997-'99	San Diego Creek Watershed	Surface water toxicity	Toxicity and pesticides in watershed
CDPR Red Imported Fire Ant (RIFA) study	1999-present	San Diego Creek Watershed	Surface water	Toxicity and pesticides Insecticides and OP pesticides in watershed; toxicity and chemical concentrations
IRWD (1999) Database	Fall 1997 --March 1999	San Diego Creek; Upper and Lower Bay (10 sites)	Surface water; sediments	metals and organics using appropriate sampling and analytical techniques, one day composites, year round, no storm events
OCPFRD (2000) (NPDES annual report)	1996-2000	All freshwater tributaries, San Diego Creek; Upper and Lower Bay, Rhine Channel	Surface water; sediments	7 metals, some organics, dry and wet weather events; some four consecutive day sampling; semi-annual sediment data
Orange County Coastkeeper (1999)	Oct. 1999	Rhine Channel (2 sites); Lower Bay (1 site)	Sediments	Metals, sediment core in Rhine
Ogden Env. (1999, for City of Newport Beach)	June 1999	Lower Bay (12 sites)	Sediment	Metals; few priority organics in dredge studies
BPTCP (1997) (for SWRCB/ NOAA/EPA)	1994; '96	Upper and Lower Bay (18 sites total)	Sediment triad study	Metals; many organics; toxicity; benthic comm. Index
Bight '98 (coordinated by SCCWRP)	1998	Lower Bay (11 sites; not Rhine).	Sediment triad study	chemistry; toxicity; benthic comm. index; interstitial porewater data for AVS & SEM
Cal. Dept. Fish & Game	1999-2000	San Diego Creek watershed	Sediment; Fish tissue	OP Pesticides; insecticides in sediment and fish tissue as part of Red Imported Fire Ant project
Calif. Fish Contamin. Study (CFCS) (for SWRCB/ OEHHA)	1999–2000	Upper and Lower Bay	(sport) Fish tissue	Preliminary results for three metals; many organics in fish fillets with skin off
State Mussel Watch (SMW) (for SWCRB)	1980-2000	mostly Upper and Lower Bay	Shellfish tissue	Metals; organics in resident or transplanted mussels, no recent data in SDC
Toxic Substance Monitoring (TSM) (for SWRCB)	1983–1998	all Newport Bay waterbodies	Fish tissue	Total metals; organics in whole fish with skin on
SCCWRP (2001a) Sediment Toxicity Study (for SA RWQCB)	On-going	Upper and Lower Bay; including Rhine Channel (10 sites)	Sediment; Water Toxicity	chemistry; toxicity; benthic comm. index, some preliminary results available
SCCWRP (2001b) Fish Study (for SA RWQCB)	On-going	Upper and Lower Newport Bay	Fish tissue	Four metals; priority organics, sportfish samples in 2001; ecological risk samples in 2002
SCCWRP (2001c) Freshwater Study (for SA RWQCB)	On-going	San Diego Creek (1 site)	Freshwater Toxicity	TIEs for metals in Winter 2002; Se bioaccumulation study

III. Organophosphate (OP) Pesticide TMDLs

TMDLs are required for chlorpyrifos and diazinon for San Diego Creek. To address impairment specified in the 1998 Section 303(d) list, the TMDLs for San Diego Creek address both Reach 1 and Reach 2, unless otherwise explicitly indicated. A TMDL is also required for chlorpyrifos in the Upper Newport Bay. TMDLs are required despite recent re-registration agreements to phase out certain uses of these two OP pesticides by 2006 (EPA 2001b, 2000b). A large portion of information presented here and in the Technical Support Document – Part C is based on the OP Pesticide draft TMDLs written by Regional Board staff (SARWQCB 2001a).

Problem Statement

San Diego Creek

Water column acute and chronic toxicity to aquatic life in San Diego Creek and its tributaries has been identified and attributed largely to diazinon and chlorpyrifos through toxicity identification evaluation (TIE) studies. Over 300 toxicity tests have been performed on 123 water samples collected from the Newport Bay watershed. Toxicity occurred during virtually all monitored storm events and is viewed primarily as a wet weather problem. Dry weather toxicity was generally confined to upper reaches of the watershed (near the foothills) and diluted or otherwise remediated in downstream locations (Lee and Taylor 2001a, b). These TMDLs are structured to prevent toxicity under all flow conditions.

Average diazinon concentrations in San Diego Creek during baseflow (200 ng/L) and stormflow (445 ng/L) have exceeded the chronic numeric target of 50 ng/L. Ninety-five percent of the observed concentrations were also above the acute numeric target of 80 ng/L. Average chlorpyrifos concentrations in San Diego Creek during baseflow (111 ng/L) and stormflow (87 ng/L) have exceeded the chronic numeric target (14 ng/L). At least 59% of the observed concentrations also exceeded the acute numeric target of 20 ng/L.

Upper Newport Bay

Evidence exists indicating water column toxicity due to chlorpyrifos in Upper Newport Bay. This is restricted to storm events when freshwater inputs from San Diego Creek and Santa Ana Delhi linger in the Upper Bay (Lee and Taylor 2001a, b). Average chlorpyrifos concentrations observed in Upper Newport Bay (43.3 ng/L) have exceeded the saltwater chronic numeric target of 9 ng/L during stormflow conditions, and 80% of the concentrations exceeded the acute numeric target (20 ng/L). Toxicity attributed to chlorpyrifos does not extend into Lower Bay. Diazinon does not appear to cause toxicity in saltwater bodies such as Upper or Lower Newport Bay.

Bioaccumulation

In San Diego Creek watershed, fish tissue concentrations of chlorpyrifos have consistently remained orders-of-magnitude below the OEHHA screening value (10,000 ppb) for fish consumption. Diazinon fish tissue concentrations have exceeded the OEHHA screening value of 300 ug/kg only once (440 ug/kg), according to Toxic Substances Monitoring data.

Mussel tissue concentrations of both OP pesticides have never exceeded the OEHHA screening values. Therefore, there is no compelling evidence of bioaccumulation of these substances to levels of concern, an observation consistent with monitoring from other studies (CDFG 2000, EXTOXNET).

In short, there is conclusive evidence that diazinon and chlorpyrifos are causing acute and chronic toxicity in San Diego Creek and that chlorpyrifos causes toxicity in Upper Bay. Toxicity predominantly occurs during storm events and certainly affects lower level aquatic organisms such as *Ceriodaphnia* (Lee and Taylor 2001a, b).

Numeric Targets

At present, there are no promulgated water quality criteria for chlorpyrifos and diazinon. For these TMDLs, EPA has selected the numeric targets from recommended acute and chronic criteria derived by the California Dept. of Fish and Game for chlorpyrifos and diazinon in freshwater and saltwater (CDFG 2000a). These numeric targets serve as the quantitative interpretation of the narrative water-column quality objective as specified in the Basin Plan (1995). These numeric targets will be protective of aquatic life in San Diego Creek and Upper Newport Bay and sufficient to remove impairment caused by OP pesticide toxicity. Target concentrations are shown in Table 3-1; saltwater chronic and acute targets for diazinon are not applicable since TMDLs are not required for this pollutant in any of the saltwater bodies covered by these TMDLs.

Table 3-1 Selected Numeric Targets

		Concentration (ng/L)	
Pesticide	**Criterion**	**Freshwater**	**Saltwater**
Diazinon	Chronic	50	N/a
Diazinon	Acute	80	N/a
Chlorpyrifos	Chronic	14	9
Chlorpyrifos	Acute	20	20

from Calif. Fish & Game (2000a)
chronic means 4-consecutive day average

Source Analysis

This section of the TMDL presents a synopsis of the major sources of diazinon and chlorpyrifos to San Diego Creek and chlorpyrifos to Upper Newport Bay. This synopsis focuses on water column concentrations from several studies conducted in the watershed targeting aquatic life toxicity associated with pesticides (Lee and Taylor 2001a; 2001b; DPR studies). These studies were not detailed enough to identify discrete sources, but it appears that diazinon and chlorpyrifos are problems attributed to agricultural and residential use. Investigations of DPR pesticide use reports provide some estimates of pesticide applications by land use within the watershed; however this does not comprehensively depict all sources in San Diego Creek. Additional analysis via land use information indicates that residential contributions are also significant. The synopsis is presented below, whereas the reader will find a more complete source analysis in the Technical Support Document – Part C.

Diazinon

Within freshwater bodies of San Diego Creek, monitoring results show extremely high detection frequency (>98%) of diazinon during storm events. This detection frequency decreases slightly (89%) during dry weather or base flow conditions. Maximum concentrations were observed in Hines Channel (which drains into Peters Canyon Channel, and is tributary to San Diego Creek Reach 1).

At virtually all the locations, the median stormflow concentration is significantly higher than the median baseflow concentration. Since stormwater runoff constitutes about 80% of the volume of water discharged to Newport Bay on an annual basis, this would indicate that the overwhelming majority of the pesticide load would derive from stormflow rather than baseflow. The average concentration is actually higher for baseflow, but this is biased by a few very high detections from 1998 near nurseries. These results have not been observed in later sampling and the nurseries have subsequently instituted measures targeted at reducing pesticide runoff.

Chlorpyrifos

Chlorpyrifos was detected less frequently (in 45% of samples) than diazinon. This is due in part, to the lower solubility of chlorpyrifos, and its greater affinity for sediment. The lower mobility of chlorpyrifos results in lower concentrations in the drainage channels. According to DPR Pesticide use database, over twice as much chlorpyrifos is applied as compared to diazinon (per pound of active ingredient).

Sample locations monitoring residential areas tended to have lower chlorpyrifos concentrations. Chlorpyrifos was not detected at three of the residential locations under both baseflow and stormflow conditions. The detection frequency, and maximum concentrations detected at another partly residential location (Santa Ana Delhi Channel) were low. The only residential site with relatively high chlorpyrifos concentrations was Westcliff Park (stormflow), but the baseflow concentrations were relatively low.

California DPR Pesticide Use Database

The California Department of Pesticide Regulation (DPR) Pesticide Use database provides information by county about application of pesticides by various licensed pesticide users. For the Newport Bay watershed, diazinon and chlorpyrifos applications have been estimated to comprise one-fifth the total reported for Orange County (because the watershed acreage is one-fifth that of Orange County). In addition, land use analyses indicate that commercial nurseries and residential areas are associated with high pesticide application rates, and much higher detection in water during wet weather. Urban uses account for over 90% of total diazinon and chlorpyrifos use in the Newport Bay Watershed, with residential use by homeowners accounting for roughly half the estimated total of 10,700 lbs of diazinon and 24,000 lbs of chlorpyrifos used in the watershed in 1999. Similar studies reported in literature of pesticide use and water monitoring results have indicated that residential hotspots (individual homes) can account for most of the diazinon runoff from a neighborhood (Scanlin and Feng 1997; Cooper 1996).

Based on data from investigations carried out from 1996-20001, about 36 pounds of diazinon is discharged annually to San Diego Creek, mostly during storm events. This is less than 0.4% of the estimated diazinon mass applied in the watershed. About 8 pounds of chlorpyrifos is discharged annually to San Diego Creek and Upper Newport Bay, with most of the load delivered during storm events. This amounts to about 0.03% of the applied chlorpyrifos mass. Available data and studies indicate that in normal use, OP pesticides break down quickly and therefore only a small percentage of the total amount applied is available to runoff to waterbodies. However, even small amounts of these pesticides are enough to cause acute and chronic toxicity in receiving water bodies.

In summary, surface runoff is the source of virtually all loadings. Contributions from sediment remobilization and groundwater are negligible, however, loading from atmospheric deposition to Upper Newport Bay is potentially significant, though not well quantified. The chemical properties of diazinon and chlorpyrifos ensure that they do not accumulate in the environment. Runoff derived from urban land uses accounts for about 88% of the diazinon baseflow load, and 96% of the stormflow load. Agricultural sources (including nurseries) account for the remainder of the load. For chlorpyrifos, runoff derived from urban land uses accounts for about 85% to 88% of the baseflow and stormflow loads, while agriculture (including nurseries) accounts for about 12% to 15% of the load. On a per acre basis, different land uses contribute diazinon and chlorpyrifos runoff at fairly equal rates within the watershed and distinct source areas are not readily identifiable. Median concentrations from 14 sampled drainage channels across the watershed did not exhibit large differences.

Although it appears that some of the nursery/agricultural locations yield higher chlorpyrifos concentrations than the residential areas, it should be noted that the nursery monitoring locations are selected to monitor undiluted nursery discharge, very close to where the chlorpyrifos is used. In contrast, runoff from individual homes where chlorpyrifos is applied is not monitored; rather the monitoring location is further away within a channel thereby collecting mixed/diluted runoff from many homes. In addition, because of the inherent immobility of chlorpyrifos, and its tendency to adsorb to sediment, higher chlorpyrifos concentrations are most likely to be encountered in areas nearby to where it is applied, before it partitions out of the aqueous phase and settles out along with the sediment.

Loading Capacity/Linkage Analysis

These OP pesticide TMDLs use a concentration-based loading capacity and allocations for diazinon and chlorpyrifos. The concentration-based loading capacity will address the problems of aquatic toxicity within the watershed and Upper Newport Bay. Because diazinon and chlorpyrifos are generally not known to bioaccumulate, there is no need to establish the loading capacity via mass based units. These concentration-based TMDLs will protect aquatic life from short-term exposure via acute targets and long-term exposure via chronic targets.

The concentration-based loading capacity values are exactly the same as those selected as the numeric targets (see Table 3-1). For San Diego Creek, the loading capacity for diazinon has two components: the chronic or 4-day average concentration (50 ng/L), and a maximum 1-hour average (acute) concentration of 80 ng/L. The loading capacity for chlorpyrifos in San Diego

Creek also has two components: the chronic or 4-day average concentration (14 ng/L), with a maximum 1-hour average (acute) concentration of 20 ng/L. For Upper Newport Bay, the loading capacity for chlorpyrifos has two components: the chronic or 4-day average concentration (9 ng/L), and a maximum 1-hour average (acute) concentration of 20 ng/L acute.

As discussed above regarding the numeric targets, this loading capacity (including the margin of safety discussed below) will result in achievement of the narrative water quality objective for aquatic toxicity because these numeric targets arise from aquatic toxicity tests completed during the development of these recommended water quality levels.

TMDL and Allocations

The TMDLs for diazinon and chlorpyrifos are being established at levels equivalent to the loading capacities identified above. We have also utilized concentration-based allocations for both wasteload allocations (WLA) and load allocations (LA). The WLA applies to point sources in the watershed, and includes the NPDES permittees. The LA applies to non-point sources such as agriculture, open space and atmospheric deposition.

For these OP pesticide TMDLs, EPA has established an explicit (10%) margin of safety (discussed below); therefore the concentration-based allocations are calculated as 90% of the numeric target level for each pesticide under acute and chronic exposure conditions. For example, the numeric target for diazinon under short term, acute conditions is 80 ng/L. The wasteload and load allocations are set at 72 ng/L, after subtraction of 8 ng/L to provide the 10% margin of safety.

Allocations for Freshwater Water Bodies

Table 3-2 presents the concentration-based freshwater allocations for chlorpyrifos and diazinon; these apply to all point sources (wasteload allocations) and to all non-point sources (load allocations). The diazinon allocations apply to freshwater discharges into San Diego Creek Reach 1 and Reach 2. The chlorpyrifos allocations apply to freshwater discharges into San Diego Creek (Reach 1 and Reach 2) and discharges into other freshwater tributaries into Upper Newport Bay including Santa Ana Delhi Channel, Big Canyon Channel and other drainages to Upper Bay. This includes discharges from agricultural and residential lands, including flows from the storm water systems. These limits apply regardless of season and flow; i.e., at all times of the year.

Table 3-2: Diazinon and Chlorpyrifos Allocations for San Diego Creek

Category	**Diazinon (ng/L)**		**Chlorpyrifos (ng/L)**	
	Acute	Chronic	Acute	Chronic
Wasteload Allocation	72	45	18	12.6
Load allocation	72	45	18	12.6
MOS	8	5	2	1.4
TMDL	**80**	**50**	**20**	**14**

Allocations for Upper Newport Bay

Table 3-3 presents the saltwater allocations for chlorpyrifos; these apply to all point sources (wasteload allocations) and to all non-point sources (load allocations). It applies to saltwater allocations in Upper Newport Bay, defined from San Diego Creek at Jamboree Rd. down to Pacific Coast Highway Bridge. These limits apply regardless of season and flow; i.e., at all times of the year.

Table 3-3. Chlorpyrifos Allocations for Upper Newport Bay

Category	**Acute (ng/L)**	**Chronic (ng/L)**
Wasteload allocation	18	8.1
Load allocation	18	8.1
MOS	2.0	0.9
TMDL	**20**	**9**

Chronic means 4-consecutive day average

Needed Reductions

Table 3-4 summarizes the estimated needed concentration based (load) reductions for diazinon and chlorpyrifos in order to achieve the TMDL numeric targets in San Diego Creek. Multiple samples are available from five separate storm events in the watershed from 1997-2000. The storm average concentrations in Table 3-4 are the maximum single storm averages at the San Diego Creek-Campus station. The difference between the current load and the allocation is the needed reduction. Chlorpyrifos concentrations may have begun to decline in 2000 and 2001, based on indications of a reduction in usage from the DPR database as well as from the Sales and Use Survey (Wilen 2001) conducted in late 2000. To date, there are no clear indications of declining trends in diazinon usage in the watershed. This table indicates the estimated needed reduction during average storm flows. As discussed above, the majority of the pesticide load derives from stormflow.

Table 3-4. Needed Load (concentration based) Reductions for San Diego Creek.

Constituent	**San Diego Creek Campus Station**		**Allocation**		**Needed Reduction**	
	Storm Average (ng/L)	Max (ng/L)	Chronic (ng/L)	Acute (ng/L)	Chronic (ng/L)	Acute (ng/L)
Chlorpyrifos	120	580	12.6	18	90%	97%
Diazinon	848	960	45	72	95%	93%

Phase out agreements

Diazinon – In January 2001, USEPA released a revised risk assessment and an agreement with registrants to phase out most diazinon uses (USEPA 2001b). Under the agreement, all indoor uses will be terminated, and all outdoor non-agricultural uses will be phased out over the next few years. In addition, on a national basis, about one-third of the agricultural crop uses will be removed. Within the Newport Bay watershed, non-agricultural and non-nursery uses account for over 90% of the diazinon use in Orange County. It is thus likely that the EPA agreement will result in the cessation of most diazinon use in the Newport Bay watershed soon after the outdoor non-agricultural use registration expires on December 31, 2004.

Chlorpyrifos – In June 2000, the EPA published its revised risk assessment and agreement with registrants for chlorpyrifos (USEPA 2000b). The agreement imposes new restrictions on chlorpyrifos use in agriculture, cancels or phases out nearly all indoor and outdoor residential uses, and also cancels non-residential uses where children may be exposed. Application rates for non-residential areas where children will not be exposed will be reduced, and public health use for fire ant eradication and mosquito control will be restricted to professionals. In Orange County, residential use likely accounts for over 90% of total chlorpyrifos use. Thus, it appears that over 90% of the current chlorpyrifos use in the Newport Bay watershed will be eliminated by the EPA agreement. Retail sales are scheduled to stop by December 31, 2001, and structural uses will be phased out by December 31, 2005.

While these agreements should result in significant decreases in OP pesticide use and the resulting discharge concentrations to the waterbodies, additional measures may be necessary to achieve the reductions set forth above.

Seasonal variation/Critical conditions

Pesticide usage correlates roughly with the season, with increasing usage in the warmer months due to increased pest activity. However, runoff into the drainage channels is greatest during the wet season, and higher pesticide concentrations are observed during storm events. The higher pesticide concentrations primarily account for the toxicity observed in stormwater samples collected in the watershed. The chronic criteria used as the basis for the numeric targets are designed to ensure protection of aquatic life during all stages of life, including the most sensitive stages. Because the TMDL is being expressed as a concentration, a detailed analysis of critical conditions is unnecessary. The concentration-based allocations (Table 3-2 and 3-3) will apply and be protective during all flow conditions and seasons.

Margin of Safety

An explicit 10% margin of safety was applied to the recommended criteria derived by the CDFG (2000a) and EPA (1986) for diazinon and chlorpyrifos. This explicit margin of safety is intended to account for uncertainties in TMDL calculation methods and concerning pesticide effects (e.g., potential additive and synergistic impacts from exposure to multiple OP pesticides) that may aggravate water quality impacts due to diazinon and chlorpyrifos usage in the watershed.

In addition to the explicit margin of safety, conservative assumptions were used in applying the numeric targets within the watershed. These conservative assumptions serve as implicit margins of safety to provide additional protection for aquatic life and minimize aquatic toxicity.

1. No adjustment was made to reflect the possibility of pesticide breakdown from point of discharge to San Diego Creek. Scientists have measured that half-lives of diazinon and chlorpyrifos in water range from a few days up to six months, therefore some degradation is likely to be occurring after application and within flowing waters. Assuming discharges are

within the specified concentration-based allocations, and that such degradation (via biotic and abiotic processes) occurs, there will be sufficient protection for aquatic life.

2. No adjustment was made to reflect the possibility of mixing and dilution within the drainage channels. In particular, the dilution capacity provided by groundwater seepage has not been factored into the TMDLs.

IV. Selenium TMDLs

TMDLs are required for selenium (Se) for San Diego Creek, Upper Bay, Lower Bay, and Rhine Channel. Much of the work presented below and in the Technical Support Document—Part D for Selenium is based on the Se draft TMDLs written by Regional Board staff (2001b).

Problem Statement

Selenium is a naturally occurring element that persists in soils and aquatic sediments and readily bioaccumulates through the food chain at levels that can cause adverse effects on higher level aquatic life and wildlife including fish and birds that prey on fish and invertebrates. Selenium can become mobilized and concentrated by weathering and evaporation in the process of soil formation and alluvial fan deposition in arid and semiarid climates (Presser, 1994). Moreover, selenium may be leached from sediments as a result of irrigation practices, elevation of the groundwater table, or other modifications in the natural hydrologic regime.

Dissolved selenium concentrations in San Diego Creek at Campus, and in tributaries to San Diego Creek, consistently exceed the chronic (4-day average) CTR criterion for freshwaters (5 µg/L). This has been observed in numerous studies, which also cite occasional exceedances of the acute (1 hour max.) criterion (Hibbs and Lee 1999, IRWD 1999, Lee and Taylor 2001a). Dissolved selenium concentrations in Newport Bay do not exceed the CTR saltwater criterion (71 µg/L); nonetheless, fish tissue data indicate that selenium loadings *may* be causing toxicity or contributing to conditions threatening wildlife in Upper and Lower Bay (see next paragraph). Freshwater and saltwater toxicity tests (designed for metals and trace elements such as selenium) are currently in progress (SCCWRP 2001a, b).

In the majority of aquatic sediment samples analyzed from Newport Bay watershed, selenium concentrations are below levels of concern (2—4 mg/kg dry) as defined by Enberg et al. (1998). Mussel and fish tissue concentrations from all waterbodies are below the screening value (20 mg/kg wet) for protection of human health as established by OEHHA (1999). However, these same tissue results are within the range of levels of concern (4 – 12 mg/kg dry) for toxicological and reproductive effects to wildlife (Enberg et al. 1998 and Henderson et al. 1995). In San Diego Creek, tissue concentrations of selenium in small whole fish show an increasing trend from 1983 to 2000 (TSM 2000). Fish fillet results in Newport Bay do not appear to have the same trend and maximum levels barely approach 4 mg/kg dry (TSM database), which is below reported levels of concern. Studies of avian reproductive success, specifically including selenium concentrations in eggs, have not been completed.

Numeric Targets

As discussed in Section II, the California Toxics Rule (CTR) includes numeric water quality standards (objectives) for selenium which are designed to protect aquatic life (USEPA 2000a). EPA and Regional Board staff have re-evaluated freshwater flow histories for nearly 20 water year records (see TSD part B). These records have been divided into four flow tiers as shown in Table 4-3 for San Diego Creek. Our re-evaluation indicates that mean water residence time of 4 consecutive days occurs in flow rates below 814 cfs. Thus the CTR chronic target (5 μg/L) applies to base, small and medium storms. During the large flows, shorter residence time (<4 days) exists and so an acute value is applied, 20 μg/L. EPA has incorporated this high flow (or "large storm") value into selenium targets, flow tiers and loading capacity.

Mean water residence time in the Bay also exceeds 4 days on average. Because the more stringent chronic standards are applied based on a 4 day averaging period, EPA has determined that it is appropriate to apply the chronic selenium standards at three of four flow tiers in San Diego Creek and in Newport Bay. These are equivalent to the chronic freshwater and saltwater objectives included in the CTR. The acute freshwater objective is from National Toxics Rule (NTR, USEPA 1997) and is applied for the highest flow tier for San Diego Creek because the frequency of flows in this tier exceeds 4 days fewer than once in three years on average.

EPA is currently engaged in a process of revising its national criteria recommendations for selenium based, in part, on the USFWS opinion concerning the CTR. However, the numeric objectives for selenium water column concentrations have not yet been changed, and it is not clear whether the freshwater criteria will need to increase or decrease in order to protect aquatic life and aquatic dependent species. On one hand, several commenters supported the option of basing the TMDLs on more stringent targets based on the analysis provided by USFWS. On the other hand, several commenters identified site specific characteristics of Newport Bay watershed which could support a conclusion that objectives less stringent than the CTR would be protective. In light of these uncertainties concerning the need to either lower or raise the selenium standard, we concluded that it would be appropriate to set the TMDLs based on the existing numeric standard. The evidence that the CTR objectives are not be protective of San Diego Creek was not definitive enough to warrant selection of more stringent target values.

Freshwater targets

EPA is applying two numeric targets for different freshwater flow conditions in San Diego Creek. Based on re-evaluation analysis of daily flow records for water years 1977/78 and 1985 to 2001, EPA divided all observed flows into 4 flow categories or tiers: baseflow (≤ 20 cubic feet/second (cfs)), small flows (between 20 and 181 cfs), medium flow (between 181 and 814 cfs), and large flow (>814 cfs). EPA is basing these TMDLs on a different period of flow record than proposed in the draft TMDLs because we have concluded that the flow record for 1978/79 and 1983/84-2000/01 reflects more recently available data and is more reflective of long term flow patterns. The percentage of flows in the base, small and medium flow categories that exceeded 4 days in duration during this period far exceeded the once in 3 year recurrence interval that is assumed in calculation of selenium criteria. Therefore, it was appropriate to apply the more protective chronic standard under these flow conditions. During the high flows associated with large storms, the duration does not extend to four days more than once in 3 years on average, so it is appropriate to apply an acute target concentration for the high flow tier (20 μg/L, based on National Toxics Rule [USEPA 1999]). The Technical Support Document—Part B provides a complete explanation of these flow tiers and the associated mean annual flow volumes for calculating loads.

Saltwater target

The numeric target for dissolved selenium in saltwater is 71 µg/L from CTR (USEPA 2000a). The USFWS concurred with this saltwater value in its review of the CTR. Therefore, this target is expected to result in protection of all designated uses in Newport Bay. Additionally, since San Diego Creek is the major contributor of freshwater flows to Newport Bay (>95%), reductions of selenium in the creek should also result in reductions in the Bay.

Table 4-1. Numeric targets for Selenium in San Diego Creek and Newport Bay (µg/L).

Waterbody/type	Total Se*		Dissolved Se#
	Acute	Chronic	
San Diego Creek/freshwater	20	5	N/a
Newport Bay & Rhine Channel/saltwater	N/a	N/a	71

*Total recoverable = unfiltered sample
#dissolved = <0.45 µm filter

Source Analysis

Several monitoring studies, completed with a specific focus on selenium during short time periods, provide most of our current understanding of selenium sources (IRWD 1999, Hibbs and Lee 2000, Lee and Taylor 2001a). The synopsis is presented below; the Technical Support Document—Part D presents a more thorough source analysis and description of these studies.

An investigation of selenium sources shows that shallow groundwater is a significant and constant source of selenium to surface waters in the San Diego Creek watershed (Hibbs and Lee 2000). Groundwater may seep into surface waters via natural processes or it may be pumped as part of groundwater cleanup or dewatering operations which discharge into surface waters. Thus selenium contributions to the watershed include both non-point sources (seepage) and point sources (cleanup and dewatering). Surface channels immediately downstream of nurseries were found to have low selenium concentrations during base flow conditions (Hibbs and Lee 2000, Lee and Taylor 2001a).

San Diego Creek contributes the largest load of selenium among all tributaries to Newport Bay (Lee and Taylor 2001a). Of the load from San Diego Creek, Peters Canyon Wash, which conveys selenium from selenium-laden shallow groundwater, represents the major source in dry weather. These sources may include runoff from hillsides, open spaces, agricultural lands, and commercial nursery sites. High concentrations were found in nursery channels during rain events, although it remains unclear if the selenium sources are from the commercial nurseries or from sources existing upstream of the nurseries. During rain events, the selenium load from the upper reach of San Diego Creek was comparable to that from Peters Canyon Wash, suggesting runoff from open space is a significant source during rain events. Low concentrations were found in nursery channels during baseflow conditions.

Table 4.2 Reported Selenium conc. in San Diego Creek and Santa Ana-Delhi Channel (µg/L)

Location	Lee and Taylor* 5/31/00	Hibbs and Lee[¥] 10/31/99	IRWD[@] 12/97–3/99
San Diego Creek (at Campus Dr.)	22.1	19	42.5
Santa Ana-Delhi (at Irvine Ave.)	11.9	---	---

*Lee and Taylor (2001a) results for unfiltered samples
[¥]Hibbs and Lee (1999) results for dissolved sample
[@] IRWD (1999) result is arithmetic average of time period indicated, dissolved sample

Urban runoff is found to contain very low selenium concentrations (< 1.5 µg/L) (Lee and Taylor 2001a). Atmospheric deposition of selenium is not significant compared to loading from San Diego Creek and other freshwater tributaries (Mosher and Duce 1989). The concentration of selenium in ambient seawater (0.080 µg/L) is unlikely to cause ecological impacts (Nriagu, 1989), and seawater is not believed to comprise a significant source of selenium loading to Newport Bay.

Figure 4-1 summarizes the sources of selenium in the watershed. The significance of these sources varies both on discharge location and season of the year. Nursery runoff shows moderate concentrations (~10 µg/L) in dry weather and are potential sources during storms (Lee and Taylor 2001a). There is some evidence that runoff from open space, hillsides, and agricultural lands are significant sources during rain events although this evidence is inconclusive. Groundwater seepage/infiltration, treated groundwater discharges, and groundwater dewatering discharges represent significant and constant sources.

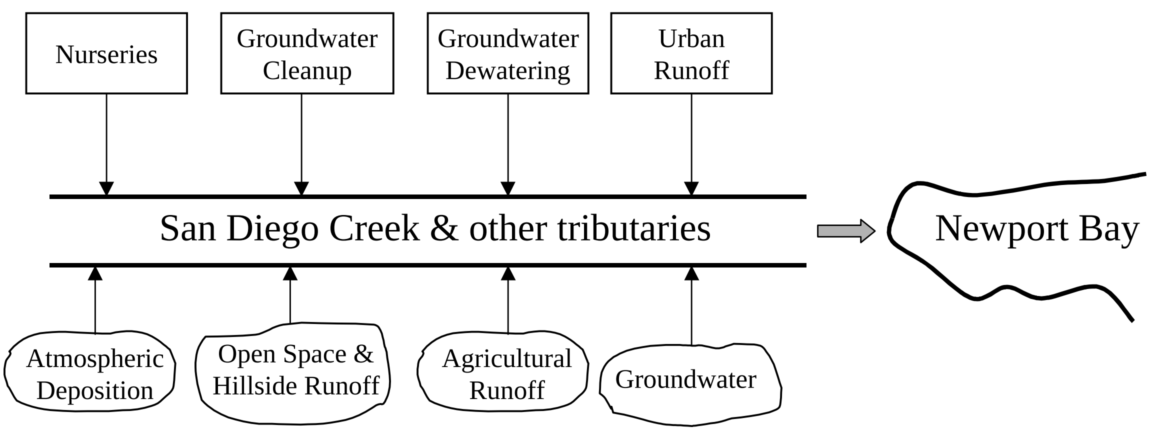

Figure 4.1 Sources of selenium in the Newport Bay/San Diego Creek watershed. (Nurseries have been grouped with agricultural runoff in Table 4-5 for allocations.)

Loading Capacity/Linkage Analysis

The loading capacities and associated TMDLs and allocations for selenium are expressed as mass loads per time. Different approaches were used to calculate loading capacities for the freshwater and saltwater water bodies in the watershed.

San Diego Creek

This TMDL uses a flow-based approach to determine the loading capacity for selenium in San Diego Creek. This approach addresses contributions of selenium under various flow regimes or tiers. Four flow tiers were chosen based on a statistical analysis of daily flow records for San Diego at Campus Drive. (See Technical Support Document – Part B for more explicit information about freshwater flows.) Specific loading capacities for each flow tier are calculated from the desired selenium concentration (i.e., the numeric target) and the annual mean flow volume associated with each tier (Table 4-3). The sum of loads in these four tiers constitutes the total loading capacity for San Diego Creek per year.

Table 4-3 Flow based tiers and corresponding volumes in San Diego Creek

Flow tier	Corresponding flow (cfs)	Flow Volume* associated with tier (million cubic ft.)	Se conc. with tier (ug/L)	Loading capacity per tier[@] (lbs/yr.)
Base flow	0—20	275.4	5	86
Small flows	21—181	347.5	5	108.4
Medium flows	182—814	357.6	5	111.6
Large flows	>814	468.8	20	585.4
Total annual amount		**1449.4**		**891.4**

*Annual mean volume based on USGS & OCPFRD records for water years: 1978, 1984 to 2001.
[@]Se per tier (lbs/yr) = flow volume (ft^3/yr) x desired Se target (ug/L) x conv. factor (6.243×10^{-8} lbs x L/mg x ft^3)

Newport Bay

The loading capacity for Newport Bay is presented in Table 4-4. This loading capacity is calculated using the selenium saltwater numeric target (71 μg/L) and the volume of water in Newport Bay. (Mean volume is 19 million cubic meters based on low and high tide estimates [RMA 1999]).

Table 4-4 Loading capacity of San Diego Creek and all Newport Bay waterbodies

Waterbody	Loading capacity (lbs/yr.)
San Diego Creek and tributaries	891.4
Santa Ana Delhi	185.3[¥]
Upper and Lower Bay and Rhine Channel	232,000[*]

[¥]Se value determined via similar method to those used for San Diego Creek but flow records for Santa Ana Delhi Channel were for water years 1995/96 – 00/01
*based on calculation of the CTR saltwater chronic value (71 μg/L) and the volume of Newport Bay water, adjusted to account for daily water movement into and out of the Bay from the Pacific Ocean.

TMDL and Allocations

EPA is setting the TMDL equal to the loading capacity for each waterbody presented above (Table 4-4). For this TMDL, EPA has defined wasteload allocations (WLAs) for point sources and load allocations (LA s) for non-point sources. Allocations for San Diego Creek are inclusive and have been sub-divided into categories presented below and allocations outlined in

Table 4-5. The loading capacity for Santa Ana Delhi has been defined to set an upper limit on selenium contributions from that waterbody into Newport Bay.

TMDL = Σ (wasteload allocations) + Σ (load allocations) + Margin of Safety

Sub-categories of allocations for Se in San Diego Creek.

Wasteload allocations	Load allocations
Groundwater cleanup Groundwater dewatering Urban runoff	Groundwater (background) Nurseries & Agricultural runoff Open space and hillside runoff Atmospheric deposition

EPA adopted the selenium allocation scheme developed by Regional Board staff for their draft selenium TMDL. Wasteload and load allocations are assigned based on the following general guidelines:

- Allocations among source categories are assigned in proportion to the relative significance of the sources, and indicated by available data concerning reported monitoring concentrations, discharge flow rates, and Se loading (see Source Analysis section), and/or acreage of land uses. In general, significant sources require larger reductions in loading than minor sources to attain the numeric target.
- Within the same source category, allocations for individual dischargers are prorated based on land area.
- For each flow tier, allocations are assigned based on the nature of each source. For example, runoff from hillside, open space, and agricultural lands is minimal in dry season but loads dramatically increase during high stream flows associated with wet weather. Loading from shallow groundwater is likely to change because creeks may change from gaining streams (water input from groundwater during dry weather) to losing streams (surface runoff percolates into shallow groundwater areas) as a result of high water level in the creeks during and/or immediately after rain events.
- Atmospheric deposition is not given a specific allocation due to the very low loading from this source (see TSD, pg. D-12). Any loading from atmospheric deposition is less than the explicit margin of safety discussed below and can be considered accounted for in the explicit MOS.
- Discharges from groundwater cleanup and groundwater dewatering are significant sources and loading from those operations depends on their location. However, the quantification of loading from individual discharges is not feasible at this time due to lack of Se data in effluent from those operations. In this TMDL, allocations are assigned as group allocations groundwater cleanup discharges and groundwater dewatering discharges. In addition, a separate wasteload allocation is provided to account for future new groundwater dewatering discharges.

Table 4-5 shows the wasteload and load allocations for San Diego Creek. The estimated current annual load is considered as the current load of selenium at Campus Drive based on IRWD monitoring data (4/98-3/99). The selenium TMDLs and allocations are expressed in mass-based annual loads. Daily loads could be calculated by dividing the annual TMDLs and allocations by 365. However, annual loading-based TMDLs and allocations are more appropriate because prospective adverse effects associated with selenium are associated more with long term mass loadings and bioaccumulation effects than with short term or acute effects. An explicit margin of safety (MOS) of 10% was included to account for uncertainty in the analysis and ensure compliance with water quality objectives.

Table 4-5 Se allocations for San Diego Creek watershed

Source	**Loading capacity (lbs/year)**					**Current load #**	**Estimated reductions**
	Tier 1	Tier 2	Tier 3	Tier 4	Annual total*		
WLA							
MCAS Tustin	1.6	2.0	1.8	7.9	**13.2**		
GW clean up	6.2	7.8	7.5	36.9	**58.4**		
Silverado GW	3.1	3.9	4.0	21.1	**32.1**		
GW dewatering	3.9	4.9	4.5	21.1	**34.3**		
Future GW facilities	0.4	0.5	0.5	2.6	**4.0**		
Stormwater Permit	0.4	1.0	1.0	5.3	**7.6**		
WLA subtotal	15.5	20.0	19.3	94.8	**149.7**		
LA							
All nurseries	3.1	3.9	4.0	21.1	**32.1**		
Ag runoff	5.4	7.3	8.0	44.8	**65.6**		
Undefined sources @	53.4	66.4	69.1	366.2	**555.0**		
LA subtotal	61.9	77.6	81.1	432.0	**652.6**		
Total allocations	77.4	97.6	100.5	526.8	**802.3**	**2443**	67%
MOS					**89.1**		
Total TMDL					**891.4**		

* sum of loading capacity for San Diego Creek only (based on 5 ug/L applied to all flow tiers)
\# undefined sources includes: open space and hillside runoff, shallow GW and saltwater Se
¥ current load based on IRWD Se data (1998-99) and corresponding OCPFRD flow records
§ other GW facilities refers to future permits

Seasonal variation/Critical conditions

As previously described, EPA is calculating these selenium TMDLs based on freshwater flow rates instead of seasons. The flow rates correspond to flow tiers which address the continuous range of San Diego Creek flow rates throughout the year. In this flow-based approach, allocations are based on in-stream flow rates which are influenced by precipitation and runoff. Given that storm events may occur at any time of the year, the corresponding elevated stream flows are addressed by this flow-based approach.

Margin of Safety

In this TMDL, an explicit margin of safety is used to account for other technical uncertainties. The margin of safety is set at 10% of the annual loading capacity (ca. 89 lbs/year). Some of the uncertainty associated with calculation of the TMDL for selenium relates to freshwater flow rates. Given the revised time period (nearly 20 years of daily flow records for San Diego Creek), this uncertainty has been reduced. That is, the draft TMDLs were based on five years of OCPFRD flow data, whereas these final TMDLs are based on flow records for 19 years that better represent the range of flows during wet and dry water years.

V. Metals TMDLs

TMDLs are required for dissolved copper, lead and zinc in San Diego Creek, Upper Bay, Lower Bay and Rhine Channel. TMDLs are required for cadmium in San Diego Creek and Upper Bay only. Information related to these metal TMDLs can be found in two Technical Support Documents, Part B which describes freshwater flows and Part E which describes metals source analysis and methods used to determine loading capacity and existing loads.

Problem Statement

Cadmium, Copper, Lead and Zinc—Dissolved heavy metal concentrations in San Diego Creek and other freshwater tributaries exceeded CTR standards during wet weather only. More specifically, cadmium, copper and lead results exceeded chronic CTR values; copper and zinc data exceeded acute CTR values (OCPFRD 2000). Water column concentrations measured in Newport Bay are highly variable. In general OCPFRD results exceed water quality standards and these data are much higher than data reported by IRWD (1999) which rarely exceed saltwater CTR values. While direct comparison of these results is not feasible, EPA has identified some quality control problems with metals analyses in saltwater by OCPFRD's contract lab and has concluded that they should be considered with caution in TMDL development.

Sediment metal concentrations generally increase along the gradient from freshwater to saltwater with maximum levels found in Rhine Channel. Sediment toxicity has been repeatedly observed in sediment and porewaters of Upper and Lower Bay, including Rhine Channel (BPTCP 1997; Bay et al. 2000, SCCWRP 2001a). Porewater is water found within the bottom sediments. Evidence of degraded benthic organisms also exists in these saltwater bodies. The cause of toxicity and benthic degradation is unknown, however a statistical correlation was found between sediment and porewater toxicity to amphipods and sea urchin larvae and elevated copper, lead and zinc sediment concentrations (BPTCP 1997). Toxicity identification evaluation (TIE) studies of saltwater bodies are currently in progress (SCCWRP 2001a).

Bioconcentration of copper and zinc has been observed in mussels within Lower Bay and Rhine Channel (SMW 2000). However, fish tissue concentrations of these metals are not elevated relative to respective metal screening values defined by OEHHA (1999). Cadmium, Copper, Lead and Zinc may bioconcentrate in lower organisms but these metals generally do not bioaccumulate and therefore are not likely to threaten organisms higher in the food chain such as fish-eating birds.

Numeric targets

In freshwater systems, the dissolved cadmium, copper, lead and zinc water quality criteria are hardness dependent as defined in CTR (USEPA 2000a). Like many flowing freshwater bodies in southern California, San Diego Creek waters exhibit a wide range of flow rates and hardness levels. Monitoring data show that low flow rates have high hardness values (e.g., 20 cfs corresponds to ≥400 mg/L hardness) whereas high flow rates have lower hardness (e.g., 814 cfs corresponds to 236 mg/L hardness). This inverse relationship between flow rate and hardness influences both acute and chronic metals numeric targets.

Based on re-evaluation of freshwater daily flow records measured at San Diego Creek at Campus (see TSD part B), EPA has identified four flow tiers for fresh water segments for use in TMDL calculation. A hardness value is defined for each flow tier which is used to calculate the associated acute and chronic targets for dissolved metal. (Table 5-2). For the baseflow tier, EPA used the maximum hardness value (400 mg/L) as allowed in CTR (USEPA 2000). A review of available data indicated that actual hardness associated with flows in these tiers often exceeds 400 mg/L; however, the CTR caps the allowable hardness value that can be used to calculate the resulting hardness. For the small and medium flow tiers EPA selected the highest flow value within this tier to determine the corresponding hardness value. For large flows, EPA used the median flow rate value to determine the corresponding hardness value.

EPA is identifying numeric targets and TMDLs for both chronic and acute conditions. It is appropriate to set TMDLs for chronic conditions in the lower three flow tiers based on an analysis of flow durations. The chronic standards for metals were calculated based on the assumption that flows of 4 days or longer in duration would reoccur no more than once in three years on average. Our analysis of the flow records showed that in each of the lower three tiers, the recurrence frequency of flows lasting 4 days or longer was greater than once in three years. For the highest flow tier, the recurrence frequency of flows lasting 4 days or longer was less than once in three years. Therefore, TMDLs are set for the high flow tier based solely on acute standards, which apply regardless of flow duration.

It was appropriate to calculate TMDLs for Newport Bay based on chronic targets because average water residence time in the Bay was estimated to exceed 4 days under all likely flow conditions. The investigation of precipitation, flow rates and the relationship to hardness is explained more thoroughly in the Technical Support Document—Part B.

Table 5-1. Flow based tiers and corresponding hardness values in San Diego Creek.

Flow tier	**Corresponding flow rate (cfs)**	**Flow volume associated with tier [#] (million cubic ft.)**	**Flow rate used to determine hardness**	**Corresponding Hardness (mg/L)**
Base flow	0 - 20	275.4	N/a*	400
Small flows	21 - 181	347.5	181	322
Medium flows	182 - 814	357.6	814	236
Large flow	>814	468.8	1595	197

[#] mean volume for each tier based on daily flow records for 19 water years: 1977/78, 83/84 to 00/01. (combination of USGS and OCPFRD data)

* flow rate not used for these tiers; hardness determined by CTR (max = 400 mg/L)

Freshwater bodies

For freshwater bodies in San Diego Creek, EPA calculated the hardness-based dissolved metals numeric targets (Table 5-2) using equations provided in CTR. EPA is identifying targets representing concentrations of the metals in the water column for each flow tier. As discussed above, we are identifying targets for both acute and chronic conditions for base, small and medium flows and for acute conditions only in large flows (>814 cfs). Given that water residence time is longer than four days during most of the year, we anticipate the chronic targets will be most important for compliance, however, the acute targets also set an upper limit for input concentrations. The Technical Support Document - Part E presents a step-by-step discussion of how numeric targets were calculated based on CTR equations for each pollutant, fresh water flow rates, and corresponding hardness values.

Table 5-2. Metals Numeric Targets (ug/L) based on flow tiers for San Diego Creek.

Dissolved Metal	**Base Flows (<20 cfs) hardness @ 400 mg/L**		**Small Flows (21 - 181 cfs) hardness @ 322 mg/L**		**Medium Flows (182 -815 cfs) hardness @ 236 mg/L**		**Large Flows (>815 cfs) @ 197 mg/L**
	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute
Cd	19.1	6.2	15.1	5.3	10.8	4.2	8.9
Cu	50	29.3	40	24.3	30.2	18.7	25.5
Pb	281	10.9	224	8.8	162	6.3	134
Zn	379	382	316	318	243	244	208

Note: actual ambient hardness must be determined for each monitoring sample regardless of which flow condition exists

Saltwater bodies

In saltwater systems, EPA uses the chronic dissolved metals numeric targets to develop mass based TMDLs. Saltwater targets are straightforward since hardness is not involved. The dissolved saltwater targets are outlined in Table 5-3. Additional numeric targets have also been selected to address toxicity in saltwater sediments. These sediment targets are the threshold effect levels for saltwaters as defined by NOAA SQuiRTs (Buchman 1999). Sediment metal concentrations below these target values are likely to alleviate toxicity to benthic organisms. Both dissolved water column and sediment targets apply for Cu, Pb and Zn within Upper Bay, Lower Bay and Rhine Channel, and for Cd only in Upper Bay.

Table 5-3. Numeric targets for metals in Newport Bay

Metal	**Dissolved saltwater acute target (ug/L)**	**Dissolved saltwater chronic target (ug/L)**	**Alternate target in saltwater sediments (mg/kg dry)**
Cd*	42	9.3	0.67
Cu	4.8	3.1	18.7
Pb	210	8.1	30.2
Zn	90	81	124

(Source: CTR values for dissolved metals in saltwaters; NOAA TEL values for sediments)
*Cd value applies to Upper Newport Bay only

EPA also considered setting targets for both fresh water and salt water in terms of total metals instead of dissolved metals due to the potential concern that particulate metals could become bioavailable. There are several reasons for selecting dissolved metal targets. The existing numeric standards are expressed in the CTR in terms of dissolved metals (EPA 2000a). The CTR rationale is that dissolved forms are the most bioavailable to aquatic organisms. Particulate/dissolved metal ratios were estimated from OCPFRD stormwater data and could be used to translate these dissolved metal mass loads into total loads. However, these translator values developed from paired metals data are close to unity. For example, we calculated a site-specific translator ratio for copper of 1.16 total Cu to dissolved Cu; this is reasonably close to the generic EPA value that dissolved is roughly 80% of total concentration. Therefore, dissolved metals measures are probably fairly good predictors of total metals concentrations. Moreover, we have incorporated an extra explicit margin of safety to account for the possibility that a focus on dissolved metals does not fully account for total metals concentrations. EPA recognizes the Sediment TMDLs already established for these waterbodies will augment efforts to reduce total metal loadings into the saltwater bodies and help to achieve the sediment targets to protect benthic organisms by reducing discharges of metal-contaminated sediments.

Source Analysis

This section summarizes our analysis of the major sources of dissolved cadmium (Cd) for San Diego Creek and Upper Newport Bay and for dissolved copper (Cu), dissolved lead (Pb) and dissolved zinc (Zn) within all water bodies of Newport Bay. This synopsis draws conclusions from several different studies which report concentrations of metals in the water column and sediments of all water bodies. Where applicable this synopsis also presents information about inputs of copper from sediments and from recreational boats moored in Newport Bay. The Technical Support Document—Part E presents a more thorough presentation of all monitoring results and source analysis pertaining to metals.

Within San Diego Creek and its tributaries, metal inputs are heavily influenced by rainfall and stream flow rates. Base flow conditions yield approximately 25% of total loadings, storm events yield approximately 55% of total loadings, the remainder is associated with low and medium flows. Surface runoff is estimated to be the largest source of metals; this includes both natural and man-made contributions. A recent study of pollutant inputs from tributaries within the San Diego Creek watershed concluded that the largest metals inputs come from “urban stations”, whereas agricultural and open space exhibit the lowest loadings (Lee and Taylor 2001a). The difference could be as much as five fold higher for urban areas based on estimates of total copper per acre of runoff (see Table E-7 in TSD – Part E). While this study does provide a basis for estimating the relative importance of metals loadings from different land uses within the watershed, insufficient data were available to accurately estimate annual loads from each source.

Currently, the only published annual metal loading estimates from freshwater tributaries are based on total (unfiltered) metal concentrations (OCPFRD 2000). These estimates for Cu, Pb and Zn indicate that San Diego Creek contributes up to ten times more of each metal than Santa Ana-Delhi Channel. Within San Diego Creek, inputs from Peters Canyon Wash and the rest of the San Diego Creek drainage are about the same. Table 5-4 summarizes these estimates for San Diego Creek and Santa Ana-Delhi Channel for the 1998 and 1999 water years. (The 1998 water year is defined from July 1997 to June 1998.) These results show considerable variability due to different rainfall amounts and fluctuating freshwater flows during each water year. The 1998 water year is considered an extremely wet year (38.4 inches of rainfall) due to El Nino conditions; whereas, 1999 water year is considered relatively dry (8.8 inches) relative to average annual rainfall (13.3 inches).

Another study of surface water runoff during storm events has approximated the relative contribution of metals associated with natural sources such as soil minerals versus the metal inputs from anthropogenic activities. The authors used results from unfiltered (i.e., total metal) samples in the Santa Ana River watershed and report the anthropogenic contribution is metal specific: Cd (63% human-caused), Cu(42%), Pb (35%) and Zn (33%) (Schiff and Tiefenthaler

2000). Total metals loading estimates in Table 5-4 have also been adjusted based on these results to report the approximate load believed to be associated with anthropogenic activities.

Table 5-4 Estimates of Total metal loadings from two freshwater inputs to Upper Bay

Metal	**Site**	**1998 water year (OCPFRD)**	**Adjusted* 1998 results (Man-made)**	**1999 water year (OCPFRD)**	**Adjusted* 1999 results (Man-made)**
		Total load (lbs.)	Total load (lbs.)	Total load (lbs.)	Total load (lbs.)
Cu	San Diego Creek	15,087	6261	1643	682
	Santa Ana –Delhi	1643	682	185	77
Pb	San Diego Creek	10,385	3977	449	172
	Santa Ana –Delhi	1297	497	124	47
Zn	San Diego Creek	63,021	20,985	3784	1260
	Santa Ana –Delhi	7031	2341	805	286

Source: 1998 and 1999 water year results from OCPFRD 2000
*Adjustments made from man-made approximations reported by Schiff and Tiefenthaler 2000

Several other sources of metals exist in the watershed: runoff from open spaces, nursery and agricultural applications, groundwater dewatering and cleanup, and atmospheric deposition. Monitoring data exist for background dissolved metals concentrations in surface runoff from hillsides and open spaces. EPA has selected wet weather results from the San Joaquin Channel site (Lee and Taylor 2001a) to serve as proxy for these open spaces because the area upstream from this site is essentially undeveloped. Much of the metals loading associated with open spaces is probably naturally occurring; however, it is likely than some portion of loads from these areas is human caused (e.g., from atmospheric deposition or historic land use activities). Based on State pesticide use reports (CDPR 1999) for some nurseries, applications of copper sulfate appears as the most prominent metal containing substance used in nurseries; nonetheless annual metal applications are small (e.g., 72 lbs/yr) relative to watershed wide surface runoff estimates (ranging from 1643 to 15,087 lbs/yr, Table 5-4). To date, reliable dissolved metal concentrations in shallow ground waters have not been reported. Atmospheric deposition—onto the watershed land surface and into San Diego Creek and other freshwater tributaries—has already been included within surface runoff estimates. It is considered minimal in comparison to other contributions to surface runoff because there are no likely local airborne sources of these metals.

For the salt waters of Upper and Lower Newport Bay, including the Rhine Channel, the largest ongoing sources of most dissolved metals (except for copper) are estimated to be the freshwater-borne loads from San Diego Creek (95% of freshwater-related loads), Santa Ana-Delhi Channel (<5%) and other drainages (<1%). Ambient surface seawater may be the next most significant source. Concentrations of dissolved metals in seawater collected off the Southern California coast range from 0.06 ug/L for Pb, 0.1 ug/L for Cd, 0.2 ug/L for Cu, to 2.4 ug/L for Zn (pers. commun., R. Gossett). The influence of ambient seawater on metal levels within Newport Bay depends on marine tides and freshwater flows from the watershed. During high tides and low freshwater flows, surface seawater contributions could be relatively higher, yet low tides concurrent with dramatically higher freshwater inputs during storm events would yield much lower ambient seawater contributions.

The phenomenon of dissolved copper inputs to marine waters from recreational boats has been repeatedly monitored in San Diego Bay as reported in the draft TMDL for dissolved Cu for Shelter Island yacht harbor (San Diego RWQCB 2001). Using mass loading calculations presented in that TMDL and local data concerning boats in Newport Bay, passive leaching from recreational boats and underwater hull cleaning are estimated to comprise the most significant sources (>80%) for dissolved Cu into Lower Bay, Rhine Channel and, to some extent, Upper Bay.

To date, no study within Upper Bay has examined whether sediment resuspension or porewater fluxes contribute significant metals loads to the water column. Porewater concentrations measured in Lower Bay (not including Rhine Channel) suggest that Cu levels are elevated enough to create potentially negative impacts (Bight '98). Levels for the other metals are within the range of concentrations observed in ambient seawater and well below the dissolved saltwater numeric targets.

Air deposition of metals is traditionally assessed in two parts—indirect and direct. Indirect deposition, where metals are deposited onto dry land areas and then washed into streams via surface runoff, has already been included as part of the freshwater inputs from San Diego Creek, Santa Ana Delhi Channel and other drainages to Newport Bay. Direct deposition, where metals directly enter the water surface, comprises less than 1% of metal contributions to Upper and Lower Bay and can be considered accounted for in the explicit margin of safety.

Loading Capacity/Linkage Analysis

In the draft TMDLs, EPA outlined two options for defining dissolved metals loading capacity and associated TMDLs. These two options were to apply a concentration based or a mass based approach for to each water body. Based on our review of public comments and further analysis, we are establishing TMDLs based on concentration for San Diego Creek and both concentration and mass loads for Newport Bay as discussed below.

San Diego Creek and tributaries

The metals loading capacities and TMDLs for San Diego Creek are set on a concentration basis for dissolved metals. The rationale for addressing dissolved metals is that dissolved metal forms are the most bioavailable to aquatic organisms. These metals are generally not know to bioaccumulate from one organism to the next, nor has sediment toxicity attributed to metals in the Creek been reported; therefore, long term mass loading which could contribute to bioaccumulation or sediment toxicity concerns is less of an issue in San Diego Creek. For these reasons, a concentration-based approach is more appropriate for these pollutants. These concentration-based loading capacity will protect aquatic life from short term exposure via acute targets (for all flow conditions) and longer term exposure via chronic targets (for flows <814 cfs).

These concentration based loading capacity values are hardness dependent. Freshwater systems experience a wide range of flows and individual hardness conditions. In the future, it will be necessary to measure actual ambient hardness concurrent with each metals monitoring sample (grab or composite) in order to help determine compliance with the TMDLs. The CTR sets an upper limit for hardness is 400 mg/l; the lower recommended limit is 25 mg/l.

The acute and chronic targets and associated loading capacities and TMDLs apply to base, small and medium flows. However, targets, loading capacities, and TMDLs for the highest flow tier (>814 cfs) are based on acute standards only. As discussed above, this approach is based on our review of flow records for San Diego Creek to examine the duration of elevated flows and the frequency of chronic conditions (See TSD Part B for freshwater flow).

Newport Bay

For Upper and Lower Bay, including Rhine Channel, the loading capacities were calculated by multiplying the chronic numeric target by the volume of water in the Bay, accounting for water exchange rates between Newport Bay and the Pacific Ocean. The loading capacities are based on the saltwater dissolved metals targets (Table 5-3). The mass-based loading capacity for all of Newport Bay is shown in Table 5-5a. (A complete description of this calculation is presented in TSD – Part E.)

The rationale for setting mass-based metals TMDLs and allocations is to address observed sediment toxicity in all areas of Newport Bay. Over longer time frames, cumulative metals discharges are of concern in embayments and possibly fresh water waterbodies because metals may associate with sediment and accumulate in bottom sediments, where they may contribute to sediment toxicity and associated ecosystem impacts. The alternate metals sediment targets (Table 5-3) will help to evaluate acceptable conditions for benthic organisms.

Mass based allocations set a definitive upper limit on the amount of each metal allowed to be discharged from San Diego Creek into Newport Bay, which would probably be most effective in addressing long term sediment toxicity concerns. Loading contributions from San Diego Creek and Santa Ana Delhi Channel were calculated by multiplying the chronic numeric target for base, small and medium flow tiers and acute target for large flow tier (see Table 5-1) by the mean annual water flow volume associated with each tier to yield an allowable mass load for each flow tier. This approach is similar to that presented in the Se TMDLs. (An example of this calculation for dissolved copper is provided in the TSD – Part E.) The sum of all four tiers yields the upper limit to the mass-based loading capacity for San Diego Creek (Table 5-5a).

Table 5-5a. Mass-based dissolved metal loading capacity for Newport Bay

Dissolved Metal	Upper and Lower Bay including Rhine Channel Dissolved load (lbs/yr)
Cd	14,753*
Cu	11,646
Pb	27,136
Zn	285,340

*Cd load applies to Upper Bay only, where volume of Upper Bay is approximately 40% of the total volume of Newport Bay

To ensure that Newport Bay is protected from potential adverse effects of short term metals loading "spikes", the loading capacities and associated TMDLs for Newport Bay are also defined in terms of the concentration-based water quality standards for the Bay. In the absence of this complementary approach, it would be possible for the Bay to meet the annual loading-based TMDL and still exceed water quality standards on a short term basis. The concentration based TMDLs are listed in Table 5.5b

Table 5.5b Concentration-based dissolved metal loading capacity for Newport Bay

Metal	Dissolved saltwater acute loading capcity (ug/L)	Dissolved saltwater chronic loading capacity (ug/L)
Cd*	42	9.3
Cu	4.8	3.1
Pb	210	8.1
Zn	90	81

TMDLs and Allocations

The freshwater dissolved metals TMDLs are concentration–based; whereas the saltwater TMDLs are both mass-based and concentration-based. The TMDLs and allocations may be expressed in terms of the following general equation:

TMDL = Σ (wasteload allocations for point sources) + Σ (load allocations from non-point sources and background) + Margin of Safety

San Diego Creek

As discussed in the loading capacity section, EPA is expressing the San Diego Creek metals TMDLs on a concentration basis. The freshwater allocations are equivalent to the concentration-based targets, reduced by 20% to provide the margin of safety discussed below (see Table 5-6 for freshwater TMDLs and allocations). These allocations apply to all freshwater discharges to San Diego Creek, Santa Ana-Delhi Channel, Big Canyon Channel, East Costa Mesa Channel and other drainages. This includes discharges from agricultural, urban and residential lands, including flows from the storm water systems. These allocations would apply at all times of the year. Because flow tiers for the freshwater channels other than San Diego Creek were not specifically calculated, it is assumed that the same TMDLs applicable to San Diego Creek during different flow conditions apply to the other channels at the same times. For example, when flow is 50 cfs in San Diego Creek, the "small flows" TMDLs and allocations listed in Table 5-6 apply in all the other freshwater channels in addition to San Diego Creek.

Table 5-6. Metals WLAs, and LAs in (ug/L) (based on flow tiers for San Diego Creek)

Dissolved Metal	Base Flows (<20 cfs) hardness @ 400 mg/L		Small Flows (21 - 181 cfs) hardness @ 322 mg/L		Medium Flows (182 -815 cfs) hardness @ 236 mg/L		Large Flows (>815 cfs) @ 197 mg/L
	Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute
Cd	19.1	6.2	15.1	5.3	10.8	4.2	8.9
Cu	50	29.3	40	24.3	30.2	18.7	25.5
Pb	281	10.9	224	8.8	162	6.3	134
Zn	379	382	316	318	243	244	208

Values are 80% of freshwater numeric targets in Table 5-2
Note: actual ambient hardness must be determined for each monitoring sample regardless of which flow condition exists

The wasteload allocations apply to the following NPDES discharges:

- Orange County Stormwater
- CalTrans
- Other NPDES Discharges (see Section II, p. 19 for description of this allocation category)

The load allocations apply to the following source categories:

- Agricultural runoff (including nurseries)
- Air deposition
- Other sources (includes open space runoff, background, and undefined sources).

Newport Bay

Table 5-7a presents the mass based TMDLs and allocations for dissolved metals in Newport Bay. These allocations apply to the water column in Upper Newport Bay (defined from San Diego Creek at Jamboree Rd. down to Pacific Coast Highway Bridge), Lower Newport Bay (defined from PCH Bridge to the Newport Jetty) and to Rhine Channel (confined by line drawn from 20th St. across to Lido Beach St. to channel end). These allocations apply to the receiving waters of Newport Bay at all times of the year, regardless of freshwater flow from San Diego Creek, Santa Ana-Delhi, Costa Mesa Channel and other tributaries into Newport Bay.

Several methods were used to determine allocations. First, because NPDES boatyard permittees are not authorized to discharge into salt waters of Newport Bay, the wasteload allocation for boatyards is zero. Second, air deposition and undefined sources (background from medium and large storm runoff and ambient seawater contributions) were assigned mass loadings based on existing loading since reductions were not expected. Third, agriculture runoff was also assigned an explicit mass loading of one-half the total annual estimated loads based on the assumption that erosion control planned under the sediment TMDL implementation plan would result in approximately a 50% reduction in erosion-related metals loading, and that the small amount of metals load associated with agricultural chemical use could be reduced through use of best management practices (EPA, 1993). The allocations for the remaining sources (urban stormwater, CalTrans, other NPDES, and boats (for copper and zinc)) were based on best professional judgement, as discussed below, because insufficient data were available to accurately estimate their relative contributions to existing loads. The allocation for runoff from the watershed from urban stormwater and CalTrans facilities and discharges from the other NPDES permittee category is based on the assumption that approximately half the metals loading can be reduced through use of available management practices (EPA, 1993). The runoff allocation is divided between the Orange County stormwater permit, CalTrans permit, and other NPDES facility category based on the relative proportions of watershed land area under the jurisdiction of these three permits. The remaining allocation for boats represents a reduction in metals loadings from boats of greater than 80%, based on the assumption that changes in boat paint usage and maintenance practices could substantially reduce the direct loading of copper (and potentially zinc) into Bay waters (EPA 1993). Table 5-7b presents the concentration-based allocations for Newport Bay.

Table 5-7a. Mass-based Allocation Scheme for Metals in Newport Bay

Category	Type	Copper	Zinc	Lead	Cadmium*
WLA	Urban runoff	3,043	174,057	17,638	9,589
	CalTrans	423	22,866	2,171	1,185
	Boatyards	0	0	0	0
	Other NPDES permittees	190	17,160	1,154	596
	Sub-total	**3,656 lbs/yr**	**214,083 lbs/yr**	**20,963 lbs/yr**	**11,370 lbs/yr**
LA	Ag runoff	215	114	0	0
	Boats	4,542	1,056	0	0
	Air deposition	101	606	68	4
	Undefined (open space, existing sed.)	803	11,414	678	428
	Sub-total	**5,661 lbs/yr**	**13,189 lbs/yr**	**746 lbs/yr**	**431 lbs/yr**
MOS		**2,329 lbs/yr**	**57,068 lbs/yr**	**5,427 lbs/yr**	**2,951 lbs/yr**
Total TMDL		**11,646 lbs/yr**	**285,340 lbs/yr**	**27,136 lbs/yr**	**14,753 lbs/yr**

*values apply to Upper Bay only (estimated as 40% of Newport Bay volume)

Table 5.7b Concentration-based dissolved metal TMDLs, WLAs, and LAs for Newport Bay

Metal	Dissolved saltwater acute TMDLs and allocations (ug/L)	Dissolved saltwater chronic TMDLs and allocations (ug/L)
Cd*	42	9.3
Cu	4.8	3.1
Pb	210	8.1
Zn	90	81

The concentration based WLAs and LAs apply only to the sources which discharge directly to the Bay, including stormwater discharges from stormdrains directly to Bay segments (such as Costa Mesa Channel and Santa Ana Delhi Channel) and metals loading associated with boats. The concentration-based WLAs and LAs for San Diego Creek and the other fresh water tributaries will address short term metals concentrations associated with discharges to the fresh water system.

Seasonal Variations/Critical Conditions

These TMDLs rely on careful analysis of the full range of potential flow conditions to address seasonal variations and critical conditions in loads and flows. In general, base and low flows do not present conditions within San Diego Creek that result in either exceedances of numeric targets. This is due to higher hardness levels during low flows that mitigate metals toxicity through competitive binding by calcium and magnesium ions present in freshwater.

Wet weather conditions, which may occur at any time of the year, yield medium and large flows and a range of hardness values. High flows are more likely to produce both low hardness and higher metal levels; these conditions are the biggest threat to aquatic organisms in San Diego Creek and its tributaries. For Newport Bay, the TMDLs address long term metals accumulations which are associated with metals-caused sediment toxicity measured in the Bay. Therefore, there is no single season or critical season of greatest concern for metals loadings and effects in Newport Bay. The saltwater allocations apply during all seasons, regardless of flow.

For both San Diego Creek and Newport Bay, the approach of setting concentration based TMDLs and allocations based on chronic and acute targets helps address and mitigate any short term effect associated with brief periods of high metals loading.

Margin of Safety

EPA has applied a 20% explicit margin of safety to the dissolved metals TMDLs for both freshwater and saltwater bodies of Newport Bay watershed. This explicit margin of safety is intended to account for uncertainty concerning total (particulate and dissolved) metal loads into San Diego Creek which are transported downstream and deposit in the sediments of Upper and Lower Bay, including Rhine Channel. These metals TMDLs address aquatic life toxicity due to concentrations in the dissolved fraction; this is consistent with current regulatory status for metals as defined by CTR (USEPA 2000a). In recognition of sediment toxicity in Newport Bay correlated to elevated metals, we have selected the 20% margin of safety based on the default total/dissolved metal translator provided in CTR. Our estimates of site-specific total/dissolved translator values are fairly close to the CTR value. It is reasonable to assume that reductions in the particulate metal load will achieve the concentration-based dissolved metal targets.

In addition to the explicit margin of safety, conservative assumptions were used in applying the numeric targets within the watershed. These conservative assumptions provide an implicit margin of safety to ensure that TMDLs are set at levels that will attain applicable standards and protect aquatic life.

1. No adjustment or lowering has been made to address mixing and dilution within the drainage channels contributing to San Diego Creek. Also, there has been no consideration of precipitation (forming particulate metals forms) of dissolved metals as freshwater mixes with saltwater.

2. Chemical speciation has not been included within calculations of loading capacity nor allocations. Aquatic chemists believe the truly bioavailable metal fraction (free metal ion concentration) is much lower (at least 10 times) than dissolved metal concentration. This has been reported for Cd, Pb, Cu and Zn within freshwater and saltwater systems (Buffle 1988, Bruland 1991, Sunda et al. 1987).

3. Setting both acute and chronic-based TMDLs and allocations for San Diego Creek and Newport Bay helps ensue that short-term toxic effects are not allow to occur even if longer term mass loading-based TMDLs and allocations are met. This approach helps ensure that water quality standards will be met throughout the year.

VI. Organochlorine TMDLs

TMDLs are being established for chlordane, total DDT and total PCBs in all waterbodies: San Diego Creek, Upper Bay, Lower Bay and Rhine Channel. Dieldrin TMDLs are being established for San Diego Creek, Lower Bay and Rhine Channel. A TMDL for toxaphene is being established for San Diego Creek only. The term "organochlorine compounds" includes all of these pollutants and the phrase "organochlorine (OC) pesticides" refers to DDT, chlordane, dieldrin and toxaphene.

Additional information on the source analysis, modeling approach and relevant monitoring results for these TMDLs is provided in Technical Support Document – Part F.

Problem Statement

Use of these pollutants has been banned because of potential harm to human health and/or wildlife. However, many of the environmental concerns associated with their use and ultimate transport to the environment are directly related to their ability to persist in water, soil, and biological tissue for long periods of time after their introduction to the environment.

Monitoring results show exceedances of EPA and State fish tissue screening values, which indicate the applicable narrative water quality standards are not being met. Specifically, toxaphene exceedances (87%, n=15) of the OEHHA tissue screening value occur only in San Diego Creek (TSM). Tissue exceedances have also occurred for Chlordane (40%), Dieldrin (93%), total DDT (93%), and total PCBs (67%) in San Diego Creek (n= 15 for all, TSM). Similar elevated fish tissue concentrations indicate bioaccumulation for Chlordane, Dieldrin, total DDT and total PCBs in all saltwater bodies of Newport Bay (except for dieldrin in Upper Bay). Conclusions for Newport Bay are based on finfish and shellfish tissue results from several monitoring efforts (SMW, TSM, CFCS and SCCWRP databases, see Table 2-2). A review of tissue data for a 20 year period indicates that fish tissue concentrations are declining for the OC compounds, yet exceedances of OEHHA tissue screening values are still occurring. Freshwater and saltwater tissue concentrations show declining trends, with higher levels generally occurring in San Diego Creek than in Newport Bay. The sediment data did not exhibit clear trends, rather erratic spikes, which is common for this heterogeneous media.

Numeric Targets

As discussed in Section II, EPA evaluated the applicable water quality criteria and sediment and tissue screening levels to determine the appropriate numeric targets for these organochlorine TMDLs. We have prioritized sediment quality guidelines over tissue screening values and water column criteria. This decision is based on the following factors:

1) these pollutants are directly associated with sediments (i.e., fine particulate matter);
2) sediments are the transport mechanism for these organochlorine compounds from freshwaters to salt waters;
3) limited water column data are available to adequately describe the past or current conditions
4) attainment of the sediment targets will be protective of the water column criteria and tissue screening values.

The use of sediment criteria in this analysis yields an environmentally conservative interpretation of water quality criteria, including the narrative water quality objectives in the Regional Board Basin Plan (1995).

The numeric targets for freshwater and saltwater systems for chlordane, dieldrin, DDT, PCBs and toxaphene, are shown in Table 6-1a and 6-1b. The primary target value is based on sediment levels, and the alternate targets are provided for fish and shellfish tissues and for water column concentrations in freshwater. The specific numeric values for sediment targets were selected from NOAA Sediment Screening Quick Reference Tables (SQuiRTs) (Buchman 1999). By selecting sediment targets, EPA will address protection of benthic organisms as well as bioaccumulation of these organochlorine compounds into tissues of higher organisms such as fish, wildlife predators and humans. Sediment targets are used for TMDL development except where sediment data were not available; e.g., toxaphene in San Diego Creek. The alternate targets – fish tissue screening values from OEHHA and water column objectives from the CTR– are included in this TMDL report as means of gauging improvement in the water quality and progress towards achievement of the TMDL, and to assist in assessing the accuracy of the analysis supporting the TMDLs.

Table 6-1a. Numeric targets for organochlorine compounds for all waterbodies.

Waterbody	**Pollutant**	**Sediment target ¥ (ug/dry kg or ppm)**	**Fish tissue target# (ug/kg wet or ppb)**
San Diego Creek and tributaries	Chlordane	4.5	30
	Dieldrin	2.85	2.0
	Total DDT	6.98	100
	Total PCBs	34.1	20
	Toxaphene	0.1*	30
Upper and Lower Newport Bay, and Rhine Channel	Chlordane	2.26	30
	Dieldrin	0.72	2.0
	Total DDT	3.89	100
	Total PCBs	21.5	30

*this value assumes 1% total organic carbon in sediment sample
¥sediment targets equivalent to threshold effect levels (TEL) from Buchman 1999, except toxaphene from NY Dept. Environmental Conservation
#all tissue targets from OEHHA

Numeric targets for water column concentrations are provided in Table 6-1b based on CTR criteria. These concentrations apply to freshwater bodies (USEPA 2001a); numeric objectives are not available for several of the pollutants in saltwater. We used these targets when modeling the maximum allowable concentrations for water-associated loads from particulate pollutants. (See modeling and analysis section).

Table 6-1b. Freshwater column target values for organochlorine compounds.

Pollutant	**CMC (acute) (µg/L)**	**CCC (chronic) (µg/L)**
PCBs	--	0.014
DDT *	1.1	0.001
Chlordane	2.4	0.0043
Dieldrin	0.24	0.056
Toxaphene	0.73	0.0002

* DDT value cited for 4,4' DDT, but value will apply to one one isomer or sum of all isomers detected

Source Analysis

Except for PCBs and possibly small amounts of DDT, the pollutants addressed in this TMDL are no longer believed to be discharged in the watershed except in association with erosion of sediments to which these pollutants may have adhered in the past. The source analysis is therefore primarily a qualitative assessment. The assessment is based on reviews of available information on the physical and chemical properties of each chemical, the expected uses of each, the likely locations of use, and available monitoring data that characterizes current conditions in the environment. A wide range of information was evaluated to identify potential sources and to characterize contributions, including monitoring data, data from national, state and county program databases, and scientific literature. More details on the efforts to identify and characterize potential sources of organochlorine compounds are provided in the Technical Support Document – Part F.

Available data and analyses indicate that there is an existing "reservoir" of historically-deposited organochlorine pollutants in Newport Bay sediment, to which continuing relatively low levels of ongoing pollutant loads are contributing from the watershed. The main source of continuing loadings of organochlorine compounds in the Newport Bay watershed is estimated to be erosion of surface soils or in-stream sediments to which these pollutants have adsorbed (binded). Sediment-adsorbed pollutants enter Newport Bay from San Diego Creek (88%) and various smaller tributaries and local drainages (12%). The sediment load is then distributed throughout Newport Bay via internal circulation patterns under a variety of flow conditions. In preliminary results from one sampling event of sub-surface waters in Lower Bay, SCCWRP (2001a) reported detections of total PCBs and DDT. At the Turning Basin, these compounds were associated with particulate matter (PCBs = 8.86 ug/kg dry; DDT = 15.3 ug/kg dry) and in the dissolved phase (PCBs = 0.15 ng/L; DDT 0.43 ng/L). Dieldrin and Chlordane were not reported.

These organochlorine compounds may also exist in groundwater (due to percolation), may transport via volatilization (from surface soils or water surface) and as implied above they may become resuspended into the water column via physical processes in water bodies. Insufficient data were available to estimate the loads from these sources. Ground water-related loading is expected to be minor because only a small proportion of organochlorine pollutant loads generally occurs in dissolved form. On the other hand, resuspension of sediments to which organochlorine pollutants have adhered is likely to be a more important "loading" source.

Organochlorine (OC) pesticides

Because of the legacy nature of the sources of the OC pesticides, assessment of possible nonpoint sources of these types of pollutants has been based on a review of available monitoring data, historical land use practices, literature reviews, and anecdotal information. One of the major routes for the OC compounds to enter Newport Bay and its tributaries is believed to be runoff and erosion processes. Masters and Inman (2000) have examined fluvial transport of DDT and other legacy pesticides in Upper Newport Bay; they hypothesize that historic agricultural and urban applications of these compounds are the primary upstream sources. In general, these runoff and erosion processes have the ability to pick up and transport these OC pesticides and deposit them in a different location in the watershed, to stream systems, or to the Bay. The amount of transport and the locations of deposition depend on many factors, including the presence of the pollutant and the intensity and duration of the precipitation event, which drives stream flow velocity and possibly direction. Because organochlorine residuals from past applications still remain in soils, the potential still exists for these chemicals (and their degraded metabolites) to be transported into water bodies during runoff-producing rainfall events. Insufficient information exists on the specific location and actual magnitude of these sources to support precise loading estimates; therefore, we inferred existing loadings based on limited data and we estimated the pollutant distributions amongst many diffuse sources. No local “hot spots”-specific locations with highly elevated levels of OC pesticides-- were identified.

The only potentially active application of any of the OC pesticides identified is the application of Dicofol, a registered pesticide that may contains small amounts of DDT (i.e., up to .015% based on its registered formulation). The actual DDT content of Dicofol, if any, is unknown. The DPR pesticide use database indicates that Dicofol (trade name “Kelthane”) was recently applied to agricultural fields within the Newport Bay watershed (502 lbs. in 1998 and 470 lbs. in 1999). Relative to other sources of DDT (i.e., residuals in soils and aquatic sediments), Dicofol is not estimated to be a significant source of DDT to Newport Bay. However, because DDT in low concentrations may pose an continuing ecological concern, it may be appropriate to further investigate and reduce possible runoff of DDT associated with Dicofol.

Polychlorinated biphenyls (PCBs)

Electrical transformers are the most common use of PCBs. Existing PCB projects such as the Hudson River project in New York and the Housatonic River project in Massachusetts have found that historical discharges caused sediment contamination and that the contaminated soils tend to collect in slow river stretches or reservoirs (GE 1999). The contaminated soils remain there until they are dredged or dislodged by storms. Based on our review of limited information about PCB spills and waste sites containing PCBs, we hypothesize that accidental PCB spills, which were most likely to have occurred at the El Toro and Tustin Air Stations as well as other hazardous waste sites, are the most likely historical loading source of PCBs. Insufficient information exists on the specific location and actual magnitude of these sources, thus we inferred existing loadings based on limited data and we estimated the pollutant distributions amongst many diffuse sources.

Modeling and Analysis

This section describes the methods used to determine the loading capacity and to estimate the existing loads for each organochlorine contaminant with respect to each waterbody. The modeling approach and various resources utilized to complete these tasks are outlined here, although more details, such as equations and specific values, are provided in the Technical Support Document – Part F. To the extent possible, we used hydrologic and modeling information previously compiled by Resource Management Associates (RMA 1997, 1998, 1999) for the U.S. Army Corp of Engineers (ACOE). This model provides sediment deposition information used to determine both loading capacities and estimate existing loads for (for the Upper and Lower Bay, including Rhine Channel. RMA model calibration results were utilized because these results incorporate circulation patterns, spatial distribution and net settling rates for each area of Newport Bay. These RMA results were generated using a wide spectrum of flow rates from San Diego Creek addressing a 12 year time span (1985 to 1997). Thus the RMA model has implicitly addressed sediment transport and resuspension in Newport Bay as well as dry and wet weather conditions and flow rates in San Diego Creek.

Within San Diego Creek, the RMA model does not provide more specific data such as spatial distribution of sediments, so sediment deposition and the corresponding pollutant load must be estimated via stream flow rates. EPA used nearly 20 water years of flow records for San Diego Creek. The time span of daily flow rates covers water years 1977/78 and 1984/85 - 00/01. This is discussed more in TSD Part B – Flow and consistent with flow records used in Se and dissolved metals TMDLs. For the OC TMDLS, three flow tiers were used -- low flow (0 to 181 cfs), medium (between 181 and 814 cfs) and high flow (>814 cfs). This was designed to represent conditions during dry weather and very light rains (low flow events), intermediate storms (medium flows) and those large storms (high flows) when extensive sediment transport occurs. Pollutants associated with fine particles (especially clay) and dissolved phase are assumed present in all three flow tiers.

Loading capacity

San Diego Creek

For the listed OC pollutants in San Diego Creek the loading capacities were calculated based on pollutant contributions from water column and sediments. The sediment associated loading capacity was determined from target sediment concentrations and sediment load estimates, which were based on regression results presented in RMA model (1997) to link flow rates with sediment loads. We estimated the associated water column loading capacity by backcalculating, from sediment loads to particulate concentrations and dissolved concentrations, using partition coefficients. Where appropriate, these water column derived loads were constrained by chronic water targets for low and medium flows and acute targets for large flows. The sum of the allowable loads in particulate form and dissolved form represents the loading capacity in San Diego Creek. The loading capacities are presented as long term annual loading estimates consistent with the patterns of sediment deposition in the system. Loading capacities for San Diego Creek are presented in Table 6-2.

Newport Bay

The loading capacity for Newport Bay relied on RMA (1998) sediment deposition budget and bottom sediment conditions with target concentrations. The Bay was sub-divided into discrete areas for which individual loading capacities were calculated and summed to provide loading capacities for each water body of the Bay (Upper, Lower and Rhine). To determine the particulate associated load, several factors were used and included: saltwater sediment target, net sediment deposition (volume), porosity, and sediment density. Sediment volume is converted to dry weight by an estimated porosity (0.65). The net loading capacities are presented as average mass per year for each water body to reflect the long-term accumulation patterns associated with sediment and pollutant accumulation in Newport Bay. Loading capacities for Newport Bay are presented in Table 6-3.

Existing Loads

San Diego Creek

A slightly different approach was required to estimate the existing loading to San Diego Creek. Due to incomplete sediment monitoring data for all organochlorine pollutants in San Diego Creek, we used recent fish tissue results (TSM data from 1998) to help estimate water and (indirectly) sediment loads. Water column associated loads were back calculated by using pollutant- and fish species- specific bioconcentration factors (BCFs). The particulate load was estimated from these water column derived values using partition coefficients. The sum of the particulate and water column associated loads yields the estimated existing loads for San Diego Creek based on the most reliable and current data for these hydrophobic compounds. Existing loading estimates for San Diego Creek are presented in Tables 6-5.

Newport Bay

The methods used to estimate existing loads in Newport Bay were similar to those described earlier for loading capacity in Newport Bay. Fortunately, more monitoring data exists for Newport Bay and, in particular recent sediment data (OCPFRD 1999/00 and SCCWRP 2001a) was maximized to give more representative or current conditions in each portion of the bay. These monitoring results were used with the RMA sediment deposition budget to yield the existing pollutant loads. Resuspension and recirculation of sediments, along with the water associated load was implicitly included since these conditions were included in the RMA approach for Newport Bay. (Upper and Lower Bay existing loads represent the sum of several individual areas, as defined in Appendix Table 3 in TSD – Part F.) The net pollutant existing loading estimates for Newport Bay segments are presented in Tables 6-6 to 6-8.

Loading Capacity/Linkage Analysis

The loading capacity for each pollutant was calculated for San Diego Creek, Upper and Lower Bay, and Rhine Channel. The loading capacity for each water body was derived as described above and in the Technical Support Document – Part F. The loading capacity was determined to define the maximum amount of loading which could occur and still result in attainment of the sediment targets, and at the same time, not exceed water quality targets. The model takes into consideration such factors as the particulate and dissolved contributions and flow rates in San Diego Creek. In Newport Bay, the loading capacities were determined via the RMA model and target sediment concentrations. The OC compound loading capacities for San Diego Creek and Newport Bay are listed in Tables 6-2 and 6-3, respectively.

The loading capacity was determined to define the maximum amount of loading which could occur and still result in attainment of the sediment targets. The model links estimates of ongoing pollutant contributions from the watershed with existing pollutant concentrations in the bottom sediments and predicts the cumulative effects in terms of future pollutant concentrations in the bottom sediments and associated trends. The model takes into consideration such factors as the existing water column concentrations (either observed or calculated based on fish or mussel tissue concentrations), data and modeling of sediment deposition into the water bodies, decay rate for a pollutant in the water column, thickness of the water column and active sediment layer, sediment resuspension rates, and sediment burial rates.

Table 6-2. Loading Capacity for San Diego Creek

Pollutant Name	Sediment Target Concentration (ug/kg dry)	Loading capacity (g/year)
Chlordane	4.5	314.7
Dieldrin	2.85	261.5
DDT	6.98	432.6
PCBs	34.1	2226
Toxaphene	0.1	8.9

Table 6-3. Estimated Loading Capacity for Newport Bay

Waterbody	Sediment Target Concentration (ug/kg dry)				Loading Capacity (g/year)			
	Chlordane	Dieldrin	DDT	PCBs	Chlordane	Dieldrin	DDT	PCBs
Upper Bay	2.26	0.71	3.89	21.5	160.4	N / A	276.5	1528.2
Lower Bay*	2.26	0.71	3.89	21.5	59.2	18.6	101.85	562.9
Rhine Channel	2.26	0.71	3.89	21.5	1.7	0.53	2.92	16.2

(This table is summary of information presented in Table F-4 in TSD—Part F.)

TMDLs and Allocations

For these organochlorine TMDLs, we have expressed the TMDLs and allocations in mass-based units (grams per year) for each waterbody. For each organochlorine compound, the loading capacity in each waterbody is equal to the sum of allocations and an explicit margin of safety. Identification of the TMDL is based on a comparison of the existing loading with the loading capacity. In situations where existing loadings are less than the loading capacity, the TMDLs and allocations are set at the existing loading levels in order to ensure that the TMDL targets are eventually met, and to ensure that pollutant levels in the sediments do not increase in the future (defined as Condition 1 in Table 6-4 below). In situations where existing loads are greater than the loading capacity, the TMDLs and allocations are set equal to the loading capacity (after subtracting the explicit margin of safety). This situation is defined as Condition 2 in Table 6-4 below. Table 6-4 identifies the decision rules applied for each water segment and OC pollutant to define the individual TMDLs.

Table 6-4. Decision rules applied to define TMDLs based on condition applicable to each waterbody/pollutant combination.

Pollutant	San Diego Creek	Upper Newport Bay	Lower Newport Bay	Rhine Channel
Chlordane	Condition 2	Condition 2	Condition 1	Condition 1
Dieldrin	Condition 2	NL	Condition 1	Condition 2
DDT	Condition 2	Condition 2	Condition 2	Condition 2
PCBs	Condition 1	Condition 1	Condition 1	Condition 2
Toxaphene	Condition 2	NL	NL	NL

NL: Not listed for this pollutant

Tables 6-5 through 6-8 summarize the existing loads, the estimated loading capacity, and the total allocation for each pollutant with respect to each waterbody. For most pollutant/waterbody combinations, the loading capacity value is less than the existing load and thus the loading capacity determines the TMDL, as seen in Table 6-4. A 10% margin of safety was subtracted from the loading capacity or existing load, whichever is smaller value.

Table 6-5. Summary of San Diego Creek Loadings and TMDL

Pollutant	Existing Load[1] (g/year)	Loading Capacity[2] (g/year)	TMDL (g/year)	Margin of Safety (g/year)
Chlordane	615.7	314.7	314.7	31.5
Dieldrin	381.8	261.5	261.5	26.2
DDT	3733.8	432.6	432.6	43.3
PCBs	282.1	2226	282.1	28.2
Toxaphene	582.1	8.9	8.9	0.9

[1] existing load based on observed data (OCPFRD 1999/00 and SCCWRP 2001a)
[2] loading capacity based on sediment targets
TMDL is lesser value of existing load or loading capacity; TMDL = Total allocation + MOS

Table 6-6. Summary of Upper Newport Bay Loadings and TMDL

Pollutant	Existing Load[1] (g/year)	Loading Capacity[2] (g/year)	TMDL (g/year)	Margin of Safety (g/year)
Chlordane	290.7	160.6	160.6	16.1
DDT	1080.2	276.5	276.5	27.7
PCBs	858.7	1528.2	858.7	85.9

[1] existing load based on observed data (OCPFRD 1999/00 and SCCWRP 2001a)
[2] loading capacity based on sediment targets
TMDL is lesser value of existing load or loading capacity; TMDL = Total allocation + MOS

Table 6-7. Summary of Lower Newport Bay Loadings and TMDL

Pollutant	Existing Load[1] (g/year)	Loading Capacity[2] (g/year)	TMDL (g/year)	Margin of Safety (g/year)
Chlordane	50.2	59.2	50.2	5.0
Dieldrin	5.9	18.6	5.93	0.59
DDT	438.4	101.85	101.8	10.2
PCBs	409.8	562.95	409.8	41.0

[1] existing load based on observed data (OCPFRD 1999/00 and SCCWRP 2001a)
[2] loading capacity based on sediment targets
TMDL is lesser value of existing load or loading capacity; TMDL = Total allocation + MOS

Table 6-8. Summary of Rhine Channel Loadings and TMDL

Pollutant	Existing Load[1] (g/year)	Loading Capacity[2] (g/year)	TMDL Allocation (g/year)	Margin of Safety (g/year)
Chlordane	0.33	1.70	0.33	0.3
Dieldrin	3.76	0.53	0.53	0.05
DDT	5.60	2.92	2.92	0.23
PCBs	70.0	16.2	16.2	1.6

[1] existing load based on observed data (SCCWRP 2001a)
[2] loading capacity based on sediment targets
TMDL is lesser value of existing load or loading capacity; TMDL = Total allocation + MOS

Tables 6-9, 6-10, 6-11, and 6-12 present the allocations for each OC pollutant-waterbody combination. The explicit margin of safety (10%) has been included for clarification. Allocations were assigned for sources to San Diego Creek primarily in proportion to land use area. The allocations to nurseries and other agriculture factor in two considerations. First, it was assumed that erosion control activities pursuant to the sediment TMDL implementation plan would result in approximately a 50% reduction in OC pollutant runoff from agriculture. In addition, these load allocations factor in a small amount of possible DDT loading associated with possible DDT content in the pesticide Dicofol. The allocations are based on the assumption that only a small fraction of Dicofol reaches water ways, and that DDT loading to waterways associated with Dicofol is a minor source. Undefined sources (existing sediments, air deposition, possible groundwater contributions) were assigned 3% based on existing loading estimates. The remaining portion (approximately 72%) was allotted to urban runoff. We estimate that erosion control practices will result in substantial reduction in OC pollutant loadings associated with eroded sediments (EPA, 1993).

PCBs are particularly stable in aquatic sediment, so we assigned a slightly higher percentage of available allocations to undefined sources (10%) and 4% to other NPDES permits because PCBs chemicals are more likely to be present in groundwater and therefore they may be contained in discharges of groundwater clean up and treatment facilities. This quantity may be modified in subsequent TMDL revisions after subsequent monitoring with adequate sampling and analytical methods to verify PCB loads.

Table 6-9. Allocations for San Diego Creek watershed

Category	**Type**	**DDT (including Dicofol)**	**Chlordane**	**Dieldrin**	**PCBs**	**Toxaphene**
WLA	Urban runoff	302.8	220.3	183.4	177.7	6.2
	Caltrans	8.7	6.3	5.2	42.3	0.2
	Other NPDES permittees	34.6	25.2	21.0	5.6	0.7
	Sub-total	**346.1 g/yr**	**251.8 g/yr**	**209.6 g/yr**	**225.6 g/yr**	**7.1 g/yr**
LA	Ag runoff	8.6	6.2	5.2	5.6	0.2
	Undefined *	34.6	25.2	21.0	22.6	0.7
	Sub-total	**43.2 g/yr**	**31.4 g/yr**	**26.2 g/yr**	**28.2 g/yr**	**0.9 g/yr**
MOS		**43.3 g/yr**	**31.5 g/yr**	**26.2 g/yr**	**28.2 g/yr**	**0.9 g/yr**
Total TMDL		**432.6 g/yr**	**314.7 g/yr**	**262.0 g/yr**	**282.0 g/yr**	**8.9 g/yr**

*undefined = existing sediments + air deposition
Total TMDL = WLA + LA + MOS

Table 6-10. Allocations for Upper Newport Bay

Category	Type	DDT (including dicofol)	Chlordane	PCBs
WLA	Urban runoff	207.4	120.5	609.7
	CalTrans	2.8	1.6	8.6
	Other NPDES permittees	2.8	1.6	8.6
	Sub-total	**212.9 g/yr**	**123.7 g/yr**	**626.9 g/yr**
LA	Ag runoff	2.8	1.6	8.6
	Undefined*	33.2	19.3	137.4
	Sub-total	**35.9 g/yr**	**20.9 g/yr**	**146.0 g/yr**
MOS		**27.7 g/yr**	**16.1 g/yr**	**85.9 g/yr**
Total TMDL		**276.5 g/yr**	**160.6 g/yr**	**858.7 g/yr**

*undefined = existing sediments + air deposition
Total TMDL = WLA + LA + MOS

Table 6-11. Allocations for Lower Newport Bay

Category	Type	DDT (including dicofol)	Chlordane	Dieldrin	PCBs
WLA	Urban runoff	76.3	12.6	4.45	303.3
	CalTrans	0	0	0	4.10
	Other NPDES permittees	0	0	0	0
	Sub-total	**76.3 g/yr**	**12.6 g/yr**	**4.45 g/yr**	**304.7 g/yr**
LA	Ag runoff	0	0	0	0
	Undefined*	15.3	32.6	0.89	61.5
	Sub-total	**15.3 g/yr**	**32.6 g/yr**	**0.89 g/yr**	**73.8 g/yr**
MOS		**10.2 g/yr**	**5.0 g/yr**	**0.59 g/yr**	**41.0 g/yr**
Total TMDL		**101.8 g/yr**	**50.2 g/yr**	**5.93 g/yr**	**409.8 g/yr**

*undefined = existing sediments + air deposition
Total TMDL = WLA + LA + MOS

Table 6-12. Allocations for Rhine Channel

Category	Type	DDT	Chlordane	Dieldrin	PCBs
WLA	Urban runoff	0.7	0.1	0.13	4.1
	Other NPDES permittees	0	0	0	0
	Sub-total	**0.7 g/yr**	**0.1 g/yr**	**0.13 g/yr**	**4.1 g/yr**
LA	Undefined*	1.9	0.21	0.34	10.5
	Sub-total	**1.9 g/yr**	**0.21 g/yr**	**0.34 g/yr**	**10.5 g/yr**
MOS		**0.3 g/yr**	**0.03 g/yr**	**0.05 g/yr**	**1.6 g/yr**
Total TMDL		**2.9 g/yr**	**0.33 g/yr**	**0.53 g/yr**	**16.2 g/yr**

*undefined = existing sediments + air deposition
Total TMDL = WLA + LA + MOS

Margin of Safety

EPA has applied an explicit 10% margin of safety to the loading capacity for these OC TMDLs. The specific mass-based margin of safety for each pollutant with respect to each waterbody is included in Tables 6-5, 6-6, 6-7 and 6-8. This margin of safety will provide additional protection for aquatic life, wildlife predators and human health. The explicit margin of safety is intended to address uncertainties in the relationship between OC pollutant loadings and environmental responses in different areas of the watershed.

In addition, EPA is providing an implicit margin of safety through the selection of several conservative analysis approaches and assumptions used to calculate the TMDLs. Insufficient information is available to specifically quantify the potential uncertainty associated with each of the assumptions used in the analysis. The parameters used in analysis were based on best available information and were selected to be conservative (i.e., most protective) where possible. The use of an explicit margin of safety and recommendation of subsequent follow-up monitoring is intended to ensure that numeric targets are successfully achieved and that the adequacy of the load allocation is evaluated over time. Key areas of uncertainty recognized in the margin of safety include the following:

- The loading capacity is calculated as a long-term annual average that results in meeting water quality standards (expressed as sediment, water column, and/or tissue targets). Because the analysis is focused on long-term predictions, periodic fluctuations are not represented, and actual loading may differ in the short-term.

- Long-term sediment deposition patterns were used to calculate the total amount of sediment deposited in each region. This long-term average value does not represent short-term or localized fluctuations in deposition rates. Periodic accumulation or scouring could be significant during large storm events. This could result in higher or lower deposition rates than the predicted sediment deposition and pollutant concentrations.

- A constant sediment porosity value was used to calculate loads associated with deposited sediment. Sediment porosity values used in the model to estimate loading capacity for San Diego Creek and Newport Bay (0.65) were slightly lower than those used to estimate historical loads (0.80) by RMA. No sediment consolidation was assumed. This resulted in a conservative assumption, since consolidation would result in a lower porosity, which would increase the load associated with deposited sediment.

Seasonal variation/Critical conditions

OC pollutants are of potential concern in the Newport Bay watershed due to possible long term loading and food chain bioaccumulation effects. There is no evidence of short term potential effects. However, pollutant loads and transport within the watershed may vary under different flow and runoff conditions. Therefore the TMDLs consider seasonal variations in loads and flows but are established in a manner which accounts for the longer time horizon in which ecological effects may occur.

These TMDLs rely on careful analysis of the full range of potential flow conditions to address seasonal variation and critical conditions in loads and flows. The sediment transport and deposition within each waterbody is driven by the velocity and sheer conditions of flow. The annual deposition is accounted for by using the sediment budget developed by RMA (1998) which incorporates various flow regimes throughout each year. The sediment budget (generated via model) represents various weather patterns and flow conditions for 12 years.

Obviously the wet weather events, which may occur at any time of the year, produce extensive sediment redistribution and transport downstream. This would be considered the critical condition for loading. However, the effects of organochlorine compounds are manifested over long time periods in response to bioaccumulation in the food chain. Therefore, short term loading variations (within the time scale of wet and dry seasons each year) are not likely to cause significant variations in beneficial use effects.

VII. Chromium and Mercury TMDLs

TMDLs are being established for chromium (Cr) and mercury (Hg) only for the Rhine Channel area of Lower Newport Bay. Additional information on the source analysis, modeling approach and relevant monitoring results for these TMDLs is provided in Technical Support Document—Part G.

Problem Statement

Chromium—Chromium levels are elevated in Rhine Channel mussel tissue samples over the tissue screening value (1.0 mg/kg wet), providing some evidence of chromium bioaccumulation (31%, n= 13). Chromium in Rhine Channel sediments are occasionally (8%, n= 13) above the sediment quality guideline (52 mg/kg dry).

Mercury—Mercury sediment concentrations in Rhine Channel are above sediment quality guidelines levels associated with negative impacts on benthic organisms in all samples tested (100%, n=6). The mercury levels in the limited number of available samples were very high (e.g., recent data shows 5.3 ppm versus PEL level 0.7 ppm). Sediment toxicity has been consistently reported for Rhine Channel (BPTCP 1997, SCCWRP 2001a) although specific contaminants causing this toxicity have yet to be identified. Mussel tissue concentrations were not above the EPA tissue screening value (0.3 mg/kg wet methylmercury), and there is no current evidence that mercury has bioaccumulated to levels of concern.

Numeric Targets

The numeric targets for chromium and mercury in Rhine Channel are presented in Table 7-1. Two targets are provided for each chemical, one for sediment and one for tissue levels. The primary target value (sediment) is for TMDL development, whereas the alternate target (tissue) is designed to provide another means of assessing desired water quality conditions of Rhine Channel.

There are several available screening values for mercury concentrations in sediment and fish tissue. For mercury in Rhine Channel, EPA applied the sediment numeric target, 0.13 mg/dry kg, as the most appropriate indicator of desired water quality. This threshold effect level (TEL) is associated with no observed effect on benthic organisms as part of a study by MacDonald et al. 1996 and cited in NOAA SQuiRTs (Buchman 1999). For comparison, the TEL value is much lower than the probable effects level (PEL = 0.696 mg/kg dry). The NOAA Effects Range-Low (ERL) value for mercury (ERL = 0.15 mg/kg dry) is close to the TEL target value. The alternate mercury numeric target is fish tissue (0.3 mg/kg wet methylmercury), from EPA proposed criteria and analysis provided in the USFWS Biological Opinion on the CTR (2000). This methylmercury target is designed to protect human health, yet it will also be effective at reducing impacts to wildlife predators due to bioaccumulation.

EPA has also evaluated the available water quality criteria and levels for sediments and fish tissue to determine the appropriate numeric target for chromium TMDL in Rhine Channel. EPA selected the sediment target (52 mg/kg dry, Buchman 1999) as the best available target to protect both wildlife predators and benthic organisms. The alternate chromium numeric target is fish tissue, 0.2 mg/kg wet (USFWS 2001). This fish tissue target is more stringent than the screening value used to evaluate State mussel watch data in order to ensure protection of wildlife predators.

Table 7-1. Numeric targets for Chromium and Mercury in Rhine Channel.

Waterbody	Analyte	Sediment target (mg/kg dry)	Alternate Fish tissue target (mg/kg wet)
Rhine Channel	Chromium (Cr)	52	0.2
Rhine Channel	Mercury (Hg)	0.13	0.3*

*mercury tissue target is interpreted as 0.3 mg/kg wet methylmercury (EPA proposed criteria and USFWS 2000)

Source Analysis

Chromium (Cr)

Probable sources of chromium include the heavily contaminated sediments existing in Rhine Channel, previous discharges by metal plating facilities near Rhine Channel, historic deposits in the San Diego Creek watershed and atmospheric deposition. The Regional Board has documented two previous investigations of metals contamination at Newport Plating Company. These investigations found extremely high levels of chromium in sediment boring samples. Furthermore, a storm drain which drains runoff from the Newport Plating facility area discharges into Rhine Channel. This facility should be considered a potential source and should receive further investigation. More complete information on this source is presented in TSD part G – Chromium and Mercury.

Chromium may also be leaching from treated wood pylons in marine areas (Weis et al. 1991). Chromium is a naturally occurring element in many area, which can be found in volcanic dust and gases. However, chromium emissions can also come from commercial and industrial facilities, resulting in chromium discharges into the atmosphere. Currently, there is not sufficient information to estimate chromium atmospheric deposition rates in the Newport Bay watershed. The heavily contaminated sediments in Rhine Channel are most likely associated with historic discharges from industrial facilities around Rhine Channel, and these legacy sources are likely to be the largest current sources of chromium.

Mercury (Hg)

No investigation has been completed to explain elevated (total) mercury sediment concentrations within Rhine Channel. Orange County Coastkeeper (1999) measured mercury concentrations in one sediment core and the results provide historical perspective. Total mercury results show lowest concentrations at the core top (3.4 mg/kg dry) and highest concentrations (11 mg/kg dry) at the bottom of the one foot long core. Other researchers have found similar sediment concentrations in Rhine Channel; SCCWRP (2001a) reports 5.3 mg/kg dry and BPTCP (1997) reports (8.7 mg/kg dry) for surface (top six inches) sediment samples. Perhaps historical uses of ship anti-fouling paints which contained mercury are responsible for elevated sediment levels based on previous activities in Rhine Channel (Regional Board 1998). Most likely the existing sediments are the largest sources of mercury in Rhine Channel.

Another potential source of mercury is the historical mining operations at the old Red Hill mine in the western part of San Diego Creek watershed (in Tustin). Historic records show mercury mining and processing occurred at Red Hill mine between 1880 and 1939 (CA Division of Mines 1976). The total amount of mercury produced is not known. Mine shafts were sealed off in 1976, though some shafts are still open and can receive storm runoff. The Red Hill mine is upgradient of the Swamp of Frogs and mine drainage may have flowed to Peters Canyon Wash. Other minor sources of Hg deposits have been mapped in the area. At this time, no additional information is available to accurately assess whether mercury from this mining location reached the Rhine Channel area. However, available evidence for all of Newport Bay suggests that mercury levels in the rest of Newport Bay are not elevated. It is unlikely that mercury loads from the upper watershed would have contributed to mercury contamination of Newport Bay sediments solely in the Rhine Channel area. Therefore, it is unlikely that discharges from the Red Hill mine area are a principal cause of mercury contamination in Newport Bay.

Based on water column measurements (IRWD 1999) of dissolved mercury (Hg) and chromium (Cr), the loads from San Diego Creek can be estimated. Analysis of previous hydrologic modeling studies for Newport Bay (RMA 1997), yields estimates of sediment transported from San Diego Creek to be deposited in the Rhine Channel annually (approx 6%). Assuming that most of the chromium and mercury is adsorbed by suspended sediment, the estimated annual loads for chromium and mercury from San Diego Creek that are delivered to Rhine Channel are about 46.9 kg/year and 0.054 kg/year, respectively (Table 7-2).

Table 7-2. Estimated Mercury and Chromium Loads from San Diego Creek.

Pollutant Name	**Year**	**Water Column Conc. (ug/L)**	**Estimated Load to Rhine Channel (kg/yr)**
Cr	‘97-99	16	46.9
Hg	‘97-99	0.0186	0.054

(source: water (IRWD 1999); sediment budget (RMA 1997, 1998)

Atmospheric deposition probably is contributing small amounts of mercury to the watershed; however, there are no likely nearby sources upwind of the watershed. In any event, atmospheric deposition is estimated to contribute very small amounts of mercury to Rhine Channel relative to the amounts of mercury in existing Rhine sediments as well as freshwater sediment deposition. Ambient seawater concentrations of mercury are extremely low, typically less than 1 ng/L.

Modeling

The approach to determining the loading capacities for mercury and chromium is similar to the approach used for the organochlorine compounds (TSD – Part F) and was based on an understanding of the sources of these compounds (past, present, and future) and the transport and ultimate fate of these compounds in various environmental media. Based on a review of literature sources, it was observed that mercury and chromium environmental persistence and affinity for adsorbing to sediment and accumulating in biota generally limits their presence in the water column, at least relative to sediment and biota.

Previous modeling studies, completed by RMA for the U.S. Army Corps of Engineers (USACE) have examined the circulation patterns, and transport and deposition of sediments in Newport Bay (RMA 1997, 1998). By examining model calibration results (RMA 1997) for Newport Bay from 1985-1997, the sediment deposition in Rhine Channel was estimated. The approach relies on the following key information: sediment deposition rates, deposition patterns (from the RMA (1997) model), pollutant targets (used for loading capacity) (see TSD Table G-2) and sediment moritoring data for mercury and chromium concentrations (used for existing loads) (see TSD, Table G-1 and Appendix 1) Historic pollutant loads to the bottom sediment were estimated by using observed pollutant concentrations in bottom sediments and net sedimentation rates. Sediment volume was converted to dry weight using an estimated porosity of 0.65. The loading capacities were determined by “back-calculating” the allowable load from the selected sediment target (Table 7-3) and the associated estimates of sediment loads.

Loading Capacity/Linkage Analysis

Determination of loading capacity has been described above and uses similar methods to those outlined for organochlorine TMDLs (see Section VI of this document and TSD Part G for more comprehensive explanation. These TMDLs express the loading capacities, TMDLs, and allocations in mass loading terms for Rhine Channel. Because most of the mercury and chromium loads are associated with contaminated sediments already in Rhine Channel, it will be necessary to remediate contaminated sediments in order to meet water quality standards and prevent adverse ecological effects.

TMDL and Allocations

For these TMDLs, EPA has calculated both wasteload allocations (WLA) and load allocations (LA). Inputs from historically deposited sediments and atmospheric deposition are included in load allocations. Ongoing sediment deposition (containing mercury and chromium) from San Diego Creek is addressed as a wasteload allocation because this source is generally subject to coverage under the existing NPDES stormwater permit.

For mercury, the on-going load, which is associated principally with local contaminated sediments, is higher than the estimated loading capacity. Therefore, the mercury TMDL (0.10 kg/yr)and associated allocations are set based on this loading capacity. The opposite is true for chromium, where the existing load is slightly lower than the loading capacity, therefore the chromium TMDL is based on 33.1 kg/yr. The loading capacities for chromium and mercury are expressed as annual averages (Table 7-3).

Table 7-3. Historical Loading and Estimated Loading Capacity for Rhine Channel

Pollutant	existing conc. * (mg/kg dry)	Estimated Load (kg/yr)	Sediment Target (mg/kg dry)	Loading Capacity (kg/yr)
Chromium	44	33.1	52	39.1
Mercury	5.8	4.36	0.13	0.10

* (SCCWRP 2001a)

The wasteload and load allocations (Table 7-4) were calculated based principally on best professional judgement . Most of the available loads were assigned to sediments already in Rhine Channel, which are by the far the largest source. These allocations to existing sediments reflect substantial reductions in sediment loads from in-Channel sources based on the expected effectiveness of remedial actions identified in the 1997 remedial action plan. The remaining available load was allocated roughly in proportion to the land areas associated with the remaining source categories after allocating 5% of available loads for undefined sources. Further investigation of Newport Plating facility may warrant revision of such a high allocation to sediments in Rhine Channel for Chromium.

Table 7-4. Rhine Channel Wasteload and Load Allocations (kg/yr) and % of total loads

	Mercury (Hg)	Chromium (Cr)
Wasteload allocations		
Stormwater	0.0171 (19%)	5.66 (19%)
Caltrans	0.0027 (3%)	0.89 (3%)
Boat yards	0	0
Other NPDES permittees	0.0027 (3%)	0.89 (3%)
Load allocations:		
Existing sediment	0.063 (70%)	20.85 (70%)
Undefined sources: air deposition, ambient seawater	0.0045 (5%)	1.49 (5%)
Margin of safety	0.01	3.30
TMDL	**0.1 kg/yr**	**33.1 kg/yr**

TMDL = WLA + LA + MOS

Margin of Safety

EPA has applied an explicit 10% margin of safety to the loading capacity for these TMDLs. The specific mass-based quantity for each pollutant with respect to each waterbody is included in Table 7-5. This margin of safety will provide additional protection for aquatic life, wildlife predators and human health.

A number of assumptions were used in the derivation of each TMDL. Insufficient information is available to quantify the potential uncertainty associated with each of the assumptions used in the analysis. The parameters used in analysis were based on best available information and were selected to be conservative (i.e., most protective) where possible. The use of an explicit margin of safety and subsequent follow-up monitoring is intended to ensure that numeric targets are successfully achieved and that the adequacy of the load allocation is evaluated over time. Key areas of uncertainty recognized in the margin of safety include the following:

- The loading capacity is calculated as a long-term annual average that results in meeting water quality standards (expressed as sediment, and tissue targets). Because the analysis is focused on long-term predictions, periodic fluctuations are not represented, and actual loading may differ in the short-term.

- Long-term sediment deposition patterns were used to calculate the total amount of sediment deposited in each region. This long-term average value does not represent short-term or localized fluctuations in deposition rates. Periodic accumulation or scouring could be significant during large storm events. This could result in higher or lower deposition rates than the predicted sediment deposition and pollutant concentrations.

- A constant sediment porosity value was used to calculate loads associated with deposited sediment. Sediment porosity values used in the model to estimate loading capacity for San Diego Creek and Newport Bay (including Rhine Channel) (0.65) were slightly lower than those used (0.80) in RMA model. No consolidation was assumed. This resulted in a conservative assumption, since consolidation would result in a lower porosity, which would increase the load associated with deposited sediment.

Seasonal variation/Critical conditions

These TMDLs rely on careful analysis of the full range of potential flow conditions to address seasonal variation and critical conditions in loads and flows. The sediment transport and deposition within each waterbody is driven by the velocity and sheer conditions of flow. The annual deposition is accounted for by using the sediment model developed by RMA (1997) which incorporates various flow regimes throughout each year. The model represents various weather patterns and flow conditions for 12 years.

As previously stated, freshwater flows from San Diego Creek and Santa Ana-Delhi Channel do not significantly transport sediments into Rhine Channel. The most important scenario may be the large flows associated with wet weather events, which may occur at any time of the year and produce extensive sediment redistribution and transportations downstream. This has yet to be verified in hydrologic modeling of chromium and mercury in Rhine Channel.

VIII. Arsenic Analysis

EPA has concluded that an arsenic TMDL is not required because available data indicate that applicable numeric water quality standards, and the best available screening guidelines used to interpret narrative standards, are not being exceeded. Although the State and EPA initially concluded that arsenic TMDLs were needed based on comparisons with older recommended screening values, we have revised our conclusions based on an updated data set and new information concerning arsenic toxicity and consumption risk. This section explains the basis for EPA's revised assessment of the need for arsenic TMDLs.

EPA's initial assessment of fish tissue monitoring results was based on comparisons with two screening values. Total arsenic concentrations in fish tissue were compared to the California OEHHA screening value (1.0 mg/kg wet for total arsenic). This screening value was developed from a human health study for chemical contaminants in sportfish from two California freshwater lakes (OEHHA 1999). OEHHA recognized that inorganic arsenic is the preferred contaminant to evaluate for potential human health risk; however, analytical methods to measure inorganic arsenic were not available during that study. OEHHA developed a plan to a) evaluate total arsenic fish tissue results against the screening value for freshwater species and b) delay further decisions about water quality impairment or potential health risk until they had actually measured inorganic arsenic in popular sportfish (pers. commun. B. Brodberg). Furthermore, OEHHA recognizes its total arsenic screening value is ill-suited for saltwater systems. EPA Region 9 has reconsidered using this *freshwater* total arsenic tissue screening value and has determined that it would be inappropriate to make final decisions based only on comparison of total arsenic in tissues with this screening value.

EPA's initial assessment also considered another fish tissue screening value, (0.026 mg/kg wet for inorganic arsenic); however no monitoring data exists for measurements of inorganic arsenic in Newport Bay fish. To enable a comparison of available data to the inorganic arsenic screening value, EPA estimated levels of inorganic arsenic present in Newport Bay fish as a percentage of total arsenic for finfish (4% of total) and for shellfish (60% of total). These percentages were based on information obtained from a literature search (for finfish, Donohue and Abernathy 1999) or discussion with analytical chemists (for shellfish, pers. commun. J. Creed). Upon further review of the screening values cited in recent EPA guidance for assessing fish advisories (USEPA 2000d), EPA has determined the 0.026 mg/kg wet inorganic screening value is incorrect and that 1.2 mg/kg wet inorganic arsenic is a more reliable risk-based screening value. Preferably this screening value should be compared to measurements of inorganic arsenic in local fish, although calculation of inorganic arsenic as a percentage of total arsenic is still acceptable.

In the process of developing these TMDLs, EPA reevaluated local fish tissue data in comparison with the new EPA screening value of 1.2 mg/kg wet inorganic arsenic based on EPA's fish advisory guidance. The most recently available set of fish tissue monitoring results was compiled from Toxics Substances Monitoring program (1995-1998), California Fish Contamination Study (1999-2000) Southern California Coastal Water Research Project (2001b) and State Mussel Watch program (1995-2000). We evaluated results from both San Diego Creek and saltwater bodies of Newport Bay but focused more on saltwater results since those results showed some exceedances with respect to the OEHHA screening value applied in EPA's earlier assessment. To be conservative and consistent with other agencies (e.g., FDA), EPA assumed that inorganic arsenic comprised 10% of total arsenic for finfish and 60% of total for shellfish. We used only one screening value, 1.2 mg/kg wet for inorganic arsenic, which is consistent with both State and Federal agencies' determination that human health risk from arsenic exposure is attributed to inorganic arsenic exposures.

The final assessment of saltwater tissue results (using calculated values of inorganic arsenic) shows no exceedances of the EPA inorganic screening value (1.2 mg/kg wet). This is true for both finfish (0%, n = 80) and shellfish (0%, n = 24). There are also no exceedances of freshwater tissue results. Table 8-1 summarizes arsenic tissue concentrations for Newport Bay. Table 8-2 provides a perspective of arsenic tissue concentrations for Newport Bay and other saltwater bodies. The raw data and calculated results for this reassessment are provided in Appendix B at the end of this summary document. Therefore, based on this revised assessment, EPA concludes that San Diego Creek and Newport Bay are not exceeding water quality standards for arsenic and that no TMDLs are needed. This result is consistent with local ambient water column data for arsenic, which indicate that Bay arsenic levels are about the same as average sea water arsenic levels.

Table 8-1. Total Arsenic results in fish tissue in Newport Bay waterbodies (mg/kg wet)

Waterbody	Collection dates	Org.	n	Min	Max	Mean	Median
San Diego Creek	1995 -- 98	TSMP	15	0.06	0.88	0.18	0.13
Newport Bay (finfish)	1995 -- 98	TSMP*	4	0.4	8.6	2.93	1.3
	1999 -- 00	CFCS	26	0.2	4.0	1.29	0.79
	2000 - 01	SCCWRP	50	0.22	8.6	1.64	0.68
(shellfish)	1995 - 00	SMW	24	0.8	2.5	1.28	1.25

*these TSMP results for individual samples, all other results are tissue composites

Table 8-2. Total Arsenic results in marine waterbodies (mg/kg wet)

Tissue	Study	n	Range	Mean	Median
Finfish	Newport Bay	80	0.2 – 8.6	1.5	0.7
	Wash State	12	0.15 – 10.7	3.5	0.9
	Donohue	77	0.2 – 65	5.1	2.1
	Great Britain	720	0.9 – 30.1	5.6	4.3
Shellfish	Newport Bay	24	0.8 – 2.5	1.3	1.3
	Wash State	10	1.0 – 6.9	2.4	2.2
	Donohue	57	0.2 – 126	15.9	4.2

Newport Bay results compiled from Table 8-1
Washington State results from Yilmazer et al. 2000
Donohue results from various North American waterbodies (1996)
Great Britain results from Collins et al. 1996

IX. Implementation Recommendations

This section provides general recommendations of implementation actions and monitoring work to assist in implementing the TMDLs and allocations identified in this decision. Several commenters, including the Regional Board, dischargers, and environmental groups specifically requested that EPA discuss TMDL implementation recommendations when we made the final TMDL decisions. The implementation and monitoring actions are not required and are not part of the TMDL decisions being made by EPA at this time; rather, they are included with the TMDLs to assist followup planning and implementation work by the State and local stakeholders. As discussed in Section I above, the State—not EPA—is responsible for developing implementation plans necessary to attain TMDLs. In its comments concerning the EPA TMDLs, the Regional Board signaled its commitment to adopt TMDLs and implementation plans for these toxic pollutants in a timely manner.

General Recommendations

The toxic pollutant TMDLs address several pollutant types which come from a variety of sources. Therefore a range of pollutant management options will be available to the State to address them. Based on information we gathered in developing the TMDLs as well as feedback obtained from the State and local stakeholders during the development of the TMDLs, we have identified several appropriate implementation approaches for different pollutants.

Consistent with the State's approach to developing and implementing other TMDLs in the Newport Bay watershed for sediments, nutrients, and pathogens, EPA believes a phased, iterative approach to implementation and monitoring is appropriate to address the toxic pollutants of concern. Substantial uncertainty remains concerning pollutant sources and the relationship between pollutant loads and environmental effects in the watershed. EPA believes some specific implementation actions should be carried out to address pollutant sources which are most clearly of concern. Several of these actions are already underway or in the planning stages. It is also appropriate to collect and analyze additional monitoring data to improve the understanding of pollutant sources and effects, periodically review the TMDLs and implementation actions in light of new monitoring results, and revise the TMDLs and implementation actions if necessary. Depending upon the State's priorities, additional monitoring data could also assist in reviewing and, if necessary revising the applicable water quality standards to provide the appropriate level of beneficial use protection. This combination of early actions to address clear pollutant sources and an ongoing commitment to iterative monitoring and adjustments provides an appropriate balance in followup implementation work.

When the Regional Board considers adoption of TMDLs for toxic pollutants along with associated implementation plans, the State may adopt the TMDLs identified in this decision or further assess these pollutants and adopt different TMDLs if warranted. EPA recommends that the State consider the specific areas of analytical uncertainty identified in the analysis supporting our TMDL decisions as a starting point in targeting any additional analytical work (including monitoring) planned in support of TMDL adoption.

It is expected to take several years for toxic pollutant levels in the watershed to decline to the point where all applicable water quality standards are fully attained. For some pollutants such as the diazinon and chlorpyrifos, the pollutant levels will probably decline quickly in response to actions to reduce their use. For some other pollutants with long residence times in the environment, or which are associated with historical discharge, there will probably be some lag time between the initiation of controls to reduce loading or remediate contaminated sites and the observation of decreased pollutant levels throughout the watershed. For these reasons, EPA supports the past State practice of identifying interim targets or benchmarks in terms of pollutant control actions, pollutant loadings and/or receiving water responses to help ensure that control actions are taken and progress is being made toward attaining water quality standards. Specification of clear interim targets also assists in the evaluation of whether the TMDLs or implementation actions need to be adjusted in the future.

EPA's TMDLs do not contain compliance timeframes or interim implementation targets because these elements are addressed by the State in the implementation planning process. EPA urges the State to work with local dischargers and stakeholders to design and carry out effective implementation actions sufficient to implement the TMDL in a timely manner.

As discussed in Section 1, the Clean Water Act creates federal regulatory jurisdiction only over point sources. Therefore, the direct implementation effect of EPA's TMDLs is that when NPDES permits for point source discharges are issued or revised for discharges to waters in the watershed, the State is required to ensure that the permits contain effluent limitations necessary to be consistent with the wasteload allocations (WLAs) contained in theTMDLs (40 CFR 122.44(d)). Permit modification may occur when existing permits are reopened or reissued, or when a new discharge source seeks a permit. NPDES permit holders should contact the Regional Board to discuss how and when action will be taken to implement applicable WLAs. The State has discretion to determine how the point source permit provisions will be made consistent with applicable WLAs. Depending upon the situation and the level of precision in the WLA, it may be appropriate to:

- incorporate numeric effluent limitations for the pollutant(s) of concern in the permit,
- identify best management practices and associated pollutant control effectiveness which demonstrate that the WLAs will be attained, and/or
- require the discharger to submit a WLA compliance plan and schedule which demonstrates how the WLA will be implemented.

In addition to addressing WLA implementation through the NPDES permitting process, the State should work with local stakeholders to identify specific actions necessary to carry out load allocations identified in the TMDLs. These actions may be based on voluntary or regulatory approaches. We note that CWA Section 319(h) nonpoint source implementation grant funds may be available to assist in implementing controls necessary to implement load allocations. Section 319(h) projects designed to implement TMDLs currently receive priority for funding. Landowners or land managers interested in seeking Section 319(h) funding assistance should contact the Regional Board staff for more information concerning the State's grant funding process.

OP Pesticide TMDL Implementation Recommendations

EPA's pesticide program has intiated a phase-out of household uses of diazinon and chlorpyrifos (EPA 2000b, EPA 2001b). It is expected that the phase-out will greatly assist in reducing the levels of these pesticides found in the waters of Newport Bay watershed. Because approximately 90% of diazinon and chlorpyrifos use in the watershed is estimated to be associated with urban and household uses, the phase-out program may be sufficient to result in attainment of the TMDLs and associated allocations. We recommend that the Regional Board continue its work with nurseries in the watershed to minimize use of these pesticides. We recommend continued monitoring in San Diego Creek and its tributaries to assess reductions in OP pesticide runoff in the next several years. If monitoring demonstrates that the urban use phase-outs are inadequate to implement the TMDLs, it may be necessary in the future to implement additional controls on agricultural uses of these pesticides in coordination with the California Department of Pesticide Regulation

We are concerned by potential conflicts between programs to reduce use of these pesticides and mandates to use these pesticides for fire ant control. EPA urges that Regional Board to work with the State Water Resources Control Board, California Department of Pesticide Regulation, California Department of Food and Agriculture, and EPA's pesticide program to assess and, if necessary, reconcile these potentially conflicting mandates concerning OP pesticide use.

Selenium TMDL Implementation Recommendations

EPA is in the process of reviewing and potentially revising the numeric criteria for Se in freshwater. In addition, other local studies are underway to assess the potential effects of Se on aquatic organisms. EPA expects to complete this review within approximately 2 years. EPA recommends that the State review and, if necessary, revise the Se TMDLs following adoption or promulgation of the revised water quality standards. Several commenters raised concerns about whether the CTR criteria are appropriate for conditions in the San Diego Creek watershed, and identified several local factors (e.g. local water chemistry) which could support consideration of alternative site specific criteria. In consultation with EPA and the State Water Board, the Regional Board should consider whether it is feasible and appropriate to assess the applicable Se water quality standards in light of these concerns, and potentially adopt site specific water quality standards.

The TMDL analysis found that the most significant sources of Se loading appear to be associated with groundwater entering surface waters (sometimes directly and sometimes through discharge from dewatering operations). Control of these sources will be difficult. However, EPA recommends that the State begin working with permitted dischargers to assess options for reducing Se discharges through discharge management practices and/or treatment technologies. The State may wish to sequence its planning activities to settle issues concerning applicable standards before carrying out actions to further tighten discharge controls.

EPA recommends that the Regional Board monitor flow and Se concentrations in discharges from cleanup and ground water dewatering operations in order to provide the basis for establishing effluent limits in the permits consistent with the TMDLs. When NPDES permits for groundwater cleanup or dewatering operations are considered, the Regional Board will need to ensure that the total allowable Se loadings do not exceed the group WLA established in the TMDL.

Metals TMDL Implementation Recommendations

Metals loading in the watershed is associated primarily with ongoing runoff from urban and undeveloped areas, and aquatic sediments containing previously discharged metals. Our recommendations address all the metals for which TMDLs are established, including mercury and chromium. EPA recommends five areas of action to address metals loading in the watershed.

First, metals levels in the Rhine Channel area are estimated to be substantially higher than in other areas of the watershed. No significant ongoing loading sources were identified, and the aquatic sediments in Rhine Channel have been identified as a significant toxic hot spot. EPA recommends aggressive action to complete and implement the contaminated sediment remediation plan initiated by the State and Regional Boards in 1997. One potential ongoing source of concern with respect to chromium loading is the Newport Plating facility. EPA recommends that the State further assess this facility and, if necessary, carry out discharge controls or remedial actions necessary to address any ongoing loadings.

Second, the source analysis indicated that copper leaching from boat paints is probably a significant source of copper loading to the Bay. In coordination with marina and boatyard operators, other Regional Boards, the State Board, and EPA, the Santa Ana Regional Board should develop specific actions to reduce the use of copper-containing boat paints or their leaching to water bodies through use of additional boat storage and maintenance practices.

Third, the Regional Board should work with the stormwater discharge permittees to further assess the potential effectiveness of available management practices to reduce metals loading in discharges of urban runoff under high and low flows. In future iterations of the stormwater permits, provision should be made to implement effective metals reduction practices, with particular emphasis on implementation of the more cost-effective methods identified. Additional work will be needed in the immediate future to more thoroughly assess and document the prospective effectiveness of available practices.

Fourth, he State adopted a sediment TMDL and implementation plan in 1999 which called for an overall 50% reduction in sediment loading from San Diego Creek through implementation of a locally developed sediment reduction plan. Reductions in sediment loading should assist in reducing loadings of total metals. EPA recommends that the State continue implementation of this sediment reduction plan and monitor to determine whether both total and dissolved metals loading levels decline over time.

Fifth, the State may wish to consider reevaluation of the metals criteria and associated TMDLs in the future based on application of criteria calculation methods which are currently under development. Metals criteria calculation protocols are nearing completion which may enable States to calculate metals standards that more accurately represent the bioavailable portion of total metals loading through consideration of water effects ratios (WERs). It may be relatively straightforward recalculate metals criteria based on local hardness and organic carbon data and revised WER equations. In light of the potential cost of extensive actions to further control metals loading from urban runoff in the watershed, EPA believes it may be reasonable to consider whether newly emerging criteria calculation methods would result in protective but easier-to-implement standards.

Organochlorine Compound TMDL Implementation Recommendations

This TMDL decision addresses two types of organochlorine compounds whose use is no longer authorized: several chlorinated pesticides (DDT, chlordane, dieldrin and toxaphene) and PCBs, which were used in electrical equipment. Because these compounds are very stable in the environment and often adhere to sediments, they may continue to reach and remain in water bodies at levels of concern for many years following their discharge to the environment. Two potential routes of environmental exposure of these compounds are of greatest potential concern—ongoing loadings from the watershed of historically deposited pollutants and exposures to organochlorine compounds already present in aquatic sediments (principally in Newport Bay). There is substantial evidence indicating that levels of these compounds in Bay sediments and aquatic organisms has declined over the past 20 years or more.

No terrestrial "hot spots" (locations with significantly elevated levels of these pollutants were located during the TMDL development process; however, limited historical information indicates that there may have been some spills (e.g., PCB spills at El Toro and Tustin Air Stations). We recommend that the State conduct more thorough investigations of potential spill sites based on the preliminary information compiled for this TMDL effort in order to determine whether there are any significant hot spot sites in the watershed warranting further remedial action.

The most likely source of ongoing loading of organochlorine pollutants is erosion of sediments to which these compounds have adhered. The State adopted a sediment TMDL and implementation plan in 1999 which called for an overall 50% reduction in sediment loading from San Diego Creek through implementation of a locally developed sediment reduction plan. EPA recommends that the State continue implementation of this sediment reduction plan and monitor to determine whether levels of organochlorine compounds continue to decline. Monitoring should examine not only the levels of organochlorine pollutants in the water column, but also sediment running into tributary streams, sediment moving down San Diego Creek, and sediments in Newport Bay.

If future monitoring indicates that declines in levels of the pollutants in the watershed are continuing or accelerating, it may be unnecessary to implement additional erosion and sediment controls. If the levels of these pollutants in sediments and tissue do not decline or actually begin to rise, the State will need to revisit and potentially revise terrestrial sediment control strategies in the watershed as a whole and aquatic sediment management strategies in the Bay.

Newport Bay sediment and tissue monitoring programs should continue to test for organochlorine pollutants. Although no obvious aquatic sediment "hot spots" were found for these pollutants (with the possible exception of Rhine Channel for some pollutants), the available data appear to indicate that the reservoir of these pollutants still found in Bay sediments far outweighs the additional loads to the Bay from the watershed. Therefore, in coordination with monitoring and assessment programs to evaluate the full suite of toxic pollutants of concern, the State should continue to consider whether any specific locations warrant remedial action to remove, cap, or otherwise immobilize Bay sediments. It is always important to consider whether the long term benefit of aquatic sediment remedial action is outweighed by the potential short term adverse effects associated with disturbing contaminated sediments. The remedial action plan adopted by the State for Rhine Channel should help reduce any ongoing availability of these pollutants at that location, and we repeat our recommendation that this remedial action plan be carried out in a timely manner.

The U.S. Army Corps of Engineers and Orange County have been examining the feasibility of removing sediment from containment basins in Upper Newport Bay (ACOE 2000). This study has refined various alternatives, obtained necessary funding and is presently entering the preconstruction, engineering and design phase. Restoration is *scheduled* to begin in 2003/2004. We recommend that the State work with the project sponsors to ensure that potential disturbance of sediments containing the pollutants addressed in this TMDL report is considered in the design process and minimized during project implementation.

Monitoring Recommendations

This action establishes TMDLs for numerous toxic pollutants, in a watershed for which several other TMDLs have previously been established. We recommend that the State work with the other State and federal agencies, the County, permitted cities, local industries, and perhaps local academic institutions to develop a coordinated monitoring program for Newport Bay and its tributary streams. While much of this work could be carried out pursuant to the NPDES stormwater permit, the scope of the monitoring needed to more fully characterize toxic pollutant trends in the watershed and the effectiveness of pollutant control strategies goes beyond the scope of traditional monitoring required under these permits. Substantial monitoring has conducted in the past but it was (with the exception of the County's monitoring) usually relatively narrow in scope in terms of pollutant coverage, geographical extent, and temporal scope. Newport Bay watershed is a good candidate for development of a more integrated and comprehensive monitoring approach which could result in a more cost-effective overall approach to monitoring than currently created by independent monitoring approaches.

We recommend that the State consider the areas of uncertainty in each TMDL analysis as discussed in the margin of safety sections and TSDs in order to identify the types of monitoring data which are most important to reduce analytical uncertainty and improve our ability to target meaningful control actions.

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XI. Glossary and abbreviations

205(j)	Section 205, part j of Clean Water Act, addresses water monitoring grants
319(h)	Section 319, part h of Clean Water Act, addresses non-point source pollution
ACOE	Army Corps of Engineers
ai	active ingredient
ambient	existing environmental conditions (or concentrations)
BAF	Bioaccumulation factor
BCF	Bioconcentration factor
BSAF	Biota-sediment accumulation factor
bgs	Below ground surface, relates to monitoring wells
Bight '98	Southern California Bight (coastal waters) study
BMP	best management practice
BPTCP	Bay Protection and Toxic Cleanup Program
CCC	criterion continuous concentration = chronic
CDFG	(California) Department of Fish and Game
cfs	Cubic feet per second, pertains to stream flow rates
CFCS	California Fish Contamination Study (OEHHA)
CMC	criterion maximum concentration = acute
CTR	California Toxics Rule
cv	coefficient of variation
CWA	Clean Water Act
DO	dissolved oxygen
DPR	(California) Department of Pesticide Regulation
DTSC	(California) Dept. of Toxic Substances Control
ELISA	Enzyme Linked Immunosorbant Assay
EPA	U.S. Environmental Protection Agency
ERL	Effects Range-Low, sediment quality guideline for low impact
ERM	Effects Range-Median, NOAA sediment quality guideline for median negative impact
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
f_{lip}	Fraction (of organic compound associated) with lipid
f_{oc}	Fraction (of organic compound associated) with octanol
GC	Gas chromatograph
GC/MS	Gas chromatography/mass spectrometry
HPLC/MS	high performance liquid chromatography/mass spectrometry
IPM	Integrated Pest Management, part of UC-Cooperative Extension
IRWD	Irvine Ranch Water District
LA	Load allocation for non-point sources (including background)
MLLW	mean low low water
MOS	Margin of safety
NAWQA	National Water Quality Assessment Program
ng/L	Nanograms per liter (= parts per trillion)
NOAA	National Oceanic Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NY DEC	New York Dept. of Environmental Conservation
OC	Organochlorine compound; e.g., chlordane, dieldrin, DDT, PCB, toxaphene
OCHCA	Orange County Health Care Agency
OCPFRD	Orange County Public Facilities and Resources Department

OEHHA	Office of Environmental Health Hazard Assessment
OP	Organophosphate, type of pesticide
OPP	Office of Pesticide Programs
PCB	polychlorinated biphenyl
PCH	Pacific Coast Highway
PCW	Peters Canyon Wash, a tributary of San Diego Creek
PEL	Probable Effects Level, sediment quality guideline for Florida Dept. of Env. Protection
PERA	probabilistic ecological risk assessment
POTW	Publicly owned treatment works
ppb	Part per billion = ug/L (for solution concentration) or ng/g (for dry soil conc.)
ppm	Part per million = mg/L (for solution concentration) or ug/g (for dry soil conc.)
PPT	parts per thousand (salinity)
Porewater	(interstitial) water contained in sediments
RIFA	Red Imported Fire Ant
RMA	Resource Management Associates, developed hydrologic models for US Army Corp of Eng.
SA RWQCB	Santa Ana Regional Water Quality Control Board
SD RWQCB	Santa Diego Regional Water Quality Control Board
SAD	Santa Ana-Delhi Channel
SCCWRP	Southern California Coastal Water Research Program
SDC	San Diego Creek
se	standard error [as used in table column headings]
SMW	State Mussel Watch
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TEL	Threshold Effects Level, sediment quality guideline (for Florida Dept. of Env. Protection)
TIE	toxicity investigation evaluation = study to identify and characterize chemicals causing toxicity
TMDL	total maximum daily load
TOC	total organic carbon
TSMP	Toxic Substances Monitoring Program (State Water Board)
TUa	acute toxic units
UCD	University of California, Davis
ug/L	micrograms per liter (= parts per billion)
US FWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
WDR	Waste discharge report,
WLA	Wasteload allocation for point sources (including general stormwater permit)
WYL	San Diego Creek at Culver sampling site
xe	mean error [as used in table column headings]

Appendix A

Designated beneficial uses for Newport Bay and San Diego Creek watershed.

Water Body	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	COLD	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST
Lower NB	+					x		x	x	x				x	x	x	x	x	
Upper NB	+							x	x	x			x	x	x	x	x	x	x
San Diego Creek Reach 1	+							x	x		x			x					
San Diego Creek Reach 2	+							I	I		I			I					
Tributaries of San Diego Creek	+							I	I		I			I					

x present or potential beneficial use
I intermittent beneficial use
\+ excepted from MUN

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 sport fishing
WARM = warm freshwater habitat
COLD = cold freshwater habitat
BIOL = preservation of biological habitats
WILD = wildlife habitat
RARE = rare, threatened, or endangered species
SPWN = spawning, reproduction, and/or early development
MAR = marine habitat
SHEL = shellfish harvesting
EST = estuarine habitat

Appendix B

Arsenic Fish Tissue Monitoring data

	SPECIES NAME	Date		Total Arsenic		Inorganic Arsenic
	Screening Value (mg/kg wet)		OEHHA =	1.0	EPA =	1.2
			#/samp.		(4% Tot. As)	(10% Tot. As)
OEHHA data ' 00						
Newport Beach	Barred Surfperch	6/00/2000	10	0.601	**0.024**	**0.060**
Newport Beach	Shiner Surfperch	06/00/2000	10	1.130	**0.045**	**0.113**
Newport Beach	White Croaker	06/00/2000	5	0.778	**0.031**	**0.078**
Newport Beach Pier	Barred Surfperch	06/00/2000	10	0.577	**0.023**	**0.058**
Newport Beach Pier	White Croaker	06/00/2000	5	0.668	**0.027**	**0.067**
Balboa Pier	Barred Surfperch	06/00/2000	3	0.911	**0.036**	**0.091**
Balboa Pier	Diamond Turbot	06/00/2000	4	3.094	**0.124**	**0.309**
Newport Jetty	Black Surfperch	06/00/2000	5	0.774	**0.031**	**0.077**
Newport Jetty	Shiner Surfperch	06/00/2000	10	0.906	**0.036**	**0.091**
Newport Jetty	Spotted Turbot	06/00/2000	5	3.673	**0.147**	**0.367**
Newport Bay/above PCH Br	Shiner Surfperch	06/00/2000	10	0.969	**0.039**	**0.097**
Newport Bay/above PCH Br	Spotted Turbot	06/00/2000	5	1.775	**0.071**	**0.177**
Newport Bay/above PCH Br	Yellowfin Croaker	06/00/2000	4	0.585	**0.023**	**0.059**
Newport Beach	Barred Surfperch	8/4/99	5	0.811	**0.032**	**0.081**
Newport Beach	California Corbina	8/4/99	5	0.449	**0.018**	**0.045**
Newport Beach	Walleye Surfperch	6/22/99	3	0.618	**0.025**	**0.062**
Newport Pier	Barred Surfperch	8/4/99	5	1.06	**0.042**	**0.106**
Newport Pier	California Corbina	8/4/99	5	0.411	**0.016**	**0.041**
Newport Pier	Spotted Turbot	6/16/99	3	2.69	**0.108**	**0.269**
Newport Pier	Yellowfin Croaker	8/4/99	3	0.529	**0.021**	**0.053**
Balboa Pier	Diamond Turbot	6/15/99	5	4	**0.160**	**0.400**
Balboa Pier	Walleye Surfperch	6/9/99	5	0.587	**0.023**	**0.059**
Newport Jetty	Spotted Scorpionfish	5/19/99	5	0.202	**0.008**	**0.020**
Newport Jetty	Spotted Turbot	5/19/99	5	3.12	**0.125**	**0.312**
Newport Bay	Diamond Turbot	5/19/99	5	1.88	**0.075**	**0.188**
Newport Bay	Shiner Surfperch	5/27/99	5	0.672	**0.027**	**0.067**
SCCWRP		**Winter '01**				
barred sand bass	Outer Lower	1	1	0.65	**0.026**	**0.065**
black perch	Outer Upper	1	2	0.53	**0.021**	**0.053**
black perch	Outer Lower	1	3	0.96	**0.038**	**0.096**
black perch	Outer Lower	2	4	0.86	**0.034**	**0.086**
black perch	Outer Lower	3	5	0.69	**0.028**	**0.069**
California halibut	Outer Upper	1	6	0.58	**0.023**	**0.058**
California halibut	Outer Upper	2	7	0.85	**0.034**	**0.085**
California halibut	Outer Upper	3	8	0.47	**0.019**	**0.047**
California halibut	Outer Lower	1	9	0.91	**0.036**	**0.091**
California halibut	Outer Lower	2	10	0.41	**0.016**	**0.041**
C-O sole	Outer Lower	1	11	5.74	**0.230**	**0.574**

C-O sole	Outer Lower	2	12	5.01	**0.200**	**0.501**
diamond turbot	Outer Upper	1	13	1.82	**0.073**	**0.182**
diamond turbot	Outer Upper	2	14	3.89	**0.156**	**0.389**
diamond turbot	Outer Upper	3	15	2.85	**0.114**	**0.285**
diamond turbot	Outer Lower	1	16	4.20	**0.168**	**0.420**
diamond turbot	Outer Lower	2	17	3.45	**0.138**	**0.345**
fantail sole	Outer Lower	1	18	0.97	**0.039**	**0.097**
shiner perch	Outer Upper	1	19	0.67	**0.027**	**0.067**
spotted sand bass	Outer Upper	1	20	0.47	**0.019**	**0.047**
spotted sand bass	Outer Lower	1	21	0.63	**0.025**	**0.063**
spotted turbot	Outer Upper	1	22	3.92	**0.157**	**0.392**
spotted turbot	Outer Lower	1	23	7.28	**0.291**	**0.728**
spotted turbot	Outer Lower	2	24	8.57	**0.343**	**0.857**
spotted turbot	Outer Lower	3	25	5.53	**0.221**	**0.553**
SUMMER 2001						
barred sand bass	Outer Lower	1	13	0.44	**0.018**	**0.044**
black perch	Outer Lower	1	10	0.50	**0.020**	**0.050**
black perch	Outer Lower	2	11	0.40	**0.016**	**0.040**
black perch	Outer Lower	3	12	0.58	**0.023**	**0.058**
California corbina	Outer Lower	1	17	1.24	**0.050**	**0.124**
California corbina	Outer Lower	2	18	1.15	**0.046**	**0.115**
California corbina	Outer Lower	3	19	1.57	**0.063**	**0.157**
California halibut	Outer Lower	1	25	0.52	**0.021**	**0.052**
diamond turbot	Outer Upper	1	20	2.52	**0.101**	**0.252**
diamond turbot	Outer Upper	2	21	2.89	**0.116**	**0.289**
diamond turbot	Outer Lower	1	22	2.12	**0.085**	**0.212**
jacksmelt	Outer Upper	1	1	0.51	**0.020**	**0.051**
jacksmelt	Outer Upper	2	2	0.53	**0.021**	**0.053**
jacksmelt	Outer Upper	3	3	0.58	**0.023**	**0.058**
kelp bass	Outer Lower	1	4	0.49	**0.020**	**0.049**
spotfin croaker	Outer Lower	1	23	0.68	**0.027**	**0.068**
spotfin croaker	Outer Lower	2	24	0.93	**0.037**	**0.093**
spotted sand bass	Outer Lower	1	14	0.22	**0.009**	**0.022**
spotted sand bass	Outer Lower	2	15	0.24	**0.010**	**0.024**
spotted sand bass	Outer Lower	3	16	0.25	**0.010**	**0.025**
yellowfin croaker	Outer Lower	1	5	0.36	**0.014**	**0.036**
yellowfin croaker	Outer Lower	2	6	0.34	**0.014**	**0.034**
yellowfin croaker	Outer Lower	3	7	0.47	**0.019**	**0.047**
yellowfin croaker	Inner Lower	1	8	0.49	**0.020**	**0.049**
yellowfin croaker	Inner Lower	2	9	0.27	**0.011**	**0.027**
TSMP data '95--'98						
Upper NB/Dunes	Brown Sm. Shark (F)	6/10/98	1	8.620	**0.345**	**0.862**
Upper NB/Dunes	Diamond Turbot (F)	6/20/97		1.480	**0.059**	**0.148**
NB/Rhine Channel	Chub Mackerel (F)	7/11/97		0.427	**0.017**	**0.043**
NB/Rhine Channel	Black Croaker (F)	6/18/95		1.200	**0.048**	**0.120**

(Data is for Individual Filet Samples)

saltwater finfish results

count	80		
max	8.62	**0.34**	**0.86**
mean	1.59	**0.06**	**0.08**
median	0.78	**0.03**	**0.08**

				Tot. As	**Inorg. As**
State Mussel Watch	mussels				
Upper Newport Bay					(60% of As Total)
UNB/Mariner's Drive	TCM	1/27/97		1.10	**0.018**
UNB/Mariner's Drive	TCM	3/24/98		1.70	**0.028**
UNB/Mariner's Drive	TCM	NA			
UNB/Mariner's Drive	TCM	2/2/00		0.90	**0.015**
UNB/ PCH Bridge	TCM	1/30/95	NA		
UNB/ PCH Bridge	TCM	1/17/96		1.40	**0.023**
UNB/ PCH Bridge		NA	NA		
UNB/ PCH Bridge	TCM	3/24/98		1.40	**0.023**
UNB/ PCH Bridge	TCM	3/29/99		1.40	**0.023**
UNB/ PCH Bridge	TCM	2/2/00		1.00	**0.017**
Lower Newport Bay					
LNB/Turning Basin	TCM	1/30/95	NA		
LNB/Turning Basin	TCM	1/17/96		1.20	**0.020**
LNB/Turning Basin		na	NA		
LNB/Turning Basin	RBM	3/24/98		0.80	**0.013**
LNB/Turning Basin	TCM	3/29/99		1.30	**0.022**
LNB/Turning Basin	TCM	2/2/00		1.00	**0.017**
LNB/Police Docks	RBM	3/24/98		1.10	**0.018**
LNB/Entrance	TCM	3/29/99		2.50	**0.042**
Rhine Channel					
Rhine Ch./Crows Nest	TCM	1/30/95	NA		
Rhine Ch./Crows Nest	TCM	1/17/96		1.20	**0.020**
Rhine Ch./Crows Nest	TCM	1/27/97		1.20	**0.020**
Rhine Ch./Crows Nest	TCM	3/24/98		1.60	**0.027**
Rhine Ch./Crows Nest	TCM	3/29/99		1.50	**0.025**
Rhine Ch./Crows Nest	TCM	2/2/00		1.10	**0.018**
Rhine Ch./End	TCM	1/30/95	NA		
Rhine Ch./End	TCM	1/17/96		1.30	**0.022**
Rhine Ch./End	TCM	1/27/97		1.30	**0.022**
Rhine Ch./End	TCM	3/24/98		1.40	**0.023**
Rhine Ch./End	TCM	3/29/99		1.30	**0.022**
Rhine Ch./End	TCM	2/2/00		0.90	**0.015**
Rhine Ch./Upper	TCM	2/2/00		1.00	**0.017**

(Data is for Composite Mussel Samples)

Saltwater shellfish results

count	24	
max	2.50	**0.04**
mean	1.28	**0.02**
median	1.25	**0.02**

			Tot. As	Inorg. As	
TSMP data '96--'98				**4%**	**10%**
San Diego Creek					
San Diego Creek/Michelson	Red Shiner	6/9/98	0.344	**0.014**	**0.034**
Peters Canyon Channel	Red Shiner	6/9/98	0.116	**0.005**	**0.012**
San Diego Creek/Barranca	Red Shiner	6/9/98	0.200	**0.008**	**0.020**
Delhi Channel	Striped Mullet	6/9/98	0.882	**0.035**	**0.088**
San Diego Creek/Michelson	Red Shiner	6/19/97	0.134	**0.005**	**0.013**
Peters Canyon Channel	Red Shiner	6/19/97	0.057	**0.002**	**0.006**
Peters Canyon Channel	Red Shiner	6/19/97	0.063	**0.003**	**0.006**
San Diego Creek/Barranca	Red Shiner	6/19/97	0.148	**0.006**	**0.015**
Delhi Channel	Red Shiner	6/18/97	0.085	**0.003**	**0.009**
San Diego Creek/Michelson	Red Shiner	11/6/96	0.06	**0.002**	**0.006**
San Diego Creek/Michelson	Red Shiner	11/6/96	0.07	**0.003**	**0.007**
Peters Canyon Channel	Red Shiner	11/6/96	0.15	**0.006**	**0.015**
San Diego Creek/Michelson	Red Shiner	6/17/95	0.150	**0.006**	**0.015**
San Diego Creek/Michelson	Red Shiner	6/17/95	0.170	**0.007**	**0.017**
Peters Canyon Channel	Red Shiner	6/17/95	0.090	**0.004**	**0.009**

Freshwater finfish results

count	15		
max	0.88	**0.04**	**0.09**
mean	0.18	**0.01**	**0.02**
median	0.13	**0.01**	**0.01**