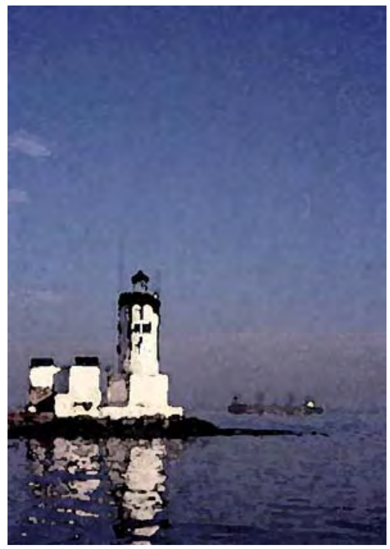
STATE OF THE WATERSHED – Report on Surface Water and Sediment Quality

The Dominguez Channel and Los Angeles/ Long Beach Harbors Watershed Management Area



October 2008

California Regional Water Quality Control Board – Los Angeles Region
Shirley Birosik, Watershed Coordinator

PREFACE

This report is a descriptive document and no policy or regulation is either expressed or intended. It is one in a series written by the Regional Board's watershed coordinator which summarizes and characterizes surface water or sediment quality data for the Region's watersheds. The Regional Board is often asked very basic questions about water quality and in many instances State of Watershed reports answer these questions. The reports are also helpful in showing how effectively or ineffectively we are all collectively doing monitoring and sharing data by going through the process of acquiring and merging data from different sources and making these data accessible.

In an highly industrialized area where sediment deposition occurs on an ongoing basis and water circulation may be limited, the ability for unlined channel and harbor waters to support biota is as dependent (or often more dependent) on sediment quality as it is on surface water quality. Sediment concentrations of pollutants are also less variable than water column concentrations. And, much of the previously hard-to-obtain sediment data are now in a consolidated database or otherwise available via the Internet. Thus, this document puts great emphasis on evaluating sediment data and less attention is given to evaluating water column information except for general water quality trends. Additionally, various reports, including the Dominguez Watershed Management Master Plan, have provided a comprehensive summary of water column information within the watershed. And, while there are certainly interactions between groundwater and surface water in the WMA, with groundwater contamination a possible contributor to some surface water or sediment impairments, this report is focused on evaluating surface conditions.

There is some discussion of the watershed's biological resources due to their widespread occurrence and since there are many aquatic life-related beneficial uses sensitive to water and sediment quality problems; however, this report is not meant to be a complete documentation of these resources.

Prior to release of the public draft, in-house comments were provided by Regional Board staff. An announcement of the public draft report's availability for review and comment was made to the Email list for the Dominguez Watershed Advisory Council. Comments were received from the cities of Carson and Los Angeles, the Ports of Long Beach and Los Angeles, and a consultant to the ports, Weston Solutions, Inc.

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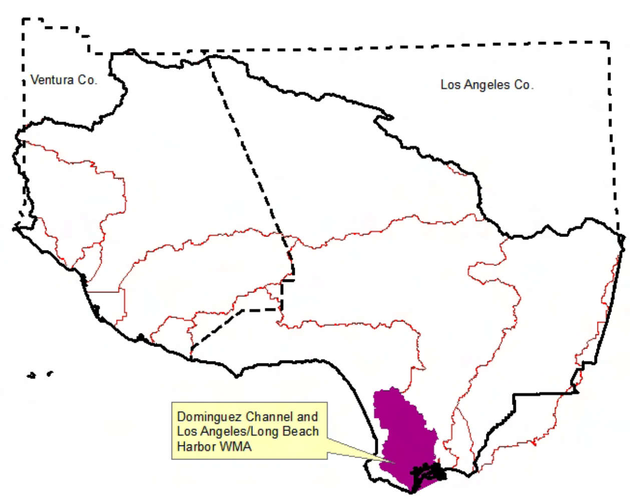


The Dominguez Channel and Los Angeles/Long Beach Harbors Watershed Management Area (Dominguez WMA) is located in the southern portion of the Los Angeles Basin. Along the northern portion of San Pedro Bay is a natural embayment formed by a westerly extension of the coastline which contains both harbors, with the Palos Verdes Hills the dominant onshore feature. Historically, the area consisted of marshes and mudflats. Near the end of the19th century and during the beginning of the next century, channels were dredged, marshes were filled, wharves were constructed, the Los Angeles River was diverted, and a breakwater was constructed in order to allow deep draft ships to be directly offloaded and products be swiftly moved. Eventually, the greater San Pedro Bay was enclosed by two more breakwaters and deep entrance channels were dredged to allow for entry of ships with need of 70 feet of clearance. The Los Angeles/Long Beach (LA/LB) Harbor complex is now one of the largest ports in the country (CRWQCB, 2007b).

Permitted discharges:

- Eight major NPDES discharges: one POTW, two generating stations, and five refineries; 38 minor NPDES discharges; 54 discharges covered by general NPDES permits
- 440 dischargers covered under an industrial storm water permit
- 214 dischargers covered under the construction storm water permit

Despite its industrial nature, contaminant sources, and low flushing ability, the inner harbor area supports fairly diverse fish and benthic populations and provides a protected nursery area for juvenile fish. The California least tern, an endangered species, nests in one part of the harbor complex. The outer part of both harbors (the greater San Pedro Bay within the breakwaters) has been less disrupted and supports a great diversity of marine life and a large population of fish. It is also open to the ocean at its eastern end and receives much greater flushing than the inner harbors. Small freshwater wetlands continue to persist elsewhere in the WMA, as well (CRWQCB, 2007b).

Various parts of the WMA are currently 303(d)-listed (2006 list) as impaired for metals, PCBs, PAHs, historic pesticides, coliform, trash, and nitrogen (CRWQCB, 2007b).

Potential sources of pollution:

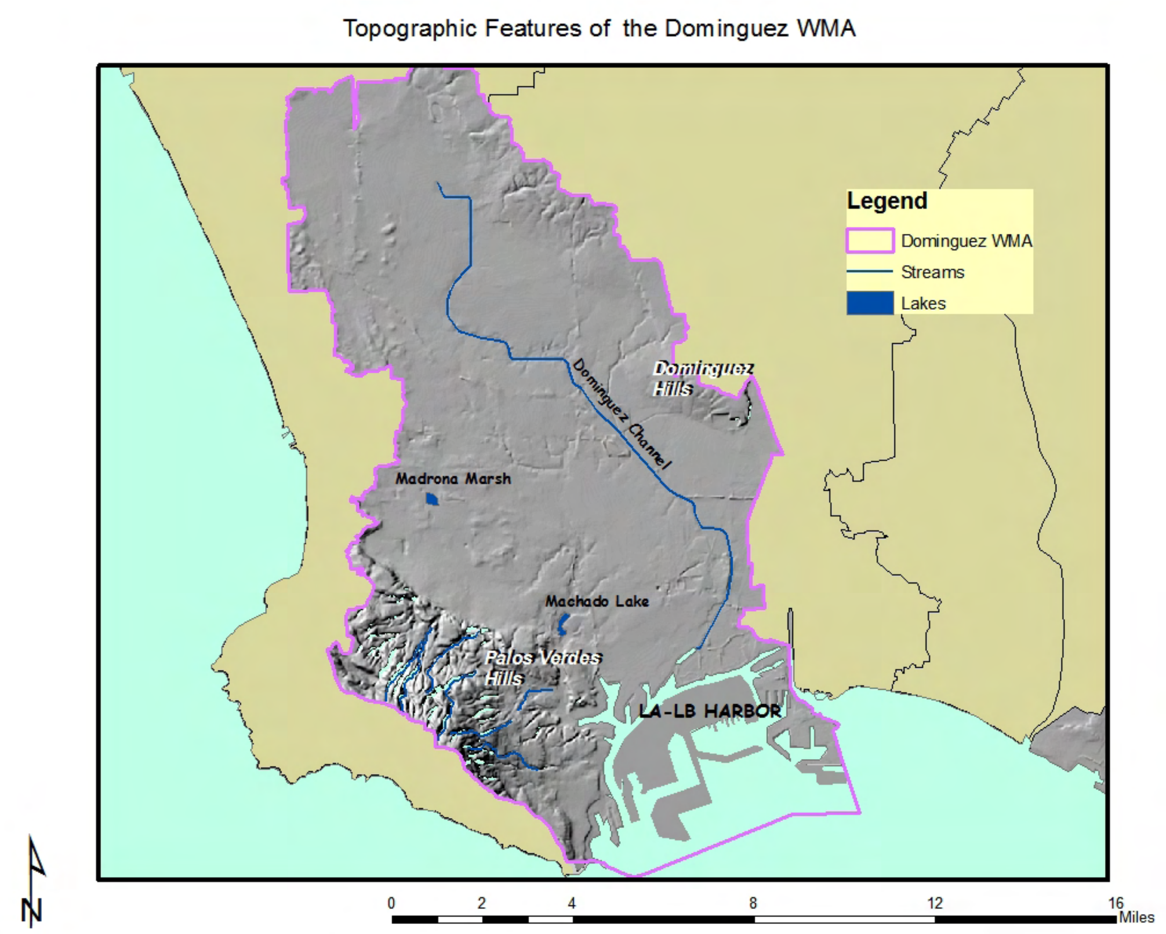
- Historical deposits of DDT and PCBs in sediment
- Discharges from POTW & refineries
- Spills from ships and industrial facilities
- Leaching of contaminated groundwater
- Stormwater runoff

STATE OF THE WATERSHED

Physical Description of Watershed

The Dominguez WMA is located in the southern portion of the Los Angeles Basin. A natural embayment occurs along the northern portion of San Pedro Bay, formed by a westerly extension of the coastline which contains LA/LB Harbors; the Palos Verdes Hills is the dominant onshore feature as can be seen below. Unlike more "traditional" watersheds containing a river flowing toward the ocean and draining upland and mountainous areas to the ridgeline, the watershed has a generally low gradient. Its boundaries are not visually apparent in many locations and are defined by the directions that underground storm drains flow.

Figure 1



Los Angeles Harbor is 7,500 acres in size while Long Beach Harbor is 7,600 acres; together they have an open water area of approximately 8,128 acres. The 15 miles-long Dominguez Channel drains a densely urbanized area to inner Los Angeles Harbor (LACDPW, 2004).

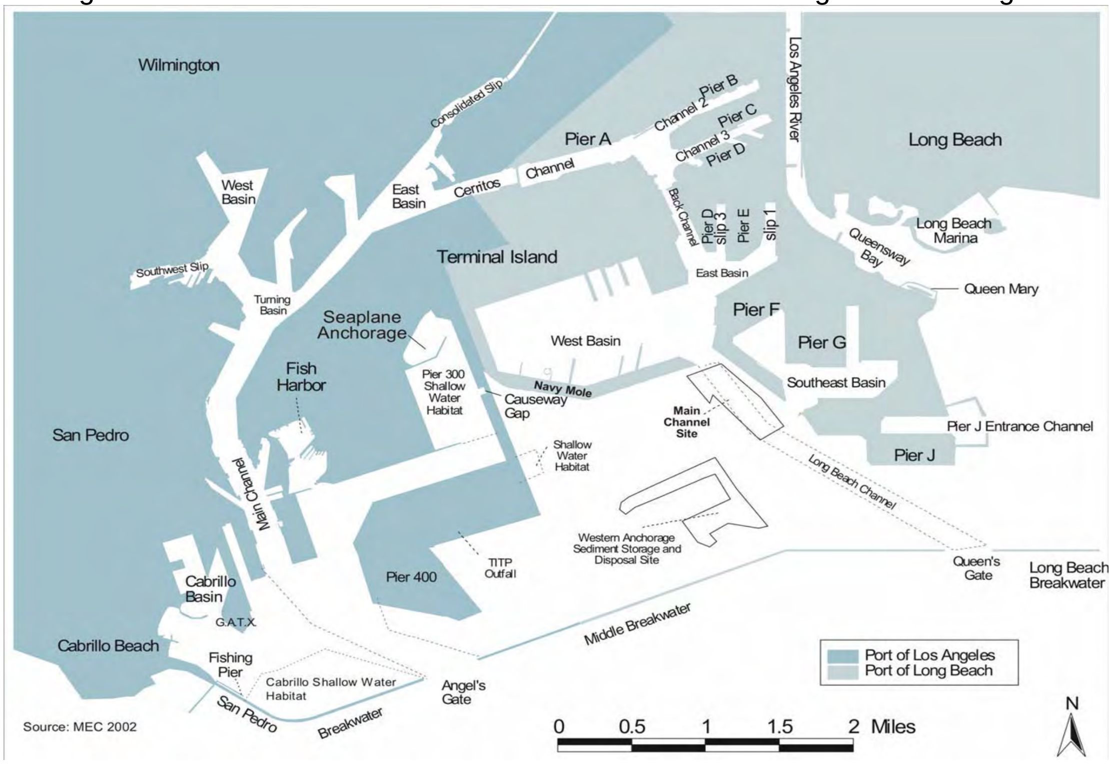
Historically, the area consisted of marshes and mudflats with large marshy areas, including Dominguez and Bixby Sloughs, to the north. Flow from the Los Angeles River drained to different locations over the years, including to Santa Monica Bay, but for a time it entered where Dominguez Channel now drains. The map below from 1903 depicts the extensive wetlands that were in the area (LACDPW, 2004 [labels added]).

Figure 2. Map of the Dominguez WMA from 1903

Near the end of the19th century and during the beginning of the next century, channels were dredged, marshes were filled, wharves were constructed, the Los Angeles River was diverted, and breakwaters were constructed in order to allow deep draft ships to be directly offloaded at docks and products be swiftly moved. The Dominguez Slough was completely channelized and became the drainage endpoint for runoff from a highly industrialized area. Eventually, the greater San Pedro Bay was enclosed by two more breakwaters and deep entrance channels were dredged to allow for entry of ships with need of 70 feet of clearance. The LA/LB Harbor complex together is now one of the largest ports in the country (CRWQCB, 2007b).

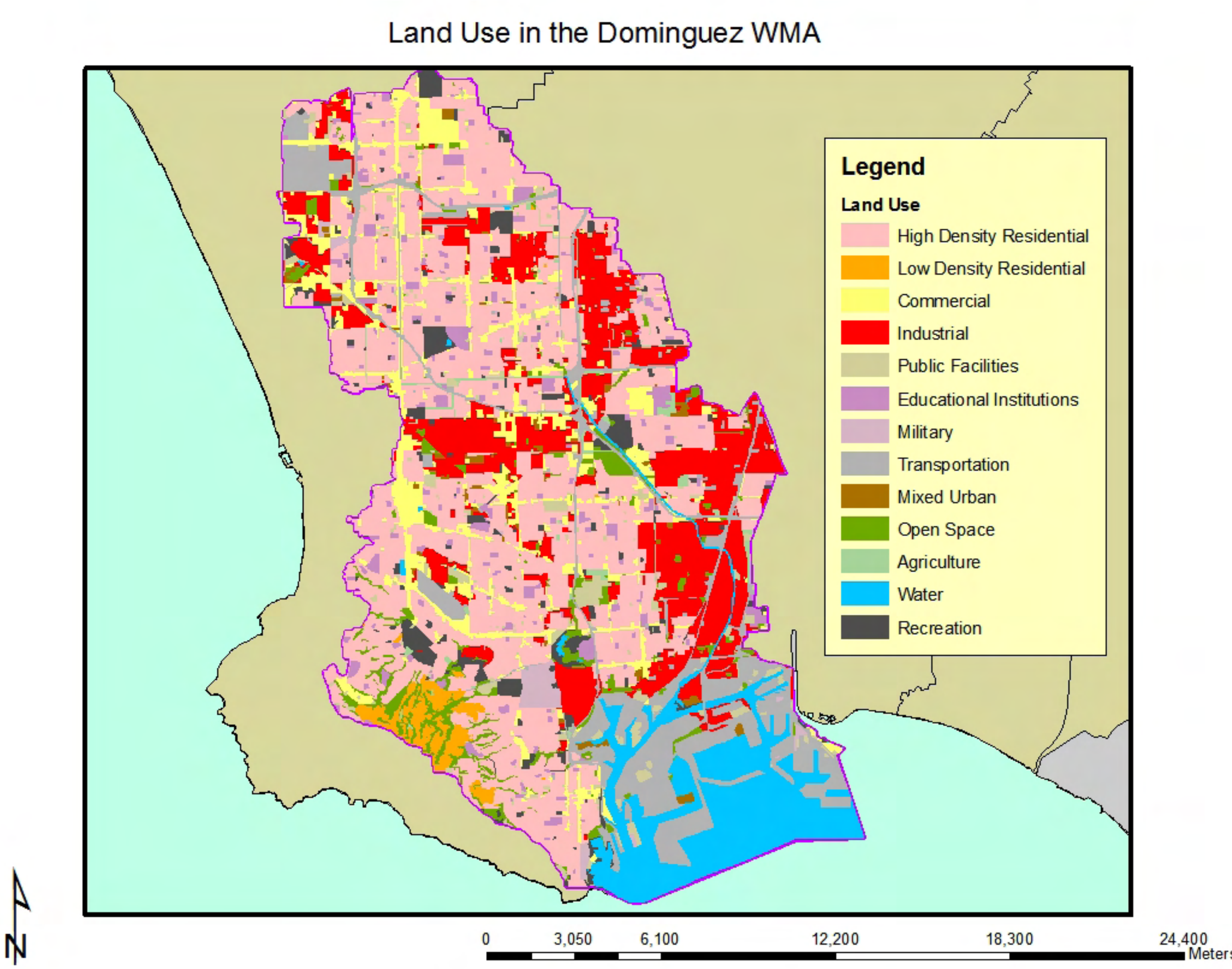
The following figure shows the various features of the area in and around the ports (LACDPW, 2004).

Figure 3. Features of the Area Around the Ports of Los Angeles and Long Beach



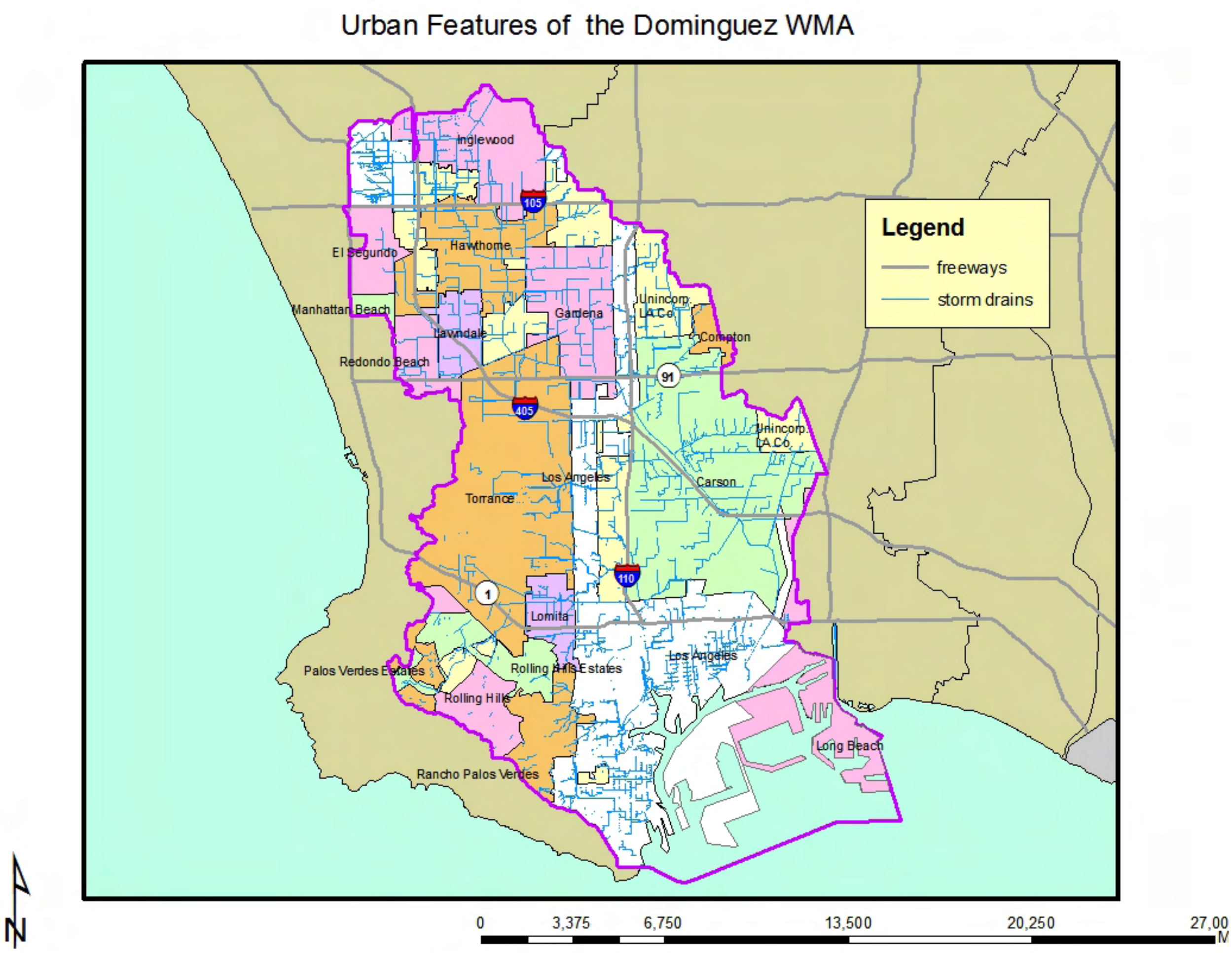
The highly industrialized nature (and resultant large amount of impervious surface) of the Dominguez WMA can be seen in the figure below based on Southern California Association of Governments 2005 GIS layers.

Figure 4



Other urban features of the WMA can be seen in the figure below.

Figure 5



Major Historical Events in Watershed

- 1542 – San Pedro Bay is discovered by Juan Rodriguez Cabrillo (Port of Los Angeles website)
- 1869 - Los Angeles and San Pedro Railroad begins service between San Pedro Bay and City of Los Angeles (Port of Los Angeles website)
- 1871 - Main Channel dredged to -10 feet; breakwater built between Rattlesnake Island (now Terminal Island) and Deadman's Island (formerly located near Terminal Island) (Port of Los Angeles website)
- 1899 – Construction of the San Pedro breakwater begins (Port of Long Beach website)
- 1901 – Brighton Beach, on the southern end of the former Rattlesnake Island, becomes fashionable resort (LA Times, 7/20/1992)
- 1907 – Port of Los Angeles officially founded with creation of Los Angeles Board of Harbor Commissioners (Port of Los Angeles website)
- 1909 – The towns of Wilmington and San Pedro become part of the City of Los Angeles (Port of Los Angeles website)
- 1911 – Port of Long Beach officially founded (Port of Long Beach website)

- 1911–1912 - First 8500-foot section of the San Pedro breakwater completed; Main Channel widened to 800 feet and dredged to -30 feet; Southern Pacific Railroad completed its first major wharf in San Pedro (Port of Los Angeles website)
- 1916 – Brighton Beach resort closes down as major dredging begins (LA Times, 7/20/1992)
- 1916 – Dredging of channels and a turning basin completed (Port of Long Beach website)
- 1917 - Todd Shipyard began operation (as Los Angeles Shipbuilding & Dry Dock Corporation) (LA Times, 7/8/1989)
- 1917 – First Port of Long Beach Board of Harbor Commissioners formed (Port of Long Beach website)
- 1926 – Long Beach attains deepwater port status (Port of Long Beach website)
- 1932 – Construction begins on the middle breakwater (Port of Long Beach website)
- 1936 – Oil is discovered in the harbor (Port of Long Beach website)
- 1937 - Construction of the 18,500-foot-long extension of the middle breakwater completed (Port of Los Angeles website)
- 1940 – A U.S. naval station is established on Terminal Island (Port of Long Beach website)
- World War II - Shipbuilding becomes the Port's prime economic activity with shipyards collectively employing more than 90,000 workers (Port of Los Angeles website)
- 1949 – Construction completed on Long Beach breakwater (Port of Long Beach website)
- 1959 – Beginning of containerized shipping (Port of Los Angeles website)
- 1962 – Beginning of containerized shipping (Port of Long Beach website)
- 1963 – Vincent Thomas Bridge opens to traffic (Port of Los Angeles website)
- 1965 – Construction of Piers F and J completed (Port of Long Beach website)
- 1983 – Dredging of Main Channel to -45 feet completed (Port of Los Angeles website)
- 1989 - Todd Shipyard ceases operation (LA Times, 7/8/1989)
- 1993 – Pier J expansion completed (Port of Long Beach website)
- 1997 - The Terminal Island Container Transfer Facility is completed, allowing for the direct transfer of containers to and from ships and railcars (Port of Los Angeles website)
- 2000 – Completion of dredging and landfills for Pier 400 (Port of Los Angeles website)
- 2002 – Alameda Corridor opens; the 20-mile rail expressway directly connects the Port to downtown Los Angeles (Port of Los Angeles website)

Biological Setting

Despite its industrial nature, contaminant sources, and low flushing ability, the inner harbor area supports fairly diverse fish and benthic populations and provides a protected nursery area for juvenile fish. The California least tern, an endangered species, nests in one part of the harbor complex. The outer part of both harbors (the greater San Pedro Bay within the breakwaters) has been less disrupted and supports a great diversity of marine life and a large population of fish. It is also open to the ocean at its eastern end and receives much greater flushing than the inner harbors (CRWQCB, 2007b).

The Ports contracted with a consultant team to conduct a biological baseline study in 2000 which was the first study of its kind since the 1970s (the Ports have plans to repeat the biological studies in 2008). A number of surveys were conducted including those quantifying the benthic community; larval, juvenile, and adult fish populations; bird use patterns; and biological communities attached to rocky riprap habitats; as well as, mapping of kelp and eelgrass distributions. Collectively, the fish population of both inner and outer harbors was estimated at 44 million in 2000 which makes a large portion of this WMA a valuable marine resource. A total of 74 species of fish were collected in the harbors in the 2000 study. Pelagic schooling fish ranged in high abundances throughout the harbor complex, while demersal fish were more common in the deepwater habitats of the outer and middle harbor areas. The shallow waters of the harbors provide an important nursery habitat for a variety of species including California halibut and queenfish. The most abundant species in the harbor included northern anchovy, white croaker, queenfish, topsmelt, Pacific sardine, salema, white surfperch, and shiner surfperch. Other relatively abundant commercially and recreationally important species included California halibut, barred sand bass, and California corbina (POLB and POLA, 2002).

Over 400 species of benthic infauna and larger macroinvertebrates were reported in Long Beach and Los Angeles Harbors in 2000. Over the past half century a steady improvement in benthic habitat quality of the harbors has been demonstrated by increased diversity and less dominance by pollution-tolerant benthic infauna species. The harbor areas exhibiting the highest quality for benthic communities are in the created shallow water habitats and in the deep open waters of both harbors. While much improvement has occurred in the harbors, polluted and "semi-healthy" areas still exist. The Consolidated Slip of Los Angeles Harbor remains the most polluted while "semi-healthy" areas exist in Cerritos Channel of the inner harbor, and in confined basins and slips in both harbors. The spatial extent of these poorer habitat areas are not as widespread today as they were in the 1950s (POLB and POLA, 2002).

A total of 265 species of invertebrates and algae was identified within the riprap community and spatial patterns were similar to those found during the 1980s. More species occurred on riprap in the outer than inner harbor areas (POLB and POLA, 2002).

A total of 99 species of birds, representing 31 families, were observed within the Ports during the 2000-2001 monitoring year for the 2000 baseline study. Of those, 69 species are considered to be dependent on marine habitats. The most abundant birds were western gulls. Diving birds that feed on fish were second in abundance and were dominated by elegant terns and brown pelicans. The third most abundant bird guild was waterfowl, represented largely by western grebe, Brant's cormorant, and surf scoter. Upland birds, dominated by large numbers of rock doves roosting under docks and pilings, were the next most dominant followed by small shorebirds, large shorebirds, and wading/marshbirds. Survey zones along the breakwaters supported the highest densities of birds. Several sensitive species were observed including the California brown pelican, total observations of which had increased substantially from studies during 1973-1974, and peregrine falcons, several pairs of which are known to nest within the Ports and vicinity. California least terns also nest in the Port of Los Angeles. There were over 500 nesting pairs in 2000, which was substantially higher than the approximately 100 nesting pairs during the 1986-1987 study. Other sensitive species nesting within the Port of Los Angeles and observed in high numbers during the 2000 summer surveys were caspian tern, elegant tern, and black skimmer. Other sensitive species observed during surveys included black-crowned night herons, black oystercatcher, burrowing owl, and loggerhead shrike (POLB and POLA, 2002).

The 2000 study found that kelp and macroalgal communities are for the most part restricted to the shallow hard bottom environments associated with riprap shorelines, breakwaters, and pier structures, as well as harbor debris. The true kelp communities were restricted to the outermost portions of the harbor where giant kelp forms a principal component of the assemblages. There is a general trend of lessening algal diversity from the outermost portions of the Ports to the innermost channel environments. Giant kelp communities within harbors totaled about 25 acres in the spring of 2000 and declined to about 14 acres in the fall of 2000. Giant kelp was established within the Ports as transplants to the San Pedro Breakwater in 1977 and distribution of kelp has expanded within outer Los Angeles Harbor since that time. During the 2000 study, giant kelp also was found along the Middle Breakwater, on a submerged dike at the Cabrillo Shallow Water Habitat, on riprap edges of Pier 400, at other localized riprap shorelines, and on cobbles offshore Cabrillo Beach (POLB and POLA, 2002).

Eelgrass habitat occurs in shallow waters offshore Cabrillo Beach and within the Pier 300 Shallow Water Habitat in Los Angeles Harbor. The beds vary seasonally in overall area; beds within the Port of Los Angeles ranged from approximately 50 acres in the spring of 2000 to approximately 100 acres at their peak in the fall (POLB and POLA, 2002).

Dominguez Channel drains into Consolidated Slip within Los Angeles Inner Harbor. Most of the WMA's runoff to the harbors enters through the Channel which is approximately 15 miles long and is fed by several tributary channels, most notably the Torrance Lateral, Del Amo Lateral, Victoria Creek, and 132nd and 135th Street Drains. Dominguez Channel is concrete-lined from its origin in Hawthorne to approximately Vermont Street in the City of Gardena. Few biological resources occur within the upper Dominguez Channel or its tributary channels, which are concrete-lined. From Vermont Street downstream to Los Angeles Harbor, Dominguez Channel has a soft-bottom with riprap banks, and is tidally-influenced; however, during the highest high tides in Dominguez Channel, the upper limit of tidal influence extends to near Artesia Street (within the concrete-lined portion). In Torrance Lateral, the highest high tides can extend upstream about 0.75 miles (Port of LA comment letter, 8/29/08). Mussels grow on bridge pilings and fish are seen in the channel. The channel banks are mostly unvegetated. A total of 43 species of birds were observed by private citizens during lunch breaks at the park and ride near Vermont and Artesia Boulevard during 2001 and 2002. The most abundant species included western grebe, double-crested cormorant, snowy egret, mallard, cinnamon teal, American coot, black-necked stilt, least sandpiper, western sandpiper, western gull, ring-billed gull, and European starling (LACDPW, 2004).

Other habitat areas within the harbor include the Cabrillo Salt Marsh and the 22nd Street Wetland. The Cabrillo Salt Marsh (3 acres) was created in the late 1980s and consists of lagoon and salt marsh habitats. Topsmelt and goby fish occur in the lagoon. The 22nd Street Wetland is supported by water seepage from an underground source. Red-winged blackbirds and other birds use the site, and mosquitofish have been observed within waters at the site (LACDPW, 2004).

Canyons on the Palos Verdes Peninsula, interspersed among low-density residential lots, provide wildlife habitat and riparian areas. The canyons are mostly privately-owned canyons and include Dodson, Colt, and Miraleste Canyons on the east facing slopes, and Sepulveda, Agua Manga, Chadwick and George F. Canyons on the north facing slopes of the peninsula. These canyons support relatively undisturbed coastal sage scrub, chaparral, and riparian communities in which numerous wildlife species occur. Several sensitive species of birds, reptiles, and mammals exist, or have the potential to exist, in these areas (LACDPW, 2004).

Wetlands persist in the Ken Malloy Harbor Regional Park area (Machado Lake Wetlands and the unlined portion of Wilmington Drain), in Gardena (Telco Wetlands and Gardena Willows), in Carson (Albertoni Farms Wetlands), and in Torrance (Madrona Marsh) (LACDPW, 2004).

Harbor Regional Park, located in Wilmington and Harbor City, is operated by the City of Los Angeles Department of Recreation and Parks. The park is 231 acres in size, and contains a large perennial freshwater lake (Machado Lake) with extensive freshwater marsh habitats. Willow woodland and scrub habitat borders much of the east side of the lake. Approximately, 200 species of birds occur at the park annually. The California least tern, a federal- and state-listed endangered bird, uses the park for foraging, and the endangered Least Bell's vireo was present there in. Many raptor species have been observed in the area including the osprey, white-tailed kite and Cooper's hawk. Only exotic fish species live in the lake including carp, goldfish, green sunfish, bluegill, large-mouthed bass, channel catfish, black bullhead and mosquitofish (LACDPW, 2004).

Wilmington Drain discharges into Machado Lake from the north; the channel is concrete-lined from its origin south of Sepulveda Boulevard (between Normandie and Vermont Avenues) to where it crosses under the Harbor Freeway north of Lomita Boulevard. South of this point it changes to a soft bottom with natural side banks to where it empties into Machado Lake. Habitat in this part of the drain includes mature riparian woodland, riparian scrub, freshwater marsh, and weedy vegetation. The biological value of the habitat is not considered great due to the lack of adjacent natural open space; however, the area is well-utilized by birds (LACDPW, 2004).

The Gardena Willow Wetlands is approximately nine acres in size and contains water much of the year; it is characterized by dense stands of large willows. A number of bird species utilize the wetlands which is surrounded by a highly urbanized area. The Telco Wetlands is partially supported by drainage from the Gardena Willows Wetlands as well as water from a second drainage; it drains to Dominguez Channel. Habitat is rather limited but includes some willows and sycamores. Albertoni Farms Wetlands is along a drainage which runs through a mobile home park. The wetlands are heavily infested with nonnative vegetation but may support some use by native wildlife (LACDPW, 2004).

Madrona Marsh is a vernal freshwater marsh preserve located in the City of Torrance which encompasses approximately 43.5 acres. It includes willow riparian habitats, vernal marsh and pool habitats, and upland areas. Over 90 species of plants, 232 species of birds, 58 taxa of aquatic insects, and 30 species of butterflies have been reported there (LACDPW, 2004).

Watershed Stakeholders

The Dominguez Watershed Advisory Council was formed in February 2001 and met on a monthly basis for three years to conduct a variety of tasks including development of a Watershed Management Master Plan (funded by Proposition 13) aimed at protecting and improving the environment and beneficial uses of the watershed. The watershed plan was finalized and a list of potential implementation projects/programs was included in the Plan. Meetings are now held less frequently. The group’s website is at http://ladpw.org/wmd/watershed/dc/ where a copy of the Watershed Plan may be downloaded. The Council consists of a diverse group of stakeholders including municipalities, refineries, environmental groups, and neighborhood representatives.

The WMA’s Designated Beneficial Uses

The Regional Board designates beneficial uses of all waterbodies in the Water Quality Control Plan for the Ventura and Los Angeles Coastal Watersheds (usually referred to as Basin Plan). These beneficial uses are the cornerstone of the State and Regional Board's efforts to protect water quality, as water quality objectives are set at levels that will protect the most sensitive beneficial use of a waterbody. Together, beneficial uses and water quality objectives form water quality standards (CRWQCB, 1994).

Fourteen beneficial uses for waters in the Dominguez WMA are designated in the Regional Board's Basin Plan. These beneficial uses are listed by waterbody and hydrologic unit in the table below. Certain site specific water quality objectives, namely TDS, sulfate, chloride, boron, and--for surface waters--nitrogen, reflect background levels of constituents in the mid-1970s, in accordance with the State Board's Antidegradation Policy. Water quality objectives for these and for other constituents and parameters can be found in the Basin Plan (CRWQCB, 1994).

Table 1. Beneficial Uses of waters within the Dominguez WMA (CRWQCB, 1994)

Watershed[a]	Hydro Unit #	MUN	IND	PROC	AGR	GWR	FRSH	NAV	POW	REC1	REC2	COMM	AQUA
DOMINGUEZ CHANNEL WATERSHED													
Dominguez Channel to Estuary	405.12	P*								Ps	E		
Dominguez Channel Estuary [w]	405.12							P		Es	E	E	
Los Angeles – Long Beach Harbor													
Outer Harbor	405.12							E		E	E	E	
Marinas	405.12		E					E		E	E	E	
Public Beach Areas	405.12							E		E	E	E	
All Other Inner Areas	405.12		E					E		P	E	E	

Watershed[a]	Hydro Unit #	WARM	COLD	SAL	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL	WET[b]
DOMINGUEZ CHANNEL WATERSHED													
Dominguez Channel to Estuary	405.12	P					P		E				
Dominguez Channel Estuary [w]	405.12				E	E	E		Ee	Ef	Ef		
Los Angeles – Long Beach Harbor													
Outer Harbor	405.12					E			E			P	
Marinas	405.12					E			E			P	
Public Beach Areas	405.12					E	E		E		P	E	
All Other Inner Areas	405.12					E			Ee			P	

E: Existing beneficial use
I: Intermittent beneficial use
P: Potential beneficial use
E, P, and I shall be protected as required.
*: Asterisked MUN designations are designated under SB 88-63 and RB 89-03. Some designations may be considered for exemption at a later date (See pages 2-3, 4 of Basin Plan for more details).

(a) Waterbodies are listed multiple times if they cross hydrologic area or subarea boundaries. Beneficial designations apply to all tributaries to the indicated waterbody, if not listed separately.
(b) Waterbodies designated as WET may have wetlands habitat associated with only a portion of the waterbody. Any regulatory section would require a detailed analysis of the area.
(e) One or more rare species utilize all ocean, bays, estuaries, and coastal 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 which are heavily influenced by freshwater inputs.
(s) Access prohibited by Los Angeles County Department of Public Works.
(w) These areas are engineered channels. All reference to Tidal Prisms in Regional Board documents are functionally equivalent to estuaries.

Beneficial Use Definitions

Beneficial uses in the Regional Board's Basin Plan are defined below. The uses are listed in no preferential order.

Municipal and Domestic Supply (MUN)
Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR)
Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Process Supply (PROC)
Uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply (IND)
Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Ground Water Recharge (GWR)
Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Freshwater Replenishment (FRSH)
Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Navigation (NAV)
Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Hydropower Generation (POW)
Uses of water for hydropower generation.

Water Contact Recreation (REC-1)
Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-contact Water Recreation (REC-2)
Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Commercial and Sport Fishing (COMM)
Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Aquaculture (AQUA)
Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Warm Freshwater Habitat (WARM)
Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD)
Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Inland Saline Water Habitat (SAL)
Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST)
Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Wetland Habitat (WET)
Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

Marine Habitat (MAR)
Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Wildlife Habitat (WILD)
Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats (BIOL)
Uses of water that support designated areas or habitats, such as **Areas of Special Biological Significance (ASBS),** established refuges, parks, sanctuaries, ecological reserves, or other areas where the preservation or enhancement of natural resources requires special protection.

Discharges into the Watershed

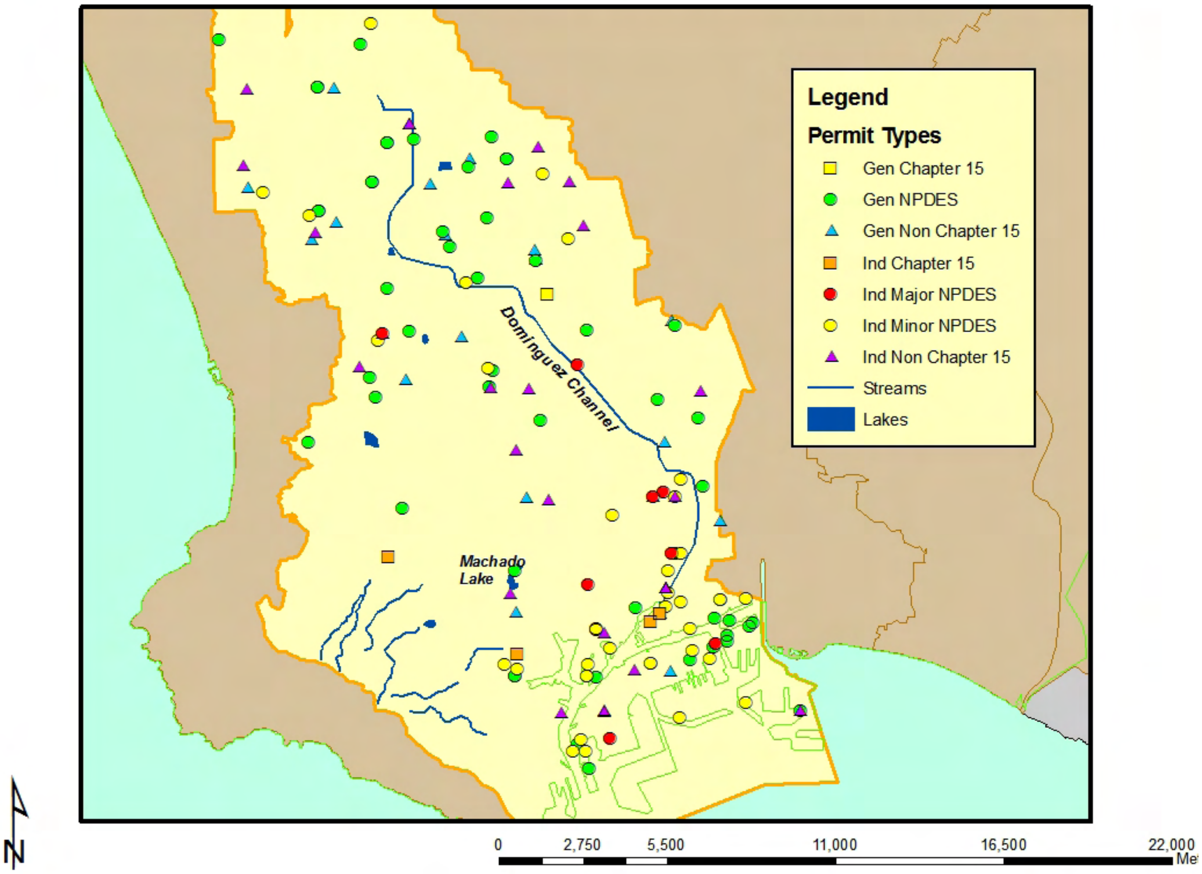
A Publicly-Owned Treatment Works (POTW), the City of Los Angeles' Terminal Island Treatment Plant, discharges tertiary-treated effluent to the outer LA/LB Harbor and is under a time schedule order to remove the discharge. The discharger's plan consists of achieving full reclamation (mostly for industrial reuse purposes) by 2020 which would eliminate the discharge completely. Two generating stations have permits to discharge to the inner harbor areas. Many smaller, non-process waste discharges to both Dominguez Channel and harbor waters also occur. Another POTW, the Joint Water Pollution Control Plant, is physically located in the watershed but discharges off of the Palos Verdes Peninsula to the Santa Monica Bay WMA (CRWQCB, 2007b).

There are eight major National Pollutant Discharge Elimination System (NPDES) discharges: the previously mentioned POTW, two generating stations, and five refineries (five Channel discharges, three Harbor discharges). In addition, there are 38 minor individual permits (15 Channel, 23 Harbor) and 54 discharges covered by general NPDES permits (32 Channel, 22 Harbor). About one-half of the 100 NPDES permitted facilities discharge to Dominguez Channel; the rest discharge to the LA/LB Harbor complex (CRWQCB, 2007b).

Major NPDES discharges are those from either POTWs with a yearly average flow of over 0.5 MGD, from an industrial source with a yearly average flow of over 0.1 MGD, or are those discharges with lesser flows but with potential acute or adverse environmental impacts to surface waters. Minor NPDES discharges are all other discharges to surface waters that are not categorized as a Major. Minor discharges may be covered by general NPDES permits, which are issued administratively, for those that meet the conditions specified by the particular general permit. Non-Chapter 15 discharges are those to land or groundwater such as commercial septic systems or percolation ponds that are covered by Waste Discharge Requirements, a State permitting activity. Chapter 15 discharges generally relate to land disposal (landfills) under Chapter 15 of the California Code of Regulations, again an exclusively State permitting activity. The locations of facilities with discharges to surface water or to the ground (other than those covered by general industrial or construction stormwater permits) are shown in the following figure (CRWQCB, 2007b). A complete list of dischargers in the watershed may be obtained electronically from the author.

Figure 6

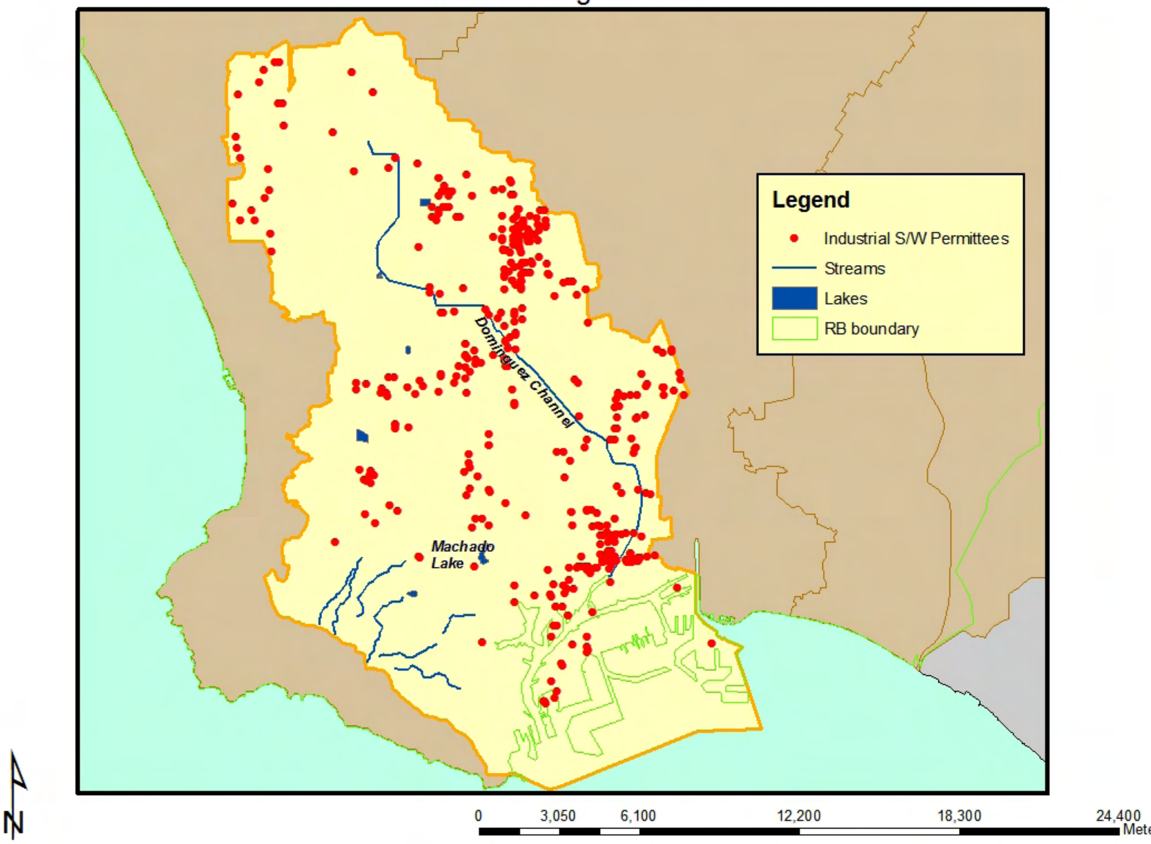
NPDES, Non-Chapter 15, and Chapter 15 Discharger Locations in the Dominguez WMA



There are 214 sites enrolled under the general construction storm water permit (the number of enrollees varies from year to year). The sites are spread fairly evenly throughout the watershed and are a mix of residential, industrial, and commercial sites; about one-half of the sites are five acres or larger in size. The larger parcels of up to 500 acres in size are mostly located in the ports (CRWQCB, 2007b).

Of the 440 dischargers enrolled under the general industrial storm water permit in the watershed, the largest numbers are located in the cities of Gardena, Wilmington, Torrance, and Carson, along Dominguez Channel. Wholesale trade-durable goods, fabricated metal products, trucking & warehousing, chemicals & allied products, transportation equipment, and rubber & miscellaneous plastics products are a large component of these businesses based on their Standard Industrial Classification (SIC) code. The locations of facilities with discharges covered by the general industrial stormwater permit are shown in the following figure (CRWQCB, 2007b).

Figure 7
Locations of Dischargers Covered by General Industrial Stormwater Permit
in the Dominguez WMA



Water/Sediment Quality Concerns and Impairments

There are a total of 96 pollutant/waterbody impairments in the WMA. The Los Angeles/Long Beach Inner Harbor is on the 2006Clean Water Act Section 303(d) list due to bacteria, impaired benthic community, sediment toxicity, DDT, copper, zinc, PAHs, and PCBs. In addition, two areas within Los Angeles Harbor are considered to be toxic hot spots under the Bay Protection and Toxic Cleanup Program (BPTCP): Dominguez Channel/Consolidated Slip, based on sediment concentrations of DDT, PCBs, cadmium, copper, lead, mercury, zinc, dieldrin, chlordane, sediment toxicity, and degraded benthic infaunal community; and Cabrillo Pier area, based on sediment concentrations of DDT, PCBs and copper, sediment toxicity and issuance of a human health (fishing) advisory for DDT and PCBs in white croaker and exceedances of National Academy of Science guidelines for DDT in fish and shellfish (CRWQCB, 2007b).

Also, several locations are listed as sites of concern under the BPTCP: Inner Fish Harbor, due to sediment concentrations of DDT, PCBs, copper, mercury and zinc and sediment toxicity (not recurrent); Kaiser International, due to sediment concentrations of DDT, PCBs, PAHs, copper and endosulfan; Hugo Neu-Proler, due to PCBs sediment concentrations; Southwest Slip, due to sediment concentrations of DDT, PCBs, PAHs, mercury, and chromium, and sediment toxicity; Cerritos Channel, due to sediment concentrations of DDT, PCBs, metal, chlordane, TBT, sediment toxicity and accumulation in mussel tissue; Long Beach Outer Harbor, due to sediment concentrations of DDT and chlordane and sediment toxicity; and West Basin, due to sediment concentrations of DDT and PCBs, sediment toxicity, and accumulation in clam tissue. Potential sources of these materials are considered to be historical deposition, discharges from the nearby POTW (especially for metals), spills from ships and industrial facilities, as well as stormwater runoff. Many areas of the harbors have experienced soil and/or groundwater contamination, which may result in possible transport of pollutants to the harbors' surface waters. Dredging and disposal, capping, and/or remediation of contaminated sediments and source control of pollutants in the harbors is a major focal point for the Contaminated Sediment Task Force described further elsewhere in this document (CRWQCB, 2007b).

The WMA is a highly industrialized area with numerous nonpoint sources of pollution for PAHs and also contains remnants of persistent legacy pesticides as well as PCBs which results in poor sediment quality both within the Dominguez Channel and in adjacent Inner Harbor areas, especially Consolidated Slip. The Channel was the recipient of runoff from the Montrose Chemical Facility which manufactured DDT for several decades until the early 1970s. Although highest in Dominguez Channel estuary and Consolidated Slip sediments, DDT is pervasive throughout the harbors. Metals, particularly copper and zinc, remain elevated at some locations in the sediments of the inner harbors. A likely major nonpoint source contributor to these concentrations is antifouling paint containing copper that leach from the many ships and boats in the harbors as well as the zinc anodes used on watercraft. Sediment toxicity occurs more frequently in parts of the Inner Harbor than elsewhere (CRWQCB, 2007b). Consolidated Slip, the part of Inner Harbor immediately downstream of Dominguez Channel, continues to exhibit a very impacted benthic invertebrate community (POLB and POLA, 2002).

Cal-EPA's Office of Environmental Health Hazard Assessment (OEHHA) advises against consumption of white croaker in the harbor and recommends no more than one meal every two weeks of black croaker, queenfish, and surfperches if caught in the harbor (CRWQCB, 2007b.

The table below shows the complete list of water quality impairments from the 2006 303(d) list.

Table 2. Water Quality Impairments in the Dominguez WMA

Water Quality Limited Segment Name	Pollutant
Dominguez Channel (lined portion above Vermont Ave)	Ammonia Copper Dieldrin (tissue) Indicator bacteria Lead (tissue) Sediment Toxicity Zinc (sediment)
Dominguez Channel Estuary (unlined portion below Vermont Ave)	Ammonia Benthic Community Effects Benzo(a)pyrene (PAHs) Benzo[a]anthracene Chlordane (tissue) Chrysene (C1-C4) Coliform Bacteria DDT (tissue & sediment) Dieldrin (tissue) Lead (tissue)

Water Quality Limited Segment Name	Pollutant
	PCBs (Polychlorinated biphenyls) Phenanthrene Pyrene Zinc (sediment)
Los Angeles Harbor - Cabrillo Marina	DDT PCBs (Polychlorinated biphenyls)
Los Angeles Harbor - Consolidated Slip	Benthic Community Effects Cadmium (sediment) Chlordane (tissue & sediment) Chromium (sediment) Copper (sediment) DDT (tissue & sediment) (Fish Consumption Advisory) Dieldrin Lead (sediment) Mercury (sediment) PCBs (tissue & sediment) (Fish Consumption Advisory) Sediment Toxicity Toxaphene (tissue) Zinc (sediment) Benzo[a]anthracene Benzo(a)pyrene Chrysene Pyrene Phenanthrene 2-Methyl-naphthalene
Los Angeles Harbor - Fish Harbor	Benzo[a]anthracene Benzo(a)pyrene Chlordane Chrysene (C1-C4) Copper DDT Dibenz[a,h]anthracene Lead Mercury PAHs (Polycyclic Aromatic Hydrocarbons) PCBs (Polychlorinated biphenyls) Phenanthrene Pyrene Sediment Toxicity Zinc
Los Angeles Harbor - Inner Cabrillo Beach Area	Copper DDT (Fish consumption advisory for DDT) PCBs (Fish Consumption Advisory for PCBs) Indicator bacteria*
Los Angeles/Long Beach Inner Harbor	Beach Closures Benthic Community Effects

Water Quality Limited Segment Name	Pollutant
	Copper DDT PCBs (Polychlorinated biphenyls) Sediment Toxicity Zinc
Los Angeles/Long Beach Outer Harbor (inside breakwater)	DDT PCBs (Polychlorinated biphenyls) Sediment toxicity
Machado Lake (Harbor Park Lake)	Algae Ammonia ChemA (tissue)** Chlordane (tissue) (Fish Consumption Advisory) DDT (tissue) (Fish Consumption Advisory) Dieldrin (tissue) Eutrophic Odor PCBs (Polychlorinated biphenyls) (tissue) Trash
San Pedro Bay Near/Off Shore Zones	Chlordane Chromium (sediment) Copper (sediment) DDT (tissue & sediment) (Fish Consumption Advisory for DDT) PAHs (Polycyclic Aromatic Hydrocarbons) (sediment) PCBs (Fish Consumption Advisory for PCBs) Sediment Toxicity Zinc (sediment)
Torrance Carson Channel	Coliform Bacteria Copper Lead
Wilmington Drain	Ammonia Coliform Bacteria Copper Lead

*Los Angeles Harbor Bacteria TMDL, 2005
** ChemA refers to the sum of the chemicals aldrin, dieldrin. chlordane, endrin, heptachlor, heptachlor epoxide, HCH (including lindane), endosulfan, and toxaphene

Summaries/Descriptions of Two Long-term Bioaccumulation Programs and Several Large-scale Studies

Monitoring in this watershed has taken quite a different approach from that taken in more traditionally-structured watersheds. Usually ambient monitoring will take place in a setting where tributaries flow to a mainstem river which discharges to an estuary. More often than not, water samples are collected in the tributaries and mainstem (targeted or randomly-sited) while, additionally, sediment and/or bioaccumulation samples are collected in the estuary (where deposition is to be expected). Sediment will often not be collected in the tributaries and mainstem due to periodic flushing during storms or due to a larger grain size (to which pollutants tend not to adsorb) while benthic infauna will be collected during more stable weather periods (late spring or fall). In any case, there is a clear connection between tributaries, mainstem, and estuary both visually and in monitoring design. However, in a watershed where much of the "upland" is paved over, tributaries are mostly underground storm drains, and the main visible water feature is a large deepwater port (with marine more so than estuarine waters but still subject to sediment deposition), monitoring programs must be adjusted accordingly.

Both ports have conducted water column monitoring for basic constituents at fixed locations, and at multiple depths, for many years and have additionally conducted large-scale special studies, most recently in 2006. Sediments have been frequently collected and tested in anticipation of dredge projects. Randomly-selected sites have been utilized for chemical, toxicological, and benthic community analysis of sediments in a number of regionally-scaled studies such as Bight'03. A feature of most of the sediment monitoring is the generally limited repeat sampling of sites. Since the locations of dredge sites vary and the very nature of sampling randomly-chosen sites results in little likelihood of repeat samples over time, there are limited data at any one site should site-specific trend analysis be of interest. On the other hand, one can choose a fairly arbitrary timespan and evaluate all data collected during it with the assumption that sediment concentrations change rather slowly through time unless an area is dredged. Other than water column sampling as an exception to this, the other fixed station sampling that has occurred is bioaccumulation monitoring through the State Mussel Watch (SMW) Program and Toxic Substances Monitoring (TSM) Program (both now merged into the structure of the State's Surface Water Ambient Monitoring Program – SWAMP). A summary of SMW and TSM Programs data and brief summaries of large-scale studies follow. The sediment data generated by the large-scale studies are further characterized in the section entitled "Discussion of Combined Sediment Quality Dataset."

State Mussel Watch Program

The SMW Program utilized the filter-feeding characteristics of bivalves (predominantly mussels) to detect and evaluate the occurrence of toxic substances in areas with stable higher salinity such as ports and marinas, as well as, some of the Region's estuaries which tend to stay open and thus are mostly saline. Data from the program documented high levels (relative to elsewhere in the State) of various organic compounds and metals in mussel tissue at several locations in the inner harbor area. The first map below shows the locations of the many SMW Program sites over the years. Only a few of the sites were sampled for five years or more. It is followed by three maps which show in essence a time series of contamination for one of the more significant pollutants in the watershed, DDT (total DDT is shown but is largely comprised of DDE, a degradation by-product). Only data for transplanted California mussel (*Mytilus californianus*) are shown which represent the bulk of the data. While there are additional data for resident California mussel, as well as, resident Bay mussel (*Mytilus edulis*) and transplanted Bay mussel, different species of mussels (and bivalves, in general) bioaccumulate at different rates. Additionally, resident mussels tend to depurate pollutants somewhat over time which make their tissue concentrations less appropriate to compare directly with the transplanted (from Bodega Bay) "clean" mussels deployed for a known period of time. The scaling of the concentrations is arbitrary considering there are currently no solid human health or wildlife protection goals for use with shellfish. The number of sites sampled decreased dramatically over the years due to budget constraints and, as previously mentioned, bioaccumulation monitoring is now conducted through SWAMP. In any case, it is clear that concentrations have generally decreased throughout the areas sampled over time as can be seen in a graph following the maps which shows total DDT concentrations in mussel tissue at two long-term inner harbor stations. Total PCBs (summed from Arochlors in the early years of the program and in later years summed from PCB congeners) and lead also have decreased over time whereas zinc concentrations do not clearly trend up or down (SWRCB - SMW Program website).

Figure 8

State Mussel Watch Program - All Locations Sampled in Dominguez WMA Since 1978

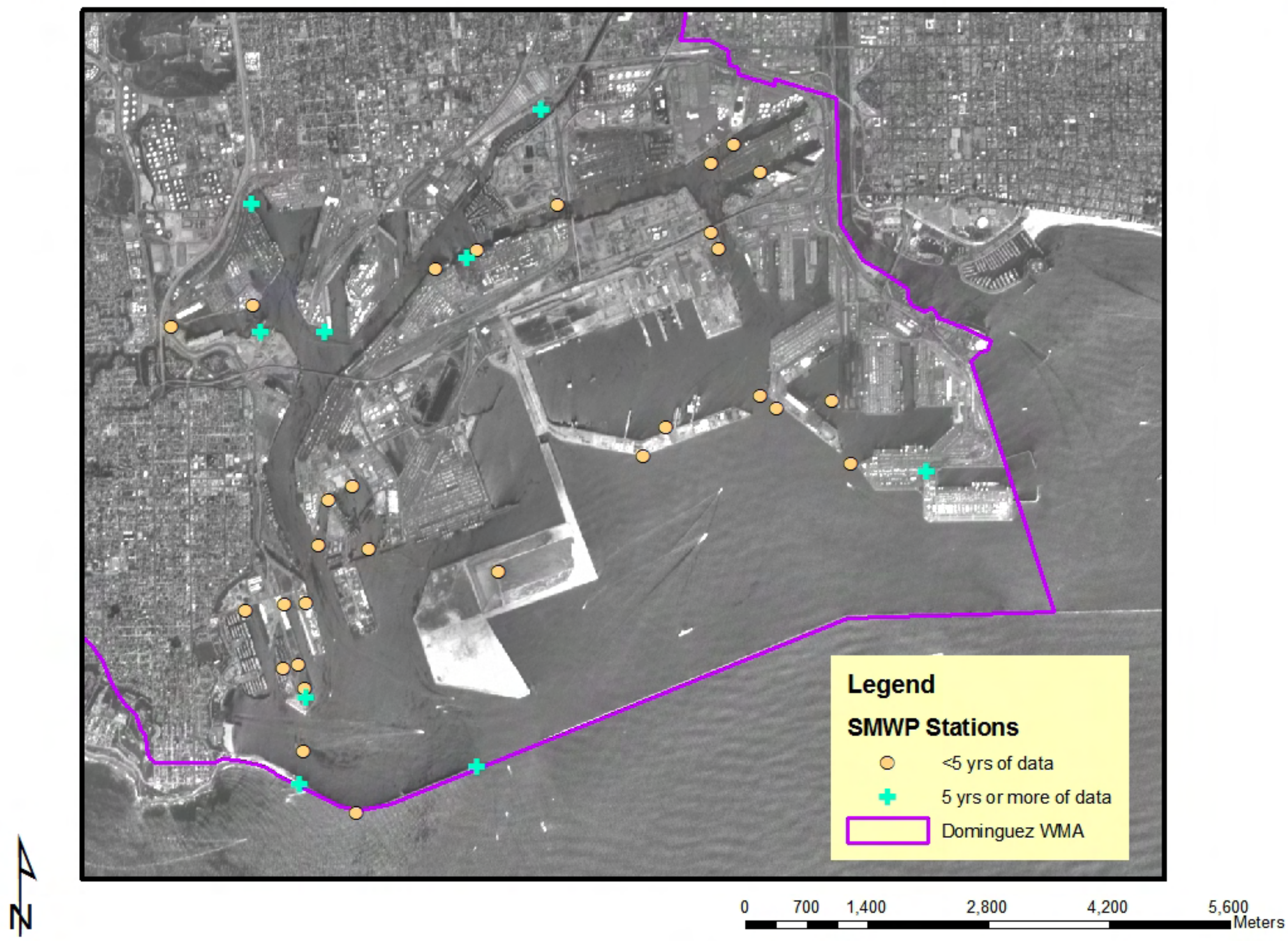


Figure 9
State Mussel Watch Program - Total DDT in Transplanted California Mussels in Dominguez WMA (1982)

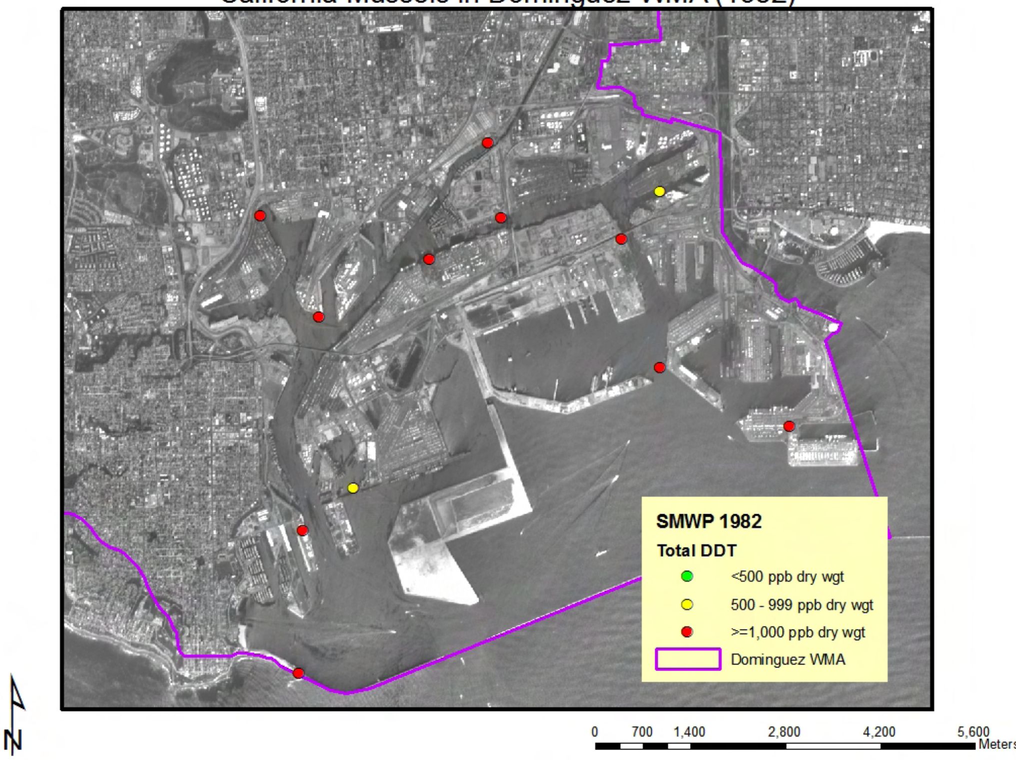


Figure 10
State Mussel Watch Program - Total DDT in Transplanted California Mussels in Dominguez WMA (1987)

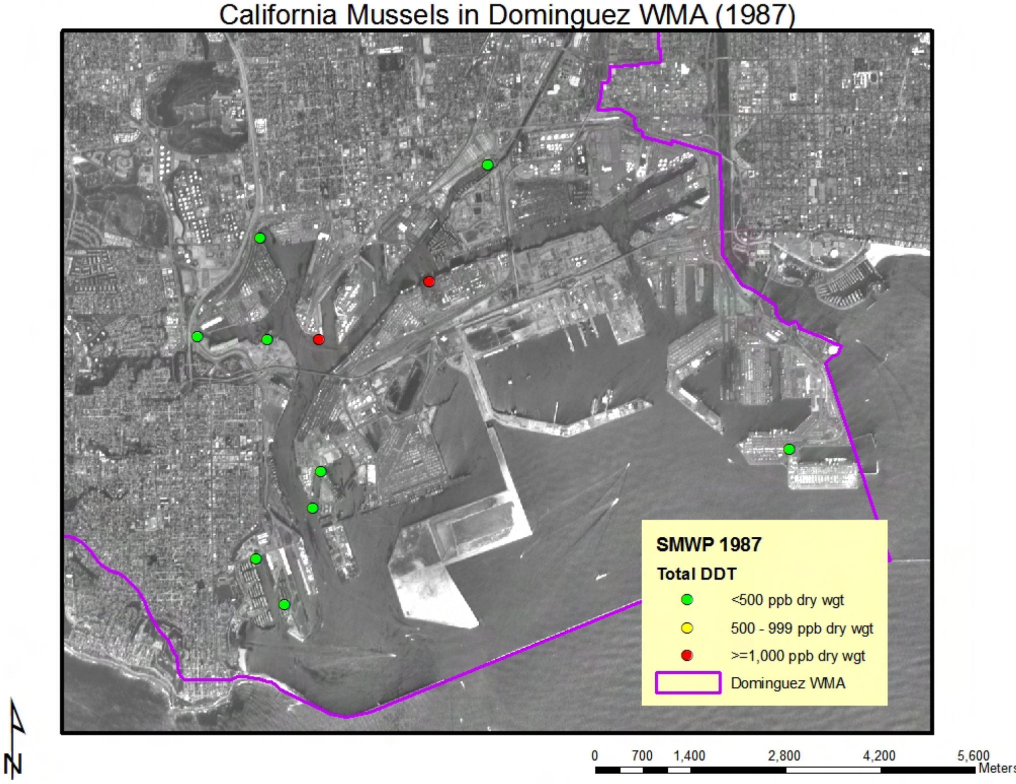


Figure 11
State Mussel Watch Program - Total DDT in Transplanted California Mussels in Dominguez WMA (2005)

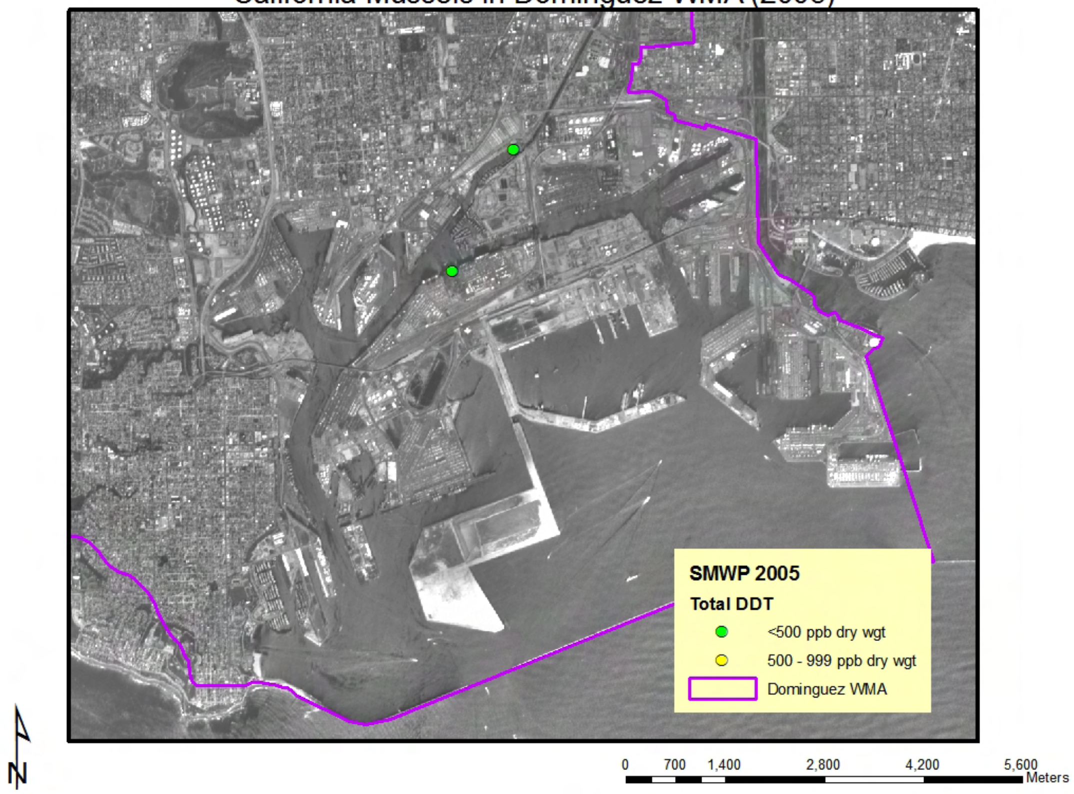
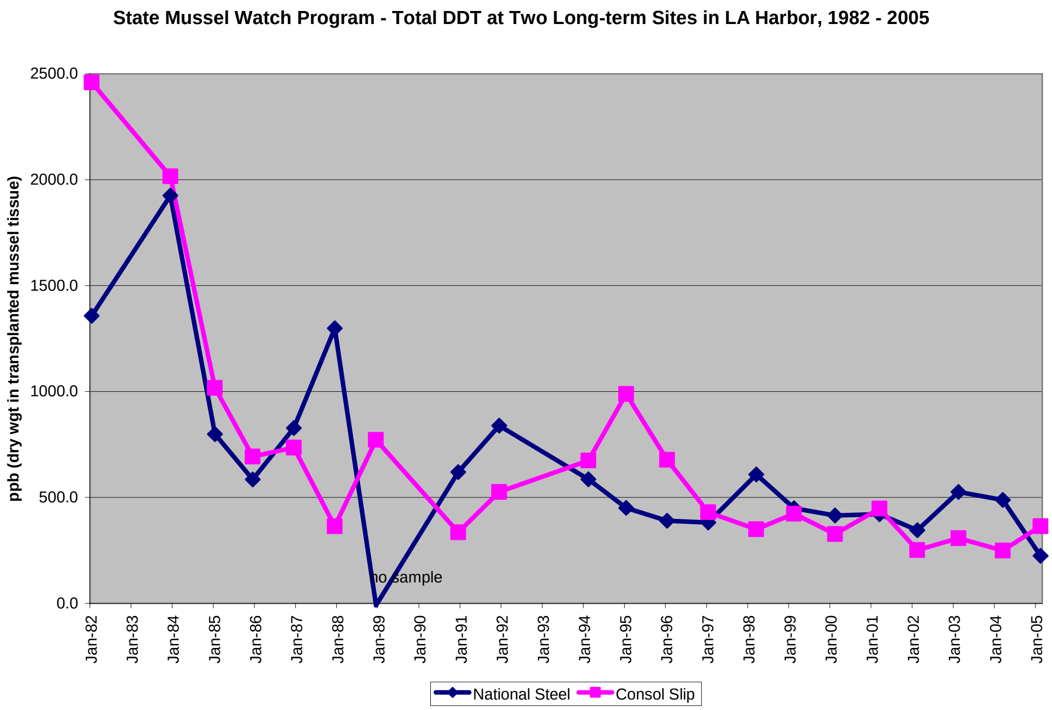


Figure 12



Toxic Substances Monitoring Program

The TSM Program collected many species of fish and, at times, other aquatic life in lakes, rivers, streams, and occasionally in estuaries and fully marine waters to detect and evaluate the occurrence of toxic substances in those waters. Fish were collected from Machado Lake during 1983, 1984, 1985, 1989, 1990, 1992, 1994, and 1997. Species collected and analyzed over the years for pollutants included channel catfish, goldfish, carp, largemouth bass, and bullhead. The various species of fish represent different trophic levels and bioaccumulate pollutants at different rates so concentrations are not directly comparable. However, in goldfish, total DDT (mostly as DDE) concentrations have gradually decreased over time from a high of 4,449 ppb wet weight in 1983 to 514 ppb in 1989. Largemouth bass consistently have had the lowest concentrations of total DDT of the species collected at approximately 20 – 30 ppb wet weight. Total DDT concentrations in carp have ranged between 200-400 ppb wet weight with no clear trend over time. Total PCBs concentrations follow a similar pattern with goldfish (mostly caught in the earlier years with concentrations ranging from 200 – 1,700 ppb), exhibiting generally much higher concentrations than carp (ranging from about 200 - 600 ppb). Largemouth bass and bullhead filets were not analyzed for PCBs (SWRCB – TSM Program website).

The California Office of Environmental Health Hazard Assessment (OEHHA) Fish Contamination Goals (FCGs) are estimates of the contaminant levels in fish that pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week over a lifetime. FCGs prevent consumers from being exposed to more than the average daily reference dose for non-carcinogens or to a risk level greater than $1x10^{-6}$ for carcinogens (not more than one additional cancer case in a population of 1,000,000 people consuming fish at the given consumption rate over a lifetime). The FCG for total DDT is 21 ppb wet weight (OEHHA, 2008).

The OEHHA has also generated Advisory Tissue Levels (ATLs) which are designed to encourage consumption of fish that can be eaten in quantities likely to provide significant health benefits, while discouraging consumption of fish that, because of contaminant concentrations, should not be eaten or cannot be eaten in amounts recommended for improving overall health (eight ounces total, prior to cooking, per week). ATLs are used to provide consumption advice to prevent consumers from being exposed to more than the average daily reference dose for non-carcinogens or to a risk level greater than $1x10^{-4}$ for carcinogens (not more than one additional cancer case in a population of 10,000 people consuming fish at the given consumption rate over a lifetime). The ATL for total DDT for one 8-ounce servings a week of fish is >1,000 – 2,100 ppb (OEHHA, 2008).

The OEHHA FCG for total PCBs is 3.6 ppb while the ATL for one 8-ounce serving a week of fish is >42 - 120 ppb (OEHHA, 2008). The tissue concentrations of total DDT and total PCBs in fish sampled by the TSM Program in Machado Lake are much higher than the current FCGs and ATLs; however, much of the data are now quite old. Carp were collected from the lake in 2007 as part of a statewide lake study, but those data are not yet available to the public.

Mercury concentrations in Machado Lake under the TSM Program appeared to pose only a minimal human health risk when compared to FCGs and ATLs. However, it is possible the concentrations were high enough to pose a risk to wildlife (particularly the endangered least tern) consuming fish from the lake. Concentrations under the TSM Program ranged from non-detect to 0.09 ppm wet weight in filets. A US Fish & Wildlife document presented a range of values (for whole fish) tied to the trophic levels of fish being consumed by wildlife that would be protective of endangered species in California. Depending on trophic level and calculation method, those numbers range from 0.013 ppm in trophic level 2 (herbivorous fish) to 0.66 ppm in trophic level 4 (top-level carnivorous fish) (USFWS, 2003).

Sampling by Ports of LA and LB in 2006/ Ports Baseline Study of 2000

The most recent large-scale sampling event for which data are available was conducted by the Ports in 2006 to support the TMDL development process. Bulk sediment, porewater, and overlying water samples were collected at about 60 sites within the ports and analyzed for various metals and organics.

The Ports contracted with a consultant team to conduct a biological baseline study in 2000 which was the first study of its kind since the 1970s. Water quality and sediment grain size were measured to provide physical/chemical characterization of environmental conditions during biological surveys. The surveys conducted included quantifying the benthic community; larval, juvenile, and adult fish populations; bird use patterns; and biological communities attached to rocky riprap habitats; as well as, mapping of kelp and eelgrass distributions. The study's findings also were compared with previous baseline studies.

Bight-wide Monitoring in 1998 and 2003

Southern California Bight-wide coordinated regional monitoring began with a pilot project in 1994 and has continued every five years since the full-scale program began in 1998. The goal of Bight-wide monitoring is to work cooperatively toward a regional assessment of coastal condition. In lieu of their ongoing routine monitoring, participants are asked to disperse their sites and use standardized methods throughout the region to help make Bight-wide assessments for little to no increase in cost over their existing program. The '98 and '03 surveys assessed the extent and magnitude of impacts for a number of indicators including sediment chemistry, benthic infauna, sediment toxicity, fish assemblages and bioaccumulation. Specifically for sediment contamination, both surveys found a large proportion of the Bight contaminated by anthropogenic pollutants with a disproportionate accumulation occurring near urban activities such as discharges from large POTWs and ports, harbors, and marinas.

Sixty-five organizations participated in at least one of the Bight'03 components which included Coastal Ecology, Shoreline Microbiology, and Water Quality. Twenty-three sampling sites fell within the Dominguez WMA. Marinas and LA estuaries consistently exhibited the highest mean concentrations for trace metal and organic analytes; copper was highest in marinas followed by ports/bays/harbors, and LA estuaries. Data from the Bight '03 sampling event are available on the Southern California Coastal Water Research Project website (SCCWRP – Bight '03 website). Many of the Bight stations sampled for sediment had a planned overlap with water column sampling locations utilized by SWAMP.

Sixty-two organizations participated in at least one of the Bight'98 components. Thirty-two sampling sites fell within the Dominguez WMA. Within the bays and harbors of the southern California Bight, higher levels of contamination were typically associated with industrial, port and marina areas. Data from the Bight'98 sampling event are available on the Southern California Coastal Water Research Project website (SCCWRP – Bight'98 website).

SWAMP Sampling in 2003

This watershed was the focus of SWAMP monitoring for FY02/03. The WMA was divided into six subareas based on their characteristics in order to simplify sampling design: (1) headwater streams, (2) the inner and outer harbors of LA and LB (integrated with Bight ’03 monitoring), (3) Madrona Marsh (not sampled in the end due to lack of suitable collection sites), (4) Machado Lake, (5) the Dominguez Channel estuary, and (6) the upper channelized Dominguez Channel above normal tidal influence. A different sampling strategy was undertaken for the LA/LB harbor complex. Sampling there included water column toxicity and chemistry, metals chemistry, and PAHs analysis - sediment in the harbors complex was collected through the Bight ’03 sampling . The focus was on a randomized probabilistic sample design as modeled after the USEPA’s Environmental Monitoring and Assessment Program (EMAP), especially for the harbor area where coordination with the Bight ’03 monitoring program occurred. The triad approach (toxicity, chemistry, and benthic community) was utilized where possible (CRWQCB, 2007a).

A report on the results of this sampling event prepared by Regional Board staff describes that while the SWAMP monitoring only provided a snapshot of water quality in the watershed, it indicates there may be some degradation in water quality within the northern end of Machado Lake, possibly due to inputs from Wilmington Drain. Dissolved oxygen and pH were lower there than elsewhere in the lake while nitrogen levels were higher. There was no appreciable toxicity in the water column, however. Sediment was also collected at the five sampling stations. Based on sediment quality guidelines, Machado Lake sediments would be classified as “possibly contaminated” for most of the trace metals and trace organics for which guidelines exist. Cadmium, chromium, copper, lead, nickel and zinc concentrations fell between the possible effects and probable effects thresholds at 4 or all 5 of the stations. However, only the nickel concentration at the station closest to Wilmington Drain exceeded the probable effects threshold. Total chlordane, total DDTs, total PCBs, and PAHs also fell between the two thresholds at all 5 stations. Chlordane concentrations also exceeded the probable effects threshold at 4 of the stations. Despite the widespread sediment contamination for many trace metals and trace organics, sediment toxicity testing demonstrated acute toxicity only at stations toward the middle of the lake. No chronic toxicity was observed (CRWQCB, 2007a; SWRCB – SWAMP website).

Dominguez Channel is listed as impaired due to benthic infaunal community effects. Benthic samples were collected at five of the estuarine stations within Dominguez Channel during the SWAMP study. The results confirm that the benthic community is adversely impacted within at least parts of Dominguez Channel, as three of the five stations were classified as being in poor condition (CRWQCB, 2007a).

The Bight’03 sampling design resulted in sampling at 17 stations within Los Angeles/Long Beach Harbor and San Pedro Bay, most of which corresponded to SWAMP stations. DDT contamination was widespread throughout Los Angeles/Long Beach Harbor in 2003. It is estimated that 94% of Los Angeles/Long Beach Harbor has DDT contamination greater than the Effects Range-Low (ER-L) threshold, while 43% of the harbor was contaminated with DDT at concentrations greater than the Effects Range-Median (ER-M) threshold (CRWQCB, 2007a).

Copper contamination was widespread throughout Los Angeles/Long Beach Harbor in 2003. Other trace organic and trace metal contaminants were less widespread throughout the study area. About half of the sites sampled exhibited sediment toxicity. Benthic infaunal community analysis indicated that in Los Angeles/Long Beach Harbor, 75% of the sampling sites were classified as being in good condition, while the remaining 25% were classified as being in poor condition. The poor stations were all located in the innermost areas of Los Angeles Inner Harbor. The outermost portions of Los Angeles Harbor and all of Long Beach Harbor were in good condition (CRWQCB, 2007a).

The State Water Resources Control Board adopted sediment quality objectives (SQOs) for enclosed bays and estuaries in September 2008 which are based upon integration of a triad of indicators (benthic infaunal community, sediment toxicity and sediment chemistry) to produce a characterization of sediments at a given sampling location. Although the formal review and approval process by USEPA for the SQOs is not yet complete and thus they are subject to change, the report evaluated how Los Angeles/Long Beach Harbor and San Pedro Bay stations would be classified via the proposed SQO approach. Based on past monitoring data at probabilistic sampling sites (primarily Bight'98 and Bight'03 monitoring study data), approximately half of the Los Angeles/Long Beach Harbor sites fall into the two unimpacted categories (unimpacted and likely unimpacted), while the other half fall into the three impacted categories (possibly impacted, likely impacted, clearly impacted). All of the most impacted (clearly impacted and likely impacted) sites are located within the inner harbor areas of Los Angeles/Long Beach Harbor, while approximately two-thirds of the outer harbor areas are unimpacted or likely unimpacted. In San Pedro Bay, approximately 40% of the sites fell into the three impacted categories, but nearly all of these sites were only possibly impacted (only one site was likely impacted and none were clearly impacted) (CRWQCB, 2007a).

It appears that at least half of Los Angeles/Long Beach Harbor has degraded bottom conditions, whether assessed based on individual sediment contamination levels of trace metals and trace organics, sediment toxicity results, the health of the benthic infaunal community or through an integration of these three indicators. Degradation appears to be worse in the inner harbor areas, where industrial activities predominate, than in the more open water areas of the outer harbors. However, the low levels of trace metals and trace organics in the surface waters of Los Angeles/Long Beach Harbor and at depth and the absence of water column toxicity indicate that water quality within the harbor is good, suggesting that the contaminants drop out of the water column and accumulate in the sediments, as would be expected (CRWQCB, 2007a).

Sampling by AMEC/USEPA in Dominguez Channel and Consolidated Slip During 2002

A sediment characterization study was conducted in Dominguez Channel and Consolidated Slip during 2002 funded by USEPA Region IX, as part of their Superfund investigation into the former Montrose facility, and by members of the Los Angeles Contaminated Sediments Task Force (CSTF). Samples were collected at 77 locations; sediment cores were collected where feasible. The results of the sampling found that for several chemicals, the maximum concentrations observed in Dominguez Channel and Consolidated Slip sediments exceeded the ER-M values. Average concentrations were close to or above the ER-M for copper, lead, mercury, DDT, PCB and chlordane. At many sites, higher concentrations were found in the deeper parts of the cores (AMEC, 2003).

Discussion of Combined Sediment Quality Dataset

Sediment data were evaluated from a number of sources. The bulk came from the CSTF's database (SCCWRP – SQO website) which includes the results of monitoring conducted for dredge projects, the State's Bay Protection and Toxic Cleanup Program, various Bight- or Harbor-wide sampling programs, and sampling results from the U.S. Navy. In addition, results from monitoring conducted by the refineries discharging to Dominguez Channel and special studies conducted in Consolidated Slip and Dominguez Channel, SWAMP sampling, and recent sampling by the Ports were evaluated. Only data for sites with latitude/longitude information were used since it was intended that all sediment data from 1996 to 2006 would be mapped (in

ArcGIS 9.2) in order to be evaluated. Sediment sampling sites are rarely visited repeatedly and since changes in the sediment are relatively slow (except when sediments are dredged), collectively examining ten years of data is reasonable. Information on which of the sites sampled for proposed dredging were eventually dredged was supplied by the Ports and those sites that were clearly dredged after sampling took place were removed. In the absence of firm information to the contrary, those sites thought to be somewhat questionable as to their dredging status were left in. About one-half of the sites related to pre-dredge monitoring were removed. Some of the Bight'98 and US Navy sampling sites were also removed utilizing the provided information. Only data from grab samples or the surface layer of core samples were used. Sediment data were evaluated against sediment quality guidelines (SQGs) where available and assigned red or green dots on maps to designate the results as above or below the SQG, respectively. In many cases, triad data were not available (toxicity and benthic infauna results in conjunction with chemistry) and, in any case, sediment quality objectives which utilize triad data are still undergoing the formal review and adoption process.

The SQGs utilized can be found in Table 12 of the State Water Resources Control Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List Policy Functional Equivalent Document. They are based on either ER-Ms, Probable Effects Levels (PELs), or other published effects-related data for marine or estuarine sediments. The table below shows the numbers (in dry weight) used when evaluating the combined sediment database (SWRCB, 2004). Not all parameters evaluated were mapped. All data evaluated are available electronically by contacting the author.

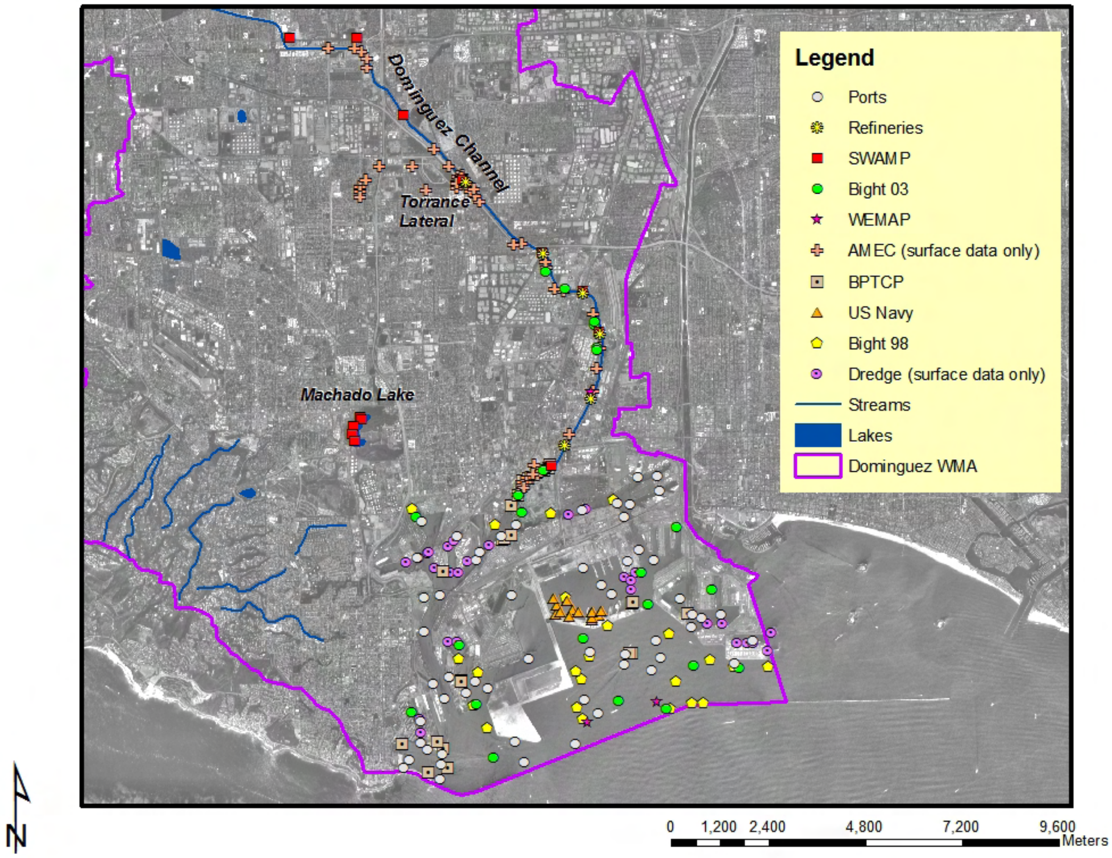
Table 3. Sediment Quality Guidelines Utilized When Evaluating Data

Chemical	ER-M	PEL	Other sediment quality guideline
Arsenic	70 ug/g		
Cadmium		4.21 ug/g	
Chromium	370 ug/g		
Copper	270 ug/g		
Lead		112.18 ug/g	
Mercury			2.1 ug/g
Silver		1.77 ug/g	
Zinc	410 ug/g		
Total PCBs			400 ng/g
Total Chlordane	6 ng/g		
2-methylnaphthalene		201.28 ng/g	
Phenanthrene		543.53 ng/g	
Low molecular weight PAHs		1442 ng/g	
Benz[a]anthracene		692.53 ng/g	
Benzo[a]pyrene		763.22 ng/g	
Chrysene		845.98 ng/g	
Dibenz[a,h]-anthracene	260 ng/g		
Pyrene		1397.4 ng/g	
High molecular weight PAHs	9600 ng/g		
Total PAHs			1800 ug/g

The locations of sampling sites from the various programs are shown in the figure below.

Figure 13

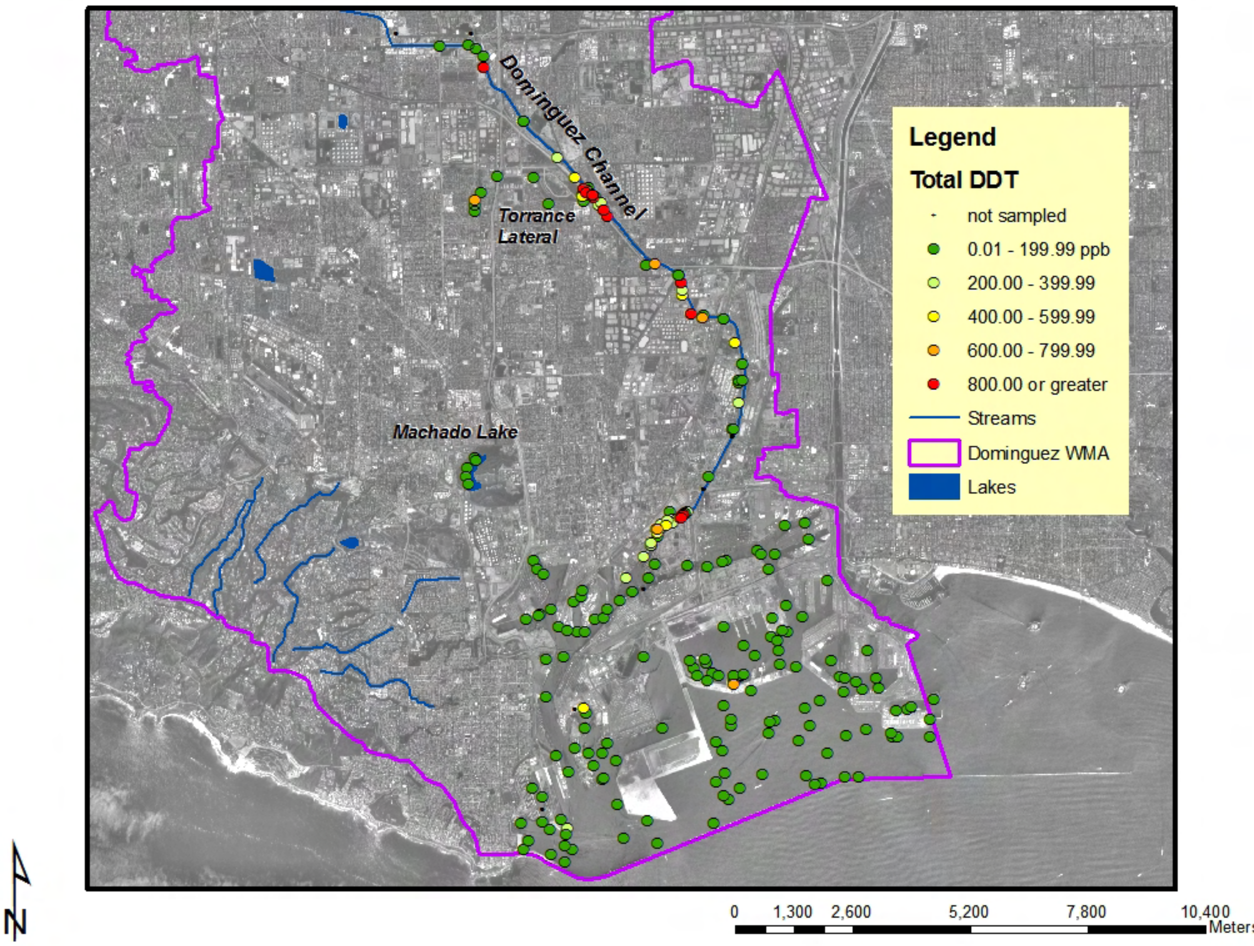
All Sediment Sampling Locations in the Dominguez WMA, 1996 - 2006



Since there is no SQG for DDT in marine sediments provided in the State Board's 303(d) listing policy, those data were depicted by graduated coloration from green shades to yellow to red shades to show smaller to larger concentrations of DDT as can be seen in the figure below. It is clear that the highest concentrations of DDT continue to persist in Dominguez Channel and Consolidated Slip with some higher levels elsewhere in Inner and Outer Harbors.

Figure 14

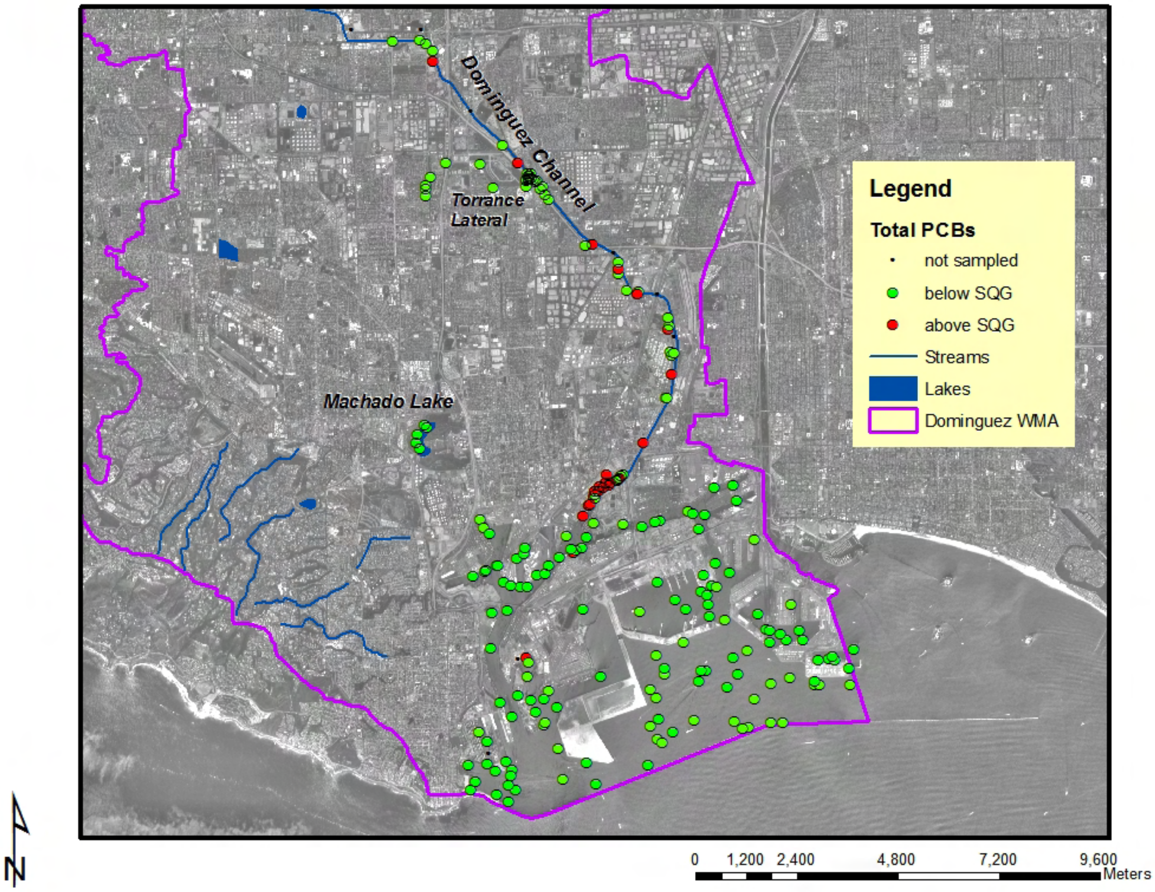
Total DDT in Dominguez WMA Sediments, 1996 - 2006



The pattern is very similar with total PCBs (sum of congeners if available or sum of Arochlors if no congener data available) as can be seen below.

Figure 15

Total PCBs in Dominguez WMA Sediments, 1996 - 2006



The pattern for high and low molecular weight polycyclic aromatic hydrocarbons (HPAHs and LPAHs) is somewhat different as can be seen in the following figures. Sediments in the main channels and at major docking locations have some elevated concentrations as well as sediments in Dominguez Channel and Consolidated Slip. LPAHs (2-methylnaphthalene, anthracene, fluorene, naphthalene, and phenanthrene) are considered petrogenic in origin - indicative of spills. HPAHs (fluoranthene, dibenzo(a,h)anthracene, chrysene, benz(a)anthracene, benzo(a)pyrene, and pyrene) are considered pyrogenic in origin - indicative of combusted petroleum, likely from street runoff or aerial deposition. Fluorene, fluoranthene, and anthracene, however, do not have SQGs for marine sediments, only sediments in freshwater.

Figure 16

Low Molecular Weight PAHs in Dominguez WMA Sediments, 1996 - 2006

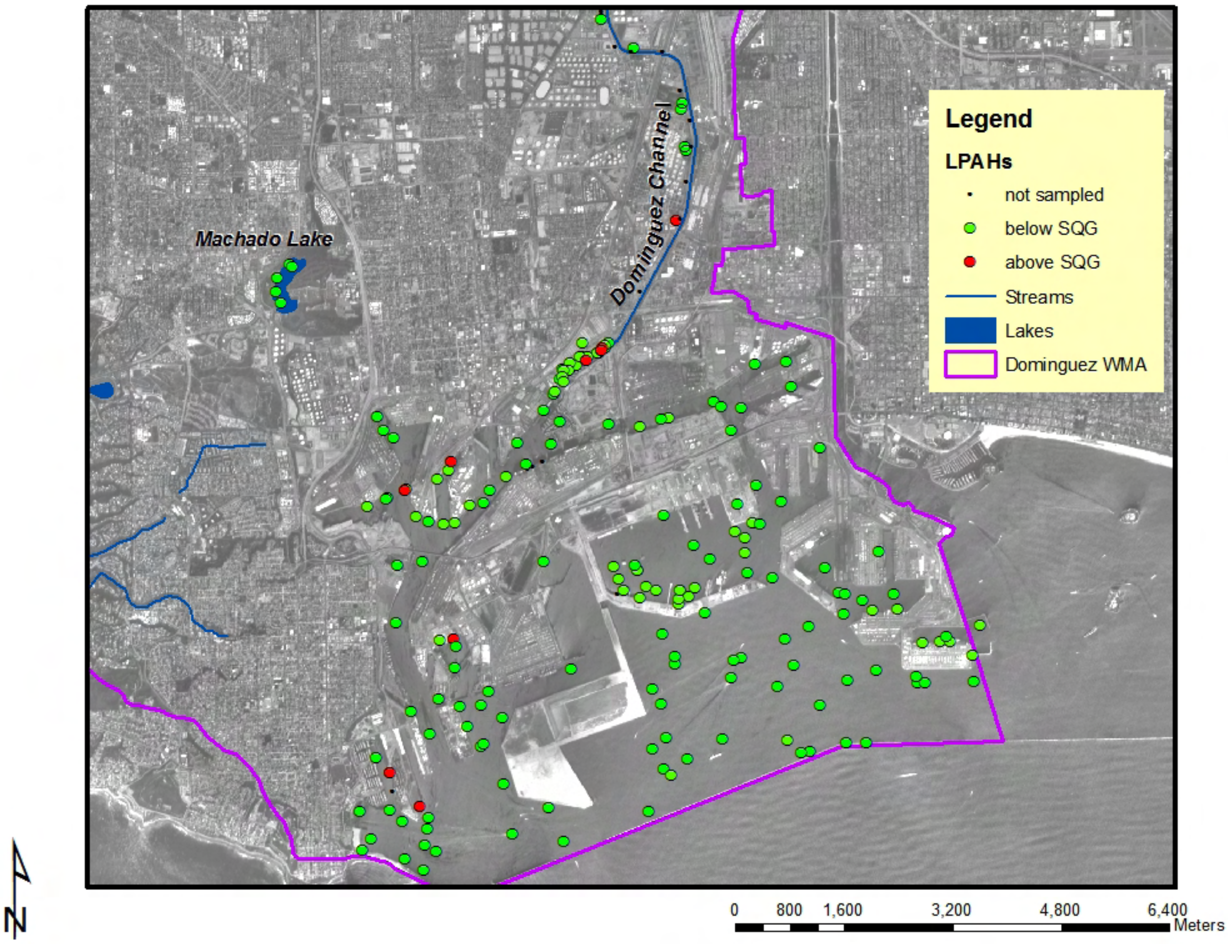


Figure 17

High Molecular Weight PAHs in Dominguez WMA Sediments, 1996 - 2006

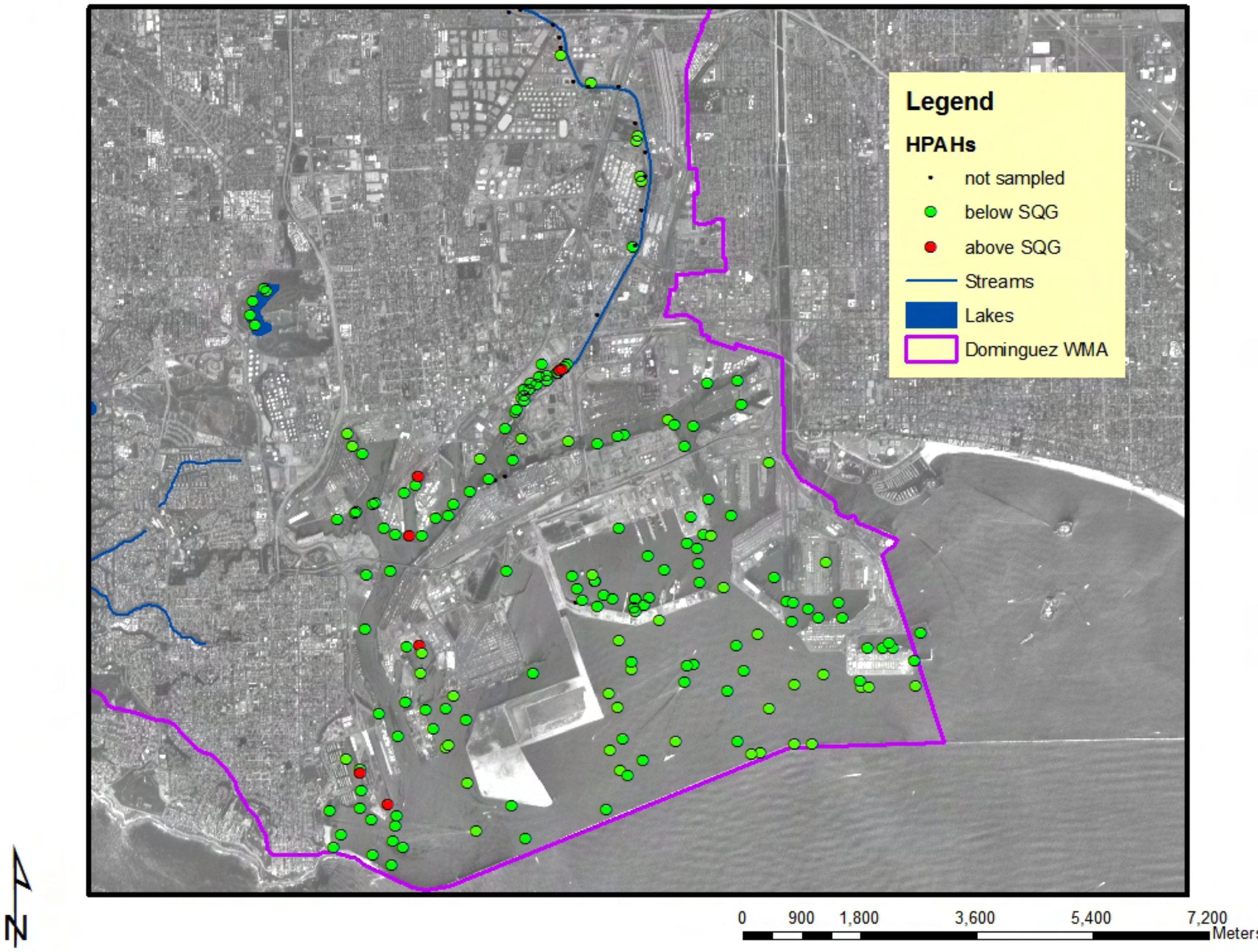


Figure 18

Dibenz[a,h]-anthracene in Dominguez WMA Sediments, 1996 - 2006

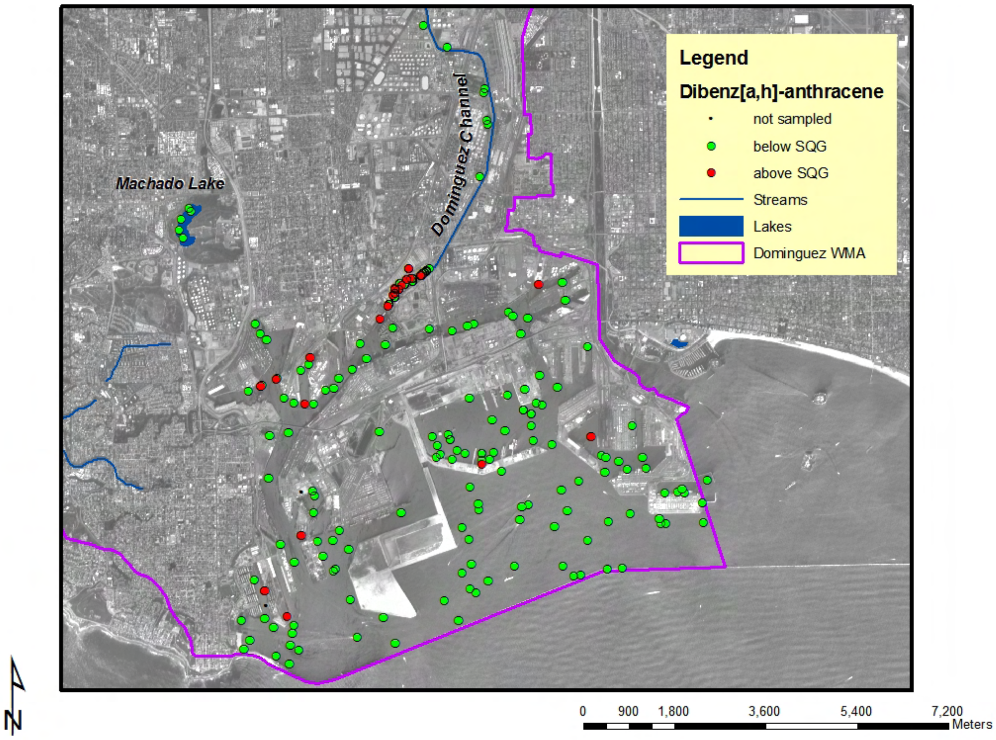


Figure 19

Benzo[a]anthracene in Dominguez WMA Sediments, 1996 - 2006

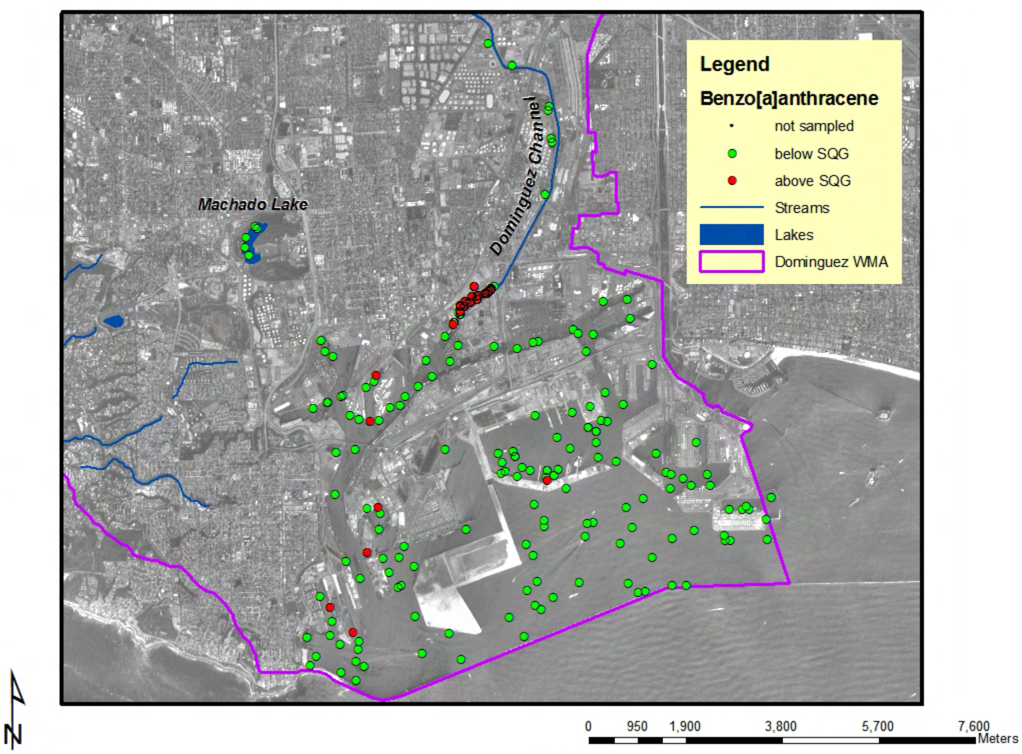


Figure 20

Benzo[a]pyrene in Dominguez WMA Sediments, 1996 - 2006

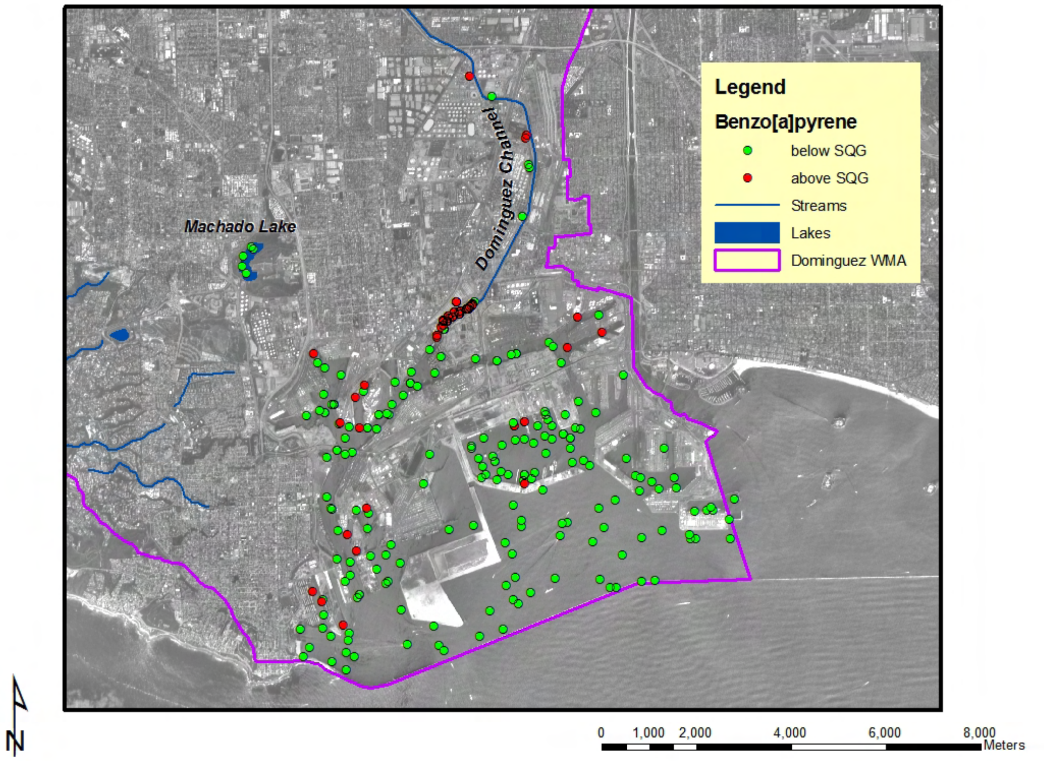


Figure 21

Chrysene in Dominguez WMA Sediments, 1996 - 2006

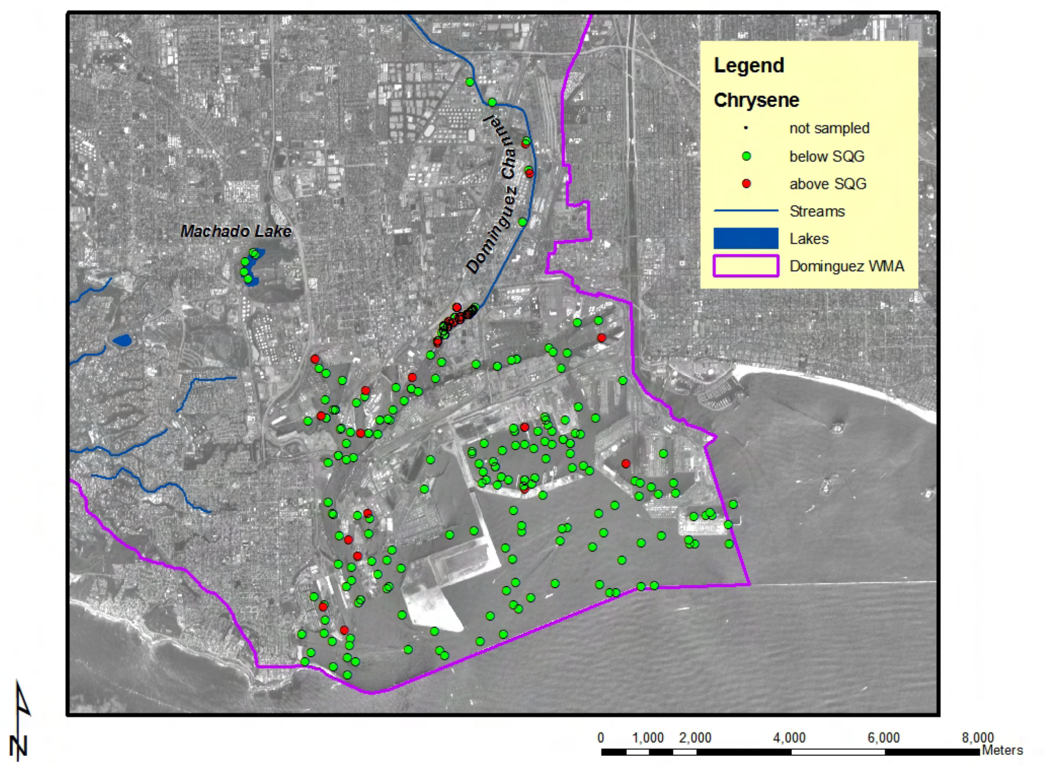


Figure 22

Phenanthrene in Dominguez WMA Sediments, 1996 - 2006

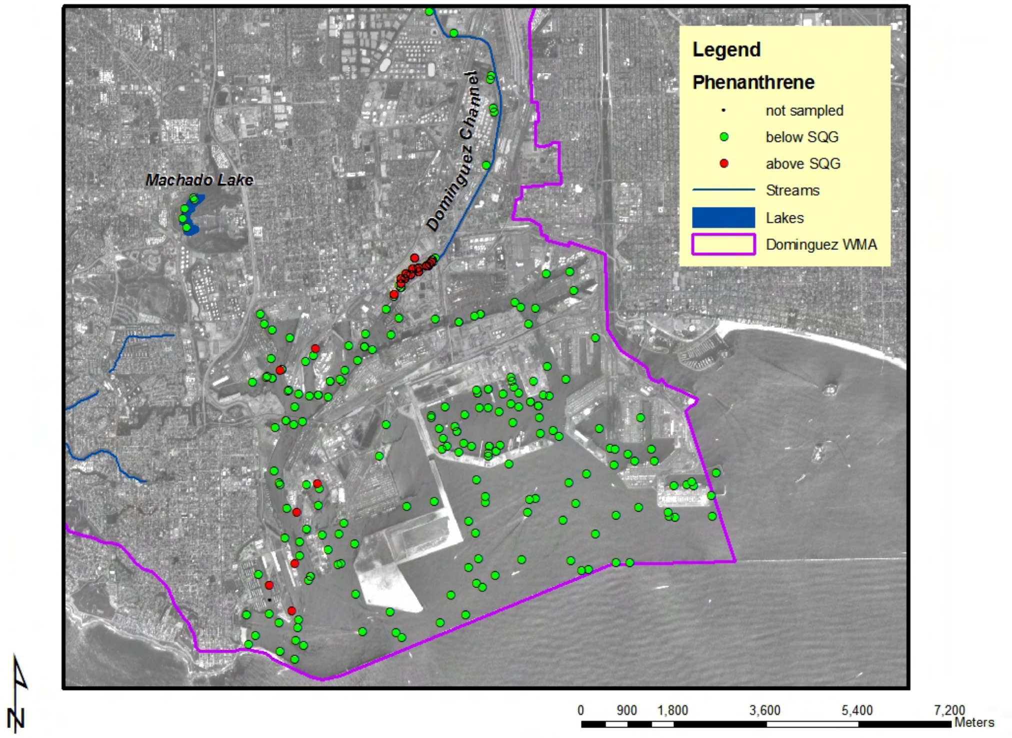
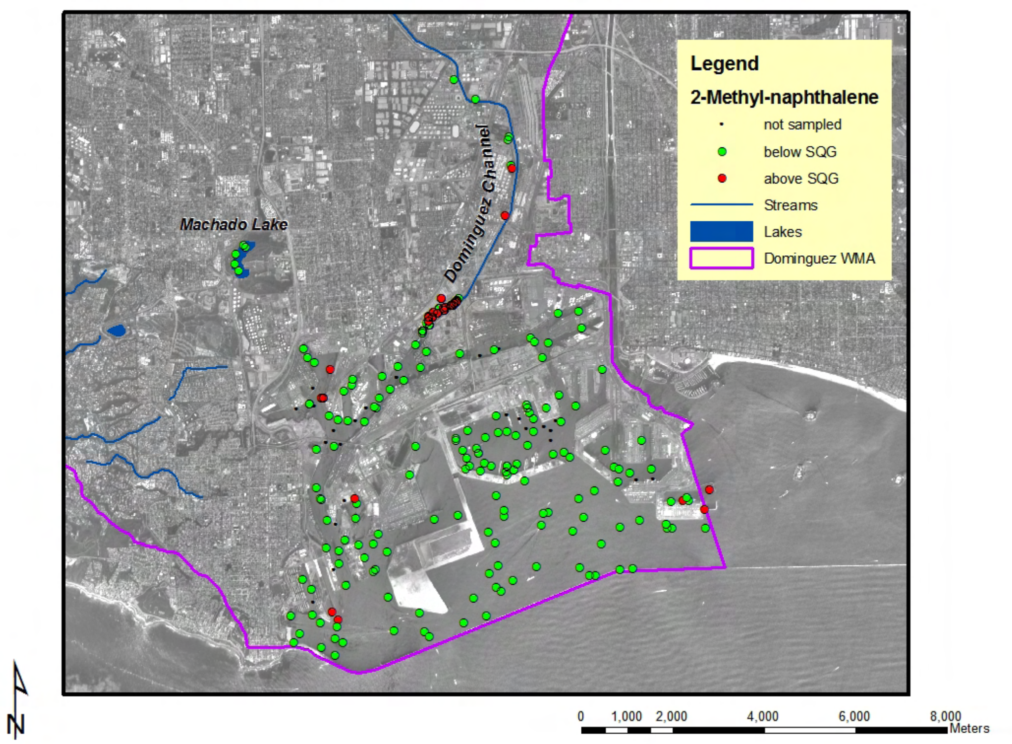


Figure 23

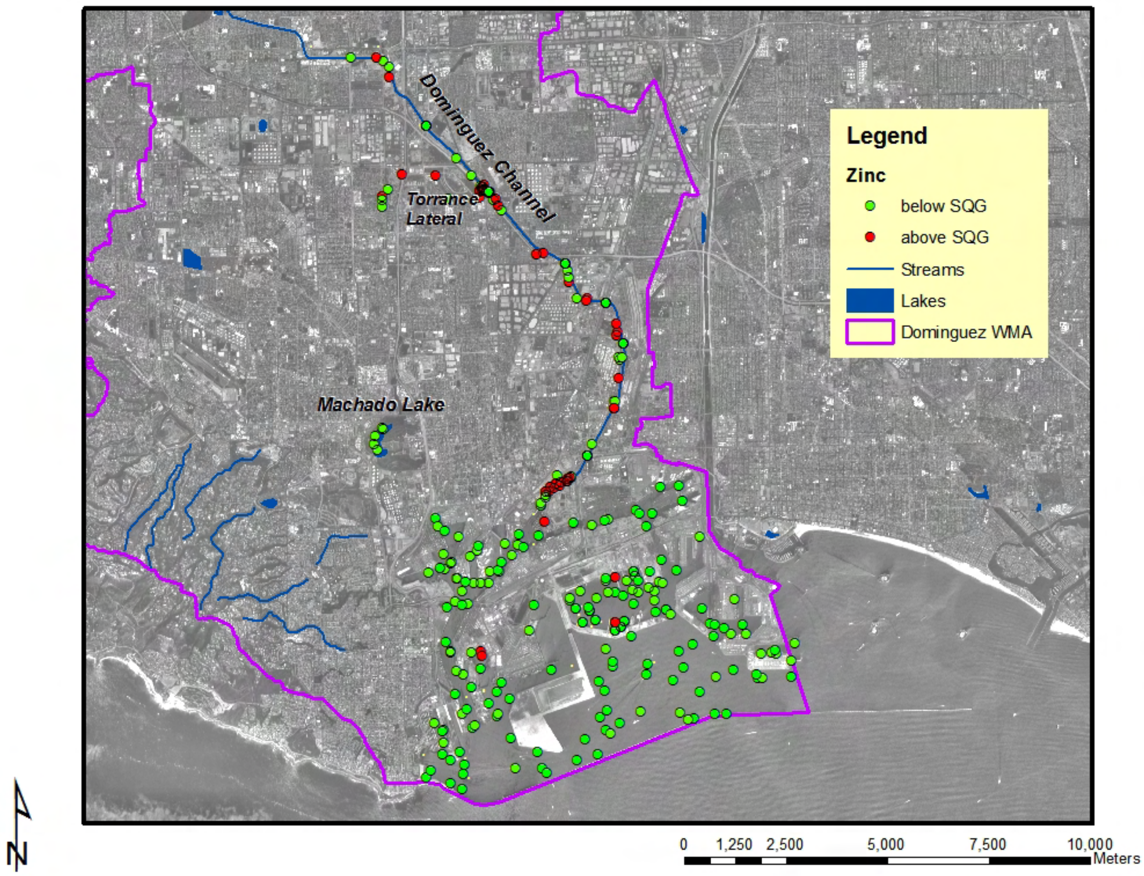
2-Methyl-naphthalene in Dominguez WMA Sediments, 1996 - 2006



Elevated concentrations of zinc in sediment (above the SQG) are found at many locations in the WMA's waterbodies as can be seen in the figure below.

Figure 24

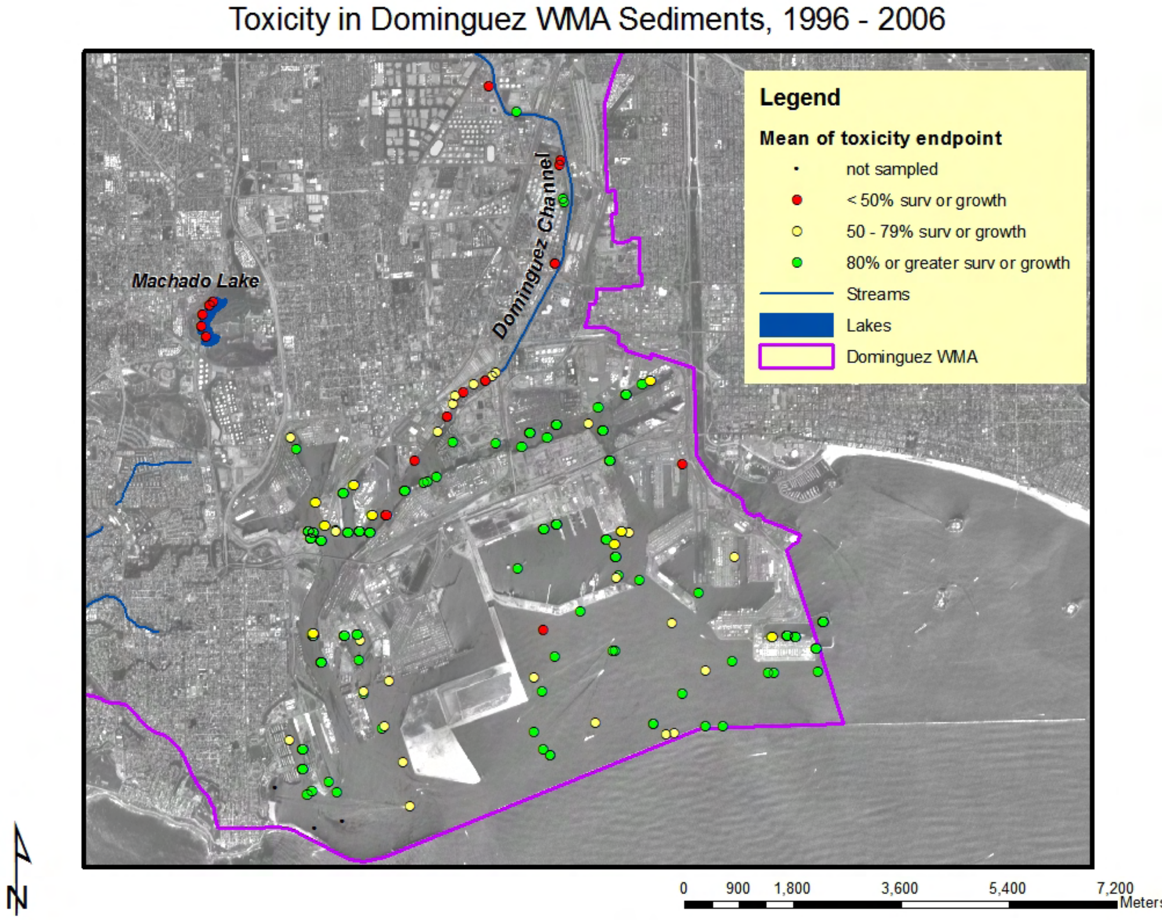
Zinc in Dominguez WMA Sediments, 1996 - 2006



On the other hand, bulk sediment toxicity is somewhat more widespread than might be predicted by those areas with SQG exceedances or by an impaired benthic community (the latter for the most part limited to Consolidated Slip/Dominguez Channel) as seen in the figure below.

The more severe toxicity (defined here as less than 50% survival) is highlighted separately from moderate or no toxicity and continues to be concentrated in Dominguez Channel and Consolidated Slip, as well as, in Machado Lake. The results are based on toxicity tests conducted on multiple species including various amphipods, mysids, and polychaetes.

Figure 25



Recommendations for Future Water Quality and Sediment Monitoring

Sediment and water column sampling occurs on a fairly regular basis within the ports. Biological sampling is conducted on a less frequent but fairly regular basis. There is great need, however, for coordinated and more extensive monitoring within the Dominguez Channel and its tributaries. The only ongoing regular monitoring in the Dominguez Channel estuary is conducted by the refineries and consists of sampling surface sediments for a large suite of constituents annually. Water column sampling for TMDL development purposes occurs on an as-needed basis in the Channel. A sampling site in the Channel has been established by the Los Angeles County Flood Control District for the purposes of fulfilling monitoring requirements in the Municipal Stormwater Permit. While overall sampling within the Ports is fairly coordinated and has established goals, multiple sampling programs do exist that are often not coordinated. Much less sampling and coordination occurs within the Channel.

Activities Addressing Water Quality Issues

Stormwater Regulation

The Dominguez WMA falls within Los Angeles County which has been covered by a municipal storm water permit since 1990. The third five-year permit was adopted on December 13, 2001 and amended on September 14, 2006, to incorporate the Santa Monica Bay Beaches Bacteria TMDL Waste Load Allocations for summer dry weather discharges from MS4 outfalls to Santa Monica Bay beaches. This permit covers Los Angeles County and all the incorporated cities, except the City of Long Beach, which was issued a separate municipal storm water permit on June 30, 1999. The Los Angeles County Flood Control District is the Principal Permittee for the Los Angeles stormwater permit. Under the requirements of the permit, the Permittees will implement the Storm Water Quality Management Plan which includes the following components: (a) Program Management; (b) Public Information and Participation Program; (c) Industrial/Commercial Facilities Program; (d) Development Planning Program; (e) Programs for Construction Sites; (f) Public Agency Activities; and (e) Illicit Connection/Illicit Discharge Elimination Program. These programs collectively are expected to reduce pollutants in storm water discharges to the maximum extent practicable. In addition, the County will conduct a storm water monitoring program to estimate mass emissions and toxicity of pollutants in its waters, evaluate causes of toxicity, and several other components to characterize storm water discharges and measure the effectiveness of the Storm Water Quality Management Program. The permits can be downloaded from the Regional Board Storm Water website at http://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/index.shtml.

An important requirement of both the Los Angeles County and the City of Long Beach municipal storm water permits is implementation of the Standard Urban Storm Water Mitigation Plans (SUSMPs) and numerical design standards for Best Management Practices (BMPs), which municipalities began implementing in February 2001. The final SUSMP was issued on March 8, 2000, and amended in the permit, adopted on December 13, 2001. The SUSMP is designed to ensure that storm water pollution is addressed in one of the most effective ways possible, i.e., by incorporating BMPs in the design phase of new development and redevelopment. It provides for numerical design standards to ensure that storm water runoff is managed for water quality and quantity concerns. The purpose of the SUSMP requirements is to minimize, to the maximum extent practicable, the discharge of pollutants of concern from new and redevelopment. The requirements are very similar to the Ventura County SQUIMP.

The numerical design standard is that post-construction treatment BMPs be designed to mitigate (infiltrate or treat) storm water runoff from the first ¾ inch of rainfall, prior to its discharge to a storm water conveyance system.

TMDLs

Those in effect as of October 2008 (approved by the Regional Board, by the State Board's Office of Administrative Law, and by USEPA):

- Los Angeles Harbor Bacteria (includes Cabrillo Beach)
- Machado Lake Trash

Those in development or under review:

- Machado Lake Nutrient
- Dominguez Channel and the Los Angeles and Long Beach Harbors Toxic and Metal (includes Los Angeles River estuary)

Additional information on TMDLs may be found at http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/tmdl_list.shtml .

Contaminated Sediment Long-term Management Strategy

The Los Angeles County's coastline includes two of the nation's largest commercial ports and several major marina complexes and small-vessel harbors. Maintenance of authorized depths in existing channels and berthing areas and expansion and modernization of ports, harbors, and marinas, requires periodic dredging in virtually all of these facilities. Some of the sediments dredged from these harbors contain elevated levels of heavy metals, pesticides, and other contaminants. In most cases, the concentrations of these contaminants do not approach hazardous levels. However, the sediments can contain enough contaminants that they are not suitable for unconfined ocean disposal. The State's Bay Protection and Toxic Cleanup Program identified bays and estuaries containing areas with contaminated sediments. Remediation of these sites may require dredging and disposal of this material. Disposal of any contaminated dredged materials requires special management, such as placement in a confined aquatic disposal site, capping, or disposal in an upland site. Additionally, some ports and harbors have considered other management techniques, such as treatment and beneficial re-use (CRWQCB, 2007b).

To enhance a regional perspective on management alternatives, cumulative impacts, and long-term solutions to prevent re-contamination of sediment, the regulatory and resource agencies, ports and harbors, environmental groups, and other interested parties established a task force. The mission of the **Contaminated Sediment Task Force** (CSTF) was to prepare a Contaminated Sediment Long-Term Management Strategy (Strategy) for the Los Angeles Region (limited to Los Angeles County). Past projects suggested that the major sources of contaminated dredge material would continue to be Marina del Rey Harbor, the ports of Los Angeles and Long Beach, and the mouth of the Los Angeles River (CRWQCB, 2007b).

The members of the CSTF agreed that the Strategy would consider confined aquatic and upland disposal, sediment treatment, beneficial re-use, other management techniques, and contamination source control. The CSTF agreed on a number of goals including identifying the scope of the contaminated sediment problem, an analysis of management and disposal alternatives, development of a unified regulatory approach, and identification of contaminant inputs to coastal waters and ongoing regional efforts to reduce such inputs with a view towards promoting efforts that would reduce the inflow of contaminants. Initially, the CSTF worked with existing watershed management programs (CRWQCB, 2007b).

The CSTF was established through a Memorandum of Understanding (MOU) among the state and federal agencies with regulatory jurisdiction over dredging and disposal activities, as identified by SB 673, and other agencies representing ports, harbors, and marinas. The following agencies are signatory to that MOU: U.S. Army Corps of Engineers; U.S. Environmental Protection Agency; California Coastal Commission; Regional Water Quality Control Board, Los Angeles Region; County of Los Angeles Department of Beaches and Harbors; City of Long Beach; Port of Long Beach; and Port of Los Angeles (CRWQCB, 2007b).

The CSTF carried out its operation by two main committees (Executive and Management Committees), and five strategy development committees (Watershed Management and Source Reduction, Aquatic Disposal and Dredging Operations, Upland and Beneficial Re-use, Sediment Screening Thresholds, and Implementation Committees). The membership of the Management Committee included those parties that signed the MOU and one organization selected to represent the environmental community (Heal the Bay). This committee was the main decision-making group with the CSTF. The Executive Committee consisted of the chief executives of the four major agencies that regulate and manage dredging and disposal in Southern California. This committee facilitated final agency concurrence, adoption, and implementation of the completed strategy. The strategy development committees developed specific elements of the long-term management plan (CRWQCB, 2007b).

The CSTF completed a Contaminated Sediment Long-Term Management Strategy in 2005 and the document is available at http://www.coastal.ca.gov/sediment/long-term-mgmt-strategy-5-2005.pdf . Other relevant documents may be found at http://www.coastal.ca.gov/sediment/sdindex.html. The CSTF recommended a long-term goal of 100% beneficial re-use of contaminated sediments (constructed fill is considered re-use) but recognized this will be difficult to achieve. Although there are pilot projects underway to develop reliable and effective treatment processes such as centrifugation, issues still need to be resolved and eventually land sites will need to be identified where the treatment equipment would be located and treated sediments could be stored. End-users of the treated material also need to be identified (CRWQCB, 2007b).

Consolidated Slip Restoration Project

Consolidated Slip is located in the East Basin area of the Port of Los Angeles. Much of the WMA empties into the northeast side of Consolidated Slip through Dominguez Channel. Approximately 96% of the watershed area is developed. Tributaries to Dominguez Channel include several storm drains and minor channels. From the 1910s until several years ago, millions of gallons per day of industrial wastewater had been discharged into the Dominguez Channel, significantly contributing to the contaminant loading within Consolidated Slip. In addition, stormwater runoff from the Montrose Chemical Corporation's pesticide manufacturing facility in Torrance, which operated from 1947 to 1982, probably contributed to DDT contamination of the watershed and Consolidated Slip (CRWQCB, 2007b).

Numerous sediment characterization studies have identified elevated levels of heavy metals, organochlorine pesticides, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) in sediment and resident organisms from Consolidated Slip. In addition, the unlined portion of Dominguez Channel, as well as, Consolidated Slip are listed as a Superfund site by USEPA. Based on available information, over 1 million cubic yards of sediment may be impacted and require remedial actions to address water quality problems and restore beneficial uses (CRWQCB, 2007bB).

The Los Angeles Regional Board, in cooperation with the USEPA, Port of Los Angeles, US Army Corps of Engineers, and other interested parties, initiated the Consolidated Slip Restoration Project. The goals of this project are to describe the extent of sediment contamination in Consolidated Slip, identify the appropriate project stakeholders, evaluate remediation and restoration options, select an approach to solve the water quality problems and restore beneficial uses, develop a cost estimate for the proposed solution, identify funding sources to implement the project, and prepare and execute a restoration plan (CRWQCB, 2007bB).

The Port of Los Angeles prepared a draft conceptual plan on behalf of the Consolidated Slip Restoration Project. This plan described the extent of sediment contamination in Consolidated Slip and the site's history, discussed potential cleanup alternatives and possible funding sources, and identified data gaps. Although considerable sediment quality data had been collected for the project area, it was not adequate for directing the actual clean up of the site. Additional sediment sampling was required to characterize the areal extent and vertical depth of contamination in Consolidated Slip. The potential for recontamination of Consolidated Slip sediments from upstream areas of the watershed also needed to be evaluated (CRWQCB, 2007bB).

The USEPA conducted a monitoring study in 2002 to assess current sediment distributions and concentrations of DDT in sediments within the surface water drainage pathway leading from the Montrose Chemical Corporation's Torrance manufacturing facility site. The USEPA agreed to work with the Los Angeles Regional Board to expand the scope of this sampling program to include additional sediment chemistry analyses (e.g., trace metals and other trace organics), deeper cores and additional monitoring stations. This extra monitoring effort was paid for by several of the stakeholders of the Consolidated Slip Restoration Project (CRWQCB, 2007b).

Although cleanup targets have not been formally established for each contaminant of concern, it appears that approximately 1.3 million cubic yards of contaminated sediments would have to be addressed in some fashion within the Consolidated Slip area. In addition, approximately 700,000 cubic yards of contaminated sediments are present in portions of Dominguez Channel upstream from Consolidated Slip; this material may require removal to prevent recontamination of Consolidated Slip following remediation efforts in that area (CRWQCB, 2007b).

Several potential remediation alternatives to deal with the sediment contamination problem have been evaluated for technical and economic feasibility. The Restoration Project's Steering Committee recommended more detailed analysis of several alternatives, including partial capping of contaminated sediments, on-site fill of a portion of the slip as part of channel reconfiguration, removal and off-site disposal of contaminated sediments, removal and disposal of contaminated sediments to a Class I landfill, and treatment and possible beneficial re-use of contaminated sediments. A final alternative has not yet been selected; however, Dominguez Channel cleanup will likely need a total of $20-25 million for an alternative involving dredging and remediation with eventual re-use. Potential additional funding sources include cost recovery from responsible parties as well as the Water Boards' Cleanup and Abatement Account. This effort would likely be led jointly by the Regional Board and the US Army Corps (CRWQCB, 2007b).

The actual cost of the proposed cleanup of Consolidated Slip will depend on the volume of contaminated sediments to be processed and the remediation alternative selected. The project could cost as much as $75 million (based on a potential maximum of 1 million cubic yards of sediment at an estimated average handling and disposal cost of $75 per cubic yard). However, there will likely be an emphasis on dredging, capping, and slip reconfiguration which would reduce the final cost. The Port of Los Angeles will lead this effort which is expected to be a multi-year endeavor. Potential funding sources include cost recovery from responsible parties, the Water Boards' Cleanup and Abatement Account, the U.S. Environmental Protection Agency, or assistance from other interested parties (CRWQCB, 2007b).

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