U.S. Environmental Protection Agency

Region IX

Santa Monica Bay Total Maximum Daily Loads for DDTs and PCBs

Photo: Santa Monica Bay

Approved by:

Alexis Strauss	26 March 2012
Alexis Strauss **Director, Water Division** **EPA Region IX**	**Date**

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Executive Summary

Contamination of DDT and PCBs in the sediments of Santa Monica Bay, largely centered on the Palos Verdes shelf, has led to a large number of fish advisories for much of Santa Monica Bay and a commercial fishing ban in the area around the Palos Verdes shelf. This TMDL addresses the impairment to human health consumption due to DDT and PCBs in Santa Monica Bay. This TMDL includes Santa Monica Bay from Point Dume to Point Vicente and the Palos Verdes shelf from Point Vicente to Point Fermin.

DDT and PCBs were widely used before they were banned in the 1970s and still persist in the environment adhering strongly to soils and sediments. PCBs may also still exist in products made before 1977 such as transformers, old fluorescent lighting fixtures, household caulking, paints and waxes.

The concentrations of DDT and PCBs in the wastewater effluent are currently at or near the detection limits. However from 1947 to 1971 large quantities of DDT were discharged from the Montrose Chemical plant in Los Angeles, which manufactured DDT, to the Los Angeles County Joint Water Pollution Control Plant (JWPCP). PCBs also entered the JWPCP from several industrial sources in the Los Angeles area. The concentrations of DDT and PCBs in surface sediments have decreased substantially since the early 1970s as much of the contamination has been carried away by currents, buried below the active sediment layer or degraded as a result of natural processes. Despite the decreasing trend, the concentrations of DDT and PCBs in surface sediments today are at levels that can still accumulate in fish tissues at levels of concern for safe human health consumption. There is also evidence that the rate of erosion on the southwest portion of the shelf will bring previously buried deposits to the surface. The Palos Verdes shelf is an active EPA Superfund site.

The sediment concentrations of DDT and PCBs in the rest of Santa Monica Bay are much lower than those on the Palos Verdes shelf. They may however still be contributing to elevated DDT and PCBs in fish tissue. Potential sources include transport of contaminants from the Palos Verdes shelf, discharge from the Hyperion Treatment Plant and stormwater. The current loadings from these sources are small relative to the estimated total mass in the sediments and small relative to the losses of DDT and PCBs due to burial in the sediment and natural decay.

The TMDL sets targets for water quality and sediment contaminant concentration to meet fish tissue concentration targets that would allow safe human fish consumption. The targets for the Palos Verdes shelf (Table ES-1) are based on Superfund remedial action objectives (RAOs). The TMDL incorporates EPA's Superfund actions on the Palos Verdes shelf which were identified in the interim record of decision. The Superfund actions include institutional controls, natural recovery and monitored attenuation, and capping the most contaminated area of the Palos Verdes shelf. The capping project is scheduled for the fall of 2013. The time for attainment of the RAOs for the Palos Verdes shelf is 22 years for DDT and 22 to 30 years for PCBs.

In the rest of Santa Monica Bay, much lower targets can be achieved. The targets for sediment and fish tissue are an order of magnitude lower than the Superfund objectives. Waste load allocations are provided for major dischargers to the Bay. Stormwater loadings are capped at existing levels. The TMDL includes recommendations for monitoring and implementing the

TMDL. The time for attainment of the TMDL targets for the rest of Santa Monica Bay is 11 years for DDT and 22 years for PCBs.

Table ES-1. Numeric targets for sediment and tissue in Santa Monica Bay

TMDL target for Santa Monica Bay (Point Vicente to Point Dume)	**Total DDTs**	**Total PCBs**
Water column (based on California Ocean Plan objective)	0.17 ng/l	0.019ng/l
Fish tissue (based on a consumption rate of 116 g/d and exposure risk of 10^{-5})	40 ng/g	7 ng/g
Sediment to meet target (normalized for organic carbon)	2.3 ug/g OC	0.7 ug/g OC
Superfund Interim Remedial Action Objectives for Palos Verdes Shelf (Point Fermin to Point Vicente)	**Total DDTs**	**Total PCBs**
Water column objective (equal to the USEPA human health criteria)	0.22 ng/l	0.064 ng/l
Fish tissue objective for white croaker (116 g/d and an exposure risk of 10^{-4})	400 ng/g	70 ng/g
Sediment to meet fish tissue objective (normalized for organic carbon)	23 ug/g OC	7 ug/g OC

1 INTRODUCTION

This report presents the required elements of the Total Maximum Daily Load (TMDL) for DDT and PCBs for Santa Monica Bay and summarizes the technical analyses performed by the United States Environmental Protection Agency, Region 9 (USEPA). This TMDL complies with 40 CFR 130.2 and 130.7, Section 303(d) of the CWA and USEPA guidance for developing TMDLs in California (USEPA, 2000a). This document summarizes the information used by the USEPA to develop TMDLs for toxic pollutants in the sediments of Santa Monica Bay.

1.1 REGULATORY BACKGROUND

Section 303(d) of the CWA requires that each State "shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality objective 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 TMDLs for such waters.

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 the USEPA guidance (USEPA, 2000a). 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 waterbody to assimilate pollutant loads (the loading capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (40 CFR 130.7).

States must develop water quality management plans to implement the TMDL (40 CFR 130.6). The USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the State Water Resources Control Board (State Board) and the nine Regional Water Quality Control Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If USEPA disapproves a TMDL submitted by a state, USEPA is required to establish a TMDL for that waterbody. The Regional Boards also hold regulatory authority for many of the instruments used to implement the TMDLs, such as the National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

As part of its 1996 and 1998 Water Quality Assessments, the Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWQCB, 1996, 1998). These are referred to as "listed" or "303(d) listed" waterbodies or waterbody segments. A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree approved on March 22, 1999 (Heal the Bay Inc., et al. v. Browner, et al. C 98-4825 SBA). For the purpose of scheduling TMDL development, the consent decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units. Analytical Unit 58 addresses the impairments in Santa Monica Bay associated with PCBs and DDTs (Table 1-1).

Table 1-1. 1998 303(d) List of impairments identified in the Consent Decree for Santa Monica Bay (AU 58)

Waterbody	DDT	PCBs	Other
Santa Monica Bay Nearshore and Offshore Zone	X	X	PAH, Sediment Toxicity, Fish Consumption Advisory
Nicholas Canyon Beach	X	X	
Paradise Beach	X	X	
Robert H. Meyer Memorial Beach	X	X	
Point Dume Beach	X	X	
Sea Level Beach	X	X	
White's Point Beach	X	X	
Trancas Beach (Broad Beach)	X	X	
Topanga Beach	X	X	
Royal Palms Beach	X	X	
Redondo Beach	X	X	
Puerco Beach	X	X	
Portugues Bend Beach	X	X	
Amarillo Beach	X	X	
Zuma (Westward Beach)	X	X	
Malibu Lagoon Beach (Surfrider)	X	X	
La Costa Beach	X	X	
Big Rock Beach	X	X	
Cabrillo Beach (Outer)	X	X	
Carbon Beach	X	X	
Castlerock Beach	X	X	
Escondido Beacn	X	X	
Flat Rock Point Beach Area	X	X	
Inspiration Point Beach	X	X	
Las Tunas Beach	X	X	
Abalone Cove Beach	X	X	
Malaga Cover Beach	X	X	
Las Flores Beach	X	X	
Long Point Beach	X	X	
Malibu Beach	X		
Palos Verdes Shoreline Point Beach			Pesticides

Paragraph 8 of the consent decree provides that TMDLs need not be completed for specific waterbody pollutant combinations if the State or USEPA determines that TMDLs are not needed for these combinations, consistent with the requirements of Section 303(d). The consent decree provides that this determination may be made either through a formal decision to remove a combination from the State Section 303(d) list or through a separate determination that the specific TMDLs are not needed. Paragraph 9 of the consent decree describes procedures for giving notice that TMDLs are not needed.

The State Board removed the listings for PAHs and the pesticide chlordane (AU 53) in the 2006 list. The list was approved by EPA on June 28, 2007. Palos Verdes Shoreline Point Beach pesticides listing in the consent decree is a clerical error and should reflect DDT and PCBs and fish advisory. The 1996 Water Quality Assessment and documentation clearly identified Palos Verdes Shoreline Park Beach as being impaired due to advisories (PCBs, DDTs). This was reflected in the 1996 305(b) report but not the 1996 303(d) report. The omission of this waterbody from the 303(d) report was rectified in the 1998 report but due to a clerical error the listing was renamed pesticides even though the underlying basis of the listing was clearly the DDT and PCBs fish advisory. In fact all the beach listings for DDT and PCBs under AU 58 were based solely on the fish advisories for Santa Monica Bay.

USEPA has determined that a TMDL is not required for the Santa Monica Bay sediment toxicity listing. This determination is based on lack of toxicity in regional surveys (1994, 1998, 2003, 2008). The basis for this finding is described more fully in Section 2.2.4 of this report.

This TMDL addresses the impairments to human health associated with consumption and aquatic life associated with DDT and PCBs in Santa Monica Bay from the Ventura County line to Point Fermin. EPA is establishing these TMDLs at the request of the Regional Board and in order to meet its obligations under the consent decree.

1.2 ENVIRONMENTAL SETTING

Santa Monica Bay (Figure 1) is comprised of different geological substrate types within nearshore and offshore areas: rocky intertidal, soft bottom, and hard bottom.

Rocky intertidal areas and areas of mixed rocky and sandy shoreline cover approximately 30% or 20 miles (32 km) of the Bay's coastline. Exposed bedrock forms the rocky intertidal from the Ventura County line to Pulga Canyon in Malibu and from Malaga Cove to Point Fermin on the Palos Verdes shelf (MBC Applied Environmental Sciences 1993). Artificial rocky intertidal areas (e.g.,jetties, breakwater, rip rap) exist in Marina del Rey, the mouth of Ballona Creek, and King Harbor (MBC Applied Environmental Sciences 1988).

Unconsolidated, soft sediment, generally with the composition of sand, silt, and clay, makes up most of the Bay's seafloor. Silty sand is found over the central plateau and the Palos Verdes Shelf. The soft-bottom in Santa Monica Bay ranges in depth from the mean lower low water line (MLLW) to deeper than 500 meters in the outer portions of the bay and the submarine canyons (Robbins, 2006).

Hard bottom environments in Santa Monica Bay include the shallow kelp-covered areas adjacent to rocky headlands, submarine canyon walls, and the deep-water plateau called Short Bank. A large gravel bed surrounds the rocky outcrops of Short Bank. Additionally, man-made features such as wastewater treatment plant outfall pipes, artificial reefs, and breakwaters are part of the hard bottom. (MBC Applied Environmental Sciences, 1993).

Kelp beds extend in the low relief, hard bottom habitat from the seafloor to the surface, creating a vertically structured habitat. Kelp beds provide protection and habitat for more than 800 species of fishes and invertebrates, many of which are uniquely adapted for life in kelp forests. Because most established kelp beds occur over hard bottom substrate, giant kelp beds in Santa Monica Bay are limited to two areas, the Palos Verdes Shelf and the area from Malibu west to Point Dume. Kelp beds grow on hard bottoms at depths ranging from 8 to 18 meters (Allen, 1985).

Pelagic, or open water, habitat is the most extensive of any of the coastal and marine habitats in the Bay. The pelagic habitat is from the sea surface to the ocean bottom, and is free from direct influence of the shore or ocean bottom.

Santa Monica Bay's sandy beaches are heavily used as a recreational resource by residents of Los Angeles and Ventura Counties, and visitors from around the world. Bay beaches attract, on average, 50-60 million visitors per year and generate significant revenue for the local economy.

Figure 1. Santa Monica Bay modified from Santa Monica Bay 2010 State of the Bay Report

1.3 ORGANIZATION OF THIS DOCUMENT

Guidance from USEPA (1991) identifies seven elements of a TMDL. Sections 2 through 6 of this document present the analysis and findings for those elements. The required elements are as follows:

- **Section 2: Problem Identification.** This section presents the data used to add the waterbody to the 303(d) list, and summarizes existing conditions using that evidence along with any new information acquired since the listing. This element identifies those waterbodies that fail to support all designated beneficial uses; the beneficial uses that are not supported for each waterbody; the water quality objectives (WQOs) designed to protect those beneficial uses; and, in summary, the evidence supporting the decision to list the waterbodies. This section also identifies the listed waterbodies and pollutants where available data indicate water quality standards are now being achieved and for which TMDL development is not needed.
- **Section 3: Numeric Targets.** This section identifies the numeric targets established for the TMDLs and representing attainment of WQOs and beneficial uses.
- **Section 4: Source Assessment.** This section identifies the potential point sources and

nonpoint sources of DDT and PCBs to Santa Monica Bay.

- **Section 5: Linkage Analysis.** This section provides an analysis of the relationship between sources and the receiving water quality impairment**.**
- **Section 6: TMDL and Pollutant Allocations.** This section presents the pollutant loading capacity (i.e., assimilative capacity) and associated TMDL for each pollutant are identified. Each identifiable source is allocated a quantitative load or waste load allocations for the listed pollutants, representing the load that it can discharge while still ensuring that the receiving water meets the WQOs. Allocations are designed to protect the waterbody from conditions that exceed the applicable numeric target. The allocations are based on critical conditions to ensure protection of the waterbody under all conditions.
- **Section 7 Monitoring Recommendations.** This section describes the recommended monitoring to ensure that the WQOs are attained. If the monitoring results demonstrate the TMDL has not resulted in attainment of WQOs, then revised allocations may need to be developed. It also describes special studies to address uncertainties in assumptions made in the development of this TMDL and the process by which new information may be used to refine the TMDL.
- **Section 8: Implementation Recommendations.** This section describes the plans, regulatory tools, or other mechanisms by which the waste load allocations and load allocations may be achieved. The Regional Board has responsibility to implement these TMDLs and incorporate them into permits.

2 PROBLEM IDENTIFICATION

This TMDL addresses the impairments to human health consumption due to DDT and PCBs in Santa Monica Bay from the Ventura County line to Point Fermin. The 1996 WQA description of impairments in the nearshore and offshore areas of Santa Monica Bay included the areas around the Hyperion 5-mile and 7-mile outfall area, the Joint Water Pollution Control Plant outfall area, Palos Verdes shelf, Marina del Rey area, Santa Monica Pier area, Manhattan Beach area, Redondo Pier area, Malibu Pier area, Short Bank, Point Dume area, Malibu area, Point Vicente area, Palos Verdes-NW and and White’s Point. The WQA also named the 29 beaches in the consent decree (Table 1-1).

Impairments associated with DDT and PCBs are primarily related to DDT and PCBs on the Palos Verdes Shelf. Between 1937 and the 1980s approximately 110 tons of DDT and 10 tons of PCBs were deposited on the shelf. Most of the material was released into the sewer system and deposited on the shelf through the Los Angeles County Sanitations Districts’ (LACSD)White’s Point outfall. The State of California issued its first interim seafood consumption warnings in 1985. In 1989 the State legislature implemented a commercial fishing ban which states:

It is unlawful to take white croaker under a commercial fishing license issued pursuant to section 7850 of the Fish and Game Code, in waters from 0 to 3 nautical miles from shore extending oceanward between a line extending 312 degrees magnetic from Point Vicente in Los Angeles County, and a line extending 166 degrees magnetic from Point Fermin in Los Angeles County. Pursuant to section 7715 of the Fish and Game Code, the provisions of this section shall become inoperative when the Director of the Department of Health Services determines that a health risk no longer exists and the Director of the Department of Fish and Game has been so notified. The Department shall fully notify the public of the reopening of these waters.

In 1991 the Office of Environmental Health Hazard Assessment (OEHHA) finalized its seafood consumption advisory for Santa Monica Bay (summarized in Table 2-1 below). The 1996 WQA identifies the same fish species and waterbody combinations as in the 1991 final seafood consumption advisory.

Table 2-1. OEHHA 1991 Fish Consumption Advisories for Santa Monica Bay

Site	Fish Species	Recommendation
Point Dume (Malibu off-shore)	White Croaker	Do not consume
Malibu Pier	Queenfish	One meal a month
Short Bank	White Croaker	One meal every two weeks
Redondo Pier	Corbina	One meal every two weeks
Point Vicente Palos Verdes-Northwest	White Croaker	Do not consume
White’s Point	White croaker, California Scorpionfish, Rockfishes, Kelp bass	Do not consume

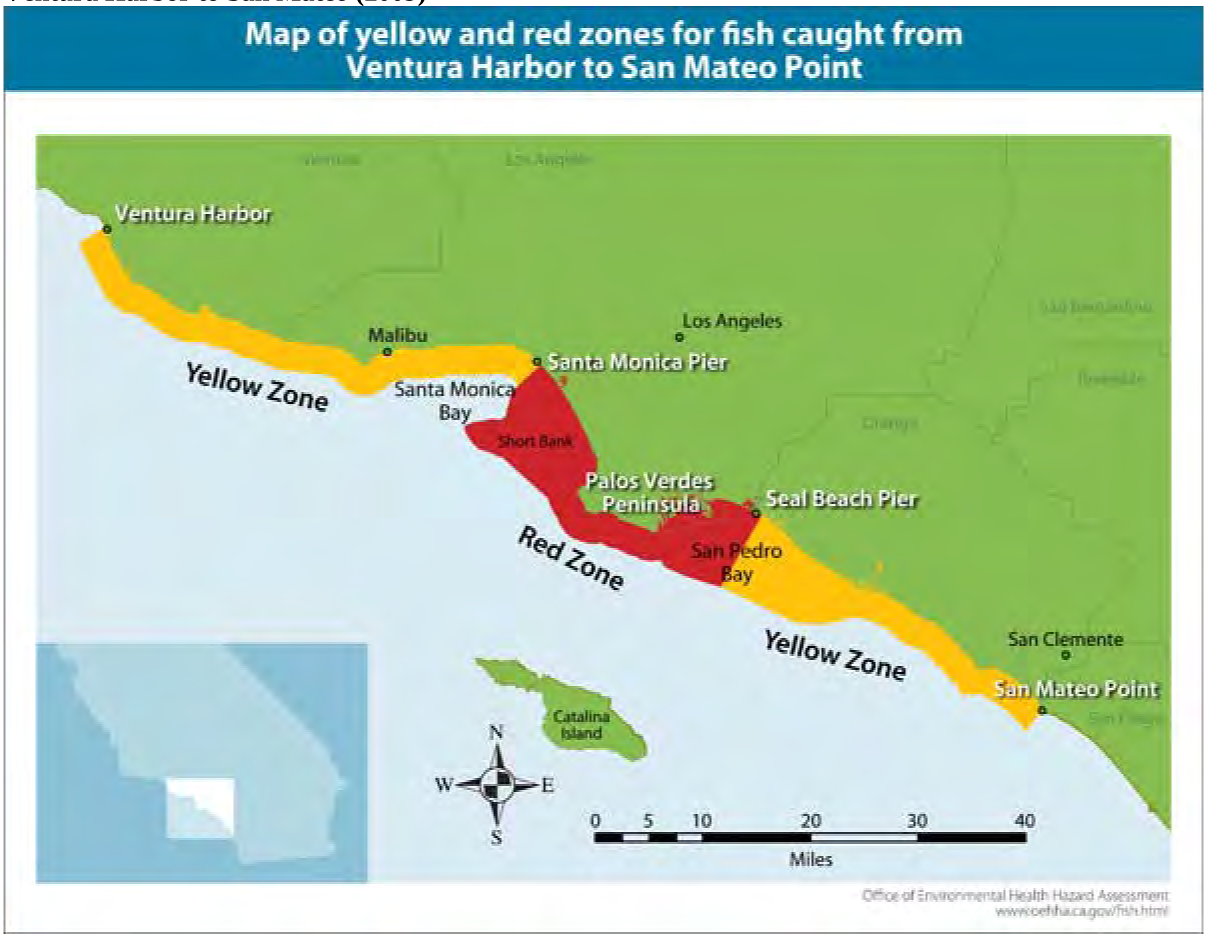
EPA added Montrose to the Superfund National Priorities list in 1989 and began its investigation and evaluation of DDT and PCB contaminated sediments of the Palos Verdes Peninsula in 1996.

In 2009 OEHHA updated the regional consumption advisory for the areas of Southern California from Ventura Harbor to San Mateo Point. The 2009 update provides information on a greater number of species and provides consumption advice based on the number of eight-ounce servings per week (See Table 2-2). The OEHHA warns that consumption advice should not be combined. The red zone in Figure 2-1 is for the areas between Santa Monica Pier and the Seal Beach Pier. The yellow zone applies to the areas north of the Santa Monica Pier to Ventura Harbor and the areas south of the Seal Beach Pier to San Mateo Point.

Table 2-2. Summary of existing fish advisories the numbers in the table reflect the recommended consumption limits for the number of 8 oz servings per week for each species. For details see OEHHA, 2009.

Species Name	Red Zone		Yellow Zone	
	Children (1-17 years) and Women (18-45)	Men (>17 years) and Women (>45 years)	Children (1-17 years) and Women (18-45)	Men (>17 years) and Women (>45 years)
Barracuda	0	1	0	1
Black croaker	0	1	0	1
Barred sandbass	0	0	1	2
California scorpionfish	1	1	1	1
Kelp bass	1	1	1	1
Sardines	1	1	1	1
Sargo	1	1	1	1
White croaker	0	0	1	2
Topsmelt	0	0	2	2
California halibut	1	2	1	2
Rockfishes	1	2	1	2
Shovelnose guitarfish	1	2	1	2
Corbina	2	2	2	2
Opaleye	2	2	2	2
Queenfish	2	2	2	2
Surfperches	2	2	2	2
Yellowfin croaker	2	2	2	2
Pacific chub mackerel	2	4	2	4
Jacksmelt	4	7	4	7

Figure 2-1. Health advisory and safe eating guidelines for fish from coastal areas of Southern California: Ventura Harbor to San Mateo (2009)



2.1 WATER QUALITY STANDARDS

California state water quality standards consist of the following elements: 1) beneficial uses; 2) narrative and/or numeric water quality objectives (WQOs); and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Boards in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each Regional Board's Basin Plan. The objectives are set to be protective of the beneficial uses in each waterbody in the region and/or to protect against degradation. Numeric objectives for toxics can be found in the California Toxics Rule (40 CFR §131.38). The California Ocean Plan (COP, 2005) also defines beneficial uses and objectives that are applicable to Santa Monica Bay.

Beneficial Uses

The Basin Plan for the Los Angeles Regional Board defines several beneficial uses for the coastal waters of Santa Monica Bay (Table 2-3). These include industrial service supply (IND), navigation (NAV), water contact recreation (REC-1), non-contact water recreation (REC-2), commercial and sport fishing (COMM), estuarine habitat (EST), marine habitat (MAR), preservation of biological habitats (BIOL), migration of aquatic organisms (MIGR), wildlife habitat (WILD), rare, threatened, or endangered species (RARE), spawning, reproduction, and or early development (SPWN), shellfish harvesting (SHELL), and wetland habitat (WET)..

Table 2-3. Beneficial uses of selected waters within Santa Monica Bay (LARWQCB, 1994). The waterbodies identified in AU 58 are in bold.

Los Angeles Coastal	**Hydro Unit #**	**IND**	**NAV**	**REC1**	**REC2**	**COMM**	**MAR**	**WILD**	**BIOL**	**RARE**	**MIGR**	**SPWN**	**SHELL**
Los Angeles Coastal		E	E										
Nearshore		E	E	E	E	E	E	E	Ean	Ee	Ef	Ef	Ear
Offshore		E	E	E	E	E	E	E		Ee	Ef	Ef	E
Nicholas Canyon Beach	404.43		E	E	E	E	E	E				P	E
Trancas Beach	404.37		E				E	E				P	E
Zuma (Westward Beach)	404.36		E	E	E	E	E	E				P	Ear
Dume State Beach	404.36		E	E	E	E	E	E				P	E
Escondido Beach	404.34		E	E	E	E	E	E				P	E
Dan Blocker Memorial (Corral) Beach	404.31		E	E	E	E	E	E				P	E
Puerco Beach	404031		E	E	E	E	E	E				P	E
Amarillo Beach	404.21		E	E	E	E	E	E				P	E
Malibu Beach	404.21		E	E	E	E	E	E			E	Eas	Ear
Carbon Beach	404.16		E	E	E	E	E	E				P	E
La Costa Beach	404.16		E	E	E	E	E	E				P	E
Las Flores Beach	404.15		E	E	E	E	E	E				P	E
Las Tunas Beach	404.12		E	E	E	E	E	E				P	E
Topanga Beach	404.11		E	E	E	E	E	E				P	E
Will Rogers State Beach	405.13		E	E	E	E	E	E				P	E
Santa Monica Beach	405.13		E	E	E	E	E	E			E	Eas	E
Venice Beach	405.13		E	E	E	E	E	E		E	E	Eas	E
Dockweiler Beach	405.12	E	E	E	E	E	E	E				P	
Manhattan Beach	405.12		E	E	E	E	E	E				P	E
Hermosa Beach	405.12		E	E	E	E	E	E				Eas	E
Redondo Beach	405.12	E	E	E	E	E	E	E		E	E	Eas	E
Torrance Beach	405.12		E	E	E	E	E	E			E	Eas	E
Point Vicente Beach	405.11		E	E	E	E	E	E				P	E
Royal Palms Beach	405.11		E	E	E	E	E	E				P	E
White's Point County Beach			E	E	E	E	E	E				P	E
Cabrillo Beach			E	E	E	E	E	E			E	Eas	E

Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.
E: Existing beneficial use. P: Potential beneficial use
e: One or more rare species utilize all oceans, bays, estuaries, and wetlands for foraging and/or nesting.
f: Aquatic organisms utilize all bays, estuaries, lagoons, and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas that are heavily influenced by freshwater inputs.
An: Areas of Special Biological Significance (along coast from Latigo Point to Laguna Point) and Big Sycamore Canyon and Abalone Cove Ecological Reserves and Point Fermin Marine Life Refuge.
ar: Areas exhibiting large shellfish populations include Malibu, Point Dume, Point Fermin, White's Point and Zuma Beach
as: Most frequently used grunion spawning beaches. Other beaches may be uses as well

Water Quality Objectives (WQOs)

The water quality objectives applicable to Santa Monica Bay are in the California Ocean Plan (COP). The applicable narrative objectives in the COP include the following

> *Marine communities, including vertebrate, invertebrate, and plant species, shall not be degraded.*
>
> *The concentrations of organic materials in marine sediments shall not be increased to levels which would degrade indigenous biota.*
>
> *The concentrations of substances set forth in Chapter II, Table B, in marine sediments shall not be significantly increased to levels which would degrade indigenous biota.*
>
> *The concentration of organic materials in fish, shellfish or other marine resources used for human consumption shall not bioaccumulate to levels that are harmful to human health.*

Chapter II, Table B of the COP identifies numeric water quality criteria for a number of chemical constituents including DDT and PCBs. The human health criteria are established to protect the general population from priority toxic pollutants regulated as carcinogens (cancer-causing substances) and are based on an assumed human consumption rate of fish and shellfish. The COP criteria for DDT and PCBs are lower than the EPA National recommended criteria (See Table 2-4)

Table 2-4. Water quality objectives related to DDTs and PCBs (all units expressed as ng/l)

Pollutant	Table B COP Objectives for the Protection of Human Health	EPA Criteria for the Protection of Human Health Organisms only	CTR Objectives for the Protection of Human Health Organisms only [3]	CTR Criteria for the Protection of Aquatic Life (Saltwater)	
				Acute	Chronic
4,4'-DDT[1]	---	0.22	0.59	130	1
4'4'-DDE	---	0.22	0.59	---	---
4'4'-DDD	---	0.31	0.84	---	---
Total DDTs	0.17	---	---	---	---
Total PCBs[2]	0.019	0.064	0.17	---	30

1 Based on a single isomer (4,4'-DDT).
2 Based on total PCBs, the sum of all congener or isomer or homolog or arochlor analyses.
3 Difference in human health numbers between EPA criteria and the CTR objectives are based on EPA updates after CTR was promulgated which changed the consumption rate from 6.5 to 17.5 oz per day.

Although not directly applicable to Santa Monica Bay, the requirements of the Basin Plan are applicable to the watershed draining to Santa Monica Bay and the Basin Plan objectives can be used to regulate sources to Santa Monica Bay. The following Basin Plan narrative water quality objectives are the most pertinent to this TMDL. These narrative WQOs apply to both the water column and the sediments.

> Chemical Constituents: *Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use.*
>
> Bioaccumulation: *Toxic pollutants shall not be present at levels that will bioaccumulate*

in aquatic life to levels, which are harmful to aquatic life or human health.

> Pesticides: *No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life*.

> Toxicity: *All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.*

The Regional Board's narrative toxicity objective reflects and implements national policy set by Congress. The Clean Water Act states that, "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited." (33 U.S.C. 1251(a)(3).)

For PCBs, the Basin Plan states that, "*Pass-through or uncontrollable discharges to waters of the Region, or at locations where the waste can subsequently reach waters of the Region, are limited to 70 picograms per liter (pg/L) measured as a 30 day average for protection of human health and 14 nanograms per liter (ng/L) measured as a daily average and 30 ng/L measured as a daily average to protect aquatic life in inland fresh water and estuarine waters, respectively*."

There are no numeric objectives for the accumulation of toxics in fish tissue in either the COP or the Basin Plan. The narrative objectives relating to bioaccumulation in the COP and the Basin Plan were described above.

There are no water quality objectives for sediment in the COP or the Basin Plan. The State Board developed sediment quality objectives (SQOs) for enclosed bays and estuaries in 2008, but these do not apply to the coastal waters of Santa Monica Bay.

Antidegradation

State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Water" in California, known as the "Antidegradation Policy," protects surface and ground waters from degradation. Any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the state, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the federal Antidegradation Policy (40 CFR 131.12).

2.2 WATER QUALITY DATA REVIEW

This section summarizes the data for Santa Monica for the listed toxic pollutants in water, fish and sediments. The summary includes data considered by the Regional Board and USEPA in developing the 1998 and 2002 303(d) lists as well as subsequent data.

The Santa Monica Bay listings in 1996 were based on the 1996 Water Quality Assessment & Documentation. These assessments were based primarily on literature. "*Due to lack of staff resources at this time, the assessment of nearshore areas, open bays, estuaries and ocean areas* *is mostly limited to the review of published reports. Fish consumption advisories and some bioaccumulation data are also used*" (LARWQCB, 1996).

The tissue data described in the 1996 WQA was primarily from the State Mussel Watch Program, the Bay Protection and Toxic Cleanup Program, the Toxic Substances Monitoring Program, California Department of Fish and Game Sport California Fishing Regulations 1994-1996 and the Santa Monica Bay Restoration Project State of the Bay 1993 Characterization Report and references therein.

Water Column Data

Prior to 1999, there were no data for DDT or PCB concentrations in the water column for Santa Monica Bay. Zeng et al. (1999) provided information on the concentration of DDT and PCBs in the water column off the Palos Verdes shelf (summarized in Table 2-5). The concentrations of DDT ranged from 0.6 to 15.8 ng/l. The concentrations of PCBs ranged from 0.06 to 1.14 ng/l. Concentrations were lowest near the surface and higher 1 meter off the sediment floor. Zeng concluded that the sediments were a source of DDTs and PCBs to the water column. The highest bottom water concentrations were at station 6C and lower concentrations were in the northwest portion of the shelf (Station 0). All the concentrations of near bottom waters reported by Zeng exceed California Ocean Plan (COP) standards for DDT and PCBs.

Table 2-5. Concentrations in bottom waters 1 m off the Palos Verdes shelf floor. Modified from Zeng, 1999.

LACSD Stations	Total DDE Winter	Total DDE Summer	Total PCB Winter	Total PCBs Summer
0C	2.2 ng/l	4.4 ng/l	0.14 ng/l	0.41 ng/l
3C	4.5ng/l	7.6ng/l	0.28 ng/l	0.94 ng/l
5C	9.2 ng/l	10.4 ng/l	0.51 ng/l	1.14 ng/l
6C	14.5 ng/l	8.7 ng/l	0.88 ng/l	0.84 ng/l
7C	9.9 ng/l	5.5 ng/l	0.65 ng/l	0.56 ng/l
9C	5.3 ng/l	5.0 ng/l	0.31 ng/l	0.30 ng/l

Zeng et al. (2005) provided data indicating that the bottom waters of Santa Monica Bay also exceeded the COP objective for DDT. Zeng's estimates of DDE and DDD in bottom waters were 0.54 and 0.051 ng/l, respectively. In contrast, the average surface water concentrations of DDE and DDD were 0.017 and <0.043 ng/l which are below the COP objective. PCB concentrations in the water column were not reported in this paper.

Sabin et al. (2011) measured DDT and PCB in near bottom waters of Ballona Creek Estuary. In that study the average DDT concentration was 0.18 ng/l, which is slightly higher than the COP objective but lower than the CTR objective. The average PCB concentration of 0.21 ng/l was higher than both the COP and CTR objectives. For comparison, the concentrations of DDT measured in Los Angeles Harbor during this study ranged from 0.42 to 0.57 ng/l. The concentrations of PCBs in LA Harbor ranged 0.41 to 0.70 ng/l. The DDT and PCB concentrations from LA Harbor are more than twice those in the Ballona Creek Estuary.

Fish Tissue Data

Concentrations of PCBs and DDTs in fish tissue have decreased substantially since the mid 1990s when the original listings were made. OEHHA in its update of the fish advisories used data primarily from the 2002-2004 Southern California Coastal Marine Fish Contaminants Survey (USEPA/NOAA, 2007), but also included some data collected by the Los Angeles County Sanitation District (LACSD) and from the Coastal Fish Contamination Program (CFCP) of the State Water Resources Control Board.

In the USEPA/NOAA study, fish were collected along the southern California coastline from just north of Ventura Harbor to San Mateo Point. Total DDT and total PCBs (calculated as the sum of 45 congeners) were generally analyzed as individual skinless fillets on all species. The exceptions were Pacific sardines, jacksmelt, and topsmelt which were analyzed as whole fish (including viscera). The data from this report are summarized in Tables 2-6 for DDT and 2-7 for PCBs. The results have been color coded to the OEHHA thresholds which are discussed in more detail in Section 3. In brief the green cells are for fish with tissue contaminant concentrations below the OEHHA Fish Contamination Goals (FCG). The unhighlighted cells are for fish with tissue concentrations above the FCG but where up to three 8-oz servings a week may be safely consumed. The yellow cells are for fish where no more than two 8-oz servings per week are recommended. The orange is for fish where no more than one 8-oz serving per week is recommended. The red cells are for fish with tissue contaminant concentrations so high that no consumption is recommended.

The highest DDT concentrations in fish tissue were from fish at or near the Palos Verdes shelf and the LA Long Beach Harbor. The species with the highest concentrations were white croaker, barred sandbass, California scorpionfish and California sheephead. Fish tissue concentrations in the rest of Santa Monica Bay tended to have much lower concentrations. Most of the fish were in the range where OEHHA would recommend up to three 8-oz servings per week. These findings are consistent with a more recent study of fish contamination in the Southern California Bight (Davis et al., 2011).

The presence of PCBs in fish tissue at concentrations of concern in Santa Monica Bay is more widespread. Similar to DDT, the fish with the highest concentrations of PCBs were near the Palos Verdes shelf and Long Beach. However a greater number of fish species exceeded ATLs for PCBs than for DDTs and fish with high concentrations of PCBs were observed farther away in both directions. To the north, fish with high PCB concentrations were observed throughout Santa Monica Bay. To the south, fish with high PCB concentrations were observed in San Pedro Bay. These findings are consistent with more recent studies of fish contamination in the Southern California Bight (Davis et al., 2011).

Table 2-6. DDT concentrations in fish tissue (ng/g ww) from USEPA/NOAA (2003)

Location (Segment #)	Barred sandbass	Black croaker	California corbina	California halibut	California scorpionfish	California sheephead	Jacksmelt	Kelp bass	Opaleye	Pacific barracuda	Pacific mackerel	Pacific sardine	Queenfish	Rockfishes	Sargo	Surfperches-BF	Surfperches-WCF	Shovelnose guitarfish	Topsmelt	White croaker	White seabass	Yellowfin croaker
Ventura Emma Wood to San Buenaventura (1)																				84		
Point Dume to Malibu Bluff (2)	34							35			58		84	40	66	15				110		
Malibu Bluff to Las Flores (3)													79							101		
Los Flores to Santa Monica Beach (4)													51							98		
Santa Monica Beach to El Segundo (5)				55	197				1							156			310	129		36
Short Bank (23)					352															230		
El Segundo to Manhattan Beach (6)					722															200		
North of Redondo Canyon (EPA F)																				204		
Manhattan Beach to Redondo Beach (8)	99	74	16					101	3			262	22		211	89	61			283		
Redondo Beach to Flat Rock Pt (9).	65						10		0			262				51			198		65	
Flat Rock Pt. to Palos Verdes Pt (11).	364																					
South of Redondo Canyon (EPA E)																				992		
Long Point to Bunker Point (12)	487				321									285						1828		
Bunker Point to Point Fermin (13-14)	1541	127			833			249	2		29			207		173				742		
5 mile offshore of breakwater (EPA B)																				1130		
Breakwater Oceanside (15)	583				245	609		200	3			145	97	193	52	187	69			3176		
EPA C 7 miles southeast of Pt Fermin (EPA C)																				440		
Horseshoe Kelp (24)					56			151		100										2516		
Outside of Middle Breakwater (EPA A)	370	35						497					94			124				203		
Outer San Pedro Bay (EPA D)																				175		
Breakwater Harbor Side (16)	118		96	89	47		42	208				145	90			71	89	44	151	439		
Inside of Middle Breakwater (EPA A)		48																				
Pier J to Fingers Pier at Shoreline Park (17)	293			165				332	2				55			35	38	68		73		
Belmont Pier/Seaport Village (18)			54										16		64	94		59		126		24
Seal Beach Alamitos to Anaheim Bay (19)	51				49			184	1							77	68			93		53
Sunset Beach to Huntington Beach (20)	124							315												104		
Huntington Beach to Pelican PointDana Point (21)			50																	88		
Dana Point: Mussel Cove to Doheny Beach (22)											70									159		
Southern Orange County (25)										85												

Table 2-7. PCB concentrations in fish tissue (ng/g ww) from USEPA/NOAA (2003)

Location (Segment #)	Barred sandbass	Black croaker	California corbina	California halibut	California scorpionfish	California sheephead	Jacksmelt	Kelp bass	Opaleye	Pacific barracuda	Pacific mackerel	Pacific sardine	Queenfish	Rockfishes	Sargo	Shovelnose guitarfish	Surfperches-BF	Surfperches-WCF	Topsmelt	White croaker	White seabass	Yellowfin croaker
Ventura Emma Wood to San Buenaventura (1)																				22		
Point Dume to Malibu Bluff (2)	9							10			18		18	12	25		4			32		
Malibu Bluff to Las Flores (3)													29							40		
Los Flores to Santa Monica Beach (4)													17							40		
Santa Monica Beach to El Segundo (5)				13	51				61								76		215	182		42
Short Bank (23)					116															95		
El Segundo to Manhattan Beach (6)					126															60		
North of Redondo Canyon (EPA F)																				43		
Manhattan Beach to Redondo Beach (8)	27	29	12					23	25			93	6		114		32	24		74		
Redondo Beach to Flat Rock Pt (9).	20						2		5			93					8		36		13	
Flat Rock Pt. to Palos Verdes Pt (11).	45																					
South of Redondo Canyon (EPA E)																				120		
Long Point to Bunker Point (12)	62				44									32						200		
Bunker Point to Point Fermin (13-14)	158	22			85			40	17		9			28			22			91		
5 mile offshore of breakwater (EPA B)																				136		
Breakwater Oceanside (15)	73				27	68		41	88			41	15	56	41		27	12		347		
EPA C 7 miles southeast of Pt Fermin (EPA C)																				51		
Horseshoe Kelp (24)					17			37		54										228		
Outside of Middle Breakwater (EPA A)	92	13						83					33				35			29		
Outer San Pedro Bay (EPA D)																				32		
Breakwater Harbor Side (16)	40		44	16	11		8	70				41	33			19	33	34	86	103		
Inside of Middle Breakwater (EPA A)		21																				
Pier J to Fingers Pier at Shoreline Park (17)	116			61				126	10				35			53	19	51		108		
Belmont Pier/Seaport Village (18)			37										13		50	39	74			106		16
Seal Beach Alamitos to Anaheim Bay (19)	23				33			101	3								51	29		43		29
Sunset Beach to Huntington Beach (20)	80							100												41		
Huntington Beach to Pelican PointDana Point (21)			27																	23		
Dana Point: Mussel Cove to Doheny Beach (22)											22									36		
Southern Orange County (25)										29												

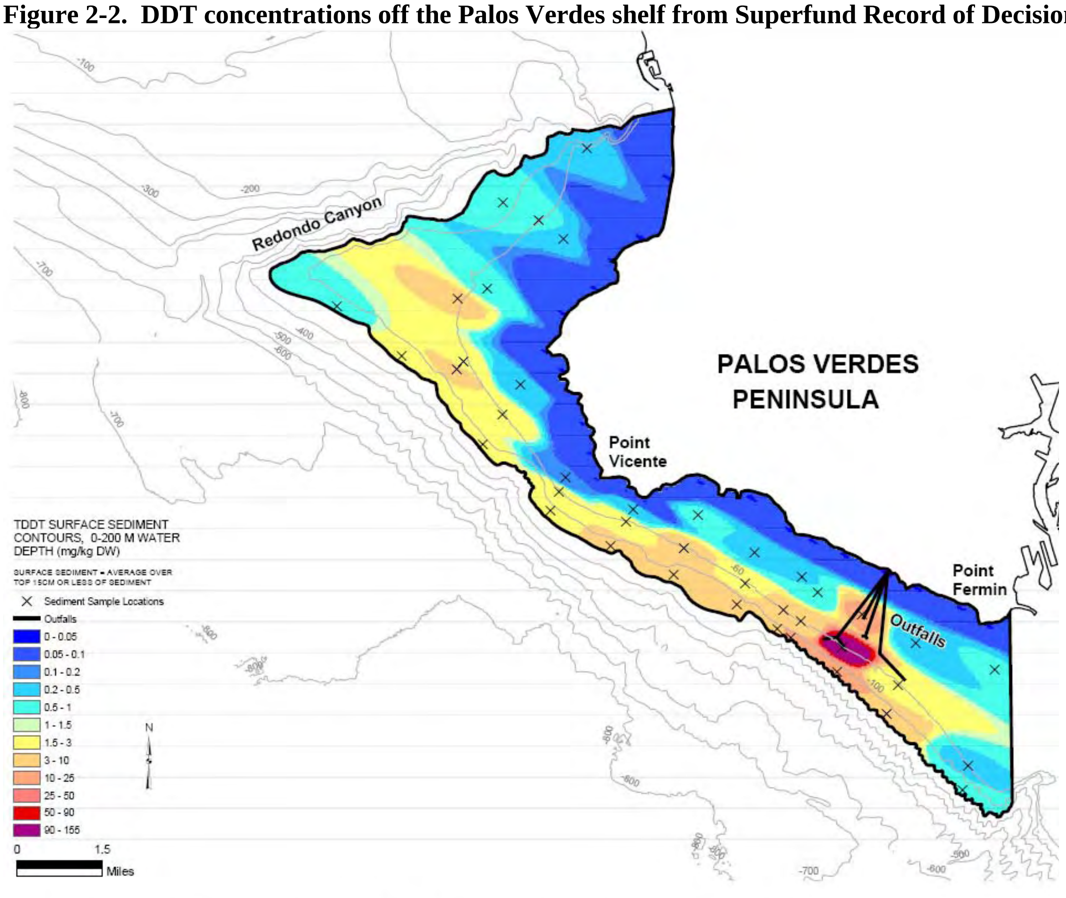
Sediment Contaminants

There is substantial evidence of widespread sediment contamination in Santa Monica Bay, largely centered on the Palos Verdes Shelf. Although, the concentrations of DDT and PCBs in surface sediments on the Palos Verdes shelf have decreased substantially since the early 1970s, largely due to burial, the concentrations of DDTs and PCBs in the surface sediments remain at levels of concern. Furthermore, there is evidence that the rate of burial has declined on the southwest portion of the Palos Verdes shelf and concern that erosion will bring the previously buried deposits to the surface.

The concentrations of DDT in surface sediments near the White's Point outfall range from around 90,000 to 155,000 ng/g. Along the 60-m depth contour, concentrations greater than 1,500 ng/g extend along the entire shelf. Concentrations are much lower in the nearshore (0 to 50 ng/g) and increase with depth (Figure 2-2).

The mass estimates of DDT and byproducts in the sediments of Palos Verdes Shelf vary. The mass estimate from the Superfund Record of Decision is around 100 metric tons (MT) for DDT. Most of the DDT (about 85%) is in the form of p,p-DDE. Lee et al. (2002) provides an estimate of 66.8 MT of p,p-DDE. Murray et al. (2002) provided estimates on the order of 61 to 72 MT for p,p-DDE. Sherwood et al. (2008) has more recently provided an estimate of 84 MT of DDT.

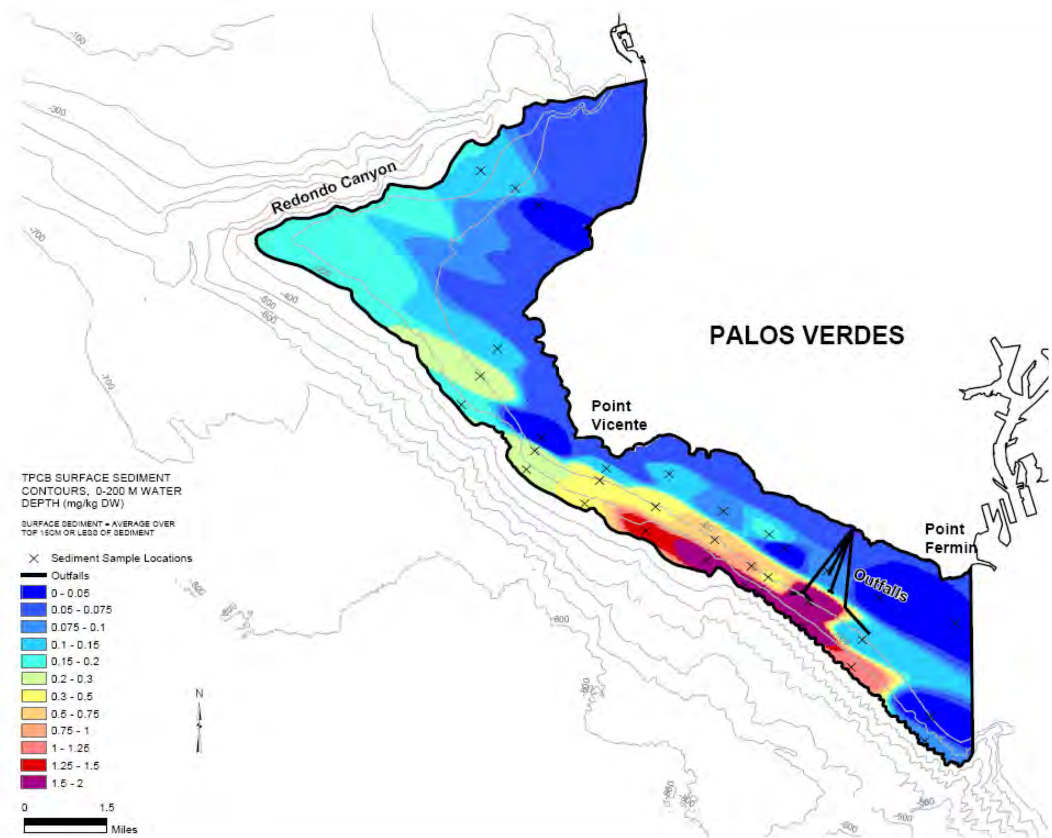
Figure 2-2. DDT concentrations off the Palos Verdes shelf from Superfund Record of Decision.



Note: In addition to the 2002/2004 LACSD data, this figure uses four Bight '94 samples, one 1993 LACSD sample, and two 1992 NOAA samples to provide actual tDDT concentrations between the 0 and 1 transects and north of the 0 transect. Shoreline concentrations set at 0.05 mg/kg for contouring.

The highest PCB concentrations are near and just offshore of the outfall. Lower concentrations (< 50 ng/g) are in the shallow nearshore area. A large portion of the shelf has concentrations greater than 200 ng/g. Concentrations generally increase with depth. The extent of high PCB concentrations extends further northwest along the PV shelf than the DDT footprint (Figure 2-3). The mass estimates from the Superfund Record of Decision were on the order of 10 MT for PCBs.

Figure 2-3. PCB concentrations off the Palos Verdes shelf from Superfund ROD



Note: In addition to the 2002/2004 LACSD data, two simulated transects were inserted between the 0 and 1 transects to approximate sediment concentrations where no data exist. The simulated transects were set as an average of the 0 and 1 transect concentrations. Shoreline concentrations have been set at 0.05 mg/kg for contouring.

Sediment contamination is not confined to the Palos Verdes shelf. Data from a number of regional surveys consistently identify elevated concentrations of DDT and PCBs in the surface sediments of Santa Monica Bay (Schiff and Gossett, 1998; Noblet et al., 2001, Schiff et al., 2011)). The pattern in concentrations suggests that Palos Verdes shelf may be a major source of DDT contamination to Santa Monica Bay (Figure 2-4). A number of studies have reported the pattern of DDE in the sediment suggests that the Palos Verdes shelf may be a source for surface sediment concentrations in Santa Monica Bay (Bay et al., 2003; Summerfield and Lee, 2003; Venkatesan et al., 2010). This is consistent with the general pattern of sediment transport on the Palos Verdes shelf which is toward the northwest (Wiberg et al., 2002).

The distribution of PCBs in the sediments suggests an additional source (Figure 2-5). The highest concentrations are in the vicinity of the Hyperion treatment plant. Venkatesan (2010) indicates that the highest concentration of PCBs is near the terminus of the old 7-mile sludge line. The fact that the discharges from this outfall were ceased in 1987 implies these are historic rather than recent deposits. Correlations with markers for sewage such as coprostanols and linear alkyl benzenes provide further evidence that the source is primarily sewage-related deposits (Venkatesan, 2010). Elevated concentrations of both DDT and PCBs in the sediments off Ballona Creek also suggest the contribution of stormwater from historic land based sources (Schiff and Bay, 2003).

Venkatesan et al. (2011) estimated there are approximately 610 kg of DDT and 440 kg of PCBs in the top 2 cm of the surface sediments in Santa Monica Bay. However, concentrations in the subsurface sediments of Santa Monica Bay are substantially higher than surface sediments (Bay et al., 2003) suggesting most of the mass of PCBs and DDTs is buried.

Figure 2-4. Distribution of DDT in surface sediments in Santa Monica Bay (from Venkatesan, 2010)

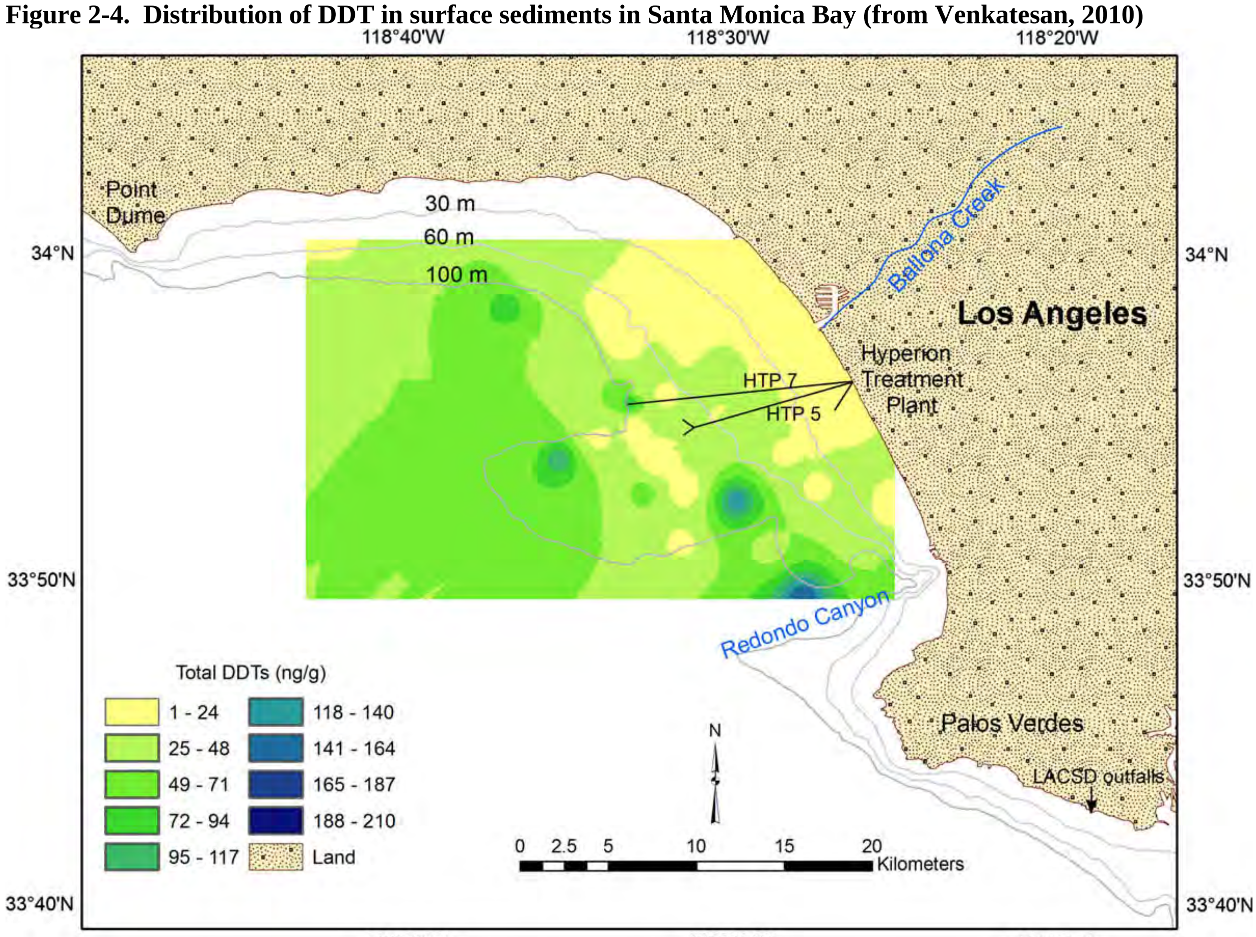
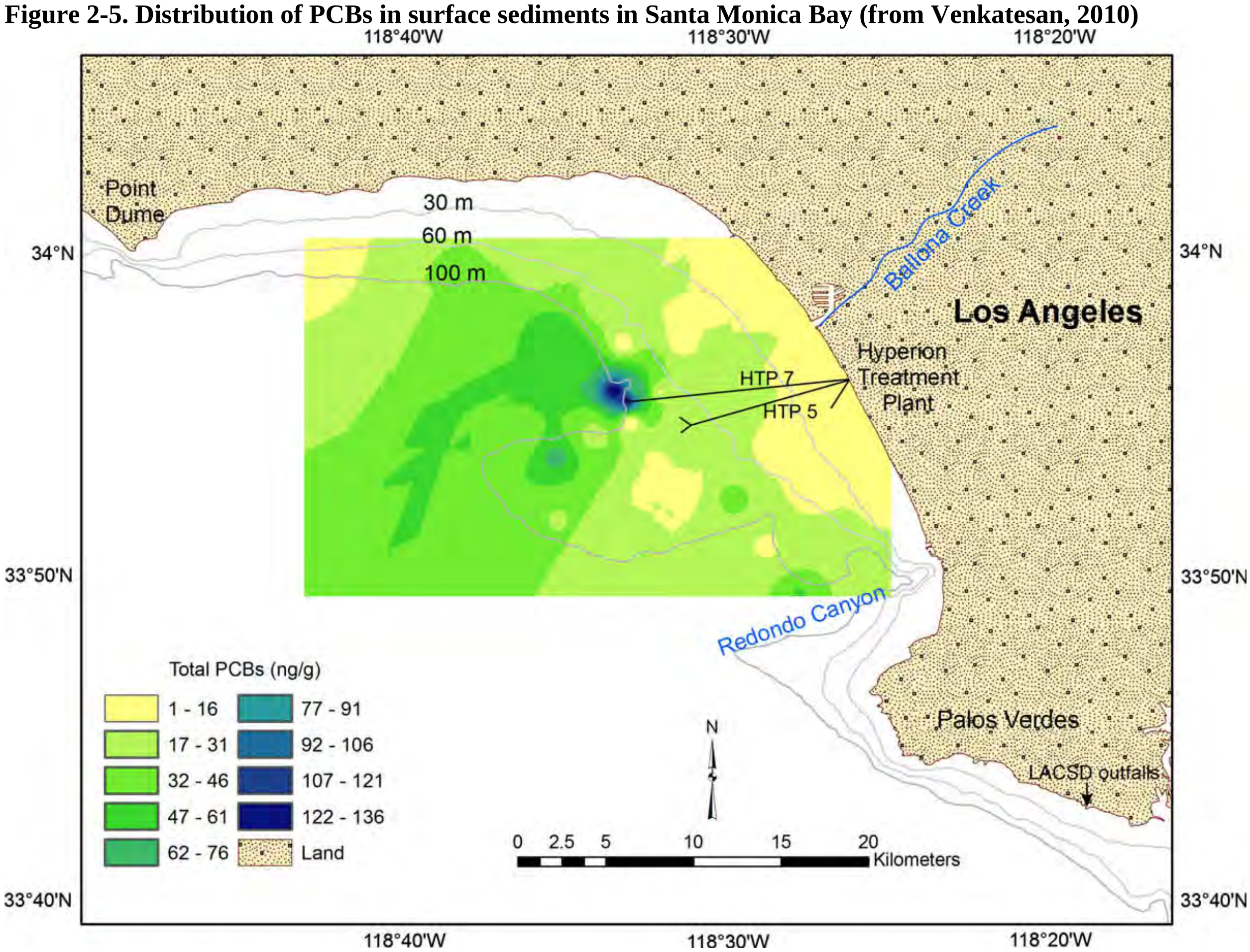


Figure 2-5. Distribution of PCBs in surface sediments in Santa Monica Bay (from Venkatesan, 2010)



Sediment Toxicity Data

There is little evidence of sediment toxicity in Santa Monica Bay. Swartz et al. (1986) reported changes in conditions at eight stations on the Palos Verdes shelf resulted in lack of any significant toxicity in surface sediments near the outfall. There was no acute toxicity in Santa Monica Bay in 1994 during the Southern California Bight Pilot Project (n = 55) or as part of the Bight survey in 1998 (n = 23). Greenstein et al. (2003) assessed toxicity in 25 sediment cores sampled in 1997. Based on the amphipod toxicity test, only 2 of 25 surface samples resulted in significant reduction in amphipod survival and one of these samples near Redondo Canyon contained both surface and subsurface (older) sediments. Similar findings were made with sea urchin fertilization tests where only 2 of the 25 surface samples indicated toxicity. Both of these were in the vicinity of the old 7-mile outfall. Cores by Greenstein et al. (2003) and Swartz (1986) show toxicity in subsurface sediments (but not in surface sediments) from the shelf and near the outfall areas.

Although Bight surveys in 2003 and 2008 had fewer samples in Santa Monica Bay; the results are similar to the earlier surveys. In 2003, seven samples showed no toxicity and one sample near Redondo Canyon showed moderate toxicity. In 2008 four samples in Santa Monica Bay showed no toxicity and one sample from the Palos Verdes shelf near Point Fermin showed a low level of toxicity. This low level toxicity threshold used in the 2008 survey is more conservative than required for the listing policy. The toxicity data is summarized in Table 2-8.

Table 2-8. Summary of amphipod toxicity data from surface sediments 1994 to 2008

Year	Toxicity	Reference	Comments
1994	0 out of 55	Bay et al., 1998	
1997	2* out of 25	Greenstein et al., 2003	*One surface sample showing toxicity was contaminated with sub-surface
1998	0 out of 23	Bay et al., 2000	
2003	1 out of 8	Bay et al., 2005	Moderate toxicity near Redondo Canyon
2008	0* out of 5	Bay et al., 2011	*Definition for low level toxicity in survey not considered toxic under the listing policy

Our evaluation of the data showed only 3 out of 116 samples exhibited toxicity. Following the California listing policy, Santa Monica Bay is meeting the toxicity objective and there is sufficient evidence to delist sediment toxicity. We therefore make a finding that there is no significant toxicity in Santa Monica Bay and recommend that Santa Monica Bay not be identified as impaired by toxicity in the California's next 303(d) list.

Summary Assessment and Findings Concerning TMDLs Required

There is widespread contamination of DDT and PCBs in the sediments of Santa Monica Bay. The Palos Verdes shelf is a major source of DDT and PCBs to the Bight. The distribution of PCBs appears to be more widespread than DDT suggesting multiple sources of PCB contamination. The concentrations of DDT and PCBs have decreased substantially from the levels observed in the early 1970's largely as a result of burial. During this time period the benthic communities in Palos Verdes shelf and Santa Monica Bay have also improved substantially to the point where impairments to benthic communities are not seen. Very little sediment toxicity is now observed in sediments from Santa Monica Bay. The concentrations of DDT and PCBs in fish tissue have also decreased over time but remain above levels of concern established by OEHHA. These TMDLs address impairments related to concentrations of DDT and PCBs in edible fish tissue as they relate to the consumption of fish.

3 NUMERIC TARGETS

Numeric targets are established for DDT and PCBs in water, sediment and fish tissue of Santa Monica Bay that are protective of human health. The USEPA Superfund Project established remedial action objectives (RAOs) for the Palos Verdes Shelf in the Interim Record of Decision for the Palos Verdes Shelf Superfund Restoration (USEPA, 2009). A description of how these targets were derived is included in the specific sections below.

Table 3-1. Numeric targets for sediment and tissue in Santa Monica Bay

TMDL target for Santa Monica Bay (Point Vicente to Point Dume)	**Total DDTs**	**Total PCBs**
Water column (based on California Ocean Plan objective)	0.17 ng/l	0.019ng/l
Fish tissue (based on a consumption rate of 116 g/d and exposure risk of 10^{-5})	40 ng/g	7 ng/g
Sediment to meet target (normalized for organic carbon)	2.3 ug/g OC	0.7 ug/g OC
Superfund Interim Remedial Action Objectives for Palos Verdes Shelf (Point Fermin to Point Vicente)	**Total DDTs**	**Total PCBs**
Water column objective (equal to the USEPA human health criteria)	0.22 ng/l	0.064 ng/l
Fish tissue objective for white croaker (116 g/d and an exposure risk of 10^{-4})	400 ng/g	70 ng/g
Sediment to meet fish tissue objective (normalized for organic carbon)	23 ug/g OC	7 ug/g OC

3.1. Water Quality Targets. The water quality target for DDT in Santa Monica Bay is 0.17 ng/l based on objectives in the California Ocean Plan. The Superfund RAO for the Palos Verdes Shelf of 0.22 ng/l is equal to the EPA Water Quality Criteria. The DDT targets for Santa Monica Bay and the Palos Verdes shelf are not substantially different.

The Water quality target for PCBs in Santa Monica Bay is 0.019 ng/l based on the COP. The Superfund RAO for the Palos Verdes shelf 0.064 ng/l is equal to the EPA human health criteria. As discussed in the Superfund Interim Record of Decision, the existing PCBs data are insufficient to project attainment of PCBs cleanup levels and therefore, the interim action includes collection of PCBs data in sediment and water that can be used to forecast PCBs loss rates. This work will be used by Superfund in the first five-year review to develop subsequent remedial actions to protect human health.

3.2. Fish Tissue Targets. To develop the TMDLs, it is necessary to translate the appropriate narrative objectives into numeric targets that identify the measurable endpoint or goal of the TMDLs and represent attainment of the applicable numeric and narrative water quality standards.

In 2009, OEHHA published guidelines to support advisories (Table 3-2). Fish Contaminant Goals (FCGs) are estimates of contaminant levels in fish that pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week (32 g/day), prior to cooking, over a lifetime. FCGs prevent consumers from being exposed to more than the daily reference dose for non-carcinogens or to a risk level greater than $1x10^{-6}$ for carcinogens (i.e., not more than one additional cancer case in a population of 1,000,000 people consuming fish at the given consumption rate over a lifetime). FCGs are based solely on public health considerations without regard to economic considerations, technical feasibility, or the counterbalancing benefits of fish consumption (Klasing and Brodberg, 2008).

Table 3-2. Fish Consumption Guidelines (OEHHA, 2009)

Guideline (serving size associated with guideline)	Risk	DDT	PCBs
Fish Contamination Goal (one 8 oz serving per week)	10^{-6}	21ng/g	3.6 ng/g
Assessment tissue level (three 8 oz servings per week)	10^{-4}	<520 ng/g	<21 ng/g
Assessment tissue level (two 8 oz servings per week)	10^{-4}	>520 to 1000 ng/g	>21 to 42 ng/g
Assessment tissue level (one 8 oz serving per week)	10^{-4}	>1000 to 2100 ng/g	>42 to <120 ng/g
No Consumption		>2100 ng/g	>120 ng/g

Advisory Tissue Levels (ATLs) were developed by OEHHA with the recognition that there are unique health benefits associated with fish consumption and that the advisory process should be expanded beyond conveying simple risk in order to best promote the overall health of the fish consumer. ATLs provide a number of recommended fish servings that correspond to the range of contaminant concentrations found in fish and are used to provide consumption advice to prevent consumers from being exposed to more than the average daily reference dose for non-carcinogens or to a risk level greater than $1x10^{-4}$ for carcinogens (i.e., not more than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime). ATLs are designed to encourage consumption of fish that can be eaten in quantities likely to provide significant health benefits, while discouraging consumption of fish that, because of contaminant concentrations, should not be eaten or cannot be eaten in amounts recommended for improving overall health (eight ounces total, prior to cooking, per week). ATLs are one of the criteria that are used by OEHHA for issuing fish consumption guidelines (Klasing and Brodberg, 2008).

The Superfund fish RAO for the Palos Verdes shelf are 400 ng/g for DDT and 70 ng/g for PCBs. These are based on white croaker tissue (skin off filets, a consumption rate of 116 g/d which represents the 90th percentile for the Asian population as determined by the Santa Monica Bay Seafood Consumption Study (SCCWRP and MBC, 1994). This results in an excess cancer risk of 1 in 10,000. The DDT RAO for fish tissue is lower than the lowest ATL. The PCB RAO for fish tissue is in the one 8-oz serving per week ATL category.

EPA is establishing a separate set of targets for the areas of Santa Monica Bay north of the Superfund site from Point Vicente to Point Dume (Santa Monica Bay proper). The TMDL target for the areas north of Point Vicente is also based on an average consumption rate of 116 g/day. The DDT tissue target of 40 ng/g and the PCB tissue target of 7 ng/g are below the lowest ATL. This results in an excess cancer risk of 1 in 100,000.

EPA recognizes that the tissue targets for Santa Monica Bay (40 ng/g for DDT and 7 ng/g for PCBs) are slightly greater than those established for the LA Harbor TMDL (21 ng/g for DDT and 3.6 ng/g for PCB) which are based on the OEHHA FCGs. However the targets for this TMDL are based on a more conservative set of assumptions. First, for Santa Monica Bay this TMDL uses a higher consumption rate (116 vs. 32 g/d) than are used for the FCGs. At this lower consumption rate the excess cancer risk would be reduced to 2 in 1,000,000. Second, the TMDL targets do not include the 30% cooking reduction factor for DDT and PCBs used by OEHHA in developing the FCGs. When these factors are taken into consideration the difference in risk levels is relatively minor.

Table 3-3. Assumptions used in calculating fish tissue target.

Assumptions	Palos Verdes Shelf		Santa Monica Bay	
	DDT	**PCB**	**DDT**	**PCB**
Target Fish Tissue Concentration (C_f in ng/g)	400	70	40	7
Ingestion Rate (g/d)	116	116	116	116
Exposure Frequency (days/year)	365	365	365	365
Exposure Duration (years)	30	30	30	30
Body Weight (kg)	70	70	70	70
Average Time (days)	25,550	25,550	25,550	25,550
Intake = (C_f*IR*EF*ED)/(BW*AT)	2.8×10^{-4}	5.0×10^{-5}	2.8×10^{-5}	4.98×10^{-6}
Cancer Slope Factors (CSF expressed as kg*d/mg)	0.34	2	0.34	2
CSF x Intake = Excess Lifetime Cancer Risk	1×10^{-4}	1×10^{-4}	1×10^{-5}	1×10^{-5}

In Santa Monica Bay the highest sediment concentrations of DDT and PCBs are in the deeper waters not readily available to subsistence fishermen who fish off of piers. The shallower waters of Santa Monica Bay typically consist of sandier sediments which are less likely to accumulate DDT and PCBs. The use of the relatively high fish consumption rates is sufficiently conservative to protect recreational fishermen using charter boats to get to these deeper waters. The TMDL targets for Santa Monica Bay when met are sufficient to protect public health.

3.3 Sediment Targets.

There are no federal or State of California promulgated standards for DDT and PCBs in sediment. Therefore a regression model developed by the USEPA Superfund Division (HydroQual, 1997, Anchor 2009) was used to relate the concentrations of p,p-DDE and PCBs in sediment to the concentrations of p,p-DDE and PCBs in fish tissue.

The HydroQual bioaccumulation model provides estimates of p,p DDE and total PCBs in fish tissue concentrations expressed on a lipid basis (mg/kg lipid) from the sediment concentrations of the DDE and PCBs expressed on an organic carbon basis (ug/g OC). Anchor (2009) updated the bioaccumulation model using white croaker fish data from the 2002/2004 Coastal Marine Fish Contaminant Survey (USEPA/NOAA, 2007) and more recent sediment data for the Palos Verdes shelf (LACSD, 2008). The relationships from the HydroQual bioaccumulation model were converted from lipid-normalized fish tissue concentrations to contaminant concentrations in skin-off filets (mg/kg wet weight) by using an average lipid content (4.5%) in skin-off filets of white croaker (Anchor, 2009). The regression equations are presented below:

Eq 1: pp-DDE in White Croaker (ug/g ww skin off) = 0.0176 x Sediment (ug/g OC)
Eq 2: Total PCBs in White Croaker (ug/g ww skin off) = 0.0101 x Sediment (ug/g OC)

The sediment concentrations in the regression equations are normalized to organic carbon.[1] On the Palos Verdes shelf total organic carbon (TOC) is typically on the order of 2 to 3%, except in the areas near the White's Point outfall where TOC is on the order of 4 to 5% (LACSD, 2009 report). In Santa Monica Bay, TOC is typically less than 1% except near the outfalls where the TOC can be as high as 3% (City of Los Angeles, 2003, 2005. 2007). Table 3-4 illustrates the relationships between fish targets and sediment targets for a range of sediment TOC values.

Table 3-4. Derivation of sediment targets

Palos Verdes Shelf	**Fish RAO ng/g**	**Slope**	**Sediment RAO ug/g OC**	**ng/g @1%TOC**	**ng/g @2%TOC**	**ng/g @3%TOC**	**ng/g @4%TOC**
DDE	400	0.0176	23	230	460	690	920
PCB	70	0.0101	7	70	140	210	280
Santa Monica Bay	**Fish Target ng/g**	**Slope**	**Sediment Target ug/g OC**	**ng/g @1%TOC**	**ng/g @2% TOC**	**ng/g @3% TOC**	**ng/g @4%TOC**
DDE	40	0.0176	2.3	23	46	69	92
PCB	7	0.0101	0.7	7	14	21	42

Given the uncertainty associated with the bioaccumulation model, the Superfund targets are interim targets. Under the selected remedy, USEPA and NOAA will conduct a white croaker tracking study to learn more about white croaker feeding patterns on Palos Verdes shelf. Data from the white croaker tracking study and data from the baseline study of DDT and PCBs in water and sediment will allow the bioaccumulation model to be refined to predict more accurately the contaminant levels in sediment correlated to contaminant levels in fish. These studies will contribute to the development of the final remediation plan and re-evaluation of the TMDL targets.

[1] To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.

4 SOURCE ASSESSMENT

DDT is an organochlorine insecticide that was widely used on agricultural crops and to control disease-carrying insects. The use of DDT was banned in the United States in 1972, except for public health emergencies involving insect diseases and control of body lice. Although DDT is no longer used, it persists in the environment, adhering strongly to soil particles. Total DDT consists of two isomers (p,p-DDT and o,p-DDT) and several degradation products (p,p-DDE, o,p-DDE, p,p-DDD, and o,p-DDD).

Polychlorinated biphenyls (PCBs) are mixtures of up to 209 individual chlorinated compounds (known as congeners). Monsanto was the only North American producer of PCBs which were marketed as arochlors. PCBs were used in a wide variety of applications, including dielectric fluids in transformers and capacitors, heat transfer fluids, and lubricants. In 1976, the manufacture of PCBs was prohibited because of evidence that they build up in the environment and can cause harmful health effects. Products made before 1977, which may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors and hydraulic oils. Although PCBs were banned in 1979, the Toxics Substance Control Act (TSCA) allows the inadvertent manufacture of PCBs as a result of some manufacturing processes..

4.1 POINT SOURCES

Point sources typically include discharges from a discrete human-engineered point. These types of discharges are regulated through the federal National Pollutant Discharge Elimination System (NPDES) program, which the Regional Boards have been delegated to implement through the issuance of Waste Discharge Requirements (WDRs). Urban runoff to Santa Monica Bay is treated as a point source and regulated under stormwater NPDES permits.

Based on the State of the Watershed (2010) report there are 193 NPDES discharges in the watersheds draining into Santa Monica Bay. Seven of these are major NPDES permit discharges including three POTWs (Los Angeles County Sanitation Districts Joint Water Pollution Control Plant, City of Los Angeles Hyperion WWTP, and the Tapia WWTP), one refinery (Chevron El Segundo), and three power generating stations (El Segundo, Redondo and Scattergood). In addition there are 18 minor discharges, 175 dischargers covered under general permits, 87 dischargers covered by an industrial stormwater permit and 401 dischargers covered by the construction stormwater permit.

Individual NPDES permits

County Sanitation Districts of Los Angeles County Joint Water Pollution Control Plant
The County Sanitation Districts of Los Angeles County (LACSD) owns and operates the Joint Water Pollution Control Plant (JWPCP). The White's Point outfall off the Palos Verdes shelf was established in the 1920s. The two main discharge points (Discharge Serial Nos. 001 and 002) account for 65% and 35% of the effluent discharge, respectively. The outfall diffusers discharge at depths ranging from 167 to 210 feet.

The JWPCP has provided full secondary treatment since 2003 with a design capacity of 400 million gallons per day (MGD). JWPCP can receive bypass from the six upstream plants operated by the LACSD. It also receives brine discharges generated by the West Basin Municipal Water District's Carson Regional Water Recycling Plant.

In 1947, the Montrose Chemical Corporation of California, Inc. (Montrose) began manufacturing DDT at its plant on Normandie Avenue in Los Angeles, California. Wastewater containing significant concentrations of DDT was discharged from the Montrose plant into the sewers, flowed through the Los Angeles County Sanitation Districts wastewater treatment plant and was discharged to the ocean waters of the Palos Verdes shelf through subsurface outfalls. Between 1953 and 1971 somewhere between 1,500 to 2,500 tons of DDT were discharged from Montrose to LACSD. Based on an average removal efficiency of 58%, the estimated DDT load discharged to the Palos Verdes shelf is between 870 and 1,200 tons (Amendola, 2000). Montrose ceased discharging waste into the county sewer system in 1971. LACSD conducted cleaning operations in the two lines adjacent to and downstream of the Montrose property. Sediments in these lines contained more than 3.5 MT of DDT. The Montrose plant was shut down and dismantled in 1983. Under USEPA order, Montrose removed approximately 73.6 MT of sediment from the sewer line downstream from the plant. In 1971, the annual loading of DDT from the JPWCP was 21.1 MT. An estimated 39.3 MT of DDT was discharged out of the White's Point outfall between 1971 and 2002, mostly in the early years (Fig. 4-1). In 2001 and 2002 LACSD discharged 1.1 and 2.7 kg of DDT, respectively (Steinberger and Stein, 2004). After 2002, the concentrations of DDT in the effluent have been at or near the detection limits. LACSD is currently permitted to discharge up to 15.4 kg/yr.

PCBs entered the LACSD sewer system from several industrial sources in the Los Angeles area, most notably from the Westinghouse Electric Corporation, which manufactured and repaired electrical equipment at its Los Angeles County plant; from a paper-manufacturing plant in Pomona owned by Potlatch Corporation; and from Simpson Paper Company. PCBs from these plants were sent to the JWPCP and, after treatment, were discharged from the White's Point outfalls onto the Palos Verdes shelf. In 1971, the annual discharge of PCBs was 5.2 MT. The total PCBs load between 1971 and 1985 is estimated to be 35.6 MT (Fig. 4-2). The PCB concentrations in effluent have largely been below detection limits since 1985. However, the current detection limits are too high to assess compliance with the permit limit or the COP. LACSD is currently permitted to discharge up to 1.8 kg/yr of PCBs.

City of Los Angeles - Hyperion Treatment Plant The City owns and operates the Hyperion Treatment Plant, a publicly-owned treatment works (POTW) with a design capacity of 450 MGD that has provided full secondary treatment since December of 1998. The Hyperion Treatment Plant has three ocean outfalls. The one-mile outfall (Discharge Serial No. 001) was used in the 1950s to discharge a blend of primary and secondary effluent to Santa Monica Bay at a depth of 50 feet. Today this is used only for emergency discharge of chlorinated secondary treated effluent or the emergency discharge of stormwater overflow during large storms. The main discharge point (Serial No. 002), known as the five-mile outfall, was placed into service in 1959 and discharges at 187 feet below the ocean surface. Discharge Serial No. 003 (the 7-mile outfall) is no longer operational. It was used to discharge sludge at a depth of approximately 300 feet below the ocean surface between 1957 and 1987 when sludge discharge to the ocean was terminated.

Hyperion discharged an estimated 1.6 MT of DDT between 1971 and 1995 (Figure 4-1). DDT concentrations in Hyperion's effluent have been largely undetected since then. The Hyperion permit currently allows the discharge of up to 8.4 kg of DDT per year. Between 1971 and 1987 about 9.7 MTs of PCBs were discharged from Hyperion (Figure 4-2). Effluent concentrations of PCBs have been largely undetected since then. Detection limits are an issue for compliance since they are much too high to assess compliance with the permit limit or the COP. The Hyperion permit (R4-2010-0200) currently allows the discharge of 0.9 kg of PCBs per year.

West Basin Municipal Water District The West Basin Municipal Water District has permits to discharge brine from Edward C. Little Water Recycling Facility through the Hyperion outfall (R4-2006-0067) and to discharge brine from the Carson Recycling Facility which discharges through the JPWCP outfall (R4-2007-0001). These permits require monitoring of effluent for DDTs and PCBs twice a year. The Regional Board assessed effluent data from 2000 to 2005 and determined that permit limits were not required for DDT or PCBs. The PCB assessments were hampered by detection limits that were above the COP objectives.

Tapia Water Reclamation Facility (Tapia) Tapia is jointly owned by the Las Virgenes Municipal Water District and Triunfo Sanitation Districts. Tapia is a tertiary wastewater treatment plant, with a design capacity of 16.1 MGD, permitted to discharge into Malibu Creek between mid-November to mid-April (R4-2010-0165). Analysis by Regional Board permitting staff indicated there were no detectable concentrations of DDT or PCBs in Tapia effluent based on data from 1986 to 2004. Consequently, there are no effluent limits for DDTs or PCBs.

Malibu Mesa Wastewater Reclamation Facility Malibu Mesa is a small (0.2 MGD) treatment plant (R4-2007-0002) which discharges disinfected tertiary treated wastewater through two discharge points to Marie Canyon and an unnamed canyon west of Marie Canyon and ultimately to Puerco Beach within Santa Monica Bay. Analysis by Regional Board permitting staff indicated there were no detectable concentrations of DDTs or PCBs in Malibu Mesa effluent based on data from 2001 to 2005. There are no effluent limits for DDT or PCBs in the permit.

Chevron Products Company – El Segundo Refinery The El Segundo Refinery's wastewater treatment facility discharges an average flow of 7.0 MGD of treated wastewater, with up to 8.8 MGD during dry weather and up to 27 MGD during wet weather, to Santa Monica Bay. The wastewater is comprised of refinery wastewater, petroleum hydrocarbon contaminated shallow well groundwater, other intermittent sources, and rainfall runoff, which may be contaminated. The outfall extends approximately 3,500 feet offshore to a depth of 42 feet.

The refinery has effluent limits and performance goals for DDT and PCBs (R4-2006-0089). The DDT limit is 13.8 ng/l (performance goal is 6 ng/l). The PCB limit is 1.54 ng/l (performance goal is 0.74 ng/l). The effluent is monitored for DDT and PCB as arochlors twice a year. The reported method detection limit of 600 ng/l for DDT and 3,500 ng/l for PCBs (Lyon and Stein, 2010) are too high to determine compliance with permit limits.

Figure 4-1. Trends in DDT loadings from Hyperion and Los Angeles County Joint Plant

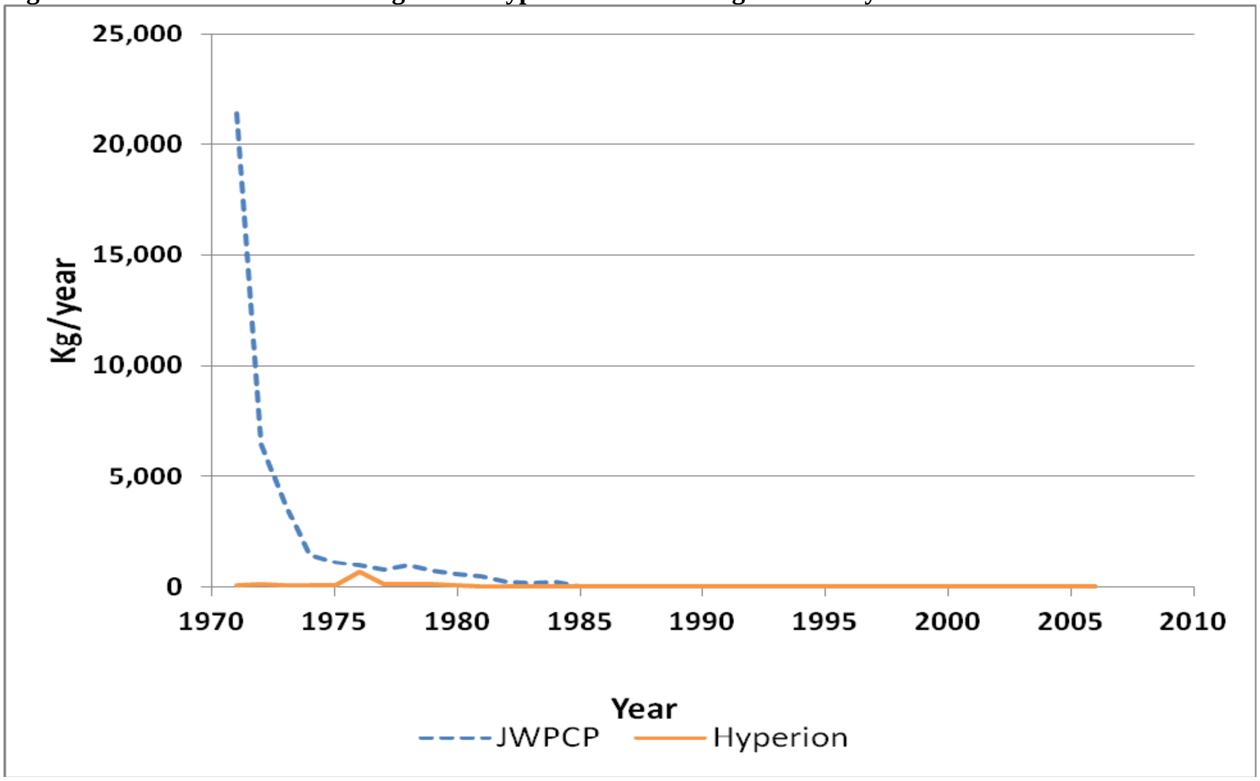
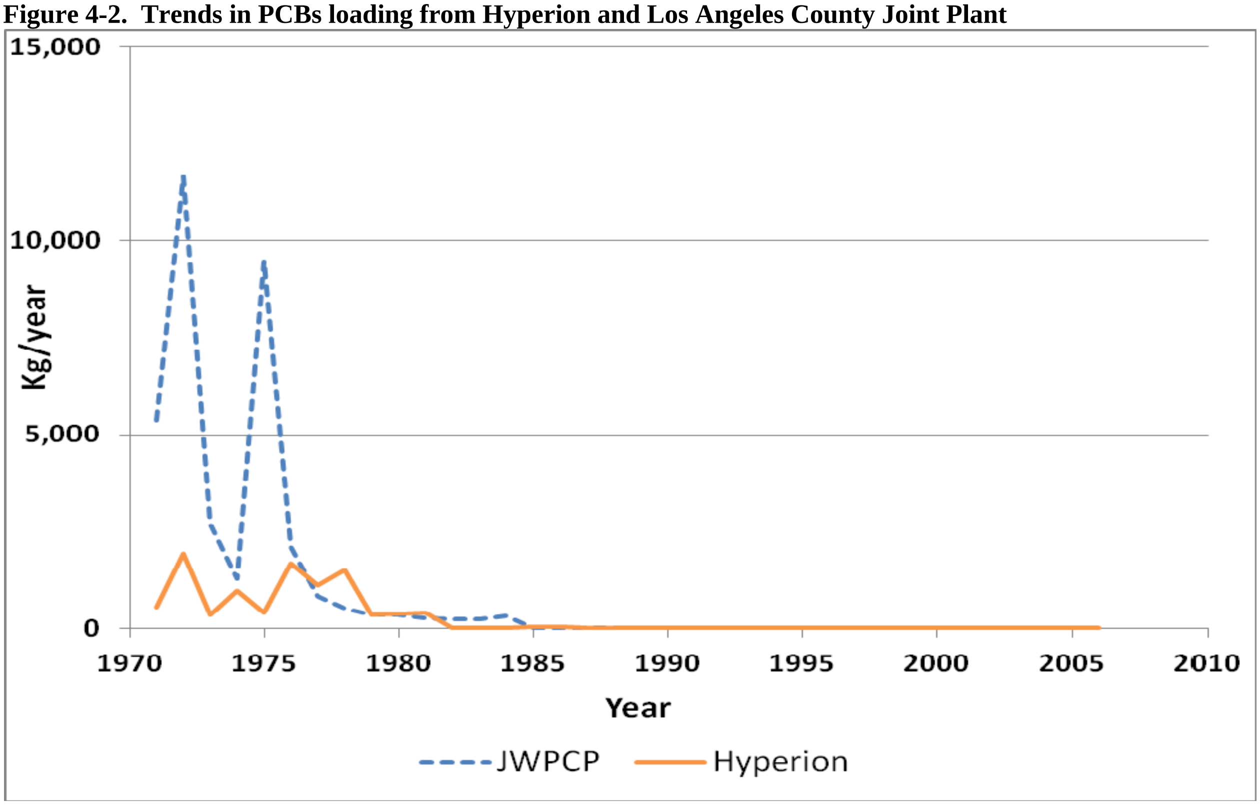


Figure 4-2. Trends in PCBs loading from Hyperion and Los Angeles County Joint Plant



AES Redondo Beach, LLC (Redondo Generating Station) The Redondo Generating Station is a steam electric generating facility permitted to discharge up to 898 MGD of waste consisting of once-through cooling water, treated chemical metal cleaning wastes, groundwater seepage, and other low volume wastes into Santa Monica Bay.

The waste is discharged through two outfalls; Discharge Serial No. 001 extends approximately 1,600 feet offshore to a depth of 25 feet. Waste discharged through this outfall consists of up to 215 MGD of once-through cooling water and smaller amounts of groundwater seepage, and other low-volume waste. Discharge Serial No. 002 extends approximately 300 feet and terminates at a depth of 20 feet. Waste discharged through this outfall consists of up to 674 MGD of once through cooling water with small amounts of condensate overboard overflow, fuel oil tank farm rainfall run-off, and yard drains. The permit (00-085) includes a narrative limit to comply with all COP objectives.

El Segundo Power, LLC (El Segundo Power Generating Station) The El Segundo Station is permitted to discharge wastes consisting of once-through cooling water from four steam electric generating units, treated chemical metal cleaning wastes, non-chemical metal cleaning wastes, low volume wastes, stormwater runoff, and treated sanitary wastes into the Pacific Ocean through two outfalls (00-084).

Heated water is discharged through Outfall No. 001which extends 1,900 feet offshore to a depth of 26 feet and Outfall No. 002 extends about 2,100 feet offshore to a depth of 20 feet. In 2008, the average discharge flows from Outfalls No. 001 and No. 002 were 29.2 MGD and 130.8 MGD, respectively (El Segundo Power, 2009). There are no effluent limits for DDTs or PCBs in the permit. The effluent is monitored once every five years for priority pollutants including DDT and PCBs.

City of Los Angeles, Department of Water and Power - Scattergood Generating Station The Scattergood Generating Station is located about 1,500 feet south of the Hyperion Treatment Plant. The plant is permitted (00-083) to discharge up to 496 MGD of wastes containing once through cooling water, pretreated metal cleaning wastes, low-volume in-plant wastes, cooling tower blowdown, and stormwater runoff into Santa Monica Bay. The average discharge during 2008 was 315 MGD.

The Seaside Lagoon Facility The Seaside Lagoon Facility in the City of Redondo Beach is a city park that consists of a 1.4 million gallon man-made saltwater lagoon. The lagoon was constructed in 1962 and has since been open to the public for swimming from Memorial Day to Labor Day. Approximately 2.3 MGD, of once-through cooling water from the Redondo Beach Generating Station is directed to the Lagoon from the Power Plant Outfall that discharges to King Harbor. To maintain the water level in the Seaside Lagoon, the City discharges approximately 2.3 MGD of dechlorinated saltwater to King Harbor when the Lagoon is in use. This discharge is permitted by the Regional Board (R4-2010-0185). There are no effluent limits for DDT or PCBs in the permit, but there are annual monitoring requirements for DDT and PCBs in effluent and receiving water.

Table 4-1. Summary of Individual Permitees in watersheds draining to Santa Monica Bay. Facilities in bold have effluent limits for DDT and PCBs.

Facility	Waterbody	Order No	NPDES No	Design Flow
LA County Sanitation Districts Joint Water Pollution Control Plant	Santa Monica Bay	R4-2006-0042	CA0053813	400
LA City Bureau of Sanitation Hyperion WWTP	Santa Monica Bay	R4-2010-0200	CA0109991	450
West Basin Municipal Water District Edward C. Little Water Recycling Facility	Santa Monica Bay	R4-2006-0067	CA0063401	4.5
West Basin Municipal Water District Carson Regional WRP	Santa Monica Bay	R4-2007-0001	CA0064246	0.9
Las Virgenes MWD Tapia WRF	Malibu Creek	R4-2010-0165	CA0056014	16.1
LA Co Dept of Public Works Malibu Mesa Wastewater Reclamation Facility	Santa Monica Bay	R4-2007-0002	CA0059099	0.2
Chevron, El Segundo Refinery	Santa Monica Bay	R4-2006-0089	CA0000337	27
Redondo Generating Station	Santa Monica Bay	00-085	CA0001201	1146
El Segundo Generating Station.	Santa Monica Bay	00-084	CA0001147	607
Scattergood Generating Station Los Angeles DWP	Santa Monica Bay	00-083	CA0000370	496
City of Redondo Beach Seaside Lagoon	Santa Monica Bay	R4-2010-0185	CA0064297	2.3

General NPDES Permits

General NPDES permits often regulate episodic discharges (e.g., dewatering operations) rather than continuous flows. Pursuant to 40 CFR parts 122 and 123, the State Board and the Regional Boards have the authority to issue general NPDES permits to regulate a category of point sources if the sources: involve the same or substantially similar types of operations; discharge the same type of waste; require the same type of effluent limitations; and require similar monitoring. The Regional Board has issued general NPDES permits for eight categories of discharges. Four of these address discharge to surface water from ground water from construction and project dewatering; petroleum fuel cleanup sites; volatile organic compounds (VOCs) cleanup sites; and potable water. The other four address discharges to surface waters from non-process wastewater; hydrostatic test waters; vector control; and aquatic weed control.

- The general NPDES permit for Discharges of Groundwater from Construction and Project Dewatering to Surface Waters (Order No. R4-2008-0032) covers wastewater discharges, including but not limited to, treated or untreated groundwater generated from permanent or temporary dewatering operations.
- The general NPDES permit for Treated Groundwater and Other Wastewaters from Investigation and/or Cleanup of Petroleum Fuel-Contaminated Sites to Surface Waters (Order No. R4-2007-0021) covers discharges, including but not limited to, treated groundwater and other wastewaters from the investigation, dewatering, or cleanup of petroleum contamination arising from current and former leaking underground storage tanks or similar petroleum contamination.
- The general NPDES permit for Discharges of Treated Groundwater from Investigation and/or Cleanup of VOCs-Contaminated Sites to Surface Waters (Order No. R4-2007-0022) covers discharges, including but not limited to, treated groundwater and other wastewaters from the investigation, cleanup, or construction dewatering of VOCs only (or

VOCs commingled with petroleum fuel hydrocarbons) contaminated groundwater.

- The general NPDES permit for Discharges of Groundwater from Potable Water Supply Wells to Surface Waters (Order No. R4-2003-0108) covers discharges of groundwater from potable supply wells generated during well purging, well rehabilitation and redevelopment, and well drilling, construction and development.
- The general NPDES permit for Discharges of Nonprocess Wastewater to Surface Waters (Order No. R4-2009-0047) covers waste discharges, including but not limited to, noncontact cooling water, boiler blowdown, air conditioning condensate, water treatment plant filter backwash, filter backwash, swimming pool drainage, and/or groundwater seepage.
- The general NPDES permit for Discharges of Low Threat Hydrostatic Test Water to Surface Waters (Order No. R4-2009-0068) covers waste discharges from hydrostatic testing of pipes, tanks, and storage vessels using domestic/potable water.
- General Permits 2004-008 and 2011-0002 covers the point source discharge of biological and residual pesticides resulting from direct and spray applications for vector control using larvicides and adulticides that are currently registered in California.
- General Permit 2004-009 addresses the discharge of aquatic pesticides related to the application of 2,4-D, acrolein, copper, diquat, endothall, fluridone, glyphosate, imazapyr, sodium carbonate peroxyhydrate, and triclopyr-based aquatic pesticides to surface waters for the control of aquatic weeds.

The activities covered under current Waste Discharge Requirements for Aquatic Pesticides for Vector Control (2004-0008) and Aquatic Weed Control (2004-0009) are for current use pesticides and herbicides which should not contain any DDT or PCBs. The activities covered under current Waste Discharge Requirements for discharges of ground water from potable water supply wells (2003-0108), from nonprocess wastewater (2009-0047), from discharges of low threat hydrostatic test water (2009-0068) are also unlikely to contain contaminants such as DDT or PCBs.

It is possible that groundwater remediation actions for petroleum fuel contaminated sites (2007-0021) or from sites contaminated with volatile organic compounds (2007-0022) could contribute DDTs or PCBs to surface waters. Construction-related dewatering activities (2008-0302) may also have the potential for discharge of contaminants. This is particularly the case for demolition of older facilities with products that still contain PCBs (e.g., lighting, paints, caulking, waxes). There are over a hundred construction related discharges covered under this general permit. Activities covered under general permits 2007-0021, 2007-0022 and 2008-0032 are required to screen their discharges for constituents listed in the CTR which include DDT and PCBs as arochlors. These data are not readily available in any electronic format and were not reviewed during TMDL development. However, given that the required detection limits for DDT (10 to 50 ng/l) and PCBs (500 ng/l) are several orders of magnitude higher than the water quality criteria, it is unlikely that DDT or PCBs would have been detected.

Table 4-2. Number and general distribution of general permits in watersheds draining into Santa Monica Bay (from LARWQCB website, May 2011)

Permit number	Descriptive title	Santa Monica Bay Watershed	Ballona Creek Watershed	Malibu Creek Watershed
2004-0008	Waste Discharge Requirements for discharges of Aquatic Pesticides for Vector Control	0	0	1
2004-0009	Waste Discharge Requirements for discharge of Aquatic Pesticides for Aquatic Weed Control	0	0	4
2007-0021	Waste Discharge Requirements for treated groundwater and other wastewaters from investigation and/or cleanup of petroleum fuel-contaminated sites to surface waters	0	4	0
2007-0022	Waste Discharge Requirements for discharges of treated groundwater from investigation and/or cleanup of volatile organic compound Contaminated-sites	1	0	0
2008-0032	Waste Discharge Requirements for discharges of groundwater from construction and project dewatering to surface waters	30	98	3
2009-0047	Waste Discharge Requirements for discharges of nonprocess wastewater to surface waters	3	2	0
2003-0108	Waste Discharge Requirements for discharges of groundwater from potable water supply wells to surface waters	8	4	1
2009-0068	Waste Discharge Requirements for discharges of low threat hydrostatic test water to surface waters	3	3	

Stormwater Permits

Stormwater runoff into Santa Monica Bay is regulated primarily through four NPDES permits. The first is the municipal separate storm sewer system (MS4) permit issued to the County of Los Angeles. The second is a separate statewide stormwater permit specifically for the California Department of Transportation (Caltrans). The third is the statewide Construction Activities Stormwater General Permit and the fourth is the statewide Industrial Activities Stormwater General Permit. The NPDES permits program defines these discharges as point sources because the stormwater discharges from the end of a stormwater conveyance system. Since, the industrial and construction stormwater discharges are enrolled under NPDES permits, these discharges are treated as point sources.

The Los Angeles MS4 permit was first issued in 1990. The latest revision of the permit (Order No. 001-182) was issued on April 14, 2011. There are 85 co-permittees including LA County and the City of Los Angeles. For the purpose of this TMDL, the co-permittees of interest are those with a potential to discharge directly or indirectly into Santa Monica Bay. The cities are grouped into two major watershed management areas.

The Ballona Creek and Other Urban Watersheds Management Area include Culver City, Beverly Hills, West Hollywood, Santa Monica, El Segundo, Manhattan Beach, Hermosa Beach, Redondo Beach, Palos Verdes Estates, Rancho Palos Verdes, Rolling Hills and Rolling Hills Estates.

The Malibu Creek and Other Rural Watersheds Management Area include Malibu, Agoura Hills, Calabasas and Westlake Village. There are about 43 square miles of land in Ventura County (including the City of Thousand Oaks), which drain into the Malibu Creek watershed and ultimately to Santa Monica Bay, that are not covered by the LA County MS4 permit but are covered under the Ventura County MS4.

The monitoring requirements in the MS4 permit include sampling at mass emissions stations in Ballona Creek and Malibu Creek. The Ballona Creek station located at Sawtelle Avenue has been sampled since 1994. The Malibu Creek station at Piuma has been sampled regularly since 1997. Sampling typically includes four wet-weather events and four dry-weather events per year at these mass emission stations.

DDT. In the 1971-72 water year, which was a particularly wet year, the annual wet weather loads for DDTs from Ballona Creek were around 18 kg (Young et al., 1973). In the 1987-88 period, wet weather loadings for DDT during a comparable size storm year were around 8 kg (Stein et al., 2003). There were no detectable concentrations of DDT in stormwater samples from 1994 to 2005 (LADPW, 2005). Similar results were found for DDT in Malibu (1997 to 2005). However the detection limits for DDT used by the LA County lab are two orders of magnitude greater than the COP human health objective. In a separate study, Curren et al. (2011) found DDT concentrations in Ballona Creek stormwater during the 2005-06 season that ranged from non-detect to 0.4 ng/l. This indicates that DDT concentrations in stormwater may exceed the human health criteria. The total DDT loadings based on the average concentrations from these three storms sampled by Curren et al. (2010) were estimated to be 6.2 g.

PCBs. In the 1971-72 water year, the annual wet weather loads for PCBs from Ballona Creek were around 15 kg (Young et al., 1973). In the 1987-88 water year, the wet weather loadings for PCBs were around 7 kg. Los Angeles Department of Public Works (LADPW) has not indicated detectable levels of PCBs in stormwater from Ballona or Malibu since the mid 1990s. However, detection levels for PCBs measured as arochlors were 65 ng/l, which are more than three orders of magnitude greater than the COP human health objective. In 1995-96 storm year, Suffet and Stenstrom (1997) measured PCB congeners and found elevated concentrations of total PCBs (calculated as the sum of the 18 congeners) ranging between 15,100 ng/l to 390,000 ng/l in Ballona Creek stormwater. More recently in the 2005-06 storm season, Curren et al.(2011) found concentrations of total PCBs that were much lower, ranging from 0.74 ng/l to 16.07 ng/l in the 2005-06 rainy season. These most recent values are all higher than the COP objective. The estimate of PCB loads based on the average concentrations from the three storms sampled by Curren et al. (2011) was 32.9 g.

General approach to estimate stormwater loads. While it is clear that stormwater concentrations have decreased over time, the data are highly variable and the detection limits associated with routine stormwater monitoring efforts are not low enough to estimate current loadings of DDT or PCBs to Santa Monica Bay. Therefore, the information presented in Table 3 of Curren et al. (2011) was used to derive concentrations of DDT and PCBs on storm-borne sediment which were then used to develop stormwater loading estimates to the Santa Monica Bay. The average storm-borne sediment concentration at each site was computed by dividing the average mass of DDT or PCB by the average TSS loads. The maximum concentration over all sites (22.7 ng/g for DDT and 86.4 ng/g for PCB) was chosen as the "conservative" estimate of stormwater toxics concentrations in Ballona Creek. The median over all sites (3.9 ug/kg for DDT and 20 ug/kg for PCB) was chosen to estimate the existing stormwater concentrations.

These calculated storm-borne sediment concentrations were then used to provide estimates of stormwater loading from Ballona Creek to Santa Monica Bay. The conservative estimate of storm-borne sediment concentration was multiplied by a TSS loading of 14,000 MT/yr using a value from Inham and Jenkins (1999) which was based on a 50-year record and influenced by a few large storm years. The estimate of existing concentration was multiplied by a TSS loading rate of 5,617 MT/yr which was based on a 10-year record using the Ackerman and Schiff (2003) model.

Assuming that DDT and PCB loadings to Santa Monica Bay is derived primarily from urban areas, the calculated loadings from Ballona Creek were divided by the urban acres in Ballona Creek watershed to derive a per unit urban area loading. The normalized loading rate was then multiplied by the total number of urbanized acres in the Santa Monica Bay watershed to obtain estimates of total storm-borne sediment loads to the Bay. This resulted in conservative estimates of stormwater loadings for DDT of 460 g/yr and 1800 g/yr for PCBs. The estimates for existing loads were 28 g/yr for DDT and 145 g/yr for PCBs.

As an alternate approach, the sediment contaminant data from Ballona Creek collected by the City of Los Angeles from 2007 to 2010 were used to approximate the loadings for DDTs and PCBs (Table 4-3). The average DDT and PCB concentrations were multiplied by the average avearge total suspended sediment load of 5,617 MT/yr to generate an estimate of annual stormwater loadings. Based on this analysis, between 0.117 and 0.145 kg of PCBs are discharged per year. These values are similar to estimates of existing loads derived above from the Curren et al. (2011) paper.

Table 4-3. Assessment of Ballona Creek sediment data (data provided by LA City)

Analyte	# of Analyses	MDL(ng/g)	RL (ng/g)	# of NDs	Average Concentration (ng/g)	Average Load (kg/yr)
Total PCBs 7Arochlors	21 samples x 7 arochlors = 147	3 to 40	83	82	25.8	0.145
Total PCB 40 Congeners	20 samples x 40 congeners = 800	0.49 to 3	5 to 10	792	20.8	0.117
Total DDT 6 isomers	21 samples x 6 isomers = 126	0.6 to 1	1.7 to 2	99	4.3	0.024

Estimated values above the method detection limit (MDL) but below the reporting level (RL) were treated as true values and non-detects were treated as ½ the MDL. Total Arochlor values were based on the average of the highest arochlor values in a sample.

4.2 NONPOINT SOURCES

A nonpoint source is a source that discharges to surface waters via sheet flow or natural discharges. Nonpoint sources, by definition, include pollutants that reach surface waters from a number of diffuse land uses and activities that are not regulated through NPDES permits. Roughly 90% of the northern watersheds draining into Santa Monica Bay are open space (Figure 4-3). A small fraction of the area was used for agriculture. The type of land uses in these areas is not likely to have significant loadings of DDT or PCBs.

There are no studies of DDT or PCB concentrations in soils from these more rural areas of the northern Santa Monica Bay watersheds. In California, DDT was used primarily for agricultural activities and only a small portion of the upper Malibu watershed is used for agriculture. Although PCBs are typically associated with more urban areas, PCBs were commonly used in a number of household products (e.g., fluourescent light fixtures, paints, waxes, caulking). Although there is little information available to estimate the potential loads from these areas, these rural areas are unlikely to be a major source of PCBs.

Figure 4-3. Land use patterns in Santa Monica Bay watersheds (LARWQCB, 2010)

Atmospheric Deposition.

Atmospheric deposition may be a potential nonpoint source of DDT and/or PCBs. There may also be potential losses of DDT and PCBs that may occur as a result of volatilization. Sabin et al. (2011) provide limited information on net-gas exchange during dry weather from sites near Ballona Creek Estuary and Los Angeles Harbor (Table 4-4).

Table 4-4. Estimates of atmospheric depositions (based on Sabin et al., 2011)

Sample ID	Parameter	Dry Particle Deposition ($ng/m^2/d$)	Gas Exchange ($ng/m^2/d$)	Net Air-Water Exchange ($ng/m^2/d$)	Dry Deposition (kg/yr)	Net Air Water Exchange (kg/yr)
BCE-1	*t*-DDT	14	-5.6	8.71	2.53	1.54
LAH-1	*t*-DDT	5.9	-26	-20	1.04	-3.48
LAH-2	*t*-DDT	15	-32	-17	2.66	-3.05
LAH-3	*t*-DDT	9.1	-13	-3.8	1.62	-0.69
Average	*t*-DDT				**2.07**	**-1.66**
BCE-1	*t*-PCB	19	-73	-54	3.42	-9.55
LAH-1	*t*-PCB	5.3	-85	-79	0.94	-14.0
LAH-2	*t*-PCB	8.3	-135	-126	1.46	-22.4
LAH-3	*t*-PCB	11	-49	-38	1.87	-6.75
Average	*t*-PCB				**1.94**	**-15.3**

Rough estimates of the loadings and/or losses were made by applying these estimates to the Palos Verdes shelf and Santa Monica Bay as a whole. An average dry deposition rate of 2.07 kg/yr for DDT and 1.94 kg/yr for PCB was calculated based on an area of 485 km^2 and the average dry-deposition rate from Sabin et al. (2011). This assumes that the deposition rate is fairly constant over the entire surface area of Santa Monica Bay which is a conservative assumption since particle-deposition rates generally decrease with distances offshore (Lu et al., 2003).

Volatilization may be an important loss term process for DDT and PCBs. However, the rates of volatilization are a function of concentrations in both the air and water which can vary greatly over time and space. The water concentration data from Sabin et al., (2011) were collected in relatively shallow water approximately 1 m above the sediment bed, so extrapolation of the data to Santa Monica Bay is more difficult. The results in Table 4-5 simply illustrate the potential for substantial loss due to volatilization.

4.3 CONTRIBUTIONS FROM IN PLACE SEDIMENTS

The contaminated sediments on the Palos Verdes shelf are a major source of DDT and PCBs to the Southern California Bight. Contaminated sediments resuspended into the water column may be transported out of Santa Monica Bay by the predominant currents or simply resettle to the sediment bed. Surface sediments may also be buried and thus become unavailable.

The flux of DDT from the Palos Verdes shelf sediments to the water column has been a major focus of the Superfund investigations. The flux has been estimated to be 401 kg/yr (Zeng et al., 2005). Studies conducted in the fall of 2011 by USEPA Superfund will provide more detailed information on the flux of DDT and PCBs. The results of these studies will not be available until a year after the Consent Decree deadline for this TMDL.

Sediment transport has been a major focus of the Superfund studies (Wiberg et al., 2002; Sherwood et al., 2002; Ferre et al., 2010). All these studies confirm that the general direction of transport is toward Santa Monica Bay. Patterns in sediment concentrations in Santa Monica Bay suggest that the Palos Verdes shelf may be a major source of DDT (Bay et al., 2003; Sommerfield and Lee, 2003, Venkatesan et al., 2010). However, there is no quantitative estimate on the amount of DDT or PCBs transported to Santa Monica Bay in the literature.

4.4 SUMMARY OF SOURCES AND LOADINGS

While POTWs were a major conveyance of DDT and PCBs in the past, the concentrations of both DDT and PCBs have decreased significantly since the early 1980's and the concentrations of DDT and PCBs at both Hyperion and JWPCP are currently at or near the detection limits. The only other individual permittee with limits for DDT and PCBs is the El Segundo Refinery. There are a number of smaller individual permits that discharge directly or indirectly into Santa Monica Bay. There are over a hundred activities that are covered under general permits. Three categories of general permits have a potential to contribute DDT or PCB loadings. Two of these are related to dewatering from the cleanup of contaminated sites, the third is related to dewatering related to construction projects. Only loadings from the two POTWs (Hyperion and JWPCP) have been characterized well. Information on loadings from most NPDES permittees is insufficient due to inadequate monitoring and high detection limits.

There is some data to suggest that stormwater loadings of both DDT and PCBs have decreased substantially since the 1970's. DDT and PCBs are no longer detected in routine stormwater sampling from Ballona Creek or Malibu Creek. However, detection limits are too high to quantify DDT or PCBs at concentrations at or near the appropriate water quality criteria. Recent studies indicate that concentrations of DDT and PCBs in Ballona Creek can exceed water quality criteria. The continued presence of high DDT and PCBs in sediments from Ballona Creek and Marina del Rey also suggest land-based inputs to the storm drain system. There is limited information to assess the impact of hundreds of individual industrial or construction stormwater projects.

Given the large mass of DDT and PCBs in the Palos Verdes shelf sediments and to a lesser extent in Santa Monica Bay, contaminated sediments are likely to be a major source of DDT and PCBs to Santa Monica Bay and its environs. The loadings from the Palos Verdes shelf to the Bight are large and have been well characterized. However, there does not appear to be any quantitative estimates of the loadings from Santa Monica Bay sediments.

5 LINKAGE ANALYSIS

In the linkage analysis, a model is used to assess the sources of pollutants identified in Chapter 4, provide estimates of sources from legacy pollutants that have not been previously characterized, and to evaluate the fate of DDT and PCBs in Santa Monica Bay.

A simple mass balance model has been developed as part of this TMDL to quantify DDT and PCB load movement into Santa Monica Bay from various sources. A higher level of model complexity is not warranted given the current data limitations. The goal of the model is not to provide precise estimates but rather to provide information on the relative magnitude of sources and the processes within the Bay that affect contaminant concentrations.

Information from the Superfund studies and models are used (Sherwood, 2008) to define the boundary condition between Palos Verdes and Santa Monica Bay (See Tetra Tech, 2011 for more detail). Santa Monica Bay is configured as three horizontal boxes: Box C represents Santa Monica Bay, Box B acts as a receiver of along-shore inputs, and Box C represents the general ocean boundary conditions (Figure 5-1). Each of these boxes is in turn divided vertically into 5 water column layers and 2 sediment layers (Figure 5-2). The box model is intended to simulate long-term average conditions in the system. The USEPA's Water Quality Simulation Program (WASP) was selected as the basis for numerically representing the conceptual model (USEPA, 2009).

Sediment data for Santa Monica Bay from 1995 to 2008 was provided by the City of Los Angeles Environmental Monitoring Division. The initial conditions for the model were based on the year 1995. The modeled sediment distribution was based on 40% fines and 58% sand based. An average bed density of 2.65 kg/L and a bed porosity of 0.5 were based on Blass et al. (2007).

Inputs from the land-based sources identified in Chapter 4 include loads from Hyperion allowed under the current NPDES permit, estimates of stormwater load extrapolated from Curren et al. (2011) and atmospheric deposition extrapolated from Sabin et al. (2011). The DDT and PCB loadings from these sources used in the model were approximately 11 kg/yr for DDT and 5 kg/yr for PCBs.

Water column data for DDT and PCBs in Santa Monica Bay to populate the model was limited (Chapter 2). The DDT and PCB data from Zeng et al. (1999) for the Palos Verdes shelf are from 8 stations. Most were from 1 m above the bed and data from multiple depths were provided for only one station (LACSD 6C). Zeng et al. (1999) developed an exponential decay function using the data from this station to extrapolate water column concentrations for the Palos Verdes shelf as a whole. The DDT data from Zeng et al. (2005) were collected at multiple depths from 7 stations on the Palos Verdes Shelf and 21 stations within Santa Monica Bay and other locations within the Southern California Bight. These data were used to develop a correlation between organic carbon normalized sediment concentrations and p,p-DDE aqueous concentrations at the 2-m depth above the sediment bed for the Southern California Bight.

The relationship from Zeng et al. (2005) was applied to sediment data from the City of Los Angeles and LACSD collected between 1995 and 2008 and sediment data from the Bight 2003 Survey (Schiff et al., 2006) to estimate water column concentrations near the sediment bed for Santa Monica Bay and Palos Verde shelf (Figure 5-3, LACSD, 2011). The exponential decay function from Zeng et al. (1999) was used to estimate concentrations throughout the water column. This information was used to populate the water column layers in Santa Monica Bay (Box C), the receiver box (Box B) and the ocean boundary condition (Box A).

Figure 5-1. Santa Monica Bay Model Segmentation

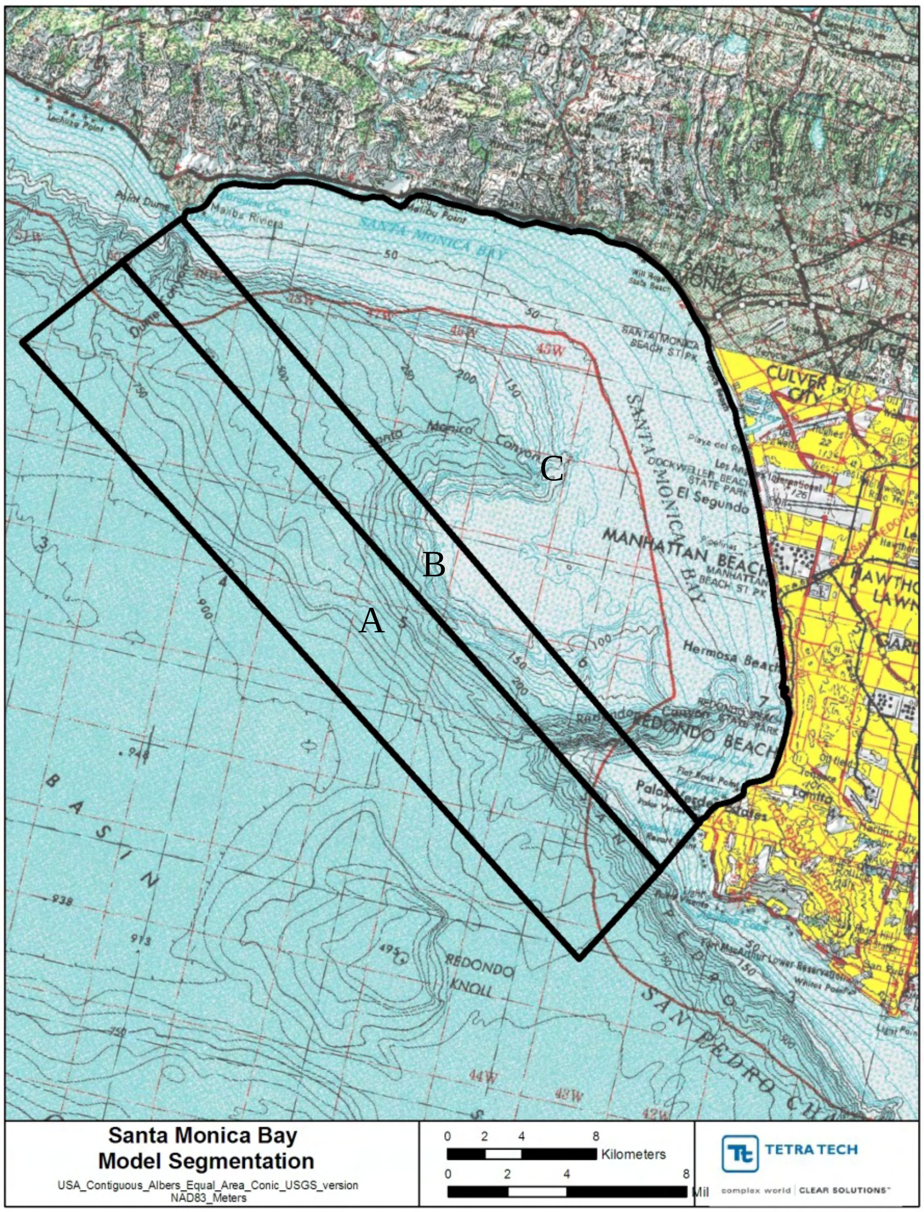
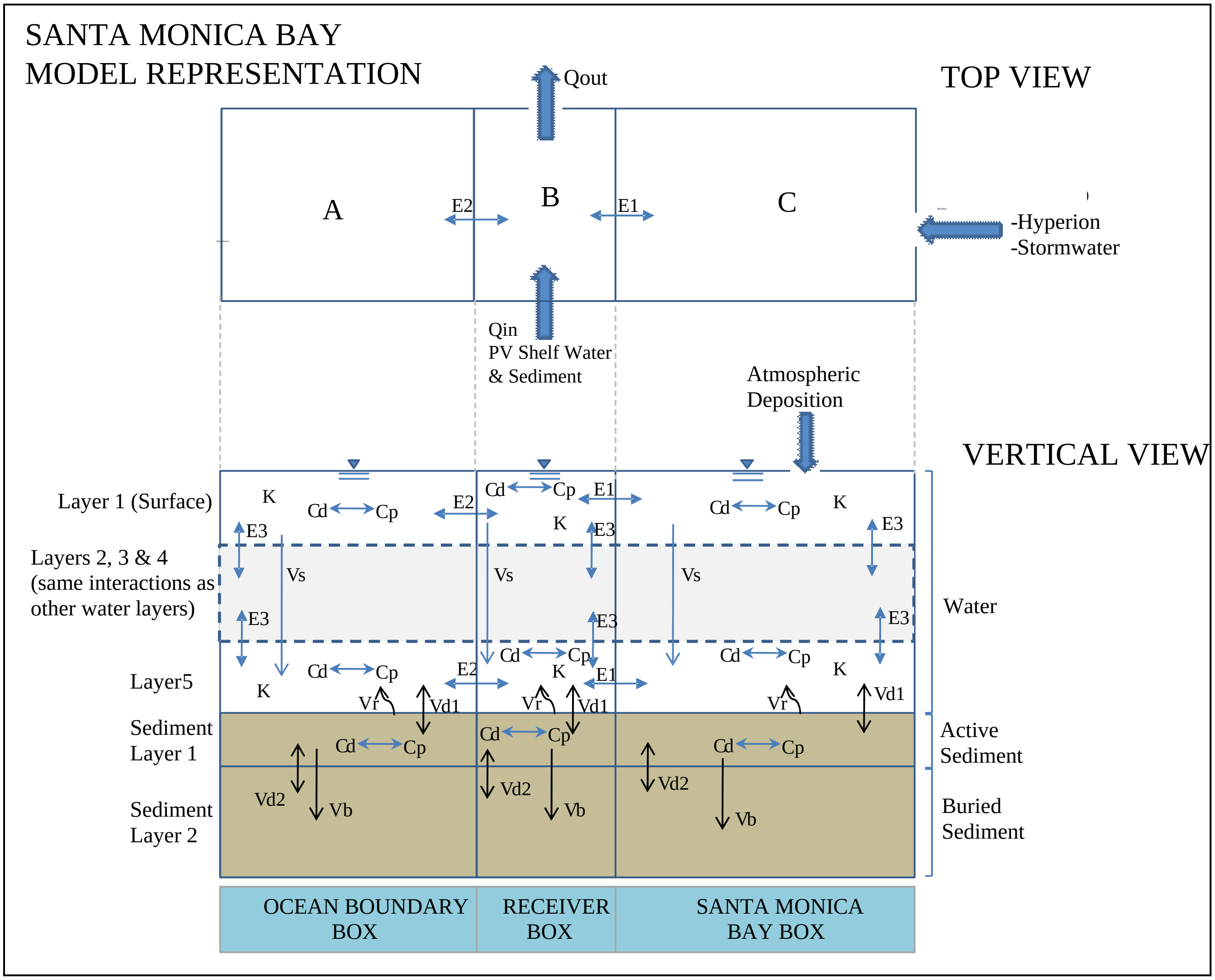
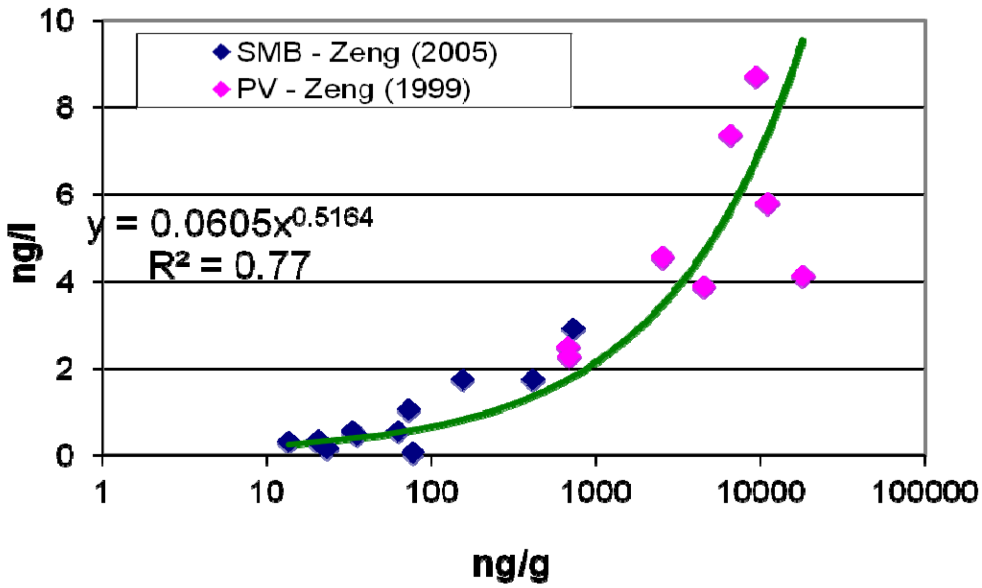


Figure 5-2. Santa Monica Bay Model Representation



Water column PCB data for the Palos Verdes shelf was limited to 8 stations. There is no data on PCB concentrations in the waters of Santa Monica Bay. The water column data for the Palos Verdes shelf collected in 1997 by Zeng et al. (1999) was compared to sediment data from these locations collected in 1996, the closest set of data for comparison. There was no relationship between sediment and water concentrations. The average ratio of 0.18% between water to sediment was used (n = 8, range 0.02% to 0.65%) to approximate the average concentrations throughout Santa Monica Bay based on the sediment data described above. The estimated concentration was extrapolated to the rest of the water column using the dilution curve from Zeng et al. (1999) and this was used to populate the water column layers in Santa Monica Bay (Box C), the receiver box (Box B) and the ocean boundary condition (Box A).

Figure 5-3. Relationships between p,p-DDE in the surface sediment (ug/kg) and concentration in the water column 2 meters above the sediment bed. Based on Zeng et al. 1999 and 2005)



The results of this analysis indicate that concentrations of both DDT and PCBs in bottom waters near the sediment bed exceed the water quality standard. However concentrations decrease rapidly with distance from the bed. The average concentrations of DDT and PCBs in the water column of Santa Monica Bay (Box C) of 0.057 ng/l and 0.016 ng/l, respectively, are below the water quality standard.

To evaluate the Palos Verdes shelf as a source, the water column values extrapolated from LACSD (2011) were combined with an average flow volume of 0.05 m/s. This yielded an estimated flux rate of 400 kg/yr for DDT and 84 kg/yr for PCBs to the receiver box (Box B).

A first order estimate of the sediment transport of DDT and PCBs was obtained using a bulk sediment transport rate of roughly 10,000 kg/d (derived from Ferre et al., 2010). This value was multiplied by the average sediment concentrations at the boundary between the Palos Verdes shelf and the rest of Santa Monica Bay. We used average concentrations of 1,343 ng/g for DDT and 212 ng/g PCBs based on data from LACSD stations 1D, 1C and 1B (1996 to 2008) to represent the sediment concentrations at the boundary. This yielded a sediment-DDT load of 4.83 kg/yr and sediment-PCB load of 0.76 kg/yr. This may overestimate the actual loadings, as not all the particles delivered are likely to settle within Santa Monica Bay. A sensitivity analysis was used to estimate the net flux of Palos Verdes shelf originated toxics entering Santa Monica Bay (Box C). The Palos Verdes shelf loadings were removed from the model simulation, and the

Figure 5-4. Modeled mass balance for DDT (rates in kg/yr)

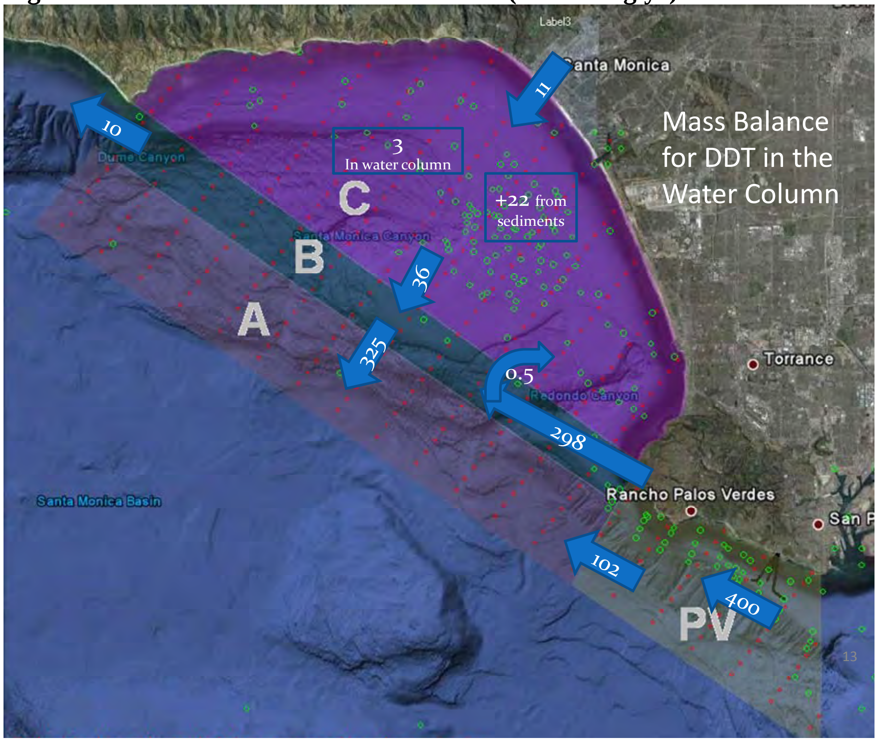
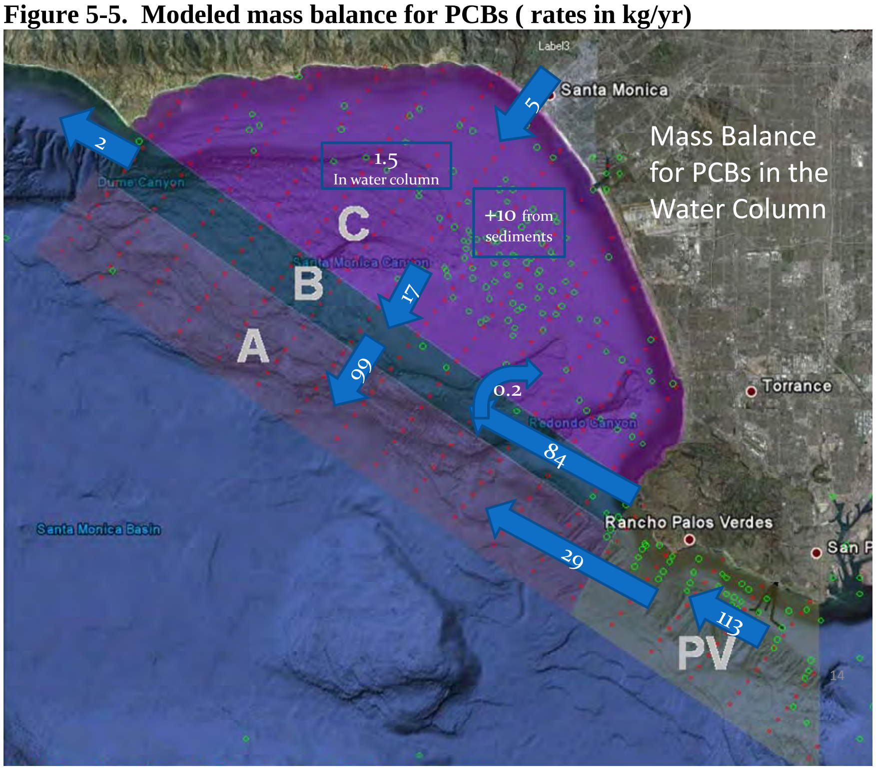


Figure 5-5. Modeled mass balance for PCBs (rates in kg/yr)



calculated changes in the mass of DDT and PCBs in the water column and the sediment bed within Santa Monica Bay (Box C) were attributed to the Palos Verdes shelf. The net loadings from the Palos Verdes shelf to Santa Monica Bay are 0.5 kg/yr for DDT and 0.2 kg/yr for PCBs. This is consistent with the general net transport toward the northwest and offshore and consistent with higher concentrations of sediments in deeper waters off the shelf.

The net flux between Santa Monica Bay and the Receiver Box B was estimated from the average gradient between the simulated water column DDT and PCB concentrations in Santa Monica Bay Box C and Receiver Box B. This resulted in an estimated net outward flux of 36 kg/yr of DDT and 17 kg/yr of PCBs to the Receiver Box B. The net flux from the Receiver Box B to the open ocean was calculated similarly and yielded a net loss of 325 kg/yr of DDT and a net loss of 99 kg/yr for PCBs.

The contributions from the sediments of Santa Monica Bay to the water column were estimated through a model sensitivity analysis in which the modeled contributions from bed diffusion and bed re-suspension were turned off in the model. Based on this analysis, we estimate that 22 kg/yr of DDT and 10 kg/yr of PCBs are fluxing from the sediments of Santa Monica Bay to the water column. This prediction is consistent with the observed loss in DDT and PCB in sediments over time. Using Venkatesan's (2011) estimates of 610 kg of DDT and 440 kg of PCBs in the surface sediments of Santa Monica Bay, this represents 14% and 9% of the mass, respectively. Most of this is due to the re-suspension of surface sediments; less than 1% is attributable to diffusive flux.

The loss of contaminants due to degradation in the active bed was estimated in the model using a first order decay rate of 0.01/yr (or 1% loss per year). Based on this simple decay rate of 0.01/yr we estimated loss rates of 52 kg/yr for DDT and 24 kg/yr for PCBs. To estimate the loss of contaminants due to burial, the total mass loss in the surface bed layer predicted by the model was calculated. The losses not attributable to re-suspension, diffusion, and first order decay were attributed to burial. The model predicts that burial within Santa Monica Bay removes 171 kg/yr of DDT and 78 kg/yr of PCBs. The simulated average annual burial rate of approximately 1.11 cm/yr is within 0.2 to 2.3 cm/yr range for Santa Monica Bay as reported in Bay et al. (2003).

The observed losses to DDT and PCB in sediments from Santa Monica Bay between 1995 and 2008 generally conform to losses predicted in the model (Figure 5-6 and 5-7). Slight deviations from the model prediction (e.g. PCBs from 2005 to 2007) are expected given the variability in sediment contaminant data and the simplicity of the model. The higher PCB concentrations are likely due to sample variability since there is no reason to expect PCBs to increase during this period.

The losses of DDT and PCBs from Santa Monica Bay due to burial (171 kg/yr and 78 kg/yr, respectively), advection of suspended and dissolved contaminants away from Santa Monica Bay (36 kg/yr and 17 kg/yr, respectively) and decay (52 kg/yr and 24 kg/yr, respectively) are larger than the current inputs to Santa Monica Bay (roughly 11 kg/yr and 5 kg/yr, respectively). To evaluate the time of recovery until compliance is met the model simulation period was extended to cover the years from 1995 to 2094. All current loadings were assumed to last for the entire period.

Figure 5-6. Trends in the average surface layer concentration of DDT and PCBs in the Santa Monica Bay box based on data from the City of Los Angeles (1995 to 2008) compared to model estimates

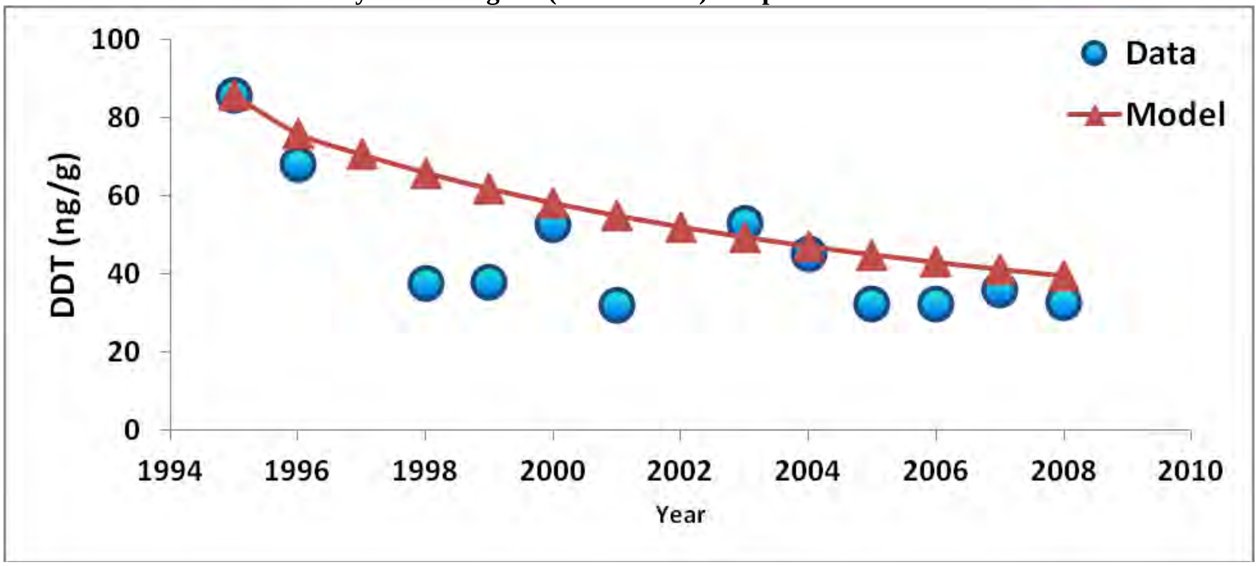
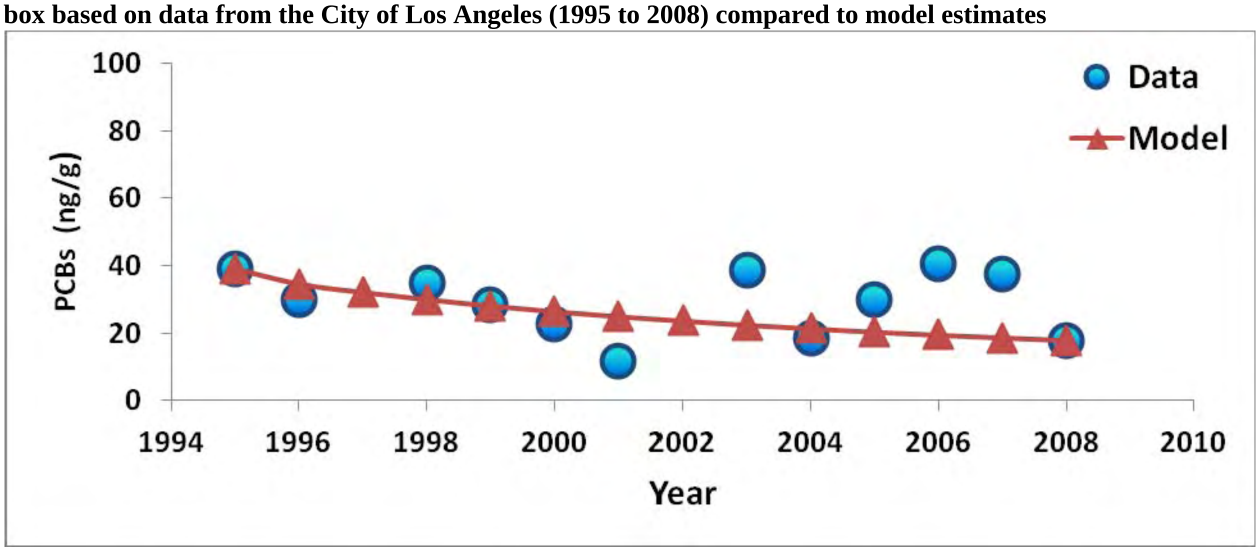
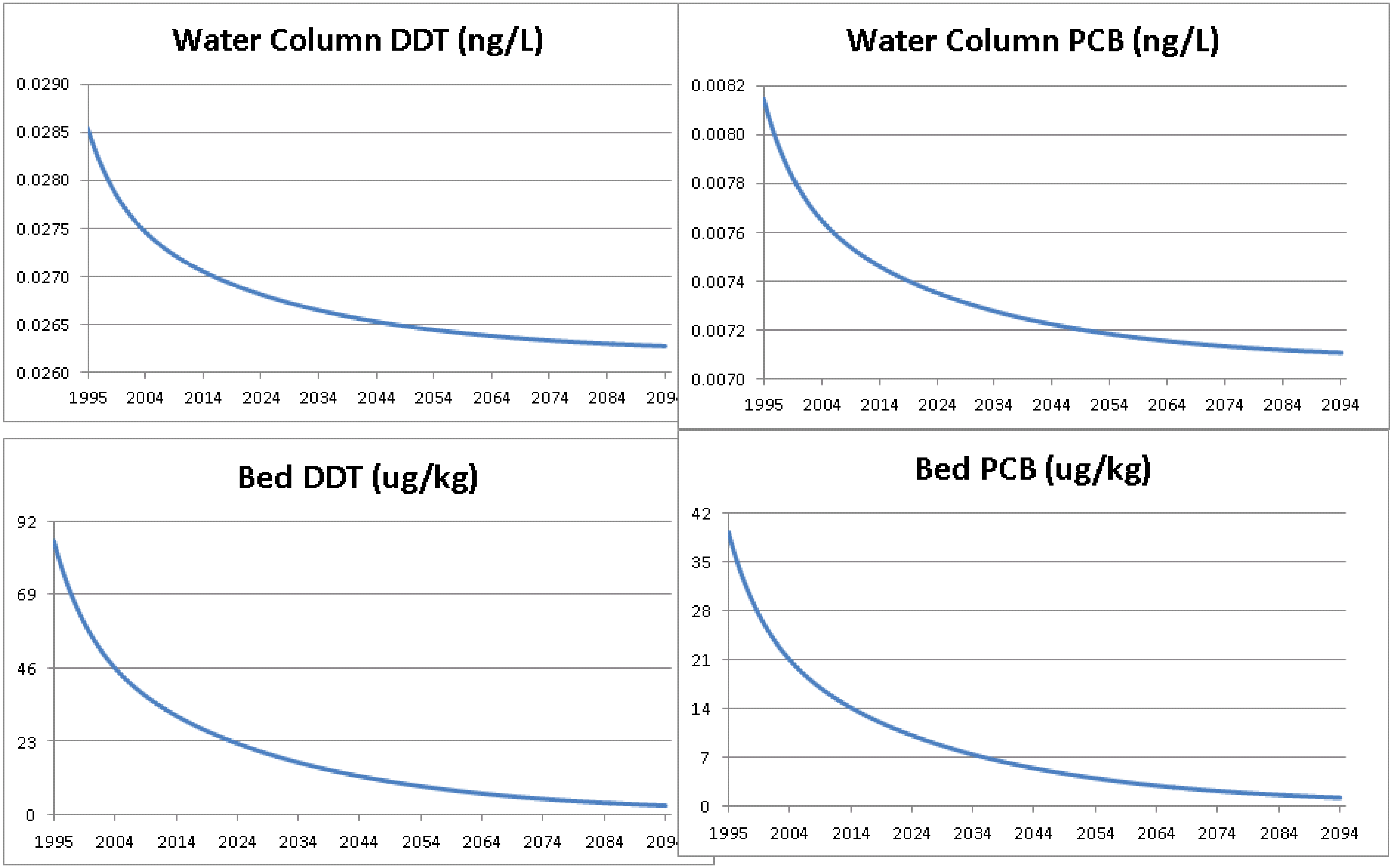


Figure 5-7. Trends in the average surface layer concentration of DDT and PCBs in the Santa Monica Bay box based on data from the City of Los Angeles (1995 to 2008) compared to model estimates



Figures 5-8 shows the simulated time series for DDT and PCB in both the water column and active bed of Santa Monica Bay. Model results indicate that the bed toxic concentrations decrease over time and compliance is predicted to be reached in approximately 2024 for DDT and 2036 for PCB. The water column targets are met under the current condition and concentrations will decrease further with time as sediment values decline.

Figure 5-8. Time to meet targets in sediment and water column



6 TMDL AND POLLUTANT ALLOCATION

The linkage analysis is used to identify the assimilative capacity of the receiving water for the pollutant of concern by linking the source loading information to the water quality target. The TMDL is then divided among existing pollutant sources through the calculation of load and waste load allocations.

6.1 LOADING CAPACITY

The loading capacity is simply the allowable load that can be accommodated by the system and still achieve water quality standards. First order estimates of loading capacity can be calculated for the water column of Santa Monica Bay and the Palos Verdes shelf by multiplying the volume of water in the water column by the respective water quality targets (Table 6-1). Similarly, estimates of loading capacity of the sediments are calculated by multiplying the surface sediment mass by the respective sediment targets. Since the sediment targets in Table 3-1 are normalized to organic carbon, the loading capacity is adjusted to account for this. For the Palos Verdes shelf, we used an average of 2.45% Total Organic Carbon (TOC) based on recent measurements made by USEPA Superfund. These are consistent with numbers from the LACSD annual reports. For the rest of Santa Monica Bay we used a value of 1% TOC. Schiff and Gossett (1998) reported an average TOC value for Santa Monica Bay of 1.2%. The average TOC values reported by the City of Los Angeles Environmental Monitoring Division (2003, 2005, 2007) typically ranged from 0.8 to 1.4%.

6-1. Loading capacity estimates

Location	DDT Water	DDT Sediment	PCB Water	PCB Sediment
Palos Verdes Shelf[1,2]	0.2 kg	1642 kg	0.058 kg	500 kg
Santa Monica Bay[3,4]	8.7 kg	1741 kg	0.97 kg	545 kg

1. Volume of Palos Verdes shelf water estimated at 9.01×10^{11} liters based on calculations in Zeng, 2005.
2. Sediment mass for Palos Verdes shelf estimated at 2.91×10^{12} g based on an area of 20.1 km^2, depth of 10 cm (from Sherwood, 2008) and density of 1.45 g/cm^3.
3. Volume of Santa Monica Bay estimated at 50.9 x 1012 liters based on area of 522 km2 and average depth of 97 m.
4. Santa Monica Bay sediment mass estimated at 7.57 x 1013 g based on area of 522 km2, depth of 10 cm and density of 1.45 g/cm3.

Zeng's (1999) estimate of 1.3 kg of DDE in the water column above the Palos Verdes shelf is significantly higher than the loading capacity of 0.2 kg. Similarly Zeng's (1999) estimate of 0.2 kg of PCBs for the Palos Verdes shelf water column is greater than the loading capacity of 0.058 kg. There are no published estimates of the existing mass of DDTs or PCBs in the Santa Monica Bay. However our modeled estimates of existing mass in Santa Monica Bay (Box C) are 2.7 kg for DDT and 0.75 kg for PCBs, which are less than the loading capacity as defined in Table 6-1.

Based on information provided in Sherwood (2008) we estimate that there is about 14,700 kg of DDE in the top 10 cm of the Palos Verdes shelf. This is about an order of magnitude higher than the 1,642 kg allowed in Table 6-1.

To compare the allowable sediment capacity for Santa Monica Bay with the existing loads of 610 kg of DDT and 440 kg from Venkatesan (2010), we normalized the values in Table 6-1 using Venkatesan's assumptions for area (550 km^2) and depth (2 cm). After adjusting for these different assumptions, the values in Table 6-1 would be 367 kg and 117 kg for DDTs and PCBs, respectively. Based on this more direct comparison, the existing DDT mass in the surface (2 cm) sediments of 610 kg is about 66% higher than the allowable mass of 367 kg The PCB sediment mass in the surface (2 cm) sediments of 440 kg is almost 4 times higher than the existing load of 117 kg.

Critical Conditions

As discussed in Chapter 3, the water column, sediment and fish targets are based on assumptions of excess cancer risks over a lifetime. Specifically, the impacts to human health through the consumption of fish assumptions are based on a 70-year life and 30 years of consumption, so the critical period of interest for this TMDL is 30 years. The critical consumption rate is 116 g/d.

6.2 WASTE LOAD ALLOCATIONS

Waste Load Allocations for Individual POTW/Industrial Permits

WQBELs for permitted facilities discharging directly to Santa Monica Bay ocean waters are currently established assuming that the background concentrations of DDT and PCBs are zero, as prescribed in the COP. However, as discussed in Chapters 2 and 5, the concentrations of DDT and PCBs in Santa Monica Bay are not zero. Concentrations are typically highest near the sediment bed and decrease exponentially with distance from the sediment bed, such that concentrations in the surface water are below the COP objectives. The water column estimates derived for model development (Chapter 5) were used to calculate average background water column concentrations for DDT and PCBs (LACSD, 2011). The estimated background DDT concentrations are 0.078 ng/l for the Palos Verdes shelf and 0.057 ng/l for Santa Monica Bay. The estimated background PCBs concentrations are 0.017 ng/l for the Palos Verdes shelf and 0.016 ng/l for Santa Monica Bay.

For the specified facilities discharging directly to ocean waters, concentration-based WLAs in Table 6-2 are calculated with Equation 1 in the COP:

Equation 1: $Ce = Co + Dm (Co - Cs)$, where:

Ce = effluent concentration limit, ng/l
Co = water quality objective to be met at the completion of initial dilution, ng/l
Cs = background seawater concentration, ng/l
Dm = minimum probable initial dilution expressed as parts seawater per part wastewater.

For the Los Angeles County Districts Joint Water Pollution Control Plant (JWPCP), the Hyperion Treatment Plant (HTP), and the Chevron El Segundo Refinery, the concentration-based WLAs in Table 6-2 are calculated with COP Equation 1, using currently permitted initial dilution (Dm) values and estimates of background concentration for DDT and PCBs developed for this TMDL.

Table 6-2. Waste Load Allocations for specified individual POTW and industrial NPDES permits.

Facility	Design Flow MGD	DDT[1] (ng/l)	PCBs[2] (ng/l)	DDT[1] (g/yr)	PCBs[2] (g/yr)
LA County Sanitation Districts Joint Water Pollution Control Plant (JWPCP)	400	15.8	0.351	8,717[3]	194[3]
Hyperion Treatment Plant (HTP)	420	10.1	0.271	5,850[3]	157[3]
West Basin Municipal Water District, Edward C. Little WRP	5.2			*WLA* [3]	*WLA* [3]
West Basin Municipal Water District, Carson Regional WRP	0.9			*WLA* [3]	*WLA* [3]
Chevron, El Segundo Refinery	27	9.6	0.259	358	10
Redondo Generating Station	1,146	0.17	0.019	---	---
El Segundo Generating Station	607	0.17	0.019	---	---
Scattergood Generating Station	496	0.17	0.019	---	---
Las Virgenes MWD, Tapia WRP	16.1	0.22	0.064	4.893	1.6
LA Co Department of Public Works, Malibu Mesa WRF	0.2	0.22	0.064	0.061	0.019

1. DDT means the sum of 4,4'-DDT, 2,4'-DDT, 4,4'-DDE, 2,4'-DDE, 4,4'-DDD, and 2,4'-DDD.
2. PCBs mean the sum of Aroclor-1016, 1221, 1232, 2342, 1248, 1254, and 1260 when monitoring using USEPA method 608. PCBs mean the sum of 41 congeners when monitoring using USEPA proposed method 1668c. PCB-18, 28, 37, 44, 49, 52, 66, 70, 74, 77, 81, 87, 99, 101, 105,110, 114, 118, 119, 123, 126, 128, 138, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 177, 180, 183, 187, 189, 194, 201, and 206 shall be individually quantified.
3. The total loads of DDT and PCBs from JWPCP, HTP, and West Basin's WRPs shall not be more than 14,567 g/yr for DDT and 351 g/yr for PCBs. To account for the mass transfers that occur during water recycling activities, "floating" WLAs (in g/yr) for each of West Basin's WRPs are established as:

Carson WRP WLA = $C_{HTP}\ (Q_{HTP\ to\ Carson}) + C_{JWPCP}\ (Q_{JWPCP\ to\ Carson})$
Little WRP WLA = $C_{HTP}\ (Q_{HTP\ to\ Little})$

where:

C_{HTP} is the concentration-based WLA for the Hyperion effluent
C_{JWPCP} is the concentration-based WLA for the JWPCP effluent
$Q_{(HTP\ to\ Carson)}$ and $Q_{(JWPCP\ to\ Carson)}$ are the flows diverted from Hyperion and JWPCP to the Carson WRP
$Q_{(HTP\ to\ Little)}$ is the flow diverted from Hyperion to the Little WRP

For loads, the DDT WLA for JWPCP is reduced from 15.4 kg/y (permitted) to 8.7 kg/yr and the WLA for HTP is reduced from 8.4 kg/yr (permitted) to 5.9 kg/yr. The PCBs WLA for JWPCP is reduced from 1.8 kg/yr (permitted) to 0.19 kg/yr and the WLA for HTP is reduced from 0.9 kg/yr (permitted) to 0.16 kg/yr.

To avoid creating an impediment to water reclamation, concentration-based WLAs are not specified for West Basin's water recycling plants (WRP). The JWPCP, HTP, and West Basin's water recycling plants are all part of an interconnected water recycling system. West Basin WRPs take secondary effluent from HTP and further treat it at Edward C. Little WRP and Carson Regional WRP. Reverse osmosis (RO) brine from the Little WRP is discharged into the Hyperion outfall and RO brine from the Carson WRP is discharged into the JWPCP outfall. As both WRPs are simply concentrating secondary effluent from the HTP (and potentially from the JWPCP in the future), there is no increase in DDT or PCBs loads from these outfalls. To avoid double counting pollutant loads, the "floating" mass-based WLAs for West Basin's water recycling plants in Table 6-2 incorporate the concentration-based WLAs for HTP and JWPCP. The total loads of DDT and PCBs from HTP, JWPCP, and West Basin's WRPs shall not be more than 14,567 g/yr for DDT and 351 g/yr for PCBs.

For the generating stations the concentration-based WLAs in Table 6-2 are based on the COP objectives to meet the TMDL target within Santa Monica Bay. Since the discharges contain predominantly once through cooling water that should have the same quality as seawater, the concentration based WLAs are set at the COP objectives with no credit for dilution.

Tapia WRF and Malibu Mesa WRF are discharges to inland surface waters that may flow indirectly to Santa Monica Bay (specified in Table 6-2). For these discharges, USEPA has established concentration-based WLAs for DDT and PCBs based on USEPA's CWA Section 304(a) criterion for human health.

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available waste load allocations (WLAs). See Chapter 8 for USEPA recommendations on implementation. For all discharges with WLAs in Table 6-2, in addition to NPDES monitoring for DDT and PCBs conducted using currently approved 40 CFR 136 methods, to ensure that useable DDT and PCBs data are acquired for effluent characterization under the TMDL, USEPA recommends that the Regional Board (and USEPA) require monitoring and reporting using sufficiently sensitive test methods (e.g., USEPA proposed method 1668 for PCBs). See Chapters 7 for additional recommendations on monitoring.

No WLAs are established at this time for discharges from groundwater cleanup activities covered under the three general NPDES permits described in Table 4-2, since there is insufficient data to suggest that the activities of these discharges are a source of DDT or PCBs to Santa Monica Bay. However, USEPA recommends that the Regional Board require applicants covered under these general permits to screen their discharges for DDT and PCBs using the more sensitive test methods recommended above, as provided for in Section 2.4.1 of the State Implementation Policy and Section III.C.5 of the COP, rather than the general permits' monitoring methods (and minimum levels).

Waste Load Allocation for Stormwater

USEPA requires that waste load allocations be developed for NPDES-regulated stormwater discharges. Allocations for NPDES-regulated stormwater discharges from multiple point sources may be expressed as a single categorical waste load allocation when data and information are insufficient to assign each source or outfall individual allocations.

Calculated maximum allowable stormwater loadings to Santa Monica Bay are based on the sediment targets of 23 ng/g DDT and 7 ng/g of PCBs multiplied by the average annual total suspended solids loadings from watersheds draining to Santa Monica Bay. The estimates of total suspended solids (TSS) are based on LSPC model outputs for the years 2000 to 2010 based on Ackerman and Schiff (2003). Using this method the theoretical maximum allowable stormwater loads would be 506 g/yr for DDT and 154 g/yr for PCBs (Table 6-3).

However, estimates of current stormwater loads are much lower. Estimates based on the median value from Curren et al. (2011) extrapolated to the other watersheds based on percent urban area were 28 g/yr for DDT and 145 g/yr for PCBs. The highest loadings were from Ballona Creek, Hermosa Beach and Santa Monica Canyon watersheds. These three watersheds are highly urbanized and combined they represent 94% of the developed area draining to Santa Monica

Bay. With the exception of PCBs from these three watersheds, all other estimates of current loading are lower than the allowable loadings.

Table 6-3. Comparison of the Maximum allowable stormwater loadings (calculated by multiplying the sediment target with the annual average total suspended solids loadings) to allowable waste loads in TMDL (based on existing load estimates).

		Maximum Allowable Loads		TMDL Allowable Loads	
Watershed	**TSS (kg/yr)**	**Total DDTs (g/yr)**	**Total PCBs (g/yr)**	**Existing DDTs Load (g/yr)**	**Existing PCBs Load (g/yr)**
Ballona Creek	5.62E+06	129	39	18	93
Malibu Creek	4.89E+06	112	34	0.76	3.9
Hermosa Beach	1.63E+06	38	11	5.2	27
Topanga Creek	1.17E+06	27	8	0.41	2.1
Solstice Canyon	9.98E+05	23	7	0.03	0.15
Escondido Creek	9.51E+05	22	7	0.10	0.51
PCH, Malibu Sunset	9.38E+05	22	7	0.02	0.11
Carbon Canyon	9.23E+05	21	6	0.10	0.52
Walnut Canyon	8.87E+05	20	6	0.24	1.22
Las Flores Canyon	8.73E+05	20	6	0.08	0.42
Santa Monica Canyon	8.60E+05	20	6	3.18	16
PCH, Big Rock Rd	7.73E+05	18	5	0.03	0.18
Pena Canyon	7.40E+05	17	5	0.01	0.03
Tuna Canyon	7.30E+05	17	5	0.01	0.06
Total Stormwater Load		**506**	**154**	**28**	**145**

1. The watershed breakout of allocations in this table are for informational purposes. The TMDL waste load allocation is for the entire watershed to provide flexibility for cost-effective implementation.

Because existing stormwater loads from the watersheds are lower than the calculated total allowable loads to achieve sediment targets, the waste load allocations for stormwater in this TMDL are based on existing load estimates of 28 g/yr for DDT and 145 g/yr for PCBs. For information purposes, the total stormwater waste load allocations are apportioned to the different watersheds based on the percent developed area in each watershed (i.e., last two columns of Table 6-3). It is not the intent of this TMDL to require compliance monitoring at the bottom each watershed. Rather, separate WLAs will be set for each of stormwater permit (which may cut across watershed boundaries). Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available waste load allocations (WLAs). The grouped waste load allocations shall be apportioned to the Los Angeles County MS4 permit, the Caltrans stormwater permit and enrollees under the general construction and industrial stormwater permits, based on their relative percent area within the watersheds draining to Santa Monica Bay (Table 6-4). For instance, as the footprint of the CalTrans stormwater permit (CAS000003) is 2.7% of the area within the Santa Monica Bay watersheds, the CalTrans waste load allocation for this TMDL would be 0.75 g/yr for DDT and 3.9 g/yr for PCBs (which equals 2.7% of the TMDL waste load allocation in Table 6-3).

Table 6-4. Mass-based waste load allocations for the four major groups of stormwater permit discharging to Santa Monica Bay.

Permit Type	Area (m2)	% of Total Area	DDT (g/yr)	PCBs (g/yr)
Los Angeles County MS4	926,705,620	96.723	27.08	140.25
CalTrans	25,746,490	2.687	0.75	3.90
Construction	5,406,683	0.564	0.16	0.82
Industrial	241,245	0.025	0.01	0.04
Entire SMB WMA	958,100,038	100	28	145

The loadings for the industrial and construction stormwater permitees are based on the aggregate area represented by the individual permittees covered under these general stormwater permits (Table 6-4). Although these are small loadings, studies performed in association with the San Francisco Bay PCBs TMDL have suggested that the runoff from industrial areas were much higher than other areas on a per acre basis. Furthermore, as PCBs were also common in light ballasts, paints and waxes, the capture of residues during building demolition is also an important source. These studies recommended best management practices (BMPs) to reduce potential PCB loads from industrial and construction runoff. Recommendations for monitoring stormwater are provided in Chapter 7. Recommendations for implementing the stormwater allocations are discussed in Chapter 8.

6.3 LOAD ALLOCATIONS

Load Allocation for Non-Point Sources

The load allocation for direct atmospheric deposition to waters of Santa Monica Bay and the Palos Verdes shelf are set at existing levels. No specific load allocation is given for atmospheric deposition to land which can be indirectly conveyed to Santa Monica Bay through stormwater as these loads are accounted for in the stormwater waste load allocations. Load allocations were not given to National Parks, State Parks or conservation areas as the loadings from these areas to Santa Monica Bay would be conveyed through stormwater conveyances. Therefore these loadings are already accounted for in the stormwater waste load allocations.

Superfund Action to Reduce Loads on the Palos Verdes shelf

The selected Superfund remedy for the Palos Verdes shelf is a mix of institutional controls which include outreach and enforcement of the commercial fishing ban, capping the most contaminated area of the Palos Verdes shelf, and monitoring natural recovery. The 1.3 km^2 cap will provide cover (i.e., a 45 cm of fine sand/silt layer) to the area on the southeast edge of the deposit most susceptible to net erosion. The estimated 661,000 cubic meters of cover will cap and contain approximately 27,000 kg of DDE, roughly a third of the total 84,000 kg DDE inventory estimated in the Palos Verdes shelf sediments. The cap will result in immediate reductions in the flux of DDT and PCBs to the water column.

USEPA Superfund anticipates that DDT concentrations will attain the water quality standard approximately 15 years after placement of the cap. Surface sediments are expected to decline to an average DDT concentration of 460 ng/g OC by year five and meet the sediment target of 230 ng/g OC within 22 years. There is some uncertainty in the timeframe for compliance with the PCB Superfund remedial action objectives of 0.064 ng/l for the water and the 70 ng/g OC for the sediment. Studies are underway to better evaluate the remedy relative to PCBs. Additional studies included under the interim Record of Decision will be used to develop timelines for achievement of water and sediment cleanup levels for PCBs. These will be reviewed 5-years after the cap has been put in place.

Table 6-5. Time required to meet the TMDL targets

DDT	Palos Verdes Shelf	Santa Monica Bay
DDTs in Water	15 years to meet 0.22 ng/l	2 years to meet 0.17 ng/l
DDTs in Sediment	22 yrs to meet 23 ug/g OC	11 years to meet 2.3 ug/g OC
PCBs	**Palos Verdes Shelf**	**Santa Monica Bay**
PCBs in Water	22-30 years to meet 0.064 ng/l	2 years to meet 0.019 ng/l
PCBs in Sediment	22-30 yrs to meet 7 ug/g OC	22 years to meet 0.7 ug/g OC

Margin of Safety

TMDLs must include a margin of safety to account for uncertainties in the development of the TMDL. A number of conservative assumptions have been made in the development of this TMDL. A conservative fish consumption rate of 116 g/d (28.6 oz per week) was used in the development of the fish tissue targets. This rate is based on the 90th percentile consumption rate of the local Asian population as determined in the Santa Monica Bay Fish Consumption Survey (SCCWRP and MBC, 1994). For Santa Monica Bay, the fish targets established in the TMDL are well below all the OEHHA assessment threshold levels and are closer to the OEHHA fish contamination goals. The tissue targets for Santa Monica Bay result in an excess cancer risk slightly less than 1 per 100,000 (due to the high consumption rate) or less than 2 per 1,000,000 (using the OEHHA consumption rate of 32 g/d). The Superfund remedial action objectives for fish tissue for the Palos Verdes shelf are higher but result in an excess cancer risk of less than 1 per 10,000 (using the high consumption rate) or less than 2 per 100,000 using the OEHHA consumption rate of 32 g/d.

There are several conservative assumptions made in the development of the model used to develop the TMDL. The modeled inputs from NPDES dischargers were based on conservative estimates. For example estimates from Hyperion were based on permit limits rather than existing concentrations which are much lower. The modeled stormwater inputs were based on the maximum particle concentration from Ballona (derived from Curren et al., 2010) and extrapolated to the entire watershed using a conservative estimate of TSS loadings. The potential for losses due to volatilization was not accounted for in the model.

Finally, implicit margins of safety were included in the development of waste load allocations. Waste load allocations for Hyperion, LACSD and other ocean discharges (Table 6-2) were based on estimates of the existing water column concentrations and do not take into account improvements to background water quality over time that will result from natural attenuation (burial, advection and decay) or improvements that will result from the USEPA Superfund action on the Palos Verdes shelf. Waste load allocations for stormwater permits were set at existing loads which were considerably lower than the modeled loadings. The waste load allocations are also lower than the theoretical maximum allowable (as shown in Table 6-3).

7 MONITORING RECOMMENDATIONS

Monitoring is recommended to assess progress towards achieving the TMDL targets, assessing the effectiveness of implementation actions and refining actions if necessary.

7.1 SUPERFUND MONITORING

The USEPA Superfund Action is intended to significantly reduce the flux of contaminants from the Palos Verdes shelf to the Bight and to reduce risks to human health. The Interim Record of Decision describes the monitoring efforts to be undertaken as part of the Superfund Action.

The monitoring associated with the institutional controls includes**:**

- The collection and analysis of DDT and PCBs in white croaker from eight key fishing piers (4 piers every year).
- Inspection of commercial fish markets for white croaker and analysis of contaminant concentrations in white croaker and kelp bass from areas within the white croaker commercial catch ban.
- Implementation of a new fish consumption survey to better target its outreach and education messages.

The monitoring associated with the capping component includes:

- Tracking the resuspension plume and turbidity by sampling of sediment and water column during construction.
- Assessing cap thickness, cap movement, cap compaction, and contaminant flux, to verify effectiveness and stability of the cap after construction.
- Assuring the cap is performing in a manner which satisfies remedy requirements.

Natural recovery monitoring will track changes in sediment, water and fish species through sampling and analysis one year after interim ROD is signed, and at five-year intervals for the Five-Year Review until a final ROD is in place. Additional data for PCBs in sediment and water will be collected to forecast PCB loss rates. This information will be used to develop subsequent remedial actions.

Monitoring will be conducted over the life of the remedial action to evaluate performance and optimize effectiveness. The detailed monitoring plans will be described in the Remedial Design/Remedial Action documents which will include specifications for monitoring cap effectiveness and points of compliance.

Five-Year Review Component for the Selected Remedy
A review is required at a minimum every five years if, under the selected remedy, contaminants remain above levels that allow for unlimited use and unrestricted exposure (40 CFR §300.430[f][4][ii]). USEPA will conduct these reviews beginning five years after initiation of the remedial action to help ensure that the selected remedy is protective of human health and the environment. When a final remedy is selected, the five-year reviews will become part of that action.

7.2 RECOMMENDATIONS FOR OTHER OCEAN MONITORING PROGRAMS

Both LACSD and Hyperion are required as part of their existing NPDES monitoring program to monitor their effluent, sediments and fish tissue for both DDTs and PCBs on a regular basis (See Table 7-1 for summary). The LACSD monitoring compliments the Superfund monitoring on the Palos Verdes Shelf. The Hyperion monitoring provides information on the greater Santa Monica Bay. The sampling designs from these permit monitoring programs are generally adequate to track trends in sediment and fish tissue and measure compliance with the Targets established in this TMDL. However, we recommend the following adjustments to the existing monitoring program.

The existing detection limits for effluent monitoring in both permits should be lowered to ensure compliance with the permit and to allow for better estimates of loadings.

USEPA recommends greater coordination between the fish tissue sampling programs associated with the Hyperion and LACSD permits and Superfund. These data should be combined to in an overall assessment framework which would track progress in meeting the tissue targets and remedial action objectives.

There is a lack of water column data for DDTs and PCBs for the Palos Verdes Shelf and the rest of Santa Monica Bay. LACSD and City of Los Angeles Bureau of Sanitation should coordinate with the Superfund program to track water column concentration and assure compliance with the Superfund RAOs and the TMDL targets.

Table 7-1. Summary of monitoring requirements for LACSD and Hyperion pertinent to this TMDL.

Type	LACSD	Hyperion
Effluent	Quarterly for DDTs and PCB Arochlors (same for influent). Annually for PCB Congeners	Quarterly for DDTs and PCB Arochlors (same for influent). Annually for PCB Congeners
Sediments	Annual measurement of DDTs, PCB Arochlors and PCB Congeners at 24 fixed sites (additional 20 fixed sites in year 5)	Annual measurement of DDTs, PCB Arochlors and PCB Congeners annually at 24 fixed and 20 random stations
Fish Trends	Summer sampling of Hornyhead turbot composites (tissue and liver) at 3 zones plus near field zone. Analyzed for DDTs, PCB Arochlors and PCB Congeners	Summer and Winter sampling of Hornyhead turbot composites (tissue and liver) at 3 zones plus near field zone. Analyzed for DDTs, PCB Arochlors and PCB Congeners
Seafood Safety	Biennial summer sampling of multiple species (tissue-filet) for DDTs, PCB Arochlors and PCB congeners Plus participation in Regional Seafood Safety Survey	Biennial summer sampling of multiple species (tissue-filet) for DDTs, PCB Arochlors and PCB Congeners Plus participation in Regional Seafood Safety Survey

7.3 STORMWATER MONITORING

Existing stormwater monitoring performed by the LADPW (as described in Chapter 4) is not providing information on the loadings or sources of DDT and PCBs. As both DDT and PCBs are highly associated with particles, monitoring should focus on sediment particles which may be transported during storms (e.g., as in Curren et al., 2011). We recommend that stormwater permittees filter water from their mass emission stations and analyze particles for DDT and PCBs. This will provide more meaningful estimates of mass loading than traditional water column sampling. We also recommend using sufficiently sensitive methods for DDT and PCBs (e.g. EPA method 1668c for PCB congeners). Monitoring should be conducted on a coordinated wastershed-wide basis. The monitoring design and assessment framework should be designed to provide credible estimates of the total mass loadings to the Bay. Any such estimates will require some extrapolation from a few locations to the entire watershed. Stormwater permittees should document the methodology for any such extrapolation.

Monitoring sediments in catch basins designed for pollutant prevention may be a way for parties to quantify load reductions to the Bay. The Regional Board may want to consider providing credits to entities that quantify the capture and removal of DDT and PCBs from the system.

7.4 AGRICULTURAL MONITORING

Monitoring of DDTs is also required as part of the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Agricultural Waiver, Order No. R4-2010-0186). This information should be used to assess sources and loadings from agricultural runoff.

7.5 SPECIAL STUDIES

Special studies are recommended to address uncertainties in the development of this TMDL. The relationship between sediment concentrations and fish tissue contamination was based on a Superfund model developed with data from the Palos Verdes shelf. Data from the Superfund white croaker tracking study and data from the baseline study of DDT and PCBs in sediment will allow for refinement of this relationship. Data from Santa Monica Bay, collected in association with the Hyperion permit, should also be evaluated to further refine the relationship.

There is very little information on the total mass of DDT and PCBs in subsurface sediments within Santa Monica Bay. Sediment coring profiles would provide better estimates of the total mass of DDT and PCBs within Santa Monica. There is also limited information on the flux rate of contaminants from the sediments of Santa Monica Bay to the water column. Direct measurements of DDT and PCBs in the water column and sediments could provide more accurate estimates of the fluxes of the DDT and PCB flux from the sediment to the water column.

There is very little information on the DDTs and PCBs in stormwater draining to Santa Monica Bay. An evaluation of embedded sediments in storm drains (e.g. as in Salop et al., 2006) would provide a better estimate of the potential stormwater loadings to the bay and could help identify potential sources of DDT and PCBs.

7.6 ASSESSMENT FRAMEWORK

The Regional Board should work with the Santa Monica Bay Restoration Commission to develop a framework to assess the monitoring data and evaluate progress toward attaining the TMDL targets and Superfund remedial action objectives.

Sediment data from Santa Monica Bay collected as a condition of the Hyperion permit (44 stations per year) should be used to track changes in the average concentration of DDT and PCB congeners in surface sediments.

Fish tissue data collected through biennial local seafood safety monitoring required as a condition of the Hyperion and LACSD permits should be used along with data from the Superfund fish pier monitoring to track changes in DDT and PCB congeners in fish tissue over time.

Periodic sampling and analysis of DDT and PCBs at multiple water depths is encouraged to assure compliance with applicable water quality standards. Passive samplers such as solid phase microextraction (SPME) filters or polyethylene devices (PEDs) are recommended. A sampling frequency of once every 3 to 5 years would be adequate to track changes. A single sampling array with multiple depths would be the minimum required to assess attainment.

Interim measureable milestones should be incorporated into a regular monitoring program for determining whether load reductions are being achieved, and whether progress is being made towards attaining water quality standards. Superfund studies will provide new information on the effectiveness of the cap and natural attenuation to achieve the remedial action objectives. The Superfund Interim Record of Decision will be reviewed 5 years after the start of implementation.

If necessary, the Santa Monica Bay TMDLs may be revised as the result of new information generated by the monitoring activities described above. USEPA recommends that future revisions to the Superfund project be incorporated into revisions of the TMDL.

8 IMPLEMENTATION RECOMMENDATIONS

Implementation measures may be developed by the Regional Board through an implementation plan, NPDES permits, or other regulatory mechanisms such as State waste discharge requirements (WDRs), conditional waivers of WDRs, and/or enforcement actions. This section describes USEPA's recommendations to the Regional Board and others as to the implementation procedures and regulatory mechanisms that could be used to provide reasonable assurances that water quality standards will be met.

8.1 IMPLEMENTING WASTE LOAD ALLOCATIONS IN TABLE 6-2

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available waste load allocations (WLAs). All discharges with WLAs identified in Table 6-2 are to be considered by NPDES permit writers to have reasonable potential under 40 CFR 122.44(d) and require WQBELs following this TMDL. Water quality based permitting for individual POTW and industrial discharges and non-stormwater general permit discharges without specified WLAs for DDT and PCBs in Table 6-2 should continue to be conducted by permit writers following all applicable State and federal regulations, plans, and policies; for these discharges, no specific WLAs are required if water quality based permitting procedures are followed by permit writers.

USEPA recommends that the concentration-based WLAs for facilities discharging to the ocean be implemented as monthly average WQBELs in permits. USEPA has evaluated the proper application of dilution when establishing the WLAs in Table 6-2 and permit writers should not further adjust these WLAs values using Dm in the COP, or D in the SIP, when calculating WQBELs. USEPA has evaluated the proper application of background concentration when establishing the WLAs in Table 6-2 and permit writers should not further adjust these WLAs values using Cs in the COP, or B in the SIP, when calculating WQBELs.

USEPA also recommends that the concentration-based WLAs for inland discharges (i.e. Tapia WRF and Maliu Mesa WRF) which are based on EPA 304(a) criterion for human health be implemented in permits using the human health WQBEL calculation procedure in the State Implementation Policy, to set monthly average and daily maximum WQBELs.

USEPA recommends that the all mass-based WLAs be directly implemented as annual average WQBELs in permits. USEPA recommends to the Regional Board (and USEPA) that the annual mass emissions (in g/yr) for discharges listed in Table 6-2 be calculated and reported as the sum of monthly emissions on a calendar year basis and computed as follows:

$$\text{Annual Mass Emission}, g/year = \sum(\text{Monthly Mass Emission Rates}, g/month)$$

or, for discharges with less frequent DDT and PCBs monitoring than monthly, the annual mass emission (in g/yr) should be calculated using the arithmetic average of available monthly mass emissions as follows:

$$Annual\ Mass\ Emission,\ g/year = \left(\frac{\sum MonthlyMassEmission,\ g/mo}{NumberofMonthlyMassEmissionsCalculated} \right) * 12 mo/year$$

where:

$$Monthly\ Mass\ Emission,\ kg/mo = \left(\frac{3{,}785}{N} \right) * \left(\sum_{i=1}^{N} Q_i C_i \right) * 30.5 = \frac{0.1154425}{N} * \left(\sum_{i=1}^{N} Q_i C_i \right)$$

and where:

C_i	= DDT or PCBs concentration of each individual sample, ng/l
Q_i	= discharger flow rate on date of sample, million gallons per day (mgd)
N	= number of samples collected during the month
0.003785	= conversion factor to convert (ng/l)*(mgd) into g/day
30.5	= number of days in a standard month
0.1154425	= product of (conversion factor)·(number of standard days per month)

and where Q_i for intermittent discharges (dischargers who do not discharge every day in a calendar month, or have no discharge for an entire month (Q_i = 0)) should be calculated as follows:

$$Q_i = \left(\frac{\sum_{d=1}^{D} Q_d}{30.5} \right)$$

where:

Q_d	= is the total flow for the day when discharge occurred, million gallons per day (mgd)
D	= total number of days where discharge occurred in a month
30.5	= number of days in a standard month

For all discharges with WLAs in Table 6-2, in addition to NPDES monitoring for DDT and PCBs conducted using currently approved 40 CFR 136 methods, to ensure that useable DDT and PCBs data are acquired for effluent characterization under the TMDL, the Regional Board (and USEPA) should require monitoring and reporting using sufficiently sensitive test methods (e.g., USEPA proposed method 1668 for PCBs). USEPA recommends that until USEPA proposed method 1668c for PCBs is incorporated into 40 CFR 136, dischargers should use for discharge monitoring reports/State monitoring reports: (1) USEPA method 608 for monitoring data, reported as aroclor results, that will be used for assessing compliance with WQBELs established using the WLAs in Table 6-2, and (2) USEPA proposed method 1668c for monitoring data, reported as 41 congener results, that will be used for informational purposes for the established TMDL. USEPA recommends that pollutant minimization programs incorporating the elements specified in the COP (or SIP) be developed and implemented, if there is evidence that DDT or PCBs are present in the discharge above the WLAs in Table 6-2, or permit's WQBELs.

WQBELs and Reporting for JWPCP, HTP, and West Basin's WRPs

When setting mass-based WQBELs for JWPCP, HTP, and West Basin's WRPs, the Regional Board (and USEPA) must consider how the mass-based WLAs are allocated among these four facilities, which operate as an interconnected water recycling system. The Carson WRP can take up to 5.9 MGD of effluent from HTP and discharge up to 0.9 MGD of concentrated brine into the JPWCP outfall. The potential DDT load associated with this transfer is about 82 g/yr. This is a small percentage (about 0.9%) of the JWPCP's WLA of 8,717 g/yr, but it should be accounted for in the mass balance. The Little WRP can take up to 60 MGD of effluent from HTP and discharge up to 5.2 MGD of concentrated brine into the Hyperion outfall. The potential DDT load associated with this transfer is about 837 g/yr, which is about 14.3% of the HTP WLA. A similar analysis can be done for the loadings of PCBs. To account for these mass transfers, USEPA recommends that annual "floating" WQBELs (in g/yr) for each of West Basin's WRPs be established as:

$$\text{WQBEL for Carson Regional WRP} = C_{HTP}Q_{(\text{HTP to Carson})} + C_{JWPCP}Q_{(\text{JWPCP to Carson})}$$

$$\text{WQBEL for E.C. Little WRP} = C_{HTP}Q_{(\text{HTP to Little})}$$

where:

C_{HTP} is the concentration WLA for the Hyperion effluent (from Table 6-2)

C_{JWPCP} is the concentration WLA for the JWPCP effluent (from Table 6-2)

$Q_{(\text{HTP to Carson})}$ and $Q_{(\text{JWPCP to Carson})}$ are the effluent flows diverted from Hyperion and JWPCP to the Carson Regional WRP

$Q_{(\text{HTP to Little})}$ is the flow diverted from Hyperion to the E.C Little WRP

NPDES permit writers must also ensure that total loads of DDT and PCBs from JWPCP, HTP, and West Basin's WRPs are not more than 14,567 g/yr for DDT and 351 g/yr for PCBs; USEPA recommends that NPDES compliance reporting requirements include reporting parameters for the total DDT load and PCB load from both outfalls that can be electronically reported and tracked.

USEPA recommends that compliance monitoring for DDT and PCBs concentrations in HTP and JWPCP effluents occur before these effluents commingle with RO brine from West Basin's WRPs. Flow rate compliance monitoring for HTP should occur after the effluent has been diverted to West Basin's WRPs. Flow rate compliance monitoring for JWPCP should occur after the effluent has been diverted to West Basin's WRPs, for any future water recycling of JWPCP effluent. For Little WRP and Carson WRP, compliance monitoring for DDT and PCBs concentrations and flow rates should occur immediately before discharge into the outfalls.

WQBELs and Reporting for Generating Stations

For the generating stations the concentration-based WLAs in Table 6-2 are based on the COP objectives without dilution to meet the TMDL target within Santa Monica Bay. An alternate approach would be to set concentration-based WLAs for each inplant waste stream using equation 1 of COP after considering initial dilution allowed in the existing permits and the background concentrations for DDT and PCBs defined in Section 6-2 of this TMDL (i.e., 0.057 ng/l for DDT and 0.016 ng/l for PCBs). Such an approach would be consistent with the intent of the TMDL to effectively monitor and limit inputs of DDT and PCBs to Santa Monica Bay. USEPA recommends that pollutant minimization programs incorporating the elements specified in the COP (or SIP) be developed and implemented, if there is evidence that DDT or PCBs are present in inplant waste streams above the WLAs in Table 6-2.

USEPA recommends that the concentration-based WLAs for these facilities be implemented as monthly average WQBELs in permits. To ensure that useable DDT and PCBs data are acquired for effluent characterization under the TMDL, the Regional Board should require monitoring and reporting using sufficiently sensitive test methods (e.g., USEPA proposed method 1668c for PCBs).

8.2 IMPLEMENTNG STORMWATER WASTE LOAD ALLOCATIONS IN TABLE 6-3

For the stormwater permits, group waste load allocations have been developed for the four major types of NPDES stormwater discharge permits (municipal stormwater separate sewer systems, CalTrans, general construction, and general industrial). The waste load based allocations derived from Table 6-3 should be placed in the stormwater permits as mass-based numeric WQBELs (CAS004001, CAS000003, CAS000002, CAS000001). Mass-based waste load allocations are to be partitioned among the four groups based on the percent area of each major group in the watersheds draining to Santa Monica Bay. Permittees covered under the general construction and stormwater permittees are not expected to perform individual sampling; instead monitoring should be conducted on a coordinated, watershed-wide base consistent with the WLAs in the TMDL. We encourage the establishment of watershed efforts to identify and address sources of DDTs and PCBs within the watersheds and reporting of the total stormwater loadings of DDT and PCB to Santa Monica Bay.

As discussed in the monitoring recommendations the analysis of DDT and PCBs on suspended particle loadings from the mass emission stations will provide more robust measures of mass loadings. If additional data indicates that existing stormwater loadings differ from the stormwater waste load allocations defined in the TMDL, the Los Angeles Regional Water Quality Control Board should consider re-opening the TMDL to better reflect actual loadings. We recommend that stormwater waste load allocations be evaluated based on a three year averaging period. This will provide more robust assessment for compliance and should smooth out variability due to wet years. This is consistent with timeframes provided for the Los Angeles Harbor/Long Beach TMDL.

BMPs and pollutant removal are the most suitable courses of action to reduce DDT and PCBs in the Santa Monica Bay Watershed. Attention should be focused on those watersheds with the highest potential loadings to Santa Monica Bay, such as those that are more heavily urbanized. Best management practices (BMPs) should also be targeted to reduce potential PCB loads from industrial and construction runoff as studies have shown that these may be a major source of PCBs.

We recommend implementation of a PCB Source Identification and Control program within stormwater permits to evaluate and identify controllable sources of PCBs. These sources may include PCB contributions to wastewater from industrial equipment and PCB contributions to wastewater from buildings with PCB containing sealants that are scheduled for remodeling or demolition.

The Regional Board may also require clean up of bed sediment through Cleanup and Abatement Orders and the California Water Code13267 or other appropriate authorities.   Regional Board may regulate nonpoint pollutant sources through the authority contained in Sections13263 and 13269 of the California Water Code, in conformance with the State Water Resources Control Board's Nonpoint Source Implementation and Enforcement Policy.

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