TOTAL MAXIMUM DAILY LOADS FOR

TOXIC POLLUTANTS IN

DOMINGUEZ CHANNEL

AND

GREATER LOS ANGELES AND LONG BEACH HARBOR WATERS

DRAFT: WATER QUALITY ASSESSMENT,
PROBLEM STATEMENT, NUMERIC TARGETS

PREPARED BY
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION
AND

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 9

MARCH 2010

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

µg/g	Micrograms per Gram
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
BPTCP	Bay Protection and Toxic Cleanup Program
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
City BOS	City of Los Angeles Bureau of Sanitation
CFR	Code of Federal Regulations
COMM	Commercial and Sport Fishing
CTR	California Toxics Rule
CWA	Clean Water Act
DDT	dichlorodiphenyltrichloroethane
DL	Detection Limit
EMCs	Event Mean Concentrations
ERL	Effects Range-Low
ERM	Effects Range-Median
EST	Estuarine Habitat
FR	Federal Register
kg	Kilograms
LACDPW	Los Angeles County Department of Public Works
LARWQCB	Los Angeles Regional Water Quality Control Board
LACSD	Los Angeles County Sanitation District
MAR	Marine Habitat
mg/kg	Milligrams per Kilogram
MS4	Municipal Separate Storm Sewer System
MTRL	Maximum Tissue Residue Level
NAV	Navigation
ng/L	Nanograms per Liter
NPDES	National Pollutant Discharge Elimination System
OEHHA	Office of Environmental Heath Hazard Assessment
PAHs	Polyaromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PEL	Probable Effects Level
POLA	Port of Los Angeles
POLB	Port of Long Beach
pg/L	Picograms per Liter
ppb	Parts per Billion
ppt	Parts per Thousand
RARE	Rare, Threatened, or Endangered Species
REC1	Water Contact Recreation
REC2	Non-Contact Water Recreation
SHELL	Shellfish Harvesting
SQOs	Sediment Quality Objectives
TEL	Threshold Effects Level
TMDL	Total Maximum Daily Load
TSMP	Toxic Substances Monitoring Program
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WDRs	Waste Discharge Requirements
WILD	Wildlife Habitat
WLAs	Waste Load Allocations
WQA	Water Quality Assessment
WQOs	Water Quality Objectives

Organization of this Document

- **Section 1: Background and Water Quality Assessment.** This section provides the background for these TMDLs and identifies specific water body-pollutant combinations on the 1998 and 2002 303(d) lists. It also describes the methodologies and benchmarks used to complete the assessment of available data.
- **Section 2: Problem Identification.** This section describes data record utilized in the assessment to demonstrate the nature and extent of the impairments addressed by TMDLs in future development. Beneficial uses of the impaired water bodies and the relevant water quality objectives are also presented.
- **Section 3: Numeric Targets.** This section identifies the numeric targets proposed for the TMDLs and representing attainment of water quality objectives (WQOs) and beneficial uses.

This TMDL staff report and accompanying Basin Plan Amendment incorporate the numeric targets, Baseline Waste Load Allocations for point sources and Baseline Load Allocations for nonpoint sources, margin of safety and implementation and compliance schedules.

- **Appendix A:** Sediment Summary. Sediment toxicity and chemistry results are summarized by water body and individual toxic parameter. Results are categorized by time periods: 1992-1995; 1996-2001, 2003, etc.
- **Appendix B:** Sediment Triad Results by Station. Spreadsheet of triad results from BPCTP, Bight 98, W-EMAP 99 and Bight 03. Map and station info included.
- **Appendix C:** Trends analyses via SMW and NOAA mussel data record from 1988 to 2000.

1. INTRODUCTION AND REGULATORY BACKGROUND

The waters of the Dominguez Channel and the Ports of Los Angeles and Long Beach in the San Pedro Bay have enormous economic, recreational and habitat value and fail to meet water quality standards. The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) has developed this total maximum daily load (TMDL) to attain the water quality standards for the Dominguez Channel and greater Los Angeles and Long Beach Harbors waters in the Dominguez Channel Watershed. The TMDL has been prepared pursuant to state and federal requirements to preserve and enhance water quality for impaired waterbodies within Coastal Watersheds of Los Angeles and Ventura Counties.

The California Water Quality Control Plan, Los Angeles Region (Basin Plan) sets standards for surface waters and ground waters in the Coastal Watersheds of Los Angeles and Ventura Counties. These standards are comprised of designated beneficial uses for surface and ground water, numeric and narrative objectives necessary to support beneficial uses, and the state's antidegradation policy. Such standards are mandated for all waterbodies within the state under the Porter-Cologne Water Quality Act. In addition, the Basin Plan describes implementation programs to protect all waters in the region. The Basin Plan implements the Porter-Cologne Water Quality Act (also known as the "California Water Code") and serves as the State Water Quality Control Plan applicable to the lake mentioned above, as required pursuant to the federal Clean Water Act (CWA).

Section 305(b) of the CWA mandates biennial assessment of the nation's water resources, and these water quality assessments are used to identify and list impaired waters. 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 resulting list is referred to as the 303(d) list. The CWA also requires states to establish a priority ranking for impaired waters and to develop and implement TMDLs. A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and allocates pollutant loadings to point and non-point sources. 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 also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (USEPA, 2000a).

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 water body. 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).

A consent decree between the USEPA, the Santa Monica BayKeeper and Heal the Bay Inc., represented by the Natural Resources Defense Council (NRDC), was signed on March 22, 1999

(consent decree). This consent decree requires that all TMDLs, as required by the 1998 303(d) list, for the Los Angeles Region be adopted within 13 years. For the purpose of scheduling TMDL development, the consent decree combined the more than 700 water body-pollutant combinations into 92 TMDL analytical units and also prescribed schedules for certain TMDLs.

Specific water body-pollutant combinations for Dominguez Channel and greater Los Angeles/Long Beach Harbor waters were identified as impaired on the 1996, 1998, 2002 and 2006 California 303(d) list (LA RWQCB, 1996, 1998, 2002, 2007). On June 28, 2007, EPA issued final decision regarding the State's 2004-2006 303(d) list. The final 2004-2006 list of impaired water body-pollutant combinations for Dominguez Channel and greater Los Angeles/Long Beach Harbor waters is contained in Table 2-6. Analytical units (AU) 73, 74, 75 and 78 are addressed via these Harbor Toxics TMDLs. However, parts of two AUs are not addressed in this TMDL project - Copper and lead in Wilmington Drain which is part of AU 75 and Chlordane, DDT and PCBs in Machado Lake which is part of AU 73. Regional Board has approved the 2008 Los Angeles Region Integrated Report Clean Water Act Section 305(b) Report and Section 303(d) List of Impaired Waters

The TMDLs for Dominguez Channel and greater Los Angeles/Long Beach Harbor waters will be implemented by Basin Plan Amendments and are therefore subject to Public Resources Code Section 21083.9 that requires California Environmental Quality Act (CEQA) Scoping and Analysis to be conducted for Regional Projects. CEQA Scoping involves identifying a range of project/program related actions, alternatives, mitigation measures, and significant effects to be analyzed in an EIR or its Substitute Environmental Documents (SEDs). On September 21, 2006 a CEQA Scoping meeting was held to present and discuss the foreseeable potential environmental impacts of compliance with the TMDLs for Dominguez Channel and greater Los Angeles/Long Beach Harbor waters at the Los Angeles Regional Water Quality Control Board. Input from all stakeholders and interested parties were solicited for consideration in the development of the CEQA environmental analysis.

2. PROBLEM STATEMENT

The waters of Dominguez Channel, Los Angeles and Long Beach Harbors, Cabrillo Marina, San Pedro Bay and Los Angeles River Estuary are impaired by heavy metals and organic pollutants. More specifically, each of these water bodies are included on the 303(d) list for one or more of the following pollutants: cadmium, chromium, copper, mercury, lead, zinc, chlordane, dieldrin, DDT, PCBs, and certain PAH compounds. These impairments may exist in one or more environmental media—water, sediments or tissue. This section provides an overview of water quality criteria and guidelines applicable to the above waterbodies and reviews the fish tissue, and sediment and water quality data compiled for the purpose of these TMDLs.

2.1 Environmental Setting

This report addresses water quality in Dominguez Channel and waters associated with greater Los Angeles and Long Beach Harbor ("greater Los Angeles/Long Beach Harbor waters"). Specifically, the greater Los Angeles/Long Beach Harbor waters include Inner and Outer Harbor, Consolidated Slip, Fish Harbor, Cabrillo Marina, Inner Cabrillo Beach, Los Angeles River estuary, San Gabriel River estuary and San Pedro Bay. (Figure 1).

Figure 1: Dominguez Channel and greater LA/LB Harbor waters.

The watershed of the Dominguez Channel and the Los Angeles and Long Beach Harbors is an important industrial, commercial and residential area with unique and important historical and environmental resources. The area includes 18 municipalities within and including Los Angeles County and roughly 1 million residents. Prior to its development, the area was largely marshland and now almost no wetland nor original coastline exists. Water quality decreased with increased development in the 1970s. Since then, the water quality has improved but there are still significant water quality and sediment quality challenges.

The ports of Los Angeles and Long Beach occupy over 10,500 acres of land and water. The Inner Harbors contains piers for ship loading and unloading and several marinas. The outer part of both harbors (the greater San Pedro Bay) has been less disrupted than the inner areas and supports a great diversity of marine life. It is open to the ocean at its eastern end and receives much greater ocean flushing than inner harbor areas.

The Harbors receive the discharges of the Dominguez Channel, Los Angeles and San Gabriel Rivers, although the latter two watersheds are not focus of these TMDLs. The Los Angeles River is largely wastewater flow and the watershed is 834 square miles, 66% developed. The San Gabriel River is 689 square miles (including The Los Cerritos Channel and Alamitos Bay) and is largely developed in the downstream end. The Dominguez Channel watershed is approximately 345 square miles, and is principally urban with 62% impervious surfaces.

The Dominguez Channel Watershed drains an area of approximately 133 square miles in southwestern Los Angeles. The watershed is composed of two hydrologic subunits. The two subunits drain primarily via an extensive network of underground storm drains. The northern subunit drains into the Dominguez Channel while the southern subunit drains directly into the Los Angeles and Long Beach Harbor Area. The headwaters of the Dominguez Channel consist of an underground storm drain system which daylights approximately 0.25 miles north of the Hawthorne Municipal Airport. The Dominguez Channel drains approximately 62 percent of the watershed before discharging to Los Angeles Harbor.

As documented in the Los Angeles County Department of Power and Water (LA Co DWP) Integrated Report (1994-2005), the Dominguez Channel watershed is dominated by urban land uses such as residential, industrial, commercial and transportation, which comprise as much as 85% of the land area. Very little vacant and open space areas are present in the watershed. The watershed is approximately 60% impervious based on assumptions of impervious areas in each land use type. The highest population density in the watershed appears to be in communities of Inglewood and Hawthorne.

The Dominguez Channel and the Los Angeles and Long Beach Harbors watershed has a Mediterranean climate with an average of approximately 14 inches of rain per year, most of it during the winter season. LA Co DWP maintains a water sampling mass emission station, S28, in the Dominguez Channel near the center of the watershed area. At this station in 2004-2005 all daily rainfall totals were below 2.5 inches. The wettest period was in late December and early January.

There are many permitted discharges to the watershed. There are approximately 60 active, individual NPDES permitted discharges to the Dominguez Channel and to the Los Angeles and Long Beach Harbors. These include four refineries that discharge to the Dominguez Channel, two generating stations that discharge to the inner harbor areas and the Terminal Island Treatment Plant. The Terminal Island Treatment Plant discharges secondary-treated effluent to the Outer Harbor and this POTW is under a time schedule order to eliminate their discharge into surface waters. In addition, there are approximately 50 active, general NPDES permitted discharges to the watershed.

Figure 1-2: Dominguez Channel sub-watershed areas
Insert simplified figure from LA RWQCB

Land use discussion SCAG 2000

Table 1-3. Land Use by Subwatershed Area for Dominguez Channel Watershed

Land Use Type*	Area %
Agricultural	1%
Industrial	17%
Mixed Use	1%
Open Space/ Recreation	3%
Residential	41%
Retail/Commercial	14%
Transportation	13%
Vacant	4%
Water	6%
Total	100%

* source: LACDPW integrated 1994-2005 report.

A number of fresh and marine habitat types are included in the TMDL area.

The Freshwater habitat areas of Dominguez Channel are concrete lined and offer minimal habitat value at this time. Upper Dominguez Channel is freshwater and concrete-lined. The Torrance Lateral and other tributary channels, 132nd and 135th Street Drains, Del Amo Laterals, and Victoria Creek, are also freshwater and concrete-lined.

From Vermont Street downstream to Los Angeles Harbor, Dominguez Channel has a soft-bottom with riprap banks, and is estuarine.

Within the Harbor areas and San Pedro Bay the habitats are marine and include shallow water habitat, deeper habitat, some beach areas and small wetland areas. A small, man-made wetland

(approx. 5 acres), "Salinas de San Pedro" which extends about 650 feet north along waterfront on northern Cabrillo Beach.

Shallow water habitat, some man-made during 1999-2000 as part of the Port of Los Angeles' Outer Harbor Channel Deepening and Pier 400 Construction Project occurs within the outer harbor and supports some kelp habitat. The Harbors also include extensive soft bottom areas and eelgrass beds. The ship channels in the Harbors are deeper and maintained by dredging.

Birds: Over 100 species of birds occupy habitats in the Port of Los Angeles and Port of Long Beach, including four species that are listed as Threatened or Endangered by either the State or federal government (California Brown Pelican (*Pelicanus occidentalis californicus*), California least tern (*Sterna antillerum browni*), Western Snowy Plover (*Charadrius alexandrinus nivosus*) and Peregrine Falcon (*Falco pereginus anatum*). At least 18 bird species nest in the Port. Birds that use Inner Cabrillo Beach include gulls and pigeons as well as seasonal snowy plovers, Caspian terns, least terns, black skimmers, Forster's terns, brown pelicans, great blue herons, sanderlings, western and least sandpipers, willets western, Clark's, and eared grebes, cormorants, occasional loons and ducks (S. Vogel, Cabrillo Marine Aquarium, personal communication).

Fish: Over 70 species of fish have been noted in the Harbor. From 1993 to 2001 trawls for fish in the Los Angeles Harbor by the City of Los Angeles Environmental Monitoring Division, typically found 20 or 30 fish species, dominated by white croaker (*Genyonemus lineatus*), queenfish (*Seriphus politus*), California toungefish (*Symphurus atricauda*), Pacific sanddab (*Citharichthys stigmaeus*) (City of Los Angeles, 2002; 2001; 2000; 1999a; 1998; 1997; 1996). In beach seines on Inner Cabrillo Beach, commonly caught fish include serfperch, topsmelt, jacksmelt, pipefish and flatfish. In addition, there are grunion runs on the Inner and Outer Cabrillo Beaches March through July (S. Vogel, Cabrillo Marine Aquarium, personal communication).

Invertebrates: Over 400 species of invertebrates have been noted in the Harbor. From 1993 to 2001 trawls for invertebrates in the Los Angeles Harbor by the City of Los Angeles Environmental Monitoring Division, were dominated by blackspotted bay shrimp (*Crangdon nigromaculata*), american spider crab (*Pyromaia tuberculata*) and New Zealand cephlaspidian (*Philine auriformis*) (City of Los Angeles, 2002; 2001; 2000; 1999a; 1998; 1997; 1996).
Mammals: Los Angeles Harbor is used by California sea lions (*Zalophus californianus*) and occasionally harbor seals, elephant seals, dolphins and gray whale calves (S. Vogel, Cabrillo Marine Aquarium, personal communication).

2.2 Water Quality Standards

California state water quality standards consist of the following elements: 1) beneficial uses; 2) narrative and/or numeric 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 region's Basin Plan. The objectives are set to be protective of the beneficial uses in each water body in the region and/or to protect against degradation. Numeric objectives for toxics in water can be found in the California Toxics Rule (40 CFR §131.38).

2.2.1 Beneficial Uses

The first part of California water quality standards is beneficial uses. The Basin Plan for the Los Angeles Regional Board (1994) defines beneficial uses for Dominguez Channel and greater Los Angeles/Long Beach Harbor waters (Table 2-1).

Table 2-1. Beneficial Uses of Dominguez Channel and greater Los Angeles/Long Beach Harbor waters (LARWQCB, 1994)

303(d) list waterbody	Basin Plan waterbody (Hydo # 405.12)	MUN	NAV	IND	REC1	REC2	COMM	WARM	EST	MAR	WILD	RARE	MIGR	SPWN	SHELL	WET
Dominguez Channel fresh Torrance Lateral	Dominguez Channel to Estuary	P			Ps	E		P			P	E				
Dominguez Channel Estuary	Dominguez Channel Estuary		P		Es	E	E		E	E	E	Ee	Ef	Ef		
Consolidated Slip Inner Harbor Fish Harbor	Los Angeles Long Beach Harbor All Other Inner areas		E	E	E	E	E			E		Ee			P	
Cabrillo Marina	Los Angeles Long Beach Harbor Marinas		E	E	E	E	E			E		E			P	
Inner Cabrillo Beach	Los Angeles Long Beach Harbor Public Beach areas		E		E	E	E			E	E	E		E	E	
Los Angeles River Estuary	Los Angeles River Estuary		E	E	E	E	E		E	E	E	Ee	Ef	Ef	P	E
Outer Harbor San Pedro Bay	Los Angeles Long Beach Harbor Outer Harbor		E		E	E	E			E		E			P	

Beneficial use designations apply to all tributaries to the indicated water body, 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.
s: Access prohibited by Los Angeles County Department of Public Works

Greater Los Angeles/Long Beach Harbor waters have designated uses to protect aquatic life including the marine (MAR) and rare, threatened or endangered species habitat (RARE). There are also beneficial uses associated with human use of these waters, including recreational use for water contact (REC1), non-contact water recreation (REC2), navigation (NAV), commercial and sport fishing (COMM), and shellfish harvesting (SHELL). The estuaries (EST) are recognized as areas for spawning, reproduction and/or early development (SPWN), migration of aquatic organisms (MIGR) and wildlife habitat (WILD). Dominguez Channel also has an existing designated use of warm freshwater habitat (WARM) and the Los Angeles River estuary has the designated use of wetland habitat (WET).

2.2.2 Water Quality Objectives (WQOs)

The second part of California water quality standards is water quality objectives. As stated in the Basin Plan, water quality objectives (WQOs) are intended to protect the public health and welfare and to maintain or enhance water quality in relation to the designated existing and potential beneficial uses of the water. The Basin Plan specifies both narrative and numeric water quality objectives. The following narrative water quality objectives are the most pertinent to this TMDL. These narrative WQOs may be applied 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).) In 2000, USEPA established numeric water quality objectives for several pollutants addressed in this TMDL in the California Toxics Rule (CTR) (USEPA, 2000b). The CTR establishes numeric aquatic life criteria for 23 priority toxic pollutants and numeric human health criteria for 92 priority toxic pollutants. These criteria are established to protect human health and the environment and are applicable to inland surface waters, enclosed bays and estuaries.

For the protection of aquatic life, the CTR establishes short-term (acute) and long-term (chronic) criteria in both freshwater and saltwater. The acute criterion equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects. The chronic criterion equals the highest concentration of a pollutant to which aquatic life

can be exposed for an extended period of time (4 days) without deleterious effects. Freshwater criteria apply to waters in which the salinity is equal to or less than 1 part per thousand (ppt) 95 percent or more of the time. Saltwater criteria apply to waters in which salinity is equal to or greater than 10 ppt, 95 percent or more of the time. For waters in which the salinity is between 1 and 10 ppt, the more stringent of the two criteria apply.

In the CTR, freshwater and saltwater criteria for metals are expressed in terms of the dissolved fraction of the metal in the water column. These criteria were calculated based on methods in USEPA's *Summary of Revisions to Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (50 FR 30792, July 29, 1985), developed under Section 304(a) of the CWA. This methodology is used to calculate the total recoverable fraction of metals in the water column and then appropriate conversion factors, included in the CTR are applied, to calculate the dissolved criteria.

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 the consumption of water and aquatic organisms or aquatic organisms only, assuming a typical consumption of 6.5 grams per day of fish and shellfish and drinking 2.0 liters per day of water. Table 2-2 summarizes the aquatic life, and human health criteria for metals and organic constituents, covered under this TMDL.

Table 2-2. Water quality standards established in the CTR for metals and organic compounds

Pollutant	Criteria for the Protection of Aquatic Life		Criteria for the Protection of Human Health	
	Saltwater			
	Acute (µg/L)	Chronic (µg/L)	Water & Organisms (µg/L)	Organisms only (µg/L)
Cadmium	42	9.3		
Copper	4.8	3.1	1300	-
Chromium VI	1100	50		
Lead	210	8.1	-	-
Nickel	74	8.2	610	4600
Selenium	290	71		
Silver	1.9	n/a		
Zinc	90	81	-	-
Chlordane	0.09	0.004	0.00057	0.00059
Dieldrin	0.71	0.0019	0.00014	0.00014
4,4'-DDT[1]	0.13	0.001	0.00059	0.00059
Total PCBs[2]	-	0.03	0.00017	0.00017
Benzo[a]pyrene			0.0044	0.049

[1]Based on total DDT, the sum of all isomer analyses.
[2]Based on total PCBs, the sum of all congener or isomer or homolog or aroclor analyses.

For PCBs, the aquatic life values in the Basin Plan are the same as in the CTR. For PCBs, the human health values are not the same. The Basin Plan human health value for PCBs is based only on the sum of Aroclor analyses; however the CTR human health value (0.17 ng/L) is for total PCBs and is applicable and more stringent since it is calculated as sum of all congener, or isomer, or homolog or aroclor analyses.

There are no numeric standards for fish tissue in the Basin Plan or CTR. However, the human health criteria in the CTR were developed to ensure that bioaccumulative substances do not concentrate in fish tissue at levels that could impact human health.

There are no sediment quality objectives in the Basin Plan or CTR. The Regional Board applied best professional judgment to define elevated values for metals in sediment during the water quality assessments conducted in 1996, 1998, and 2002. During the water quality assessments for 2006, assessments of sediments for metals and organics followed the sediment quality guidelines in the Functional Equivalent Document for the California listing policy "Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List." These guidelines were also used in the assessment of sediment quality for this TMDL.

Table 2-3. Sediment quality quidelines used for determination of impairment for metals and organic compounds

Pollutant	Marine and Estuarine Sediments			Freshwater Sediments
	Effects Range Median[1]	Probable Effects Level[2]	Other Sediment Quality Guideline	Probable Effect Concentration[3]
METALS				
Cadmium		4.21 µg/g dw		4.98 mg/kg dw
Copper	270 µg/g dw			149 mg/kg dw
Chromium	370 µg/g dw			111 mg/kg dw
Lead		112.18 µg/g dw		128 mg/kg dw
Nickel				48.6 mg/kg dw
Selenium				
Silver		1.77 µg/g dw		
Zinc	410 µg/g dw			459 mg/kg dw
ORGANICS				
Chlordane	6 ng/g dw[4]			17.6 µg/kg dw
Dieldrin	8 ng/g dw			61.8 µg/kg dw
Total DDT			590*	572 µg/kg dw
Total PCBs	-		400 ng/g[5]	676 µg/kg dw
Total PAHs			180,000(µg/kg)[8]	22,800(µg/kg)
Benzo[a]pyrene		763.22 ng/g		1450 µg/kg dw
2-methyl-napthalene		201.28 ng/g dw		
Phenanthrene		543.53 ng/g dw		1170 ug/kg dw
Lo MW PAHs		1442 ng/g dw		
Benza[a]anthracene		692.53 ng/g dw		1050 ug/kg dw

[1]Long et al. 1995 dw = Dry Weight [8]Fairey et al., 2001
[2]MacDonald et al., 1996
[3]MacDonald et al., 2000a
[4]Long and Morgan, 1990
[5]MacDonald et al., 2000b
Freshwater and saltwater SQG values from CA listing policy, FED pg. 122-123
*marine DDT value from EPA Superfund Risk Assessment (1994)

The State Board is in the process of developing sediment quality objectives (SQOs) for enclosed bays and estuaries. Draft objectives have been released for public review; however State Board has yet to propose and consider for adoption any final sediment quality objectives and an implementation policy. The final objectives and implementation policy would be subject to review by the Office of Administrative Law before becoming effective.

2.2.3 Antidegradation

The third part of California water quality standards is 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).

2.3 Impairments Identified in 303(d) lists

The waters of the Dominguez Channel and the Ports of Los Angeles and Long Beach in the San Pedro Bay, addressed by this TMDL, are impaired due to a variety of toxic pollutants, including metals, organic compounds, and sediment toxicity. In addition, certain waterbodies show impairment to the benthic community.

This section reviews the 303(d) lists issued by the State Of California and USEPA in 1998 (the list to which the consent decree refers), 2002 and 2006 which establish the impairments.

Table 2-4: 1998 303(d) list of metal and organic compound impairments, shown here by analytical units as defined in consent decree.

Water body name	Tissue	Sediment
AU #73		
Dominguez Channel freshwater	Aldrin*, Chem A Chlordane, Dieldrin DDT, PCBs	
Dominguez Channel estuary	Aldrin*, Chem A Chlordane, Dieldrin DDT,	Benthic community effects
Consolidated Slip	Chlordane, Dieldrin DDT, PCBs, toxaphene	Toxicity, benthic community effects
Inner Harbor	DDT, PCBs	Toxicity
Main Channel	DDT, PCBs	Toxicity
SouthWest Slip	DDT, PCBs	Toxicity
Fish Harbor	DDT, PCBs	Toxicity
Long Beach Harbor	DDT, PCBs	Toxicity, benthic community effects
Cabrillo Beach-Inner	DDT, PCBs	Toxicity
San Pedro Bay	DDT, PCBs	Toxicity
Los Angeles River Estuary	DDT, PCBs	Toxicity
Machado Lake **	DDT, PCBs	
AU #74		
Dominguez Channel freshwater		PAHs
Dominguez Channel estuary		PAHs
Consolidated Slip		PAHs
Inner Harbor		PAHs
Main Channel		PAHs
Fish Harbor		PAHs
Long Beach Harbor		PAHs
San Pedro Bay		PAHs
AU #75		
Torrance Carson Channel		Cu, Pb
Wilmington Drain *		Cu, Pb
Dominguez Channel freshwater		Cr, Cu, Pb, Zn
Dominguez Channel estuary		Cr, Cu, Pb, Zn
Consolidated Slip		Cr, Pb, Zn
Inner Harbor		Cu, Zn
Main Channel		Cu, Zn
Fish Harbor		Cu, Zn
AU #78		
San Pedro Bay		Cr, Cu, Zn

* Aldrin is removed from the 2006 (303) d list. Therefore, this TMDL will not address Aldrin as impairment for Dominguez Channel

** Machado Lake and Wilmington Drain will not be addressed in these TMDLs.

The consent decree provides that TMDLs need not be completed for specific water body by pollutant combinations if the State or EPA 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.

For the 2006 303(d) list, the State (and Regional) Board made several changes in water body-pollutant listings for water in Dominguez Channel and greater Los Angeles/Long Beach Harbor waters. Clarification was provided such that individual PAH compounds were listed as opposed to the general category of polyaromatic hydrocarbons (PAHs). Some areas changes also occurred. In addition. EPA proposed some additions to the State's 2006 list. Table 1-3 provides the waterbody-pollutant combinations for the 2006 list.

Table 2-6: 2006 final 303(d) list of individual pollutant impairments by water body.

Water body name	Tissue	Sediment
Dominguez Channel freshwater	Pb, Dieldrin	Zn, Cu* toxicity
Torrance Carson Lateral		Cu, Pb
Dominguez Channel estuary	Chlordane, Dieldrin DDT, Pb	DDT, PCBs, Zn benthic community effects Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Phenanthrene, Pyrene
Consolidated Slip	Chlordane, Dieldrin DDT, PCBs, toxaphene	Chlordane, DDT, PCBs Cd, Cr, Cu, Hg, Pb, Zn Toxicity, benthic community effects Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Phenanthrene, Pyrene, 2-methylnaphthalene
Inner Harbor*	DDT, PCBs,	Cu, Zn, Toxicity, benthic community effects
Fish Harbor	DDT, PCBs	Cu, Hg, Pb, Zn Chlordane, DDT, PCBs Benzo[a]anthracene, Benzo[a]pyrene Chrysene, Dibenz[a,h]anthracene, Phenanthrene, Pyrene, Toxicity
LA Harbor—Cabrillo Marina	DDT, PCBs	
LA Harbor—Inner Cabrillo Beach	DDT, PCBs	Cu
Outer Harbor*	DDT, PCBs	Toxicity
San Pedro Bay	DDT, PCBs	Chlordane, PAHs, Cr, Cu, Zn, Toxicity
Los Angeles River Estuary	--	Chlordane, DDT, PCBs, Pb, Zn

*Inner Harbor area changes made in 2006, includes Southwest Slip and portions of Main Channel, as well as portions of LA and LB Harbor, also Long Beach Harbor area changes were made in 2006, redefined into Inner and Outer Harbor (see Figure 1).

2.6 Data Review/Impairments identified for this TMDL

This section summarizes available monitoring data for Dominguez Channel and greater Los Angeles/Long Beach Harbor waters for the listed toxic pollutants in water, fish and sediments. The summary includes water quality, fish tissue, and sediment quality data from various monitoring sources, for the period of 1992 to 2006. This analysis used the data used for assessments for the final 2006 303(d) list and also reviewed more recent data that was not incorporated in the State's 2006 303(d) list. The following more recent data sets were included: Bight 2003 sediment results, POLA & POLB sediment survey in 2006, POLA & POLB water column data in 2005-2006 and SCCWRP sediment-flux study in complement to POLA & POLB sediment study in 2006. Thus, the assessment and problem statement sections of this document more accurately reflect current water quality conditions in Dominguez Channel and greater Los Angeles/Long Beach Harbor waters.

2.6.1 Assessment methodology

In general, the protocols used for this assessment are consistent with those outlined in the State's 303(d) listing policy (SWRCB 2004). The benchmarks used in this assessment are consistent with those identified in the policy's supporting Functional Equivalency Document (FED) document. The state's policy was developed by the State for purposes of water quality assessments, and the State applied this policy to develop its decisions for the 2006 303(d) list. EPA added waterbodies and pollutants to the list.

This assessment builds on the data record evaluated by the State and compiled in the 2006 303(d) list factsheets; it also includes more recent information. This is consistent with procedures provided in the State's Impaired Waters Guidance (2005, section 2) to produce an assessment more accurately reflecting current water conditions.

As described above, this assessment is generally consistent with protocols and benchmarks provided in the State's 303(d) listing policy and supporting (FED) document. For example, this assessment used the same benchmarks for comparison to determine exceedences; e.g., water quality objectives from CTR, sediment quality guideline values and OEHHA fish tissue screening values from the policy's FED. One exception (discussed below) is that this assessment used a sediment chemistry benchmark for DDT, whereas the listing policy did not include a media-pollutant specific value.

Important sources of new data include: Bight 2003 study, Los Angeles County DPW monitoring, City of Los Angeles (Terminal Island) Harbor monitoring, Port of Los Angeles (POLA) Prop 13 studies , Port of Long Beach (POLB) water monitoring and POLA/POLB TMDL monitoring of 2006 and some SCCWRP studies. The complete list of data reviewed is provided in Table 2-7. All recent data have received some QA/QC review, thus data are viable for assessment.

Table 2-7 Water Quality, sediment and fish data reviewed for this assessment.

	Data Source	Data record	Spatial scope	Sample media	2006 303d
5.	POLA/POLB Sediment survey	2006	Greater Los Angeles/Long Beach Harbor waters	Sediment, porewater, overlying water	*
3.	POLB water data	2006	Inner Harbor	Water	*
8.	SCCWRP	2006	Consolidated Slip	Sediment, porewater, overlying water	*
		2006	Dominguez Channel estuary	Air	
4.	POLA Prop. 13 POLA water data	2004—2006	Dominguez Channel estuary, Consolidated Slip, Inner Harbor	Water	
		2004—2006	Consolidated Slip, Inner Harbor	Water	*
11	Bight '03	2003	greater Los Angeles/Long Beach Harbor waters	Sediment	*
	LA RWQCB SWAMP	2003	Dominguez Channel freshwater	Water	
7.	SCCWRP DDE Inventory	2003	So. Calif. Bight and LA Harbor	Water	*
	SCCWRP	2002-03	Dominguez Channel freshwater	Water	
	POLA/AMEC	2002	Consolidated Slip	Fish	*
13	USEPA Superfund Montrose site	2002 and 1994	Stormwater pathway from site downstream to Consolidated Slip	Sediment DDT	yes
	POLA Biological baseline	2002	Inner & Outer Harbor; San Pedro Bay	Biology	
1.	LACDPW NPDES MS4	2001—2005	Dominguez Channel freshwater	Water	Yes*
	ACTA 2001	2000-01	Dominguez Channel estuary	Mussels	
6.	City of LA BOS Terminal Island WWTP	1999-2004	Outer Harbor	Sediment, Fish; Water in 2002-03	?*
	Oil Refineries NPDES	1998-2004	Dominguez Channel estuary	Sediment	Yes
2.	POLB stormwater NPDES data	1996—2005	LB Harbor	Water	
	LACSD	1995—2004	San Gabriel River Estuary	Water, Sediments	
9	CSTF sediment database	1988-2001	greater Los Angeles/Long Beach Harbor waters	Sediment, Fish	yes
14	NOAA status & trends data	1986—1998	Outer Harbor and San Pedro Bay	Mussels	yes
15	TSM	1978—2000	Dominguez Channel estuary	Fish	Yes
14	SMW	1977—2000	Inner & Outer Harbor	Mussels	Yes
12	OEHHA	1991	So. Calif. Bight	Fish	Yes
	OEHHA/CFCP	1999 & 2000	San Pedro Bay, Belmont Pier	Fish	Yes

note: numbered data sources are discussed further below.

2.6.1 Water Column

1. LACDPW NPDES MS4 *Los Angeles County Department of Public Works - Freshwater Dominguez Channel*

Los Angeles County Department of Public Works (LACDPW) collects samples at the Dominguez Channel mass emissions monitoring station (S28), which is above tidal influence. The upper portion of Dominguez Channel contains freshwater down to Artesia Blvd. S28 is in a concrete-lined, rectangular channel. LACDPW monitoring results from this site provides data for both wet and dry weather.

Metals data was reviewed for both wet and dry weather. All metal data were compared to sample-specific hardness adjusted CTR standards. From 2002 to 2007, CTR criteria for dissolved metals were exceeded in wet weather for copper, lead and zinc: Cu, 16 exceedances out of 21 wet weather samples; Pb 0 exceedances out of 2[1]; and Zn 13 exceedances out of 20. Total metal results were also provided, and were compared to total metal criteria, which were converted from dissolved criteria using saltwater translator values from CTR, and revealed additional exceedences in wet weather events: Cu 11 exceedances out of 21; Pb 6 exceedances out of 21; Zn 10 exceedances out of 21. However, in dry weather, no dissolved exceedences were observed for these three metals. In addition, no exceedences were observed for dissolved cadmium, chromium, mercury, nickel, selenium and silver in wet or dry weather.

Also, water column toxicity (reduced survival and reproductive success) was repeatedly observed at S28 monitoring station from 2002 to 2007. Chronic *Ceriodaphnia dubia* tests showed inhibited survival during wet weather events in 2002, 2004 and 2005. *C. dubia* tests also showed inhibited reproductive success in the same timeframe. Toxic responses occurred during this timeframe during both dry and wet weather events. Some water toxicity identification evaluation (TIE) studies have been performed to identify the category of causative agent(s). TIEs in 2003-04 indicated some volatile organic compounds as toxic pollutants caused toxicity; whereas 2002-03 TIEs indicated toxicity may be due to one or more non-polar organic compounds, cationic metals, and metabolically-activated organophosphates. Five of 21 samples collected as part of the Los Angeles County Stormwater monitoring program exceeded the chronic DFG fresh water hazard assessment criteria for diazinon (three of which also exceeded the acute criteria) for the protection of aquatic life.

2. POLB stormwater NPDES data *Port of Long Beach—Inner Harbor (mid-water column)*

Port of Long Beach has collected ambient samples from one site (3RW) within Long Beach Harbor. Available data from 1996 to 2005, include only total recoverable metals. Careful review of these ambient results, revealed some possible QA/QC concerns that require further clarification prior to assessment. Most notably, results from dates prior to and including 2002 are much higher than those reported from 2003 to present. These results will not be included in the assessment of Inner Harbor waters until the QA issues have been resolved.

---

[1] Pb results: 0 of 2 exceedences were reliably assessed; yet 19 other results were not reliably assessed because the lab reporting limit (5 ug/L) was above the hardness specific Pb criteria. Until there is less uncertainty in the Pb results, we are proposing wet-weather Pb TMDLs for DomChannel freshwater.

3. POLB water data
In 2006, POLB performed one sampling event with numerous sites within the Inner Harbor. All samples were below criteria. Results are summarized in Table 2-8.

Table 2-8 Water column dissolved metal results from Port of Long Beach—Inner Harbor (2006).

Pollutant	Detection Limit	# of detections	Conc. Range (ug/L)	CTR chronic saltwater objective (ug/L)
Cadmium	0.005	14	0.01 – 0.06	9.3
Copper	0.01	14	0.28 – 1.41	3.1
Lead	0.005	14	0.10 – 0.07	8.1
Mercury	0.005	14	<0.01	0.05¥
Nickel	0.005	14	0.19 – 0.39	8.2
Silver	0.02	14	<0.02	1.9*
Zinc	0.005	14	0.58 – 3.81	81

*silver value is acute criterion; ¥mercury value is human health criterion

4. POLA water data *Port of Los Angeles—various Harbor waters (mid-water column)*

Port of Los Angeles (POLA) currently has a monitoring program which obtains monthly samples for conventional parameters (DO, pH, TSS) at fixed stations which began in 2003. In 2005, POLA collected extra samples for an enhanced suite of analytes; i.e., metals and priority organics during two sampling events. Waterbodies sampled included Inner and Outer Harbor, Fish Harbor, Consolidated Slip, Cabrillo Marina and Inner Cabrillo Beach. Results for the two enhanced suite events are presented in Table 2.9 and compared with CTR chronic criteria.

Table 2-9 Water column data (2005) for POLA Inner, Fish and Outer Harbor. Dissolved results for metals; unfiltered total results for organics.

Pollutant	Detection Limit	# of sites	Conc. Range (ug/L)	CTR chronic saltwater objective (ug/L)
Cadmium*	0.005	22	0.015 – 0.104	9.3
Copper*	0.01	22	0.28 – 3.16	3.1
Lead*	0.005	22	0.02 – 0.834	8.1
Mercury*	0.005	22	0.0005 – 0.0046	0.05¥
Nickel*	0.005	22	0.27 – 0.71	8.2
Silver *	0.02	22	0.007 – 0.11	1.9*
Zinc*	0.005	2	3.28 – 58.8	81
totDDT		0	ND	0.001
totPAHs		0	ND	
totPCBs		0	ND	0.03

*silver value is acute criterion; ¥mercury value is human health criterion

POLA has also collected freshwater samples in Dominguez Channel at Artesia, the same site as the mass emission station (S28) maintained by LACDPW. Pollutograph samples were collected by capturing samples at distinct time intervals to evaluate concentration changes over short time

frame such as one day. POLA has also collected some Dominguez Channel estuary water samples during wet and dry weather to support hydrodynamic and water quality modeling for the estuary. Results are pending.

5. POLA/POLB Sediment survey *Ports of Long Beach and Los Angeles—Inner and Outer Harbor (waters overlying sediments)*

In fall 2006, POLB and POLA performed a joint monitoring survey of sediments and overlying waters at 60 sites within greater Los Angeles/Long Beach Harbor waters. More description of this survey is provided in the section describing sediment monitoring results. Analytical results for total, unfiltered samples of waters overlying the sediment are summarized in Table 2-10.

Table 2-10 Overlying Water data (2006) for PORTs—Inner and Outer Harbor. All results are total unfiltered samples collected one foot above sediment-water interface.

Pollutant	Detection Limit	# of detections	Conc. Range (ug/L)	CTR chronic saltwater objective (ug/L)
Cadmium*	0.005	43		9.3
Copper*	0.01	43		3.1
Lead*	0.005	43		8.1
Mercury*	0.005	43		0.05¥
Nickel*	0.005	43		8.2
Silver *	0.02	43		1.9*
Zinc*	0.005	43		81
totDDT		43	ND— 0.0043	0.001
totPAHs		43		
totPCBs		43	ND	0.03

*silver value is acute criterion; ¥mercury value is human health criterion

6. City of LA BOS Terminal Island *WWTP Terminal Island - Outer Harbor*

City of Los Angeles, Bureau of Sanitation, collects ambient samples in compliance with an NPDES permit for Terminal Island Treatment Plant (TITP). Some water samples were collected as part of the Interim Monitoring Program (IMP) in 2002-03, from station HW50 in the Outer Harbor. The vast majority of these water column results are below the detection limits, however, the detection limits are above the water quality criteria. The metal results have some detections for (presumably) total recoverable metal analytes. Some exceedences of water quality criteria are noted for copper (5-31.5 ppb), lead (11-58 ppb) and silver (6.7-11.6 ppb).
NOTE: These results may require additional investigation regarding appropriate QA/QC for saltwater matrices and potential confounding interferences for accurate instrumental analysis.

7. SCCWRP DDE Inventory *SCCWRP – Inner & Outer Harbor, San Pedro Bay*

SCCWRP has utilized special analytical techniques to obtain measurements of priority organics in the water column at various sites along the Southern California Bight. Special, highly sensitive, solid phase microextraction (SPME) devices were deployed into the water column for sufficient time periods as to yield actual ambient results for DDT and PCBs with extremely low

detection levels (sub-ng/L). The initial research efforts measured dissolved phase DDE (metabolite form of parent DDT compound) throughout the Bight (Zeng et al. 2005). Result from four stations within Inner and Outer Harbor waters show elevated levels of DDE in comparison to CTR human health numeric criteria. Total PCB measurements also exceed the CTR human health numeric criteria at these stations. Concentrations of DDE and total PCBs were higher at surface (2 m sub-surface) than those measured in water overlying (2m above) contaminated sediments.

8. SCCWRP *SCCWRP – Consolidated Slip*

In fall 2006, SCCWRP performed repeated sampling at one site in Consolidated Slip. The sampling was designed to obtain chemical measurements of priority organics from sediment, porewater and overlying water to characterize the sediment flux values for the pollutants of concern in the Consolidated Slip. During each of three sampling events, the overlying waters were sampled via *in-situ* high volume pump to obtain high sample volumes (e.g., 1000+ L) for chemical extraction via PUF methods and to generate lower detection limits. Average results showed elevated levels of total DDT (0.47 ng/L) and total PCBs (0.45 ng/L) in comparison to CTR human health criteria (10^{-6}) for consumption of organisms only. Measured concentration ranges for listed organic compounds are provided in Table 2-11, along with CTR human health criteria.

Table 2-11 SCCWRP (2006) overlying water data for Consolidated Slip.

Pollutant	Detection Limit	# of detections	Conc. Range (ng/L)	CTR Human health (ng/L)
Chlordane total	0.010	3	0.055 – 0.07	0.59
Dieldrin	0.020	3	<0.020	0.59
p,p-DDE*	0.050	3	0.15 – 0.23	0.59
DDT total	0.050	3	0.41 – 0.47	0.59¥
PCBs total	0.020	3	0.37 – 0.43	0.17
Benzo[a]pyrene	0.020	3	0.147 – 0.827	49
Benzo[a]anthracene	0.050	3	0.743 – 1.006	49
Chrysene	0.050	3	0.747 – 1.319	49
Phenanthrene	0.050	3	5.772 – 12.169	n/a
Pyrene	0.050	3	8.670 – 11.173	11,000

2.6.2 Sediment

Several sources provide sediment results for both sediment chemistry as well as sediment toxicity. Data was compiled through the Contaminated Sediments Task Force (CSTF), representing the data record from 1992 to 2001. For Consolidated Slip, there are also sediment results from the EPA Superfund sampling event in 2002, with added analyses by AMEC in contract with POLA. In addition, for Dominguez Channel freshwater there are some NPDES-

collected data from LA County DPW and for Dominguez Channel estuary there are some NPDES-collected data from oil refineries.

To assess impacts to sediments, we reviewed sediment results from the 2006 303(d) list as well as more recent additional data for the waterbodies of concern in these TMDLs. More recent data includes: Bight 2003 study, Terminal Island Treatment Plant NPDES samples, PORTs 2006 survey and SCCWRP sediment flux study in 2006.

Here we provide a brief discussion of each sediment data set to provide general spatial and temporal information. Further evaluation of sediment chemistry and sediment toxicity results have been compiled from all of these data sets into summary tables for each water body (see Appendix A). Summary tables in Appendix A are also divided by data sources and by data record. Appendix A summary tables provide comparison of ambient results with several sediment quality guideline values and show number of exceedences relative to each value.

Consolidated Sediment Task Force database (CSTF)

Numerous sediment results have been compiled by SCCWRP into one database (CSTF 2001). The database contains records from numerous sampling events by various monitoring groups/studies. We extracted records from 1992 to 2001, including results from Bay Protection Toxic Cleanup Program (1992, '94, 96, 97), Bight 1998, Western EMAP 1999 and dredge studies.

Refineries (NPDES)

Oil refineries that discharge process waters into Dominguez Channel are required to collect receiving water samples from within the Channel as part of their NPDES permits. Sampling sites are located within Dominguez Channel estuary. From 1994 to 2004, sampling frequency has decreased and now occurs only in years during NPDES discharge, such as 2004. However, analytical detection limits for DDT, PCBs and PAHs were not sufficiently sensitive as to allow assessment in comparison to Listing Policy sediment quality guidelines. For example, results for individual PAH compounds in sediments were expressed as "<0.8mg/kg" in 2003; whereas the State's Listing Policy has identified SQG values (all in dry wt.) for 2-methylnaphthalene (201 ug/kg), phenanthrene (543.5 ug/kg), benzo[a]pryrene (763.2 ug/kg), benzo[a]anthracene (692.5 ug/kg), chyrsene (845.9 ug/kg), pyrene (1397.4 ug/kg). Future monitoring efforts will benefit signficantly from lower detection limits for comparison with these and other relevant sediment quality guidelines.

Terminal Island WWTP (NPDES)

City of Los Angeles Terminal Island WWTP provides sediment monitoring results for five locations in Outer Harbor. We have included sediment chemistry results from 1999—2004 in sediment summary tables in Appendix A.

Bight 03—Southern California Bight Regional Monitoring Project

Bight 03 study provides an integrated assessment of Southern California coastal estuaries (SCCWRP 2004, 2006). Multiple agencies coordinated to collect samples in summer 2003 were

analyzed for sediment chemistry, toxicity, and benthic community response. The sediment toxicity and bulk chemistry results for stations in the greater Harbor waterbodies have been included in this assessment report relevant to these TMDLs. These sediment chemistry results supplement the sediment data record provided by CSTF and provide review of more recent ambient sediment concentrations. The benthic community information is pending.

PORTs (POLB & POLA)—sediment survey 2006

In fall 2006, the Ports of Los Angeles and Long Beach performed a recent monitoring survey of 60 sites in greater Los Angeles/Long Beach Harbor waters. The sampling approach was discussed by both Ports, LA RWQCB, USEPA, SCCWRP and Weston Solutions, and agreed upon as part of a more comprehensive data collection plan to support the TMDL development process. One goal was to characterize contaminant concentrations in sediment, porewater and overlying water. Physical parameters, such as grain size and percent moisture, were also measured to provide ancillary data. Another goal was to reduce uncertainty associated with spatial variability thus sampling occurred at 30 randomly selected sites within each of the Port's jurisdictional areas. A complementary study by SCCWRP (see immediately below) provided additional data at co-located sites. These studies were designed to help characterize site-specific sediment-water flux rates within these greater Los Angeles/Long Beach Harbor waters. To ensure compatibility of all data, both Weston and SCCWRP used the same analytical laboratory, therefore analytical methods and method detection limits were consistent across both programs. We have included sediment chemistry results from this 2006 study (POLB/POLA/Weston Solutions, 2006) in our assessment summary tables in Appendix A. Sampling site locations can be reviewed in Appendix A.

SCCWRP—Sediment flux study 2006

In fall 2006, SCCWRP, under separate contract with the Regional Board, performed complementary monitoring to the Port's study described above. One goal was to perform similar matrix sampling of sediment, porewater, overlying waters at one site in the Consolidated Slip and to collect samples at three different times to evaluate individual site variability. Another goal was to co-locate solid phase microextraction (SPME) devices at 11 stations with the Ports' sites to measure organics in waters overlying sediments via a different analytical approach. As mentioned above, the overall goal was to obtain site-specific data for generating sediment-water flux estimates of organochlorines and PAHs at the Consolidated Slip site and then extrapolate this information to other Harbor sites using other chemical data collected by Ports at the 60 other sites.

2.6.3 Fish and Shellfish Tissue

While fish tissue data are limited, analysis of fish tissue for chemical contaminants provides a good measure of water quality since this media represents a long term integrator of bioaccumulation of pollutants and more reliable indication of water quality impacts. The following summary discusses the existing fish advisory and then presents more recent results along with some older data for perspective.

OEHHA—LA Harbor, Cabrillo Marina, Inner Cabrillo Beach, San Pedro Bay

In 1991, OEHHA issued a fish consumption advisory for various waters along the coastline between Point Dume and Dana Point, including waters in the Harbor area. High levels of DDT and PCBs were measured in sportfish representing a human health risk. Samples collected inside the Harbor breakwater, at Pier J and at Belmont Pier clearly showed elevated total DDT and PCBs in comparison to risk-based values. Total chlordane levels (ranged from 0 to 53 ppb) in these same samples were not above risk values so chlordane was not included in the advisory.

As part of the Coastal Fish Contamination Project (CFCP), OEHHA collected more fish tissue samples off Belmont Pier in 1999 and 2000. Results are summarized in Table 2.12.

Table 2-12. Fish tissue composite results from OEHHA/CFCP (1999 & 2000) (ppb = ug/kg, wet weight).

	White Croaker (n=2)	Queenfish (n=1)	Spotted Turbot (n=1)	Total # of exceedences	OEHHA screening value
Chlordane	5.4 – 17.5	12.4	2.3	0	30
DDT total	92.4 – 254.0	396.6	104.0	3	100
PCBs total	98.0 – 294	207	116	4	20

Composite results shown for filets only, organics reported for skin-on filets

Terminal Island Treatment Plant –LA Harbor

City of Los Angeles Terminal Island Treatment Plant monitoring program has also collected fish tissue samples within the Outer Harbor. Results for 2000-2004 are summarized in Table 2-13. These results indicate non-impairment of arsenic, cadmium, mercury, selenium and chlordane, based on samples lower than Listing Policy screening values. The continued presence of high DDT and PCB levels indicates these pollutants are still creating adverse impacts and provide corroborating evidence for the consumption advisory in these waters.

Table 2-13. Fish tissue data from LA City Terminal Island TP (1999-2004) (ppb = ug/kg, wet weight).

	Count	Fish Tissue (conc. range)	Total # of exceedences	OEHHA screening value
As	30	0.46 – 1.14	1	1.0
Cd	30	<0.4	0	3.0
Hg	30	0.01 – 0.11	0	0.3
Se	30	0.10 – 0.46	0	1*
Chlordane	30	0.30 – <3.0	0	30
Dieldrin	??	--	??	2.0
DDT total	40	22 – 6514	36	100
PCBs total	40	19 – 1000	36	20

*Se tissue value from USFWS for protecting birds

USEPA Superfund (and POLA)

In 2002, USEPA Superfund Division collected fish samples via separate projects in various waters of concern to these TMDLs. The Consolidated Slip was sampled to determine DDT levels in fish tissue. POLA coordinated with EPA to have these samples analyzed by AMEC for other parameters. Two fish species were collected and four individuals of each species (halibut and white croaker) were analyzed. Various sample preparation methods were used and yielded different analytical results consistent with each approach. Analytical results for fish filets are presented in Table 2-14 below. In general, tissue levels were below Listing Policy tissue screening values for arsenic, cadmium, mercury, selenium and chlordane. DDT and PCB total levels exceeded Listing Policy values in several samples indicating impairment due to these pollutants.

Table 2-14. Fish tissue data from Consolidated Slip (ppb = ug/kg, wet weight; EPA Superfund & POLA/AMEC).

	White Croaker (n=4)	**Halibut (n=4)**	**Total # of exceedences**	**OEHHA screening value**
	Conc. Range	Conc. Range		
As	0.42—0.63	0.19—0.56	0	1.0
Cd	0.01	0.01—0.07	0	3.0
Hg	0.08—0.13	0.05—0.11	0	0.3
Se	0.31—1	0.23—0.41	1	1*
Chlordane	1—8.2	1	0	30
Dieldrin	n/a	n/a	--	2.0
DDT total	399—569	6—15	4	100
PCBs total	131—888	47	3	20

Metals reported for filets only, organics reported for skin-on filets
*Se value from USFWS (not OEHHA) for protecting birds

As part of Montrose Settlement Restoration Program, USEPA (Superfund Division) and other federal agencies collected fish samples from Point Dume to Dana Pt. in 2002. The objective of this project was to measure DDT and PCB contamination in fish tissue. Over 1000 individual fish from 123 species were collected in Santa Monica Bay, around Palos Verde peninsula, San Pedro Bay, Huntington Harbor, Newport Harbor, etc. Tissue results from three "segments" are pertinent to waterbodies within the scope of these TMDLs (EPA 2007). These segments are all inside the San Pedro Bay breakwater ranging from Cabrillo fishing pier in the west (segment #16) to Pier J/Finger Piers (segment #17) to Belmont Pier/Seaport Village in the east (segment #18). Fish tissue results for these segments are summarized in Table 2-15 below.

Table 2-15. Individual Fish tissue results from inside breakwater of Outer Harbor and eastern San Pedro Bay. (EPA /NMFS/OEHHA, 2002) (ppb = ug/kg, wet weight).

	Cabrillo Pier-inside bkwtr (Segment 16)		Pier J/Fingers Pier (Segment 17)		Belmont Pier/Seaport Village (Segment 18)	
	Conc. range	# exceeds/total	Conc. range	# exceeds/total	Conc. range	# exceeds/total
Chlordane	3 – 23	0 / 80	2 – 63	5 / 68	3 – 33	3 / 69
Dieldrin	0.4 – 1.4	0 / 74	0.4 – 7.9	8 / 65	0.5 – 1.5	0 / 69
DDT total	9 – 2522	27 / 80	0.4 – 764	13 / 68	1.4 – 206	12 / 69
PCBs total	0.5 – 278	50 / 80	46 – 188	46 / 68	4.1 – 190	50 / 69

organics reported for skin-on filets

In 1994, to demonstrate DDT contamination in the stormwater pathway coming off the Montrose Chemical plant site, USEPA Superfund Division collected biota samples in waterbodies downstream of the Montrose site in the Dominguez Channel watershed and into Consolidated Slip. Various tissue samples were obtained ranging from mosquito fish (in freshwater Torrance Lateral) to mussels, whole crabs and mallard eggs (in Dominguez Channel estuary) to whole topsmelt and black surfperch filets (in Consolidated Slip). Total DDT results for majority of these samples exceeded the OEHHA screening value (100 ppb wet wt.). No chlordane, dieldrin or PCB results were determined for these samples.

Mussel Watch data—greater Los Angeles/Long Beach Harbor waters

Both NOAA and SWRCB have monitoring programs of mussels in bay, harbor and coastal waters. Given the nature of this program which is to transplant mussels to specific sites on annual basis, these analytical results can be used for evaluating long term trends. State Mussel Watch (SMW) results for Consolidated Slip in 1982-2000 showed declining trends for chlordane, DDT, and PCBs. SMW chlordane results did not exceed the OEHHA value, and DDT results were often below the corresponding OEHHA value, whereas, PCB results were never below the OEHHA PCB value. SMW results for dieldrin and toxaphene were the basis for listing Consolidated Slip in 1996; dieldrin had one exceedence (1/20) above the OEHHA value, whereas toxaphene had more exceedences, (5/10) in ten years.

CSTF database—Inner Harbor, Outer Harbor, Inner Cabrillo Beach, San Pedro Bay

The CSTF database contains fish tissue results from BPTCP 1997 and Bight 1998. Composite results were presented for whole fish, mostly small forage species such as goby. No metal results were reported in the database. We reviewed the organic compound results and utilized those results where detections occurred. We made comparisons to Listing Policy tissue guidelines to determine exceedences and combined the results for these four waters together into this summary: chlordane = 0 of 13, total DDT = 4 of 18, and total PCBs = 7 of 18.

Toxic Substances Monitoring Program—Dominguez Channel

In 1992, Toxic Substances Monitoring Program (TSMP) collected one fish sample in Dominguez Channel. The 1998 and 2002 303(d) lists utilized this data to indicate the freshwater portion of Dominguez Channel as impaired due to high levels of organics in fish tissue. For the 2006 303(d) list, SWRCB and LA RWQCB clarified that previous conclusions of impairment within

Dominguez Channel freshwater segment were inaccurate due to mis-interpretation of the actual sampling site for the one fish (white Croaker) collected in 1992. The 2006 303(d) list analysis stated the TSMP sampling report verifies that the white Croaker was caught downstream of Vermont Ave., in the estuary segment of Dominguez Channel. We concur that the TSMP fish tissue results do not identify any specific impairments due to priority organic compounds in the freshwater segments of the Channel. Thus there is no impairment due to dieldrin within Dominguez Channel; no TMDL will be developed for this specific waterbody-pollutant combination. Table 2-16 is a summary of the TSMP data.

Table 2-16. Fish tissue data (1992) from site in Dominguez Channel estuary (ppb, wet weight, TSMP).

Program	TSMP	SWRCB	SWRCB
Date	1992	Maximum Tissue Residue Level (MTRL)	Screening Value (µg/kg)
Species	White Croaker (n=1)		
Cd	n/d	--	3
Hg	0.09	--	0.3
Se	0.68	--	1*
Chlordane	164	8.3	30
Dieldrin	5.3	0.7	2.0
Total DDTs	6487	--	100
Total PCBs	1780	5.3	20

Note: MTRLs are not used for assessment purposes , but provided for perspective.
*Se value from USFWS for protecting birds

2.3 Summary of data on pollutant basis

Metals

Copper, lead and zinc were most commonly above numeric criteria for various waterbodies. Elevated levels of these three metals were observed in the water column of Dominguez Channel watershed and copper occasionally exceeds in Inner and Fish Harbor. Elevated copper, lead and zinc levels in sediments were evident within Dominguez Channel estuary, Consolidated Slip, Inner Harbor, and Fish Harbor. Cadmium and chromium were elevated in sediments of Consolidated Slip or Dominguez Channel estuary but do not exceed in sediments elsewhere in the watershed or receiving waters. Mercury levels in fish tissue were not above Listing Policy screening values for any water body. Mercury sediment levels were high only in Consolidated Slip and Fish Harbor. Some water bodies appeared to show non-impairment for metals, Cabrillo Beach, Outer Harbor, Los Angeles River estuary and San Pedro Bay. Arsenic did not exceed water or sediment numeric criteria in any waters.

PAHs

Individual PAH results exceeded numeric sediment guidelines most frequently in Dominguez Channel estuary, Consolidated Slip, Inner Harbor and Fish Harbor. A few sediment exceedences for benzo[a]pyrene were also observed in Cabrillo Marina and Los Angeles River Estuary.

Measurements of PAH compound in water were not reliable for assessment due to inadequate method detection limits in comparison to numeric criteria. Fish tissue results for PAHs were either non-existent or do not provide sufficient information to be utilized for assessment with screening values.

Organochlorines

Chlordane sediment levels were observed above sediment guidelines in Dominguez Channel estuary, Consolidated Slip, Fish Harbor and Los Angeles River Estuary. The vast majority of fish tissue results of chlordane were below Listing Policy screening values in all waterbodies. Mussel results showed declining trend for chlordane at two locations in receiving waters.

Dieldrin tissue and sediment results were elevated and isolated to Dominguez Channel estuary and Consolidated Slip.

DDT and PCBs fish results were elevated above Listing Policy screening values in nearly all receiving waters. This does not include Dominguez Channel freshwater; DDT has been detected in stormwater samples collected in Torrance Lateral. The more recent (1999-2004) tissue results corroborated the previously established consumption advisory in these greater Los Angeles/Long Beach Harbor waters. Sediment results for DDT and PCBs were elevated in transitional waters; e.g., Dominguez Channel estuary, Consolidated Slip and Los Angeles River Estuary.

Sediment Toxicity

Water toxicity was repeatedly observed in Dominguez Channel freshwaters. Sediment toxicity was observed in Dominguez Channel estuary, Consolidated Slip, Inner and Outer Harbor, Fish Harbor, Los Angeles River estuary and San Pablo Bay. The Bight 03 study provided the most recent sediment toxicity results.

Benthic Community Effects

The Dominguez Channel estuary, Consolidated Slip and Inner Harbor were previously listed for degraded benthic communities (infauna population and species composition). The most recent survey of benthic infauna (Ports 2006 and Bight 2003) provided results on current conditions; whereas previous studies provided historical information (BPTCP 1992-97, Bight 1998 and Ports 2006). While certain areas in the Inner Harbor have shown dramatic improvement, most notably the Cabrillo and Pier 400 Shallow Water Habitat areas, the evidence did not change the overall assessment conclusion of impairment for three waterbodies mentioned above.

2.4 Assessment Findings for each water body

Dominguez Channel freshwaters

Dissolved copper, lead and zinc exceeded numeric hardness-specific CTR criteria during wet weather events. Results for other metals or organochlorine compounds did not exceed criteria or detection limits were too high for adequate assessment determinations. Water toxicity has been repeatedly observed in the freshwater at the mass emissions station; elevated diazinon levels have been concurrently observed with these samples.

Torrance Lateral

Sediment results for copper and lead were above the State listing policy sediment quality values for these heavy metals (AMEC 2002). No water column samples or water toxicity results are currently available.

Dominguez Channel estuary

Sediment toxicity has been observed in 4 of 7 results, including 3 of 6 highly toxic results in Bight 03. In recent sediment triad studies, bulk levels of Cd, Pb and Zn were above sediment guidelines (Bight 03). Historical sediment results showed elevated levels of these metals, also. PAH sediment data showed levels of five individual compounds were above guidelines and maybe contributing to sediment toxicity. Elevated DDT and PCBS occurred in fish tissue and some sediment samples. Chlordane was elevated in recent sediment samples and historical fish tissue results. Dieldrin was not measured in sediments and was observed at slightly elevated levels in the individual fish sample reported in 1992. Degraded benthic community effects were observed in BPTCP 96 & 97 and confirmed in Bight 03 (3 of 5 in poor condition).

LA Harbor- Consolidated Slip

Water results showed elevated levels of DDT and PCBs (SCCWRP, 2006). Sediment toxicity has been observed in 12 of 13 historical samples, including one highly toxic result in Bight 03. In recent sediment triad studies, bulk levels of Hg, Pb and Zn were above sediment guidelines (Bight 03). Historical sediment results showed elevated levels of these metals and Cd, Cr, Cu, also. PAH sediment data showed that levels of six individual compounds were above guidelines and may be contributing to sediment toxicity. Chlordane and dieldrin have not been measured in recent sediment samples. Tissue results were mixed. Elevated DDT and PCBs occured in fish tissue and nearly all sediment samples. Toxaphene was originally listed due to elevated levels in mussels and will remain listed until new data shows significant decreases. Benthic community effects were observed in BPTCP 96 & 97 and moderate degradation observed in recent Bight 03 results.

LA/LB Inner Harbor

A fish consumption advisory for DDT and PCBs is currently in place and is corroborated by recent fish tissue results. Sediment toxicity has been observed in 10 of 23 results, including 3 of 8 toxicity results in Bight 03. Historical sediment data (pre- 1996) showed elevated levels of metals, PAHs and PCBs. In sediment triad studies, individual PAH levels were above PAH sediment guidelines (BPTCP 96 & 97, Bight 98). PAH sediment data showed sufficient exceedences of benzo[a]pyrene and chrysene (8/80) as to be impaired. There are fewer exceedences of benzo[a]anthracene, pyrene and phenanthrene (2/72) so these PAH compounds appear to not contributing to sediment toxicity. PCB sediment results from two older studies were also above sediment guidelines (BPTCP 96 & 97, Bight 98). More recent triad studies did not show such elevated (nor threatening) levels of PCBs; however, Pb and Zn were above guidelines (Bight 03). There are some reliable measurements of metals in water and only copper exceedences were evident (POLA 2005-06, Ports 2006). DDT and PCBs in water column have been detected via solid phase microextration (SPME) devices; DDE results showed exceedences

of CTR human health criteria (Zeng, et al. 2005). Benthic community effects were observed in BPTCP 96 & 97 and Bight 98, however more recent evaluations (Ports BioBasline 2000 and Bight 03) are pending.

LA Outer Harbor

A fish consumption advisory for DDT and PCBs exists and is supported by recent fish tissue results (LA Harbor Terminal Island WWTP). Sediment toxicity has been observed in 7 of 26 results, including 3 of 7 moderate toxicity results in Bight 03. No individual contaminants were above sediment guidelines in more recent studies (Bight 98, WEMAP 99, Bight 03). Individual PAH levels were above pollutant sediment guidelines only in historical results; e.g., BPTCP 1997 and earlier. Trend analyses of NOAA mussel data for PAHs were inconclusive. To date, no reliable measurements of metals or PAHs in water exist. There are a few reliable measurements of DDT and PCBs in the water column. DDE measured in water column showed 2 of 4 exceedences of CTR criteria (Zeng, et al. 2005).

LA Fish Harbor

A fish consumption advisory for DDT and PCBs exists and is supported by recent fish tissue results. Sediment toxicity has been observed in 2 of 4 results, including 1 of 1 moderate toxicity result in Bight 03. In recent sediment triad studies, bulk levels of Cu, Pb and Zn were above sediment guidelines (Bight 03). Historical sediment results showed elevated levels of chlordane, mercury, and six individual PAH compounds. Very few reliable measurements of aqueous metals or organics exist in this waterbody.

Cabrillo Marina

A fish consumption advisory for DDT and PCBs exists and is supported by recent fish tissue results. Only one sediment toxicity result exists and showed moderate to high toxicity, with corresponding and repeatedly elevated results for benzo[a]pyrene (5 of 26 exceedences of sediment quality guideline). Historical sediment results showed elevated levels of chlordane and chrysene in comparison to sediment guidelines, yet these do not correspond with sediment toxicity results, so impairment is not associated with these two compounds. Sediment results did not show elevated levels of metals or other organic compounds. Very few reliable measurements of aqueous metals or organics exist in this waterbody; no exceedences have been recorded.

Cabrillo Beach--Inner

A fish consumption advisory for DDT and PCBs exists and is supported by recent fish tissue results. Only historical sediment toxicity results exist for this segment; however no corresponding elevated levels of individual PAHs, total PAHs or organochlorine compounds were associated with the one toxic result. Sediment metal results do not elevated values relative to sediment quality guidelines, except for copper (2 of 16 in BPTCP 1994). More recent sediment results do not show any exceedences for any metal or organic compounds (PORTs 2006). Very few reliable measurements of aqueous metals or organics exist in this waterbody; no exceedences have been recorded, including copper 0 of 4 dissolved (POLA 2005-06). Based on available data in this pre-TMDL assessment, this waterbody is not impaired for copper, although it is on 2006 303(d) list.

Los Angeles River Estuary

A fish consumption advisory for DDT and PCBs extends into the estuary based on recent fish results collected at Pier J/Fingers Pier, both near the estuary mouth. Sediment toxicity has been observed in 4 of 7 results, including 2 of 5 moderate toxicity results in Bight 03. Historical sediment results showed elevated levels of chlordane. In recent sediment triad studies, bulk levels of chlordane, PCBs, and benzo[a]pyrene were above sediment guidelines (Bight 03). Very few reliable measurements of aqueous metals or organics exist in this waterbody; no exceedences have been recorded. Based on available data in this pre-TMDL assessment, this waterbody is not impaired for lead and zinc, although it is on 2006 303(d) list.

San Pedro Bay

A fish consumption advisory for DDT and PCBs exists and is support by recent fish tissue results. Chlordane in fish tissue did not appear to be elevated above OEHHA screening values. Sediment toxicity has been observed in 4 of 18 results, including 1 of 2 moderate toxicity results in Bight 03. Elevated levels of chlordane have been repeatedly occurring (6 of 19) and are associated with sediment toxicity. Other sediment results do not show exceedences for metals nor PCBs, nor other organics. Few reliable measurements of aqueous metals or organics exist in this waterbody; no exceedences have been recorded. Based on available data in this pre-TMDL assessment, this waterbody is not impaired for chromium, copper, zinc, and total PAHs although it is on 2006 303(d) list.

2.5 Assessment changes

New findings of impairment

In the course of this assessment, we identified some waterbodies as impaired due to pollutants not previously identified on previous 303d lists. Please note that previous "PAHs" listings have been clarified, where feasible, for individual PAH compounds; these may be construed as new listings.

Dominguez Channel identified for water toxicity and diazinon.
Dominguez Channel estuary for cadmium and sediment toxicity.
Inner Harbor for benzo[a]pyrene, chrysene and sediment toxicity.
Cabrillo Marina for benzo[a]pyrene.
Los Angeles River Estuary for benzo[a]pyrene, PCBs.

Delisting = nonimpairment

The following water body-pollutant combinations were included on 2006 303d list, however, assessment decisions show each waterbody-pollutant combination is currently attaining narrative and numeric WQS.

Dominguez Channel non-impairment for dieldrin in freshwater based on results of one fish collected the estuary downstream (TSM, 1992). Also no sediment toxicity exists in the freshwater segment.

Carillo Beach delist for copper. Sediment exceedences are few and old; more recent sediment data are below SQG values. No water column exceedences.
LAR estuary delist for Pb and Zn in sediments as no individual compound results exceed sediment guidelines.
San Pedro Bay delist for Cr, Cu, Zn, and total PAHs in sediments as no individual PAH compound results exceed sediment guidelines. No metal water column exceedences.

Assessment findings of non-impairment

This assessment has identified some water body-pollutant combinations as non-impaired. Even though these combinations were previously listed, our findings show two possible conditions to explain the change of assessment status. First, the Regional Board proposed some water body name changes in 2006 that reflect more accurately the geographical extent used in 1998 listings. For example, Main Channel and Southwest Slip are now incorporated into LA/LB Inner Harbor. Second, based on review of available data, the pollutant levels are not elevated relative to water quality objectives, sediment quality guidelines or tissue screening values, thus, the assessment conclusion yields the water body is attaining standards for this particular pollutant. For example, in LAR estuary, zinc and lead sediment levels do not exceed the metal specific sediment quality guideline for any sample results. Sediment toxicity in this waterbody has been observed and coincides with other chemicals; e.g., chlordane, PCBs and benzo[a]pyrene. In both cases, the decision to not pursue TMDL development is consistent with federal regulations and provisions outlined in the consent decree.

2.6 Conclusions

Based on review of available data, including information with 2006 303d list factsheets and more recent monitoring information, the water-quality limited segments are identified in Table 2-17 below. Each waterbody-pollutant combination will require TMDL development.

Table 2-17 Assessment Findings for each water body

Waterbody	Metals	PAHs	PCBs, DDT, etc	Toxicity	Benthic Community
DC fresh	Cu, Pb, Zn			Water (diazinon)	
TorrLat	Cu, Pb				
DC estuary	Cd, Cu, Pb, Zn	Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Pyrene, Phenanthrene	DDT, PCBs, Chlordane, Dieldrin	sediment	X
ConSlip	Cd, Cr, Cu, Hg, Pb, Zn	Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Pyrene, Phenanthrene, 2-methylnapthalene	DDT, PCBs, Chlordane, Dieldrin, Toxaphene	sediment	X
Inner	Cu, Pb, Zn	Benzo[a]pyrene, Chrysene	DDT, PCBs	sediment	X
Outer			DDT, PCBs	sediment	
Fish	Cu, Pb, Zn	Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, Pyrene, Phenanthrene, Dibenzoanthracene	DDT, PCBs, Chlordane	sediment	
Marina		Benzo[a]pyrene, ~~Chrysene, Pyrene~~	DDT, PCBs,		
Cabrillo Beach			DDT, PCBs		
LARiver Estuary			DDT, PCBs, Chlordane	sediment	
San Pedro Bay			DDT, PCBs, Chlordane	sediment	

3. NUMERIC TARGETS

Numeric targets were developed for all toxic pollutants identified in Section 2, above. Metal, chlordane and individual PAH compound target values are provided for water and sediment (Tables 3-1 and 3-2). DDT and PCBs and toxaphene targets are provided for water and sediment (Tables 3-1 and 3-2) as well as for fish tissue and tissue residues (Table 3-3 and 3-4). Also, ambient water toxicity and sediment toxicity targets are included since TMDLs will be developed for these impairments, which may not be alleviated by attainment of water quality standards for metals, PAHs, or organochlorine compounds. Both freshwater and saltwater targets are provided in this section.

3.1 Water

Numeric water targets are established in this TMDL for metals, organics and toxicity. Water targets are guided by the Basin Plan and the California Toxics Rule (CTR).

3.1.1 Water: Metals and Organics

Numeric water targets for metals and organics, consistent with CTR water quality criteria for protecting aquatic life, are established in Table 3-1. All metal water targets are for dissolved forms of the metals and are hardness dependent, except mercury which is for total mercury and is not hardness dependent.

The human health target was determined using the "organism only" values from the CTR vice the "organism and water" values because the waters of the Harbors are not drinking waters.

Table 3-1. Water quality criteria established in CTR for metals and organics.

Pollutant	Criteria for the Protection of Aquatic Life				Human Health
	Freshwater		Saltwater		Organism only
	Acute (µg/L)	Chronic (µg/L)	Acute (µg/L)	Chronic (µg/L)	(ug/L)
Cadmium	1.58*	1.44*	42	9.3	n/a
Copper	5.67*	4.09*	4.8	3.1	n/a
Lead	23.5*	0.92*	210	8.1	n/a
Zinc	53.9*	54.3*	90	81	n/a
Mercury	1.4	0.77	1.8	0.94	0.051
Chlordane			0.09	0.004	0.00059
4,4'-DDT	1.1	0.001	0.13	0.001	0.00059
Total PCBs	-	0.0002	-	0.03	0.00017
Benzo[a]pyrene	n/a	n/a	n/a	n/a	0.049

* Freshwater aquatic life criteria for Cd, Cu, Pb, Zn are expressed as a function of total hardness (mg/L) in the water body. Values presented correspond to average hardness from/to [Insert years] of 40 mg/L.

3.1.2 Water: Toxicity

The Basin Plan includes a narrative toxicity objective which states, in part: "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." This objective does not allow acute toxicity in any receiving waters or chronic toxicity outside designated mixing zones.

A numeric toxicity target is established for this TMDL to allow objective evaluation of the narrative toxicity objective. To meet the narrative toxicity objective, the numeric toxicity target of 1 chronic toxicity unit (1 TUc) is established. A chronic toxicity target was selected because it addresses the potential adverse effects of long term exposure to lower concentrations of a pollutant and is therefore more protective than an acute toxicity target that may not address potential effects of longer term exposures. Equation 1 describes the calculation of a TUc.

Equation 1 TU_c = Toxicity Unit Chronic = 100/NOEC (no observable effects concentration).

Or: TUc = 100% ÷ the sample concentration, derived using hypothesis testing, to cause no observable effect, with the sample concentration expressed as a percentage.

The numeric toxicity target is set at no observable toxicity with water samples defined as toxic by toxicity testing if the following two criteria are met: 1) there is a significant difference

($p<0.05$) in mean organism response (e.g., percent survival) between a sample and the control as determined using a separate-variance t-test, and 2) the mean organism response in the toxicity test (expressed as a percent of the laboratory control) was less than the threshold based on the 90th percentile Minimum Significant Difference (MSD) value expressed as a percent of the control value.

The 90^{th} percentile MSD value is specific for each specific toxicity test protocol and is determined by identifying the magnitude of difference that can be detected 90% of the time by a specific test method. The following is a description of MSDs and how a toxic effect would be identified (SWRCB, 1996): "In toxicity tests, the MSD represents the smallest difference between the control mean and a treatment mean (the effect size) that leads to the statistical rejection of the null hypothesis (H^o: no difference). Any effect size equal to or larger than the MSD would result in a finding of statistically significant difference. For example, if the control mean for mysid growth were 80 ug/mysid and the MSD were 20, any treatment with mean mysid weight less than or equal to 60 ug would be significantly different from the control and considered toxic."

3.2 Sediment

Numeric sediment targets are established in this TMDL for metals, organics and toxicity. In addition, targets are set for sediment benthic community effects. Sediment targets are guided by the Basin Plan, the State Board Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Sediment Quality Plan) and the sediment quality guidelines of Long and Arch ET&C (Long et al., 1995; Arch ET&C 2000) which are recommended by the State Listing Policy. In this section, the Sediment Quality Plan is discussed first, as it guides targets for sediment benthic community effects, toxicity, and sediment chemistry. Then the targets for sediment benthic community effects, toxicity, and sediment chemistry are established.

3.2.1 Sediment: Applicability of the State Board Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality

California recently adopted the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Sediment Quality Plan) which applies to sediments within enclosed bays and estuaries. EPA approved the Sediment Quality Plan on September 25, 2009. Part 1 of the Sediment Quality Plan establishes a method to assess sediment quality which integrates chemical and biological measures to determine if the sediment-dependent biota are protected or degraded by exposure to toxic pollutants in sediment. The Sediment Quality Plan establishes sediment quality objectives (SQO) based on three lines of evidence including sediment chemistry, sediment toxicity and benthic community condition. These three lines of evidence are sometimes called the sediment triad.

The Sediment Quality Plan describes a method of using the three lines of evidence to categorize a sediment as "Unimpacted," "Likely unimpacted," "Inconclusive," "Possibly impacted," Likely impacted," or "Clearly impacted." "Unimpacted," and "Likely unimpacted" are considered as achieving the protective condition in tested sediment. While "Unimpacted," and "Likely unimpacted" are the goal conditions, TMDLs need to be numeric to be effective and supportive

of the development of allocations, therefore the SQOs in the Sediment Quality Plan will be used to develop or support numeric targets.

The SQOs for the protection of aquatic life and human health are described below:

a. Aquatic Life – Benthic Community Protection

Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California. This narrative objective shall be implemented using the integration of multiple lines of evidence. The assessment of sediment quality consists of the measurement and integration of three lines of evidence (LOE). The LOE are:

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

b. Human Health

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

Each line of evidence produces specific information that, when integrated with the other lines of evidence provides a more confident assessment of sediment quality relative to sediment chemistry alone. When the exposure (chemistry) and effects (toxicity and benthic community assessment) are integrated, the approach can quantify protection through effects measures and also provide predictive capability through the exposure measure.

3.2.2 Benthic community effects

This TMDL establishes benthic community targets based on the Sediment Quality Plan. Benthic community condition is a measure of the species composition, abundance and diversity of the sediment-dwelling invertebrates inhabiting surficial sediments. The narrative SQOs in the Sediment Quality Plan are designed to protect the biological organisms within marine sediments and provide a direct measure of impact to these communities.

The Sediment Quality Plan identifies methods to evaluate a waterbody's benthic community condition and its alteration from reference conditions. Four different benthic indices are provided in the Sediment Quality Plan eachusing the same benthic community data: the Benthic Response Index (BRI); the Index of Biological Integrity as adapted for California bays and estuaries (IBI); the Relative Benthic Index (RBI); and the River Invertebrate Prediction and Classification System (RIVPACS) which was adapted for use in California bays and estuaries.

Categorical thresholds for each of the four biological indices (BRI, IBI, RBI, RIVPACS) were developed based in comparison to reference condition and categorized into four levels of biological disturbance:

1) Reference: Equivalent to least affected or unaffected site
2) Low Disturbance: Some indication of stress is present, but within measurement error of unaffected condition
3) Moderate Disturbance: clear evidence of stress
4) High Disturbance: high magnitude of stress

The combination of the four benthic indices provides more information than any single index (Ranasinghe, et al., 2007). These benthic-response categories are integrated by taking the median value, rounding up when the median falls midway between two benthic-response categories.

Because the SQOs were developed in part based on a local reference condition specific to Southern California marine bays, benthic assessments can rely on these published indices in a weight of evidence approach. The target for benthic community effects are either reference or low disturbance condition for any of the four biological indices included in the SQOs (Table 3-2, shaded boxes).

Table 3-2 Benthic Index Categorization Values (Recreated from Sediment Quality Plan Part 1 Table 5)

Index	1. Reference	2. Low Disturbance	3. Moderate Disturbance	4. High Disturbance
Southern California Marine Bays				
BRI	<39.96	39.96 to 49.14	49.15 to 73.26	>73.26
IBI	0	1	2	3 or 4
RBI	>0.27	0.17 to 0.27	0.09 to 0.16	<0.09
RIVPACS	>0.90 to <1.10	0.75 to 0.90 or 1.10 to 1.25	0.33 to 0.74 or >1.25	<0.33

These benthic community numeric targets apply to Dominguez Channel Estuary, Consolidated Slip, and Inner Harbor. Recent information has demonstrated the Outer Harbor is already within these target conditions, thus no benthic community effects TMDL is required for the Outer Harbor (Ports Benthic Evaluation –draft 2008).

3.2.3 Sediment toxicity

This TMDL establishes sediment toxicity targets based on the Sediment Quality Plan. Sediment toxicity is a measure of the response of invertebrates exposed to surficial sediments under controlled laboratory conditions. This provides a measure of exposure to all pollutants present in the sediment, including non-traditional or unmeasured chemicals.

Application of SQOs per the Sediment Quality Plan requires a minimum of two sediment toxicity tests—at least one short-term survival test and at least one sub-lethal test.

For the short-term survival tests, the acceptable species are all amphipods species (*Eohaustorius estuarius, Leptocheirus plumulosus, and Rhepoxynius abronius*). For these species, toxicity is defined by tests that are statistically significant (from reference sediment sample) and exhibit more than 10% mortality. Thus the target conditions for short-term survival tests are less than or equal to 10% toxicity in comparison to a reference sediment sample. The thresholds established in the Sediment Quality Plan are based on statistical significance and magnitude of the toxic effect. Acceptable test organisms and methods are summarized in Table 3-3

Table 3-3 Acceptable Short Term Survival Sediment Toxicity Test Methods

Test Organism	Exposure Type	Duration	Endpoint
Eohaustorius estuarius	Whole Sediment	10 days	Survival
Leptocheirus plumulosus	Whole Sediment	10 days	Survival
Rhepoxynius abronius	Whole Sediment	10 days	Survival

The sub-lethal sediment toxicity tests, growth or development tests are required by the SQOs. For the acute sub-lethal tests, the selection of test organisms is constrained to two organisms—*Neanthes* for juvenile growth or *Mytillus* embryo for reproductive development. The target conditions for sub-lethal sediment toxicity tests are less than or equal to 10% toxicity for juvenile growth and 20% for reproductive development in comparison to a reference sediment sample. Acceptable test organisms and methods are summarized in Table 3-4.

Table 3-4 Acceptable Sublethal Sediment Toxicity Test Methods

Test Organism	Exposure Type	Duration	Endpoint
Neanthes arenaceodentata	Whole Sediment	28 days	Growth
Mytilus gallopprovincialis	Sediment-water Interface	48 hours	Embryo Development

Because the SQOs require both toxicity tests, the desired condition for a waterbody is a non-toxic category from each type of toxicity test as shaded in Table 3-5, Disturbance Category 1. These sediment toxicity targets apply to the following waterbodies: Dominguez Channel estuary, Consolidated Slip, Inner Harbor, Outer Harbor, Fish Harbor, Cabrillo Marina, Los Angeles River estuary and San Pedro Bay.

Table 3-5. Sediment toxicity categorization values (Sediment Quality Plan Part 1. Table 4).

Test Species/ Endpoint	Statistical Significance	Score (Disturbance Category)			
		1 Nontoxic (Percent)	2 Low Toxicity (Percent of Control)	3 Moderate toxicity (Percent of Control)	4 High Toxicity (Percent of Control)
Eohaustorius Survival	Significant	90 to 100	82 to 89	59 to 81	<59
Eohaustorius Survival	Not Significant	82 to 100	59 to 81		<59
Leptocheirus Survival	Significant	90 to 100	78 to 89	56 to 77	<56
Leptocheirus Survival	Not Significant	78 to 100	56 to 77		<56
Rhepoxynius Survival	Significant	90 to 100	83 to 89	70 to 82	<70
Rhepoxynius Survival	Not Significant	83 to 100	70 to 82		<70
Neanthes Growth	Significant	90 to 100*	68 to 90	46 to 67	<46
Neanthes Growth	Not Significant	68 to 100	46 to 67		<46
Mytilus Normal	Significant	80 to 100	77 to 79	42 to 76	<42
Mytilus Normal	Not Significant	77 to 79	42 to 76		<42

*Expressed as a percentage of the control

3.2.4 Sediment Chemistry: Metals and organics

Sediment targets are the desired surface sediment concentrations for specific toxic pollutants to protect human health, aquatic organisms and wildlife as well as to restore all beneficial uses. Sediment targets represent longer term goals than water quality targets. In addition, these sediment targets are not put forth as dredge clean-up or action levels. Other CWA program activities such as the Section 404 program has flexibility in determining the appropriate sediment clean-up levels associated with each dredge project regulated under that aspect of CWA.

This TMDL establishes numeric targets that are protective of aquatic life beneficial uses for OC pesticides, PCBs, PAHs, and metals in sediments. While, chlordane, dieldrin, DDT, and PCB impairments have been documented in fish tissue only, sediment targets are necessary as these fish tissue contaminants are directly associated with sediments which are the transport mechanism of these compounds to the fish.

The Sediment Quality Objectives (SQOs) established by the Sediment Quality Plan provides objectives based on multiple lines of evidence that can be applied to sediments but does not provide individual numeric targets for sediment chemistry. To develop a TMDL, it is necessary to translate the narrative objectives in the Basin Plan and the lines of evidences in the SQOs into numeric targets that identify the measurable endpoint or goal of the TMDL and represent attainment of applicable numeric and narrative sediment and water quality standards.

The sediment quality guidelines of Long and Arch ET&C (Long et al., 1995; Arch ET&C 2000) provide applicable numeric targets because the impairments -and the 303(d) listings for PAHs, metals, toxicity and benthic community effects - are primarily based on sediment quality data for the Dominguez Channel estuary, Consolidated Slip, , Inner and Outer Harbor, Cabrillo Beach-Inner, San Pedro Bay, and Los Angeles River Estuary. In addition, the pollutants being

addressed have a high affinity for particles and the delivery of these pollutants is generally associated with the transport of suspended solids from the watershed or from sediments within the estuaries and greater Los Angeles/Long Beach Harbor waters.

The sediment quality guidelines of Effect Range Low (Long et al., 1995) and Threshold Effects Level (Arch ET&C 2000) are used to establish the numeric targets for freshwater sediment for Dominguez Channel, and marine sediment for the greater Los Angeles/Long Beach Harbor waters, as shown in Table 3.1. The State Board listing policy recommends the use of the Effect Range Medians (ERMs), Probable Effect Levels (PELs), and other sediment quality guidelines as a threshold for listing. ERM and PEL values are interpreted as levels above which the adverse biological effects are expected, which make them applicable in the determination of impairment. The Threshold Effects Level (TEL) for freshwater sediment and Effect Range Low (ERL) for marine sediment values, on the other hand, represent the levels below which adverse biological effects are not expected to occur, and are more applicable to the prevention of impairment. The goal of the TMDL is to remove impairment and to restore beneficial uses; therefore, the TEL for freshwater sediment and ERLs for marine sediment are selected as numeric targets over the ERMs and PELs to limit adverse effects to aquatic life. In addition, the selection of the TELs and ERLs, which are lower than PELs and ERMs respectively, provides an implicit margin of safety.

Sediment targets must also be established at levels which will be protective of fish tissue contaminant levels. The organic pollutants addressed by this TMDL (e.g. Chlordane, Dieldrin, Toxaphene, DDT, and PCBs) have the potential to bioaccumulate. To account for bioaccumulation, these TMDLs will rely on the simplified assumption that reduced sediment pollutants will correspond to reduced fish tissue levels. This is reasonable based on the observation that white croaker is a bottom feeding fish and DDT and PCB levels in this fish species are contributing to the fish advisory throughout the greater Los Angeles/Long Beach Harbor waters. The Chlordane, Dieldrin, Toxaphene, DDT and PCBs sediment targets presented in section 3.1.2 may need to be revised in the future to attain the fish tissue targets. Assessment of indirect impacts of sediment contamination bioaccumulation is currently under development by State Board and SCCWRP, as part of the State's Sediment Quality Plan –Part II. Scientific information from such studies, based on local fish species and biogeochemistry specific to Southern California will be helpful in evaluating possible revision of sediment quality targets.

Table 3-2. Numeric targets for sediment chemistry in fresh and saline waters (conc. in dry wt.)

Metals	Freshwater Sediment (TELs) (mg/kg)	Marine Sediment (ERLs) (mg/kg)
Cadmium	n/a	1.2
Copper	36	34
Lead	n/a	46.7
Mercury	n/a	0.15
Silver	n/a	1.0
Zinc	123	150
Organics	Marine Sediment (ug/kg)	
Chlordane, total	0.5	
Dieldrin	0.02	
Toxaphene	10*	
Total PCBs	22.7	
Benzo[a]anthracene	261	
Benzo[a]pyrene	430	
Chrysene	384	
Pyrene	665	
2-methylnaphthalene	201	
Dibenz[a,h]anthracene	260	
Phenanthrene	240	
Hi MW PAHs	1700	
Lo MW PAHs	552	
Total PAHs	4,022	
Total DDT	1.58	

n/a = not applicable since target not needed for this pollutant in freshwater
*Toxaphene value from New York DEP (1999), assumes 1% TOC

3.4 Fish Tissue for the protection of Human Health

Fish tissue targets for DDT and PCBs are selected from *"Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene"*, which are recently developed by OEHHA in June 2008 to assist other agencies to develop fish tissue-based criteria with a goal toward pollution mitigation or elimination and protect humans from consumption of contaminated fish or other aquatic organisms (OEHHA 2008). Use of fish tissue targets is appropriate to account for uncertainty in the relationship between pollutant loadings and beneficial use effects (EPA, Newport Bay TMDL, 2002) and directly addresses potential human health impacts from consumption of contaminated fish or other aquatic organisms. Use of fish tissue targets also allows the TMDL analysis to more completely use site-specific data where limited water column data are available, consistent with the provisions of 40 CFR 130.7(c)(1)(i). Thus, use of Fish Contaminant Goals (FCGs) provides an effective method for accurately quantifying achievement of the water quality objectives/standards. FCGs and CTR human health criteria for PAHs are not available. In the absence of FCGs and CTR criteria, USEPA screening value is applied for PAHs.

Table 3-7. Numeric Targets for DDT and PCBs in fish tissue.

Pollutant	OEHHA FCGs (ug/kg wet)
Chlordane	5.6
Dieldrin	
Total DDT	21
4,4'-DDT	
4,4'-DDE	
4,4'-DDD	
Total PCBs	3.6
PAHs – total	5.47
Toxaphene	6.1

3.5 Tissue residues for the protection of Aquatic Organisms

Targets are identified for protection of wildlife habitat (WILD) and preservation of rare and endangered species (RARE) can also be achieved through tissue/residue levels for DDT and PCBs (Table 3-4). Reducing pollutant loads to attain human health targets will yield progress toward restoring all beneficial uses, yet additional wildlife specific targets must be included to address possible impairments to reproductive success (birds) or immune system suppression (seals).

Table 3-8. Numeric Targets for DDT and PCBs in residues for protecting wildlife habitat and rare and endangered species.

Pollutant	Birds	Harbor Seals
4,4'-DDE	1 ug/g in eggs[1]	
Total DDT	n/a	0.3 ug/g lipid[2]
Total PCBs	0.5 ug/g in eggs[3]	5 ug/g lipid[2]

[1]Hothem and Powell (2000) no-effect level for DDE in Foster's Tern eggs in Texas.
[2]Barron Et al (2003) no-effect level for total DDT in harbor seals from Europe.
[3]Muir et al (1999) no-effect level for deformities for total PCBs in Leghorn Chicken eggs.

8. References

ACTA 2001. *ACTA Intertidal Biological Studies: In Situ Bioaccumulation of Heavy Metals by Bay Mussels (Mytilus edulis*) Final Report prepared by Alex Horne Associates for ACET.

Agency for Toxic Substances and Disease Registry (ATSDR). 2002. Toxicological Profile for Aldrin/Dieldrin. U.S. Department of Health and Human Services. September 2002.

American Zinc Association. 2004. http://www.zinc.org/zincuses.html

Barron, MG and R Heintz, MM Krahn. 2003. Contaminat Exposure and Effects in Pinnipeds: Implications for Steller Sea Lion Declines in Alaska. *Sci. Tot. Environ*. **311**: 111-133.

Bay Protection Toxic Cleanup Program (BPTCP) 1997 *Chemistry, Toxicity and Benthic Community Conditions in Sediments of Selected Southern California Bays and Estuaries* SWRCB, EPA, NOAA, Calif. F&G, UC-Santa Cruz, Moss Landing Labs, Columbia Analytical Services, data collected in 1994 &1996.

Bay, SM and D Lapota, J Anderson, J Armstrong, T Mikel, AW Jirik, S Asato. 2000 *Southern California Bight 1998 Monitoring Program: IV Sediment Toxicity*. Southern California Coastal Water Research Project. Westminster, CA.

Bruland, KW, JR Donat, and DA Hutchins 1991 Interactive influences of bioactive trace metals on biological production in oceanic waters. *Limnol. Oceanogr*. 36: 1555—1577.

Buchman, MF 1999 NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA Coastal Protection and Restoration Division, National Oceanic and Atmospheric Admininstration, 12 pp.

California Environmental Protection Agency Office of Environmental Health Hazard Assessment, 1999. Prevalence of Selected Target Chemical Contaminants in Sport Fish from Two California Lakes: Public Health Designed Screening Study. Final Project Report. June 1999.

Caltrans. 2001. Third Party BMP Retrofit Pilot Study Cost Review. Prepared for Caltrans Environmental Program, Office of Environmental Engineering. May 2001

Caltrans. 2004. BMP Retrofit Pilot Program – Final Report. Report ID CTSW – RT – 01- 050. January 2004.

Canadian Council of Ministers of the Environment. 1999 *Canadian Sediment Quality Guidelines for the Protection of Aquatic Life: Summary Tables*. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Minister of the Environment, Winnipeg.

Carson, R.., Damon, M.., Johnson, L., and Miller, J. 2002. Transitioning to Non-Metal Antifouling Paints on Marine Recreational Boats in San Diego Bay. November 15, 2002. Agreement No. 01-106-068 between University of California and California Department of Boating and Waterways, pursuant to senate Bill 315 passed in 2001.

CH2MHILL 2002. PLOAD Model for Marina del Rey Harbor, Preliminary Results. May 2002.

Chesler, J. 2002. Personal communication. Department of Beaches and Harbors, Los Angeles County. June 17, 2002.

City of Los Angeles. 2003. Los Angeles Harbor—Annual Assessment Report. City of LA, Department of Public Works, Bureau of Sanitation, Environmental Monitoring Division.

Coastal Sport Fish Contamination Study, unpublished data. 2001 State Water Resource Board and OEHHA database. R.K. Brodberg, Office of Environmental Health Hazard Assessment, Calif. EPA, Sacramento, Calif

De Bruijn, J and F Busser, W Seinen, J Hermens 1989 Determination of Octanol/Water Partition Coefficients for Hydrophobic Organic Chemicals with the "slow-stirring" method. *ET&C* **8:** 499-512

Federal Highway Administration (FHWA). Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring. http://www.fhwa.dot.gov/environment/ultraurb/index.htm

Field, LJ and DD MacDonald, SB Norton, CG Ingersoll, CG Severin, D Smorong, R Lindskoog. 2002. Predicting Amphipod Toxicity from Sedimend Chemistry Using Logistic Regression Methods. *ET&C* 21: 1993-2005.

Hoke,RA and GT Ankley, AM Cotter, T Goldstein, PA Kosian, GL Phipps, and FM VanderMeiden 1994 Evaluation of Equilibrium Partitioning Theory for Predicting acute toxicity to field collected sediments contaminated with DDT, DDE and DDD to the amphipod *Hyalella Azteca*. *ET&C* **13:** 157-166.

Hothem, RL and AN Powell 2000. Contaminants in Eggs of Western Snowy Plovers and California Least Terns: Is there a link to Population Decline? *Bull. Env. Cont. Tox*. **65**: 42-50.

Ingersoll, CG and DD MacDonald, N Wang, JL Crane, LJ Field, PS Haverland, NE Kemble, RA Lindskoog, C Severn, DE Smorong 2000. Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines. USGS final report for USEPA Great Lakes National Program EPA 905/R-00/007 June 2000

Johnson, L.L, TK Collier, and J.E. Stein. 2002. An analysis in support of sediment quality thresholds for polycyclic aromatic hydrocarbons (PAHs) to protect estuarine fish. Aquatic Conserv. Mar. Freshwr. Ecosyst. 12: 517-538.

LAC DPW. 1994—2004. Annual Report—decade summary Los Angeles County Department of Public Works. Los Angeles, CA.

LAC DPW. 2005-2006. Annual Report. Los Angeles County Department of Public Works. Los Angeles, CA.

LARWQCB. 1996. Water Quality Assessment and Documentation. Los Angeles Regional Water Quality Control Board. Los Angeles, CA.

LARWQCB. 1998. 1998 California 303(d) List and TMDL Priority Schedule: Los Angeles Regional Water Quality Control Board. Approved By USEPA: 12-May-99. http://www.swrcb.ca.gov/tmdl/docs/303(d)tmdl_98reg4.pdf

Long E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environ Manag. 19(1): 81-97.

Long, ER, DD MacDonald, DD; SL Smith and FD Calder 1996 *Incidence of Adverse Biological Effects with Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environ. Mgmt*. **19**:1 pp. 81-97.

Long, ER, LJ Field and DD MacDonald 1998 *Predicting Toxicity in Marine Sediments with Numerical Sediment Quality Guidelines*, *Environ. Toxicol. Chem*. **17**:4, pp. 714-727.

MacDonald, D. D. 1994. *Approach to the Assessment of Sediment Quality in Florida Coastal Waters*. MacDonald Environmental Sciences, Ltd., Ladysmith, British Columbia.

MacDonald, DD; RS Carr, FD Calder; ER Long and CG Ingersoll 1996 Development and evaluation of sediment quality guidelines for Florida coastal waters, *Ecotoxicology*, **5**: 253-278.

Muir, D et al. 1999. Spatial and Temporal Trends and Effects of Contaminants in the Canadian Arctic Marine Ecosystem: a Review. *Sci. of the To.l Environ*. **230**: 83-144.

National Academy of Sciences 1973 *Water Quality Criteria (Blue Book)*. EPA-R3-73-033. USEPA Ecological Research Series.

National Pesticide Telecommunications Network (NPTN). (undated). Chlordane: Technical Factsheet. National Pesticide Telecommunications Network, Oregon State University, Corvallis, Oregon. http://npic.orst.edu/factsheets/chlordanetech.pdf

New York Department of Environmental Conservation 1994 Niagra River biota contamination project - fish flesh criteria for piscivorous wildlife. NYDEC, Division of Fish and Wildlife, Bureau of Environemtnal Protection Technical Report 87-3, 182p.

New York Department of Environmental Conservation 1998 Technical guidance for screening contaminated sediments (for wildlife bioaccumulation). Albany, NY, Div. of Fish and Wildlife, Div. of Marine Resources. 36pp.

New York State. 1999. *Technical Guidance for Screening Contaminated Sediments*. Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources. p. 24.

Pontolillo, J and RP Eganhouse 2001 The search for Reliable Aqueous Solubility (Sw) and Octanol-Water Partition Coefficient (Kow) Data for Hydrophobic Organic Compounds: DDT and DDE as a case study. USGS Water Resources Investigations Report 01-4201. Reston, VA

Ports of Long Beach and Los Angeles. Year 2000 Biological Baseline Study of San Pedro Bay. Prepared by MEC Analytical Systems, Inc.; Science Applications International Corporation; Merkel & Associates, Inc.; Keane Biological Consulting; Everest International Consultants. Dated June 2002.

POLA 2005 Mid-water column monitoring results, enhanced suite analyses. May and Sept. 2005

POLB/POLA/Weston Solutions, 2006. Characterization of Sediment Contaminant Flux in Inner and Outer Harbor Waterbodies –TMDL Implementation Support. Sampling and Analysis Plan, prepared for Port of Los Angeles and Port of Long Beach, by Weston Solutions.

POLB 2006 Mid-water column monitoring results. Oct. 2006

San Diego Regional Water Quality Control Board (SDRWQCB) 2005. Total Maximum Daily Load for Dissolved Copper in Shelter Island Yatch Basin, San Diego Bay. Resolution No. R9-2005-0019 Basin Plan Amendment andTechnical Report. February 9, 2005.

SCCWRP, unpublished data 1998 *Sediment Chemistry from Southern California Bight including offshore Harbors and estuaries.* Southern California Coastal Water Research Program.

SCCWRP, unpublished data 2006 *Sediment/Water Flux measurements in greater LA/LB Harbor waters.*

Schiff, K and L Tiefenthaler 2000 *Anthropogenic versus natural mass emission from an urban watershed.* SCCWRP Annual report. pp. 63-70.

Smith, SL, DD MacDonald, KA Keenleyside, CG Ingersoll and LJ Field 1996 *A Preliminary Evaluation of Sediment Quality Assessment Values for Freshwater Ecosystems. J. Great Lakes Res.* **22**:3 pp. 624-638.

SMW 2000 *State Mussel Watch Program 1983-00 Data Base and 1995-97 Data Report*. State Water Resources Control Board, California Environmental Protection Agency, Sacramento, California

Soule, et. al. 1977. The Marine Ecology of Marina del Rey Harbor, California. A Baseline Survey for the County of Los Angeles Department of Small Craft Harbors. 1976-1977.

Soule, et. al. 1985. The Marine Environmental of Marina del Rey, California in 1984. July 1985.

Southern California Association of Governments (SCAG) 2004. Urban Land Use GIS data.

Southern California Coastal Water Research Project (SCCWRP) 2000. Southern California Bight 1998 Regional Monitoring Program Results. http://www.sccwrp.org/regional/98bight/98docs.htm

State Water Resources Control Board (SWRCB) 1999. Toxics Substances Monitoring Program.

State Water Resources Control Board (SWRCB) 2000. State Mussel Watch Program.

State Water Resources Control Board (SWRCB) 2004. Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) list. Sept. 30, 2004.

State Water Resources Control Board (SWRCB) 2005. Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options. June 16, 2005.

State Water Resources Control Board (SWRCB) 2007. Water Quality Impaired Segments –Section 303(d) List. Final 2006 list with EPA approval. July 2007.

State Water Resources Control Board (SWRCB) 2008. Water Quality Control Plan For Enclosed Bays and Estuaries—Part I Sediment Quality Plan. Sept. 16, 2008.

Stein, E.D. and D Ackerman, K Schiff. 200. *Watershed-based Sources of Contaminants to San Pedro Bay and Marina del Rey: Patterns and Trends. Polycyclic*. Southern California Coastal Water Research Project (SCCWRP) Technical report #413, prepared for Los Angeles Contaminated Sediments Task Force.

Stein, E.D. and LL Tiefenthaler, K Schiff. 2006. *Watershed-based Sources of Polycyclic Aromatic Hydrocarbons in Urban Storm Water*. Environ. Tox. Chem. 25: 373-385.

Stolzenbach, K.D., Rong,L., Xiong, C., Friedlander, S., and Turco,R. 2001. Measuring and Modeling of Atmospheric Deposition on Santa Monica Bay and the Santa Monica Bay Watershed. Draft Final Report to the Santa Monica Bay Restoration Project.

Sutherland, R.C. and S. L. Jelen. 1997. Contrary to Conventional Wisdom: Street sweeping can be an Effective BMP. Advances in Modeling the Management of Stormwater Impact. CHI Publications.

TSMP 1987-99 *Toxic Substance Monitoring Program 1987-99 Data Base*. State Water Resources Control Board, California Environmental Protection Agency, Sacramento, California

US Army Corps of Engineers (USACE). 1999. Marina del Rey and Ballona Creek Feasibility Study – Sediment Control Management Plan. Los Angeles District, Corps of Engineers. Los Angeles, California.

US Fish & Wildlife Service 1998 *Guidelines for Interpretation of the Biological Effect of Selected Constituents in Biota, Water, and Sediment*. US Department of Interior report.

US Fish & Wildlife Service 2000 Biological Opinion on EPA's "Water Quality Standards: Establishment of Numeric Criteria for Priority Toxic Pollutants or the State of California".

US Fish & Wildlife Service 2001 *Environmental Contaminant Encyclopedia*. www.nature.nps.gov/toxic/ National Park Service website. US Department of Interior report.

USEPA 1980 *Ambient Aquatic Life Water Quality Criteria: DDT*. EPA-440/5-80-038. Office of Water, Washington, DC.

USEPA 1991 *Guidance for Water Quality-based Decisions: The TMDL Process.* EPA-440/4-91-001. Office of Water, Washington, DC.

USEPA 1997 *National Toxics Rule* [NTR], Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliance -- Revision of Metals Criteria; Federal Register Rule—40CFR Part 131.36 as amended. U.S. Environmental Protection Agency, Washington, D.C.

USEPA 2000a *California Toxics Rule* [CTR], Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Federal Register Rule—40CFR Part 131. U.S. Environmental Protection Agency, Washington, D.C.

USEPA 2000d *Guidance for Assessing Chemical Contaminant Data for Use in Fish Consumption Advisories, Vol. 1: Fish Sampling and Analysis*, 3rd ed. EPA-823-B-00-007. U.S. Environmental Protection Agency, Office of Water, Wash. DC.

USEPA 2000e *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health.* EPA-822-B-00-004. U.S. Environmental Protection Agency, Office of Water, Wash. DC.

USEPA 2001a *Update of Ambient Water Quality Criteria for Cadmium.* EPA-822-R-01-001. U.S. Environmental Protection Agency, Office of Water, Wash. DC. Notice of availability April 12, 2001

USEPA 1991b *Technical Support Document for Water Quality-based Toxics Control.* EPA-505-2-9-001. Office of Waer, Washington, DC.

USEPA 1993. *Guidance Specifying Management Measures For Sources of Nonpoint Pollution In Coastal Waters.* EPA 840-B-92-002. U.S. Environmental Protection Agency, Office of Water, Washington DC.

USEPA. 1991. Assessment and Control of Bioconcentratable Contaminants in Surface Waters. United States Environmental Protection Agency, Washington, DC.

USEPA. 1999a. National Menu of Best Management Practices for Stormwater - Phase II. http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/poll_10.cfm

USEPA. 1999b. Preliminary Data Summary of Urban Stormwater Best Management Practices. EPA-821-R-99-012, August 1999.

USEPA. 1999c. National Menu of Best Management Practices for Stormwater - Phase II (1999). USEPA 832-F-99-007. http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/post.cfm.

USEPA. 2000a. Guidance for developing TMDLs in California. USEPA Region 9. January 7, 2000.

USEPA. 2000b. 40 CFR Part 131 – Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. FR, 65(97), May 18, 2000.

USEPA. 2002. Total Maximum Daily Loads for Toxic Pollutants San Diego Creek and Newport Bay, California. June 14, 2002.

USEPA. 2007. Coastal Marine Fish Contaminants Survey, 2002-2004 Southern California, U.S. Environmental Protection Agency – Region IX and National Oceanic and Atmospheric Administration on behalf of Natural Resource Trustees.

Walker, T.A. and T.H.F. Wong. 1999. Effectiveness of Street Sweeping for Stormwater Pollution Control. Cooperative Research Centre for Catchment Hydrology. Technical Report 99/8. December 1999.

Weston Solutions, 2006. Characterization of Sediment Contaminant Flux in Inner and Outer Harbor Waterbodies – TMDL Implementation Support. Sampling and Analysis Plan, prepared for Port of Los Angeles and Port of Long Beach, by Weston Solutions.

Zeng, EY and D Tsukada, DW Diehl, J Peng, K Schiff, JA Noblet, KA Maruya. 2005. Distribution and Mass Inventory of Total Dichlorodiphenyldichloroethylene in the Water Column of the Southern California Bight. *Environ. Sci. Technol.* 39: 8170-76.

Zeng, EY and D Tsukada, JA Noblet and J Peng. 2005. Determination of polydimethylsiloxane–seawater distribution coefficients for polychlorinated biphenyls and chlorinated pesticides by solid-phase microextraction and gas chromatography–mass spectrometry. *J. Chrom. A,* 1006: 165-175.