STAFF REPORT
METALS IMPAIRMENT ASSESSMENT AND COPPER (Cu) TOTAL MAXIMUM DAILY LOADS FOR NEWPORT BAY, ORANGE COUNTY, CALIFORNIA

California Regional Water Quality Control Board
Santa Ana Region

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SANTA ANA WATER BOARD STAFF REPORT

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TABLES

FIGURES

1.0 INTRODUCTION

This document presents the required elements of the Total Maximum Daily Loads (TMDLs) for Copper (Cu) in Upper and Lower Newport Bay. A TMDL identifies the maximum daily load of a pollutant that can be discharged into a waterbody without causing exceedances of the water quality objectives and/or impairment of the beneficial uses of those waters. A TMDL must also include seasonal variations and a margin of safety. This document summarizes the Metals TMDLs established in the Toxics TMDLs for Newport Bay and San Diego Creek by the U.S. Environmental Protection Agency (USEPA 2002) and the Clean Water Act Section 303(d) (303(d)) listings for metals in Newport Bay and San Diego Creek and presents an impairment analysis of the newer data from 2002 through 2010 for Newport Bay. More recent data through 2019 is also presented. This Staff Report describes the scientific and technical basis for the recommended Cu TMDLs for Newport Bay. If adopted, these Cu TMDLs would supersede those previously established by USEPA in 2002.

1.1 ENVIRONMENTAL SETTING

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

San Diego Creek

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

- Peters Canyon Wash, which drains Peters Canyon, Rattlesnake Canyon, and Hicks Canyon Washes that have their headwaters in the foothills of the Santa Ana Mountains,
- San Diego Creek includes Reach 1, which receives flows from Peters Canyon Wash as well as Barranca, Lane, San Joaquin, and Sand Canyon Channels; and Reach 2, which receives flows from Bee Canyon, Round Canyon, Marshburn Channel, Agua Chinon Wash, Borrego Canyon Wash and Serrano Creek[1]

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

San Diego Creek is the largest contributor (85%) of freshwater flow into Upper Newport Bay, followed by Santa Ana-Delhi Channel and Big Canyon Wash. Table 1-1 summarizes the drainage areas of the major tributaries.

[1]USEPA. Toxics TMDLs for San Diego Creek and Newport Bay, 2002.

***Table 1-1 Drainage Areas of the Newport Bay Watershed**

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

*Table 1-2 in the U.S. EPA Toxics TMDLs for San Diego Creek and Newport Bay, 2002.
(Peters Canyon Channel is tributary to San Diego Creek, Reach 1.)

Upper Newport Bay

Upper Newport Bay contains one of the highest quality wetland areas remaining in Southern California. The Upper Bay estuary contains a State Ecological reserve in the upper half with habitat designated for sensitive species, including two endangered species Ridgway's rail and the California least tern (both bird species). The Upper Newport Bay estuary is also a Nature Preserve and a State Marine Protected Area.

Several sediment basins are found in the Upper Bay and are periodically dredged by the U.S. Army Corps of Engineers (USACOE). The last sediment dredging and restoration project was conducted in 2006-2010 (Upper Newport Bay Ecosystem Restoration Project). The Upper Bay also contains the Newport Dunes Recreation area (Dunes) - a small public beach which is the main swimming area in the Upper Bay. The Dunes area is located in the lower part of Upper Bay, south of the Ecological Reserve. North Star Beach is also located in the Upper Bay just south of the Ecological Reserve. The lower part of the Upper Bay also contains several marinas, including the Dunes and DeAnza marinas, which are located near the Dunes Recreation area and just north of Pacific Coast Highway bridge, respectively. Historical water uses for Upper Bay included: water skiing, commercial and sport fishing (although limited fishing occurs presently), shellfish harvesting, preservation of rare and endangered species, marine habitat; and recreation, including kayaking, boating, and bird watching. (Note that fishing and shellfish harvesting are not allowed within the portions of the Upper Bay that are located in the State Ecological reserve.)

Lower Newport Bay

The Lower Newport Bay area, including Lido and Balboa Islands, is highly urbanized and primarily a mix of residential and commercial uses. The Lower Bay also includes a number of marinas and mooring areas that contain approximately 5,000 boats, and approximately 5 boatyards. The Rhine Channel, a small dead-end reach in the southwestern part of Lower Bay, is an isolated area with poor tidal flushing and minimal storm drain input. The Santa Ana Water Board has identified the Rhine Channel as a toxic hotspot based on previous investigations (BPTCP 1997), and this designation has not been removed. This channel was partially dredged in 2011 by the City of Newport Beach; however, elevated concentrations of mecury, polychlorinated biphenyls (PCBs), and legacy pesticides still remain in the channel sediments. West Newport Bay and the Turning Basin are also areas that tend to have low tidal flushing and therefore accumulate pollutants in waters and sediments. The entire Newport Bay up to the mouth of San Diego Creek is subject to tidal influence.

Sedimentation in Upper and Lower Newport Bay is a significant problem, necessitating the adoption of sediment TMDLs by the Santa Ana Water Board in 1998. Periodic dredging remains necessary to maintain sediment basins in the Upper Bay and to maintain navigational depths throughout the Bay. Federal channels are maintained by the USACOE, with support from the City of Newport Beach and the County of Orange. The remainder of the Bay is managed and maintained by the City and the County. Dredging projects range in scope and complexity, from dredging of individual boat owner's slips to large scale dredging of channels and anchorages by the USACOE. While small scale projects occur on a routine basis, the implementation of large-scale projects is more complex, and the location, timing and scope significantly more uncertain, given the need to ensure adequate funding, the variability of pollutant concentrations in the dredge spoils, and the availability of suitable dredge spoil disposal sites. As noted above, a major dredging project in the Upper Bay was conducted from 2006-2010. In ~~the~~ Lower Bay, major dredging of navigational channels was accomplished in 2012-2014 (Lower Newport Bay Dredging Project, Phases I and II; see *Metals Sediment Study in Lower Newport Bay (Post-dredging) Final Report, 2014).* Other larger dredging projects have included Lido Yacht Anchorage (2008), Newport Dunes (2009), and Dover Shores (2011). Dredging of the Newport Bay entrance channel was completed by the USACOE in May 2021. Dredging of the navigational channels in Lower Newport Bay is also being planned by the USACOE, in conjunction with the City of Newport Beach. However, suitable spoils disposal sites must be determined before a schedule for this work can be identified.

The climate is characterized by short, mild winters, and warm, dry summers. Average rainfall is approximately 13 inches per year. Ninety percent (90%) of annual rainfall occurs between November and April, with minor precipitation during summer months. From 2006 to 2011, San Diego Creek had a mean base flow rate of less than 10 cubic feet per second (cfs) for flows less than 25 cfs (mean cfs of 8.4). This is a decrease from the mean base flow rate of 12 cfs for 1994 to 2002, reported in the Toxics TMDL. For storm events, flows may be as high as 8000 cfs. San Diego Creek is mostly freshwater with a wide range of hardness values and small influences by the slightly saline water table (less than 1 or 2% salinity). Santa Ana Delhi had a mean base flow rate of less than 5 cubic feet per second (cfs) for flows less than 25 cfs (mean cfs of 3.2) for 2006 to 2011, with storm flows almost to 500 cfs. The Upper Bay is an estuary with mostly saline water during dry weather, and heavy freshwater inflow from San Diego Creek and Santa Ana-Delhi Channel during major storms, which mostly occur in winter. Lower Bay waters are dominated by saline waters (30 to 35 parts per thousand (ppt)) due to twice-daily ocean tides which enter the Bay via the jetty entrance.

1.2 WATERSHED HISTORY

The description below is taken largely from Santa Ana Water Board staff'sProblem Statement prepared for the draft Newport Bay Toxics TMDLs (RWQCB 2000).

The nature of the Newport Bay watershed has changed dramatically over the last 150 years, both in terms of land use and drainage patterns. In the late 19th and early 20th centuries, land use changed from ranching and grazing to open farming. During this time the Santa Ana River flowed into Newport Bay, while San Diego Creek and the small tributaries from the Santiago Hills drained into an ephemeral lake and the neighboring area called "La Cienega de las Ranas" (Swamp of the Frogs) and then into the River. To accommodate rural farming, the ephemeral lake and Swamp of the Frogs were drained and vegetation cleared. Channels were constructed (but often did not follow natural drainage patterns) to convey runoff to San Diego Creek and then Newport Bay. After a major flood event in 1920's, the Santa Ana River was permanently diverted into the current flood control channel which now discharges to the Pacific Ocean. As a result of these land use and drainage changes, surface and groundwater hydrology have been substantially altered from natural conditions. Following World War II, land use again began to change from grazing and open farming to residential and commercial development. As urban development in the watershed proceeded (and continues), drainages were further modified through removal of riparian vegetation and lining of stream banks to expand their capacity and to provide flood protection. These changes culminated in the channelization of San Diego Creek in the early 1960s by the Orange County Flood Control Department. The channelization isolated the San Joaquin Marsh, the last remaining portions of the historic marsh upstream of Upper Newport Bay, from San Diego Creek (Trimble 1987).

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

Land use and drainage modifications changed the nature and magnitude of toxic substance discharges to the Bay. Converting from grazing type agriculture to orchards and row crops has increased the amount of pesticide use in the watershed, resulting in discharges of pesticides from these areas…Tustin and El Toro military bases exist within the watershed and have historically used various toxic substances during operations. [Note that both military sites have been converted to primarily urban/suburban uses.][2]

Urban development introduced new sources of toxic substances, including different pesticides and metals associated with human habitation (e.g., buildings, landscaping, and motor vehicles). In addition, land use activities which result in erosion may contribute to the delivery of pesticides and other pollutants that adhere to sediments or normally remain in solid form.

[2] El Toro Marine Corps Air Station was decommissioned in 1999. The site was remediated for contaminated soils (volatile organic compounds (VOCs)). The former air station is planned to be converted into a large recreational center, the Orange County Great Park. Tustin Marine Corps Air Station was operationally closed in 1999, and approximately 13,000 acres were conveyed to the City of Tustin. The base site is now the home of the Orange County Sherriff Department academy.

[3] USEPA. Toxics TMDLs for San Diego Creek and Newport Bay, 2002.

Table 1-2 Land Use Types in Watersheds of Newport Bay

	San Diego Creek Subwatershed		Newport Bay Watershed	
Land Use	**Acres**	**Percent**	**Acres**	**Percent**
Vacant	21,324	28.3	22,166	23.3
Residential	22,128	29.4	33,063	34.8
Education/Religion/Recreation	5,412	7.2	8,071	8.5
Roads	2,459	3.3	2,978	3.1
Commercial	10,004	13.3	13,030	13.7
Industrial	5,875	7.8	7,010	7.4
Agriculture	6,174	8.2	6,255	6.6
Transportation	122	0.2	602	0.6
No code	1,726	2.3	1,778	1.9
Total	75,224	100	94,953	100

Source: OC Public Works June 2020 (based on SCAG data 2016)
[Total percentage is not exactly 100 due to rounding of the percentages for each land use category.]

1.3 TMDL ELEMENTS

The elements of a TMDL are described in 40 CFR §§ 130.2 and 130.7 and Section 303(d) of the Clean Water Act (CWA), as well as in the USEPA guidance (USEPA, 2000a). A TMDL is defined as the "sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR § 130.2) such that the capacity of the waterbody to assimilate pollutant loads (the loading capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (USEPA, 2000). In addition, states must develop water quality management plans which incorporate approved TMDLs and implementation measures necessary to implement the TMDLs (40 CFR 130.6).

The goal of the TMDL process is to attain water quality standards and protect the beneficial uses of water bodies, including aquatic habitat, fishing, and recreation. A TMDL is a written, quantitative assessment of water quality problems and contributing pollutant sources. It identifies one or more numeric targets (endpoints) based on applicable water quality standards, specifies the maximum amount of a pollutant that can be discharged (or the amount of a pollutant that needs to be reduced) to meet water quality standards, allocates pollutant loads among sources in the watershed, and provides a basis for taking actions needed to meet the numeric target(s) and implement water quality standards.[3]

For all TMDLs, seven components must be included:

1. Problem Statement—a description of the water body setting, beneficial use impairment of concern, and pollutants causing the impairment.
2. Numeric Targets—for each pollutant addressed in the TMDL, appropriate measurable indicators and associated numeric target(s) based on numeric and/or narrative water quality standards which express the target or desired condition for the water body which will result in protection of the designated beneficial uses of water.

[3] USEPA. Toxics TMDLs for San Diego Creek and Newport Bay, 2002.

3. Source Analysis—an assessment of relative contributions of pollutant sources or causes to the use impairment.
4. Loading Capacity/Linkage Analysis—a connection between the numeric targets and pollutant sources which yields calculations of the assimilative capacity of the water body for each pollutant.
5. TMDL and Allocations— an expression of the total allowable pollutant loads as divided between pollutant sources through load allocations for nonpoint sources and wasteload allocations for point sources. The TMDL is defined as the sum of the allocations (plus a margin of safety) and cannot exceed the loading capacity for each pollutant.
6. Margin of Safety—an explicit and/or implicit margin of safety must be specified to account for technical uncertainties in the TMDL analysis.
7. Seasonal Variation/Critical Conditions—an account of how the TMDL addresses various flows and/or seasonal variations in pollutant loads and effects."

1.4 THIS TMDLS DOCUMENT

This TMDL document includes the following sections:

Section 1.0 INTRODUCTION
This section includes a description of Newport Bay –the Environmental Setting and Watershed History and outlines the TMDL elements.

Section 2.0 REGULATORY BACKGROUND
This section outlines the regulatory authority and oversight for the development and implementation of TMDLs in the state of California.

Section 3.0 TOXICS TMDLS AND 303(d) BACKGROUND
This section outlines the history of 303(d) listings for metals in Newport Bay, the Metals TMDLs established by USEPA in the Toxics TMDLs for Newport Bay in 2002, the State Water Board assessment of metals in Newport Bay in 2006, and the current 303(d) listings and decisions for metals in Newport Bay (2008-2010, 2014-2016 and 2018 303(d) Lists).

Section 4.0 METALS IMPAIRMENT ASSESSMENT AND PROBLEM STATEMENT
This section outlines the Metals impairment assessment for Newport Bay for data after 2002. This section includes the water quality objectives, sediment guidelines, and fish tissue guidelines used for this data assessment; the data analysis; and a summary of the impairment assessment for Newport Bay. This section describes the basis for concluding that TMDLs for Cu are necessary. This section also includes newer Cu monitoring and data.

Section 5.0 COPPER (Cu) TMDLS
This section outlines the components of the TMDLs for Cu, including Numeric Targets, a Source Analysis, the Loading Capacity and Linkage Analysis, the TMDLs and Allocations including the Margin of Safety and Seasonal Variations and Critical Conditions, and an Implementation Plan and Schedule to achieve the Cu TMDLs.

2.0 REGULATORY BACKGROUND

The objective of the Clean Water Act (CWA) is to "restore and maintain the chemical, physical and biological integrity of the Nation's waters" to ensure that the waters of the U.S. are "fishable and swimmable".

Section 303(d)(1)(A) of the CWA provides that "Each State shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters". Water bodies that have been identified in accordance with that requirement are placed on the CWA 303(d) list; these waters are not expected to meet water quality standards even after implementation of technology-based control practices. The CWA also requires states to establish a priority ranking of these waters on the 303(d) list; and to develop Total Maximum Daily Loads (TMDLs) for these waters. In the approved 2010 Section 303(d) list, both Upper and Lower Newport Bay are listed as impaired for Cu. Upper Newport Bay is also listed for the general category of "Metals"; however, this general listing for "Metals" needs to be removed. This delisting was approved in the 2014-16 listing cycle. (See Table 3-1 below.)

When a TMDL is established by the USEPA or the State, the State must incorporate the TMDL along with appropriate implementation measures into the State's water quality management plan (40 CFR §§ 130.6I(1), 130.7). The Water Quality Control Plan for the Santa Ana River Basin (Basin Plan), and applicable state-wide water quality control plans, serve as the State's water quality management plan that governs the Newport Bay watershed.

USEPA has oversight authority for the 303(d) program and is required to review and approve or disapprove the TMDLs submitted by states to determine if they meet all TMDL requirements. In California, the State Water Resources Control Board (State Water 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 approves the State's TMDLs, they will supersede any applicable TMDLs that have been established by USEPA. If USEPA disapproves a TMDL submitted by a state, then USEPA is required to establish a TMDL for that water body. The regional water boards also have the regulatory authority for many tools used to implement the TMDLs such as National Pollutant Discharge Elimination System (NPDES) permits and waste discharge requirements (WDRs).

3.0 TOXICS TMDLS AND 303(d) BACKGROUND

3.1 HISTORY OF 303(d) LISTINGS FOR METALS

Metals were not specifically listed as a pollutant in Newport Bay until 1996. Before that time in the early 1990s, the general category of Toxic Pollutants was listed for Newport Bay. In 1998 and 2002, both Upper and Lower Newport Bay were listed for metals. In 2006, copper (Cu) was listed for both Upper and Lower Newport Bay, and the general metals category was delisted for the Lower Bay. In 2010, both Upper and Lower Newport Bay were still listed for Cu, and the Upper Bay was still listed for the general category of metals. The general metals category was delisted for the Upper Bay in the 2014-2016 list. For San Diego Creek, metals were first listed for Reaches 1 and 2 in 1998. Metals were delisted for Reach 1 in 2002 and for Reach 2 in the 2008-2010 list. A summary of the 303(d) list history is included in Table 3-1 and Appendix 2.

The 303(d) listings in the early 1990s, and subsequent monitoring data supporting those listings, prompted Santa Ana Water Board staff to begin the development of TMDLs for toxic pollutants.

Table 3-1 303(d) List Summary for Toxic Pollutants including Metals in Upper and Lower Newport Bay (Summary through 2014-16, 2018)

	Upper Newport Bay (includes Ecological Reserve)	**Lower Newport Bay**
1990	Elevated shellfish tissue levels -no pollutants listed	Elevated shellfish tissue levels -no pollutants listed
1991	Threat of recreational impacts Threat of toxic pollutants	same as 1990
1994	same as 1991	Recreational impacts Elevated shellfish tissue levels Toxic bioassay results
1996	Recreational impacts Sedimentation **Threat of toxic pollutants** Threat from stormwater runoff	same as 1994 **Heavy metals, Toxic pollutants** Public health concern
1998	**Metals** Sedimentation/Siltation	**Metals**
2002	**Metals**	**Metals**
2006	**Copper, Metals** Sediment Toxicity	***Copper** Sediment Toxicity
2010	**Copper, Metals** Sediment Toxicity	**Copper** Sediment Toxicity
2014-16	**Copper (Cu),** Toxicity (General "Metals" Delisted this cycle)	**Copper (Cu),** Toxicity
2018	**Copper (Cu)**, Toxicity	**Copper (Cu)**, Toxicity

*For the Lower Bay, the general category of 'Metals' was Delisted due to State Water Board assessment of individual metals in 2006 (all metals assessed were Do Not List except for Copper) http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/docs/303(d) /2010_303(d) .pdf
* A 2012 303(d) List was approved by the State Water Board and USEPA. This List incorporated updated information from only 3 Regional Water Boards, not including the Santa Ana Region. The approved 2014-2016 List maintained the impairment findings for Upper and Lower Newport Bay incorporated in the approved 2010 303(d) List. The 2018 303(d) list, approved by the State Water Board and USEPA, did not include data updates for the Santa Ana Region. The Bay continues to be listed as impaired due to dissolved Cu.

3.2 TOXICS TMDLS FOR NEWPORT BAY AND SAN DIEGO CREEK - USEPA 2002

The USEPA has oversight authority for the 303(d) impaired waters program and may establish TMDLs for a state if they do not approve TMDLs developed by a state. USEPA Region 9 was required by a consent decree to complete Total Maximum Daily Loads (TMDLs) for toxic pollutants, including metals, in Newport Bay by June 2002. This consent decree, which was entered into by USEPA and Defend the Bay, Inc. vs. Marcus, on October 31, 1997 (N.D. Cal. No. C97-3997 MMC) established a schedule for the development of TMDLs in San Diego Creek and Newport Bay. The decree required the development of TMDLs for a variety of pollutants by January 15, 2002; this date was subsequently extended to June 15, 2002. Because the Santa Ana Water Board was unable to complete the development of TMDLs for toxic pollutants by the date specified in the consent decree, USEPA was required to do so.

Metals identified in the consent decree included cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), silver (Ag) and zinc (Zn); however, USEPA was required to establish TMDLs only for those pollutants they deemed necessary (USEPA 2002, Part H). Metals which were assessed by USEPA were arsenic (As), Cd, Cr, Cu, Pb, Hg, Ag and Zn (USEPA 2002). Nickel (Ni) was not part of the assessment for the Toxics TMDL; however, Ni was assessed in Board staff's Impairment Assessment.

In June 2002, the USEPA established TMDLs for Toxic Pollutants in Newport Bay and San Diego Creek (USEPA 2002). These TMDLs included metals TMDLs for dissolved copper (Cu), cadmium (Cd), lead (Pb) and zinc (Zn) for Upper Newport Bay and San Diego Creek; and dissolved Cu, Pb and Zn for Lower Newport Bay (including the Rhine Channel) (Table 3-2). Arsenic (As) was assessed but did not require TMDLs since applicable criteria were not being exceeded. Mercury (Hg) and chromium (Cr) were also assessed; TMDLs for these metals were established only for the Rhine Channel. Selenium (Se) is addressed by separate TMDLs that were approved by USEPA in 2019). USEPA's Toxics TMDLs can be found at the Santa Ana Water Board's website at https://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/tmdl_toxics.html (Note that these Toxics TMDLs are no longer on USEPA's main website.)

USEPA determined the metals that required TMDLs using a two-tiered approach based on exceedances of the dissolved metals chronic or acute California Toxics Rule (CTR) saltwater criteria, sediment guidelines and fish tissue guidelines (Part H, USEPA 2002). For sediment data, exceedances of the high sediment guidelines (effects range median (ERMs) and probable effects levels (PELs) or low sediment guidelines (effects range low (ERLs) and threshold effect levels (TELs)) (Long et al1998) were determined. In addition to the sediment chemistry data, sediment toxicity was also evaluated, and sediment toxicity was found in the Upper and Lower Newport Bay. Metal concentrations in fish and mussel tissue were also examined for exceedances of fish tissue guidelines. Cu and Zn concentrations in bivalves showed bioconcentration in the Lower Bay (SMW 2000); however, fish tissue concentrations were not elevated with respect to OEHHA (Office of Environmental Health Hazard Assessment) screening values (OEHHA, 1999). Cu, Cd, Pb and Zn do not tend to biomagnify (magnify up the food chain).

Table 3-2 Metals TMDLs established by USEPA in 2002

Upper Newport Bay (marine)	*Cd, Cu, Pb, Zn
Lower Newport Bay (marine)	Cu, Pb, Zn
San Diego Creek (freshwater)	Cd, Cu, Pb, Zn

Cd = cadmium, Cu = copper, Pb = lead, Zn = zinc

3.3 STATE WATER BOARD 303(d) DATA ASSESSMENT 2006

Subsequent to USEPA's promulgation of technical TMDLs, the State Water Board adopted the Water Quality Control Policy for Developing California's CWA Section 303(d) List (State Listing Policy) in September 2004. This policy specifies methodology for placing a water body on the CWA 303(d) list.

Upper and Lower Newport Bay. In 2006, State Water Board staff conducted an extensive analysis of individual metals in both the Upper and Lower Bay, including As, Cd, Cr, Cu, Pb, Hg, Ni, Ag and Zn. All metals examined in both the Upper and Lower Bay were designated as DO NOT LIST decisions, except for Cu, which was designated as LIST for both Upper and Lower Newport Bay. This analysis was based on one data set for water and sediment (Bay & Greenstein, 2003), a fish tissue data set (TSMP 2000), and sediment toxicity data (Bay et al 2004, Phillips et al 1998); however, some metals analyzed in these reports are missing in the 303(d) list decision sheets. County of Orange (OC) storm water data (which were used to determine the metals for which USEPA established TMDLs in 2002), were not analyzed during the 2006 assessment of data.

During this State Water Board assessment, it was also determined that the general category of "Metals" is inadequate to characterize the specific pollutants causing water quality impairment in a water body; therefore, individual metals were assessed for the Upper and Lower Bay. Specifically, Decision sheet #6772 states that
"…currently Newport Bay, lower, is listed for metals. It is not possible, in a general listing, to determine which specific pollutant is causing or contributing to a water quality impacts. There is sufficient justification for removing the general listing for metals from the 303(d) list and replace these general listings with the specific pollutants when found to be exceeding."
http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/00033.shtml#6772
It was therefore recommended that general "Metals" category be DELISTED for the Lower Bay. The same DELIST decision was not applied to the Upper Bay even though the same analyses for individual metals were conducted in the Upper Bay and a DELIST decision was justified for the general "Metals" category (decision sheet #7267). This inconsistency was discussed with the State Water Board staff in February 2008 however, the general "Metals" category was still not DELISTED for the 2010 303(d) list.

San Diego Creek. In 2006, State Water Board staff conducted an extensive analysis of individual metals for Reach 1, and all metals examined in San Diego Creek were designated as Do Not List (Cu, Cd, Pb, Zn, Ni, As, Ag, Hg). (A Do Not List sheet for Cr is appropriate but was missing.) Individual metals were not, however, analyzed for Reach 2; therefore, the general listing of metals was removed for Reach 1 but remained for Reach 2.

3.4 STATE WATER BOARD 303(d) ASSESSMENT 2008-2010

Newport Bay. In the 2008-2010 303(d) assessment, Lower Newport Bay was still listed for copper and sediment toxicity, and Upper Newport Bay was listed for copper, metals and sediment toxicity (Table 3-3). Based on the assessment for the 2008-2010 303(d) list, no metals except Cu exceeded the CTR saltwater criteria; however, County of Orange monitoring data were not evaluated, and some data from reports referenced were not evaluated. These data are evaluated in this TMDL document.

San Diego Creek. In the 2008-2010 303(d) list, Reach 2 was DELISTED for metals, based on monitoring data from the County of Orange which indicated minimal exceedances of the dissolved metals CTR freshwater criteria (Cu, Cd, Pb, Zn, Cr, Ni, Ag, As). Reaches 1 and 2 are no longer listed for metals. Since San Diego Creek is no longer listed for metals, no TMDLs are required. San Diego Creek and the Santa Ana Delhi Channel will both be addressed as sources to the Upper Bay in these Cu TMDLs.

Based on the findings from the 2010 303(d) list, where Reaches 1 and 2 were delisted for the general category of metals and no individual metals were listed, USEPA's TMDLs for Cd, Cu, Pb, Zn in San Diego Creek are no longer necessary to achieve or maintain water quality standards for metals in the Creek.

Table 3-3 2010 303(d) List for Newport Bay and San Diego Creek

Upper Newport Bay (marine)	Copper (Cu), Metals, Sediment Toxicity
Lower Newport Bay (marine)	Cu, Sediment Toxicity (General Metals Category Delisted in 2006)
San Diego Creek (freshwater)	
Reach 1*	No Metals Listed
Reach 2^	No Metals Listed

*Reach 1 is downstream of Jeffrey Road
^Reach 2 is upstream of Jeffrey Road to the headwaters

Decision sheets for the 2010 303(d) list can be found at the following links:
http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/table_of_contents.shtml#r8

3.5 CURRENT STATE WATER BOARD 303(d) ASSESSMENTS AND 303(d) LISTINGS 2014-16, 2018

The 2014-2016 303(d) list of impaired waters approved by the State Water Board and the USEPA is the most recent and applicable list of those waters in the Santa Ana Region. The 2018 303(d) list, did not include data updates for the Santa Ana Region; Newport Bay continues to be listed as impaired due to dissolved Cu. This list confirms the need for Cu TMDLs for both Upper and Lower Newport Bay.

Newport Bay. Based on the 2014-16 303(d) State Water Board assessment, both Upper and Lower Newport Bay were determined to be DO NOT DELIST for Cu and toxicity (Table 3-4). The weight of available data and information demonstrates that both the Upper and Lower Bay should continue to be included on the CWA section 303(d) List.
Since Cu continues to exceed the CTR chronic criterion in both Upper and Lower Newport Bay and these water bodies are 303(d) listed, Cu TMDLs are required to address these exceedances.

The general category of "Metals" was DELISTED for the Upper Bay in the 2014-16 approved 303(d) List (decision sheet #33892).

Table 3-4 303(d) List (2014-16) for Newport Bay

Upper Newport Bay (marine)	Copper (Cu), Toxicity (General "Metals" Delisted this cycle)
Lower Newport Bay (marine)	Copper (Cu), Toxicity

4.0 METALS IMPAIRMENT ASSESSMENT

This section includes applicable water quality standards, the State Listing Policy (State Water Board 2004) which was used to assess the data, and the analysis of the data to determine the metals causing impairment in Newport Bay.

4.1 WATER QUALITY STANDARDS

The CWA requires that states adopt water quality standards, which include (1) beneficial uses, (2) water quality objectives (numeric and narrative), and (3) an antidegradation policy. Water quality standards for the Santa Ana Region are specified in the Basin Plan for the Santa Ana River Basin. The Basin Plan can be found at http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/index.shtml.
In addition to the Basin Plan, USEPA promulgated numeric water quality objectives for priority toxic pollutants for the State of California in the CTR (40 CFR § 131.38) for the protection of human health and wildlife. The federal water quality criteria established by the CTR are equivalent to state water quality objectives and are legally enforceable.

4.1.1 Beneficial Uses

Beneficial uses of Newport Bay are designated in the region's Basin Plan and are shown in Table 4-1. Adverse impacts to these beneficial uses that result from discharges of toxic pollutants are violations of the second narrative objective for toxic substances specified in the Basin Plan (Section 4.1.3 below).

Table 4-1 The Beneficial Uses of Newport Bay

	NAV	REC1	REC2	COMM	BIOL	WILD	RARE	SPWN	MAR	SHEL I	EST
Upper Newport Bay		X	X	X	X	X	X	X	X	X	X
Lower Newport Bay*	X	X	X	X		X	X	X	X	X	

X = Existing or potential beneficial use, I = Intermittent beneficial use, * Includes the Rhine Channel
NAV =Navigation, REC1 =Water contact recreation, REC2 = Non-contact water recreation,
COMM =Commercial and sportfishing, BIOL =Preservation of biological habitats of special significance,
WILD =Wildlife habitat, RARE =Rare, threatened, or endangered species,
SPWN =Spawning, reproduction, and development, MAR =Marine habitat,
SHEL =Shellfish harvesting, EST =Estuarine habitat

4.1.2 Numeric Water Quality Objectives

In 2000, USEPA promulgated the California Toxics Rule (CTR) (40 CFR §131.38), establishing numeric water quality criteria for toxic pollutants, including dissolved metals, for the protection of human health and aquatic life. The CTR established 23 numeric aquatic life criteria and 57 numeric human health criteria for priority toxic pollutants. In the CTR, USEPA established concentration-based criteria; so that the criteria would be applicable in both wet and dry weather conditions. (There is no exception for wet weather conditions in the CTR since a pollutant concentration accounts for an increase in water volume, and aquatic life is present in wet weather as well as dry weather conditions.) Metals criteria were established for dissolved metals. Because the CTR criteria were promulgated by USEPA in 2000 for toxic pollutants, including dissolved metals in saltwater and freshwater, the criteria are legally enforceable.

For the protection of aquatic life, the CTR established criterion maximum concentrations (CMC) as acute (short-term criteria) and criterion continuous concentrations (CCC) as chronic (long-term criteria) for toxic pollutants in both saltwater and freshwater. The CTR includes acute and chronic criteria for dissolved Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Selenium (Se), Silver (Ag) and Zinc (Zn). These are also the metals of concern that are most commonly found in estuaries and bays.

These metals were assessed in the Newport Bay Toxics TMDLs (USEPA 2002), and all, except Se, are included in this Metals Impairment Assessment. (Se is addressed in a separate TMDL.) Since Newport Bay is an estuary and is mostly saltwater, the CTR Saltwater Criteria for Dissolved Metals were used for this assessment of metals in Newport Bay.

4.1.3 Narrative Water Quality Objectives

Toxic Substances

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

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

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

Sediment Quality Provisions

4. In the *Water Quality Control Plan for Enclosed Bays and Estuaries: Sediment Quality Provisions* (2018) (Sediment Quality Provisions), the State Water Board established narrative sediment quality objectives (SQOs) for the protection of the followinga. Aquatic Li–e - 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 (MLOE) as described in Chapter IV.A.1 of the Sediment Quality Provisions.

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 in bays and estuaries of California. This narrative objective shall be implemented as described in Chapter IV.A.2 of the Sediment Quality Provisions.

c. Wildlife and Resident Finfish

Pollutants shall not be present in sediment at levels that alone or in combination are toxic to wildlife and resident finfish by direct exposure or bioaccumulate in aquatic life at levels that are harmful to wildlife or resident finfish by indirect exposure in bays and estuaries of California. This narrative objective shall be implemented as described in Chapter IV.A.3 of the Sediment Quality Provisions.

4.1.4 Antidegradation Policy

The CWA requires that each state develop and adopt a statewide antidegradation policy. California's antidegradation policy is addressed by the "Policy with Respect to Maintaining High Quality Waters in California" (State Water Board Resolution 68-16) which is incorporated by reference in the Basin Plan. Resolution 68-16 incorporates the federal antidegradation policy where the federal policy applies under federal law.

The federal antidegradation policy applies to surface water and establishes three tiers of waters. (40 CFR § 131.12.). Tier 1 maintains and protects existing uses and water quality conditions to support such uses. (40 CFR § 131.12(a)(1).) Tier 2 waters have higher water quality than those required to support designated uses. (40 CFR § 131.12(a)(2).) Tier 3 waters have been designated as outstanding national resource waters. (40 CFR § 131.12(a)(3).) Some degradation may be allowed in Tier 1 and Tier 2 waters provided that certain findings are met. If degradation is allowed in a high-quality water, the state must determine, after a consideration of alternatives, that the degradation is necessary to accommodate important economic or social development in the area in which the waters are located. (40 CFR § 131.12(a)(2)(ii).) No water quality degradation is allowed in Tier 3 waters. (40 CFR § 131.12(a)(3).)

California's antidegradation policy protects high quality waters of the State, including groundwater. High quality waters are waters where existing water quality is better than required by water quality control plans or policies. The State's antidegradation policy requires that high quality waters be maintained unless it has been demonstrated that a change in water quality will be consistent with the maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial uses of the waterbody, and will not result in water quality lower than that required by the State.

4.1.5 POTENTIAL REVISIONS TO COPPER (Cu) OBJECTIVES – WATER EFFECTS RATIO AND SALTWATER Cu BIOTIC LIGAND MODEL (Cu BLM)

As discussed in Section 4.1.2, the CTR specifies the water quality criteria (or "water quality objectives" under California's Porter Cologne Water Quality Control Act) for dissolved Cu applicable to California's marine waters. These criteria ("water quality objectives" in California Water Board language) form the basis for regulatory actions by USEPA and the State Water Board and regional water boards to address Cu discharges, including discharges from Cu antifouling paints (Cu AFPs). The CTR criteria for dissolved Cu are expressed as a function of the water-effects ratio (WER). The WER is generally computed as the acute or chronic toxicity value for a pollutant measured in the affected receiving water, divided by the respective acute or chronic toxicity value in laboratory dilution water. A default WER of one (1) is assumed for the purposes of determining the applicable numeric objectives. This means that the numeric values identified in the CTR for dissolved Cu apply, unless an alternative, scientifically defensible WER is developed, approved and applied to modify the numeric value of the objective. If approved, the revised objectives form the basis for discharge requirements and other regulatory actions.

More recently in 2007, USEPA developed an alternative approach to the determination of Cu criteria/objectives based on a freshwater Biotic Ligand Model (BLM) that considers the chemical speciation of Cu in a water body. The model is based on the hypothesis that the most toxic form of Cu is the free Cu ion (Cu^{+2}) (i.e. the higher the free Cu ion concentration in solution, the higher the potential toxicity), and ligands in solution, such as chloride, sulfate, and dissolved organic carbon (DOC), bind Cu so that less free Cu is available (i.e. the higher the concentration of ligands in water, the higher the concentration of Cu complexes (bound Cu) and the lower the concentration of free Cu).

CTR Cu criterion is based on the *dissolved Cu in water (Cu^{+2} + Cu complexes)*

BLM Cu criterion is based on the *estimated Cu^{+2} in water (free Cu ion)*

The freshwater BLM also uses water chemistry parameters of a specific water body, including pH, salinity, temperature, and dissolved organic carbon (DOC), to calculate a freshwater Cu criterion for each sample.

The Saltwater Copper Biotic Ligand Model (Cu BLM) is similar to the freshwater BLM in that DOC, pH, salinity and temperature are used to calculate a dissolved Cu criterion for a single sample. The dissolved Cu criterion calculated by the saltwater Cu BLM, however, is based primarily on DOC since pH, salinity and temperature are relatively constant in ocean waters; therefore, the saltwater Cu BLM criterion is highly dependent on the DOC concentration. Since the DOC may vary throughout the year, it is critical to characterize the range of DOC concentrations in a water body, or a particular site, throughout the year (and potentially over several years) to establish an accurate Cu BLM criterion for that water body or site. Note that when the DOC concentration is close to 1 mg/L or less, the saltwater Cu BLM objective is nearly equivalent to the acute CTR saltwater criterion for dissolved Cu (4.8 µg/L), and the Cu BLM criterion increases as the DOC decreases below 1mg/L. The saltwater Cu BLM is currently in review by USEPA. A technical report on the saltwater Cu BLM may be found at
http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/copper/upload/2009_04_27_criteria_copper_2007_blm-tsd.pdf
USEPA also has a presentation on the Cu BLM:
http://water.epa.gov/learn/training/standardsacademy/upload/2008_08_20_standards_academy_special_blm_presentation-notes.pdf

If sanctioned by USEPA, the Saltwater Cu BLM, or other future USEPA bioavailability models, may be used to develop site-specific Cu objectives that may differ from those specified in the CTR. Again, to determine an accurate Cu BLM criterion, the DOC must be characterized at least throughout one year. As of this writing, the saltwater Cu BLM is still under review by USEPA.

As discussed below (Section 5.6.3 and 5.6.3.1), adjustments to the CTR criteria/objectives for dissolved Cu may be pursued for Newport Bay; these may include a site-specific objective (SSO) or a water effects ratio (WER) adjustment. Revised objectives, if approved, would likely necessitate review and possible revision of these TMDLs, including the impairment assessment, Cu allocations and this implementation plan. The recommended TMDL implementation plan described below accommodates such actions.

4.2 DATA ANALYSIS AND METHODOLOGY

A summary of the data analyses and Impairment Assessment presented below can be found in Section 4.2.3.

Metals Data and Studies Completed/In Progress Since 2002
In 2002, USEPA established Toxics TMDLs, including metals, for Newport Bay and San Diego Creek. USEPA's assessment to determine the metals that required TMDLs included the review of water and sediment data from 1996-2000.

USEPA's impairment assessment for Newport Bay was based on a two-tiered approach where a Tier 1 designation represented "clear evidence of impairment with probable adverse effects," while a Tier 2 designation represented "incomplete evidence and/or evidence of possible adverse effects or potential for future impairment" (USEPA Toxics TMDLs, Part H, p. 4, 2002). Water samples were compared to acute and chronic CTR criteria, sediments were evaluated with a triad approach (sediment chemistry, sediment toxicity, infaunal analysis), and sediment metal concentrations were compared to TEL, ERL and PEL sediment guidelines (threshold effects levels, effects range low and probable effects levels, respectively) to determine exceedances. Fish tissue impairment was based on fish consumption advisories and tissue concentrations compared to screening values. Fish tissue metals were compared to the lower screening value of USEPA (2000b) or OEHHA (1999). A minimum of ten samples and a percent exceedance of 10% for water samples, and 25% for sediment (high guideline) and tissue samples, were required to determine a Tier 1 designation. A Tier 2 designation was determined by one exceedance in 3 years for water samples, and a 10% exceedance for sediment (low guideline) and tissue samples. A water segment could also be designated as Tier 2 if it was adjacent to a water segment where impairment was determined and a TMDL was required.

USEPA's impairment assessment decisions for Newport Bay were based on the following data and criteria shown in Table 4-2 and detailed in Part H of the Toxics TMDLs (USEPA 2002). (Data for San Diego Creek are not shown.)

Table 4-2 Metals Assessment by USEPA (Toxics TMDLs –Part H, 2002)

Upper Newport Bay TMDLs	Data supporting a TMDL
Cadmium (Cd)	**Sediments* 21% (8/42) >ERL (1.2 µg/g) *Tier 2* Potential threat to UNB based on sediment data, and evidence of impairment in San Diego Creek (exceedances of the CTR criteria) *TMDL needed based on adjacent water analyses (SD Creek)*
Copper (Cu)	*Water* many exceedances of CTR criteria *Tier 2* *Sediments* 17% (7/42) >TEL (35.7µg/g) *Tier 2*
Lead (Pb)	*Sediments* 5% (2/42) >ERL (46.7µg/g) Potential threat to UNB based on sediment data, and impairment in Rhine Channel (exceedances of sediment ERM)
Zinc (Zn)	*Water* many exceedances of CTR criteria *probably Tier 2* *Sediments* 17% (8/48) >ERL (150 µg/g) *Tier 2* *Tissue* 10% (1/10) > screening value *Tier 2*
Lower Newport Bay TMDLs	*Data supporting a TMDL*

Copper (Cu)	*Water* many exceedances of CTR criteria *Sediments* 33% (9/27) >PEL (108 µg/g) *Tier 2* *Porewater* 5/10 with elevated Cu *Tier 2*
Lead (Pb)	*Sediments* 12% (5/30) >ERL (46.7µg/g) *Tier 2* Potential threat to UNB based on sediment data, and Impairment in Rhine Channel (exceedances of sediment ERM)
Zinc (Zn)	*Water* many exceedances of CTR criteria *probably Tier 2* *Sediments* 37% (14/48) >ERL *Tier 2*

*Sediment TELs, ERLs and PELs are not used for listing purposes based on the current State Listing Policy (SWRCB 2004)

In 2004, the State Listing Policy (SWRCB 2004) was adopted to provide statewide guidance to identify waters that do not meet applicable water quality standards with technology-based controls alone and to prioritize those waters for TMDL development (i.e., to determine waterbodies that are exceeding the standards for any pollutant(s). In 2006, the State Water Board used this State Listing Policy to assess metals in water and sediment data from Newport Bay studies (1998-2006) to determine the metals causing impairment to Newport Bay. Similarly, the State Listing Policy was used in subsequent 303(d) assessments. The State Water Board amended the State Listing Policy in 2015.

Santa Ana Water Board staff's Impairment Assessment evaluated data from Upper and Lower Newport Bay. The assessment of the Lower Bay did not include an assessment of data from the Rhine Channel since the Rhine Channel was dredged in 2011; therefore, data collected prior to 2011 are no longer valid to determine impairment.

4.2.1 METHODOLOGY

Criteria and Guidelines Used for this Impairment Assessment

In Board staff's Impairment Assessment, metals data were analyzed according to the State Listing Policy (SLP) (2004, as amended in 2015) to determine the metals that are causing impairment to Newport Bay. Data from 2002 through 2014 were assessed. Data not assessed for the 2008-2010 303(d) list were also analyzed for this impairment analysis, and data used for the 2006 and 2010 303(d) lists were reviewed again.

The methodology based on the State Listing Policy was somewhat different, although similar to that used by USEPA for their data assessment for the Toxics TMDL. Per the State Listing Policy, waterbodies may be considered to be impaired by exceedances of the CTR water quality criteria, exceedances of fish or mussel tissue guidelines for human health or aquatic life, or the presence of water or sediment toxicity. In addition, a waterbody may be considered to be impaired if there are exceedances of the ERM sediment guidelines and if sediment toxicity is also present in paired samples. The number of exceedances of the water quality criteria or sediment or tissue guidelines that indicate impairment is determined by the application of the binomial distribution as explained below and shown in Appendix 3 (Table 3.1 of the State Listing Policy).

The State Listing Policy, Section 3 states the following:

"Water segments shall be placed on the section 303(d) list if any of the following conditions are met.

3.1 Numeric Water Quality Objectives and Criteria for Toxicants in Water

Numeric water quality objectives for toxic pollutants, including maximum contaminant levels where applicable, or California/National Toxics Rule water quality criteria are exceeded as follows:

- *Using the binomial distribution, waters shall be placed on the section 303(d) list if the number of measured exceedances supports rejection of the null hypothesis as presented in Table 3.1 [Appendix 3].*

3.5 Bioaccumulation of Pollutants in Aquatic Life Tissue

A water segment shall be placed on the section 303(d) list if the tissue pollutant levels in organisms exceed a pollutant-specific evaluation guideline (satisfying the requirements of section 6.1.3) using the binomial distribution as described in section 3.1.

Acceptable tissue concentrations may be based on composite samples measured either as muscle tissue or whole-body residues. Residues in liver tissue alone are not considered a suitable measure. Samples can be collected either from transplanted animals or from resident populations.

3.6 Water/Sediment Toxicity

A water segment shall be placed on the section 303(d) list if the water segment exhibits statistically significant water or sediment toxicity using the binomial distribution as described in section 3.1. The segment shall be listed if the observed toxicity is associated with a pollutant or pollutants. Waters may also be placed on the section 303(d) list for toxicity alone. If the pollutant causing or contributing to the toxicity is identified, the pollutant shall be included on the section 303(d) list as soon as possible (i.e., during the next listing cycle). For water segments where adopted narrative sediment quality objectives apply, development of the Section 303(d) List shall also be in accordance with Section 6.1.3.

Reference conditions may include laboratory controls (using a t-test or other applicable statistical test), the lower confidence interval of the reference envelope, or, for sediments, response less than 90 percent of the minimum significant difference for each specific test organism.

Appropriate reference and control measures must be included in the toxicity testing. Acceptable methods include, but are not limited to, those listed in water quality control plans, the methods used by Surface Water Ambient Monitoring Program (SWAMP), the Southern California Bight Projects of the Southern California Coastal Water Research Project, American Society for Testing and Materials (ASTM), USEPA, the Regional Monitoring Program of the San Francisco Estuary Institute, and the Bay Protection and Toxic Cleanup Program (BPTCP).

Association of pollutant concentrations with toxic or other biological effects should be determined by any one of the following, unless other guidelines apply:

A. Sediment quality guidelines (satisfying the requirements of section 6.1.3) are exceeded using the binomial distribution as described in section 3.1. In addition, using rank correlation, the observed effects are correlated with measurements of chemical concentration in sediments. If these conditions are met, the pollutant shall be identified as “sediment pollutant(s).

B. For sediments, an evaluation of equilibrium partitioning or other type of toxicological response that identifies the pollutant that may cause the observed impact. Comparison to reference conditions within a watershed or ecoregion may be used to establish sediment impacts.

C. Development of an evaluation (such as a toxicity identification evaluation) that identifies the pollutant that contributes to or caused the observed impact."

Section 6 of the State Listing Policy addresses Implementation of the Policy.
Section 6.1.3, Evaluation Guideline Selection Process, shows the following additional guidelines, which are supplemental to Section 3:

"Narrative water quality objectives shall be evaluated using evaluation guidelines. When evaluating narrative water quality objectives or beneficial use protection, the Regional Water Boards and the State Water Board shall identify evaluation guidelines that represent standards attainment or beneficial use protection. The guidelines are not water quality objectives and shall only be used for the purpose of developing the section 303(d) list.

To select an evaluation guideline, the Regional Water Board or the State Water Board shall:

- *Identify the water body, pollutants, and beneficial uses;*
- *Identify the narrative water quality objectives or applicable water quality criteria;*
- *Identify the appropriate interpretive evaluation guideline that potentially represents water quality objective attainment or protection of beneficial uses. If this Policy requires evaluation values to be used as one line of evidence, the evaluation value selected shall be used in concert with the other required line(s) of evidence to support the listing or delisting decision.*
- *Depending on the beneficial use and narrative standard, the following considerations shall be used in the selection of evaluation guidelines:*

    1. *<u>Sediment Quality Guidelines for Marine, Estuarine, and Freshwater Sediments</u>:*
        <u>A.</u> *If sediment quality objectives apply, the Regional Water Boards shall use the methods and procedures that were adopted to interpret the objective and any provisions adopted to develop the section 303(d) list.*

        <u>B.</u> *If no applicable sediment quality objectives apply, or insufficient data exists to interpret sediment quality objectives, the Regional Water Boards may select sediment quality guidelines that have been published in the peer-reviewed literature or by state or federal agencies. Acceptable guidelines include selected values (e.g., effects range-median, probable effects level, probable effects concentration), and other sediment quality guidelines. Only those sediment guidelines that are predictive of sediment toxicity shall be used (i.e., those guidelines that have been shown in published studies to be predictive of sediment toxicity in 50 percent or more of the samples analyzed).*

    2. *<u>Evaluation Guidelines for Protection from the Consumption of Fish and Shellfish</u>: The Regional Water Boards may select evaluation guidelines published by USEPA*

or OEHHA. Maximum Tissue Residue Levels (MTRLs) and Elevated Data Levels (EDLs) shall not be used to evaluate fish or shellfish tissue data.

3. *Evaluation Guidelines for Protection of Aquatic Life from Bioaccumulation of Toxic Substances: The Regional Water Boards may select the evaluation values for the protection of aquatic life published by the National Academy of Science…*

The Regional Water Boards shall assess the appropriateness of the guideline in the hydrographic unit. Justification for the alternate evaluation guidelines shall be referenced in the water body fact sheet."

The above citations show that individual Regional Water Boards may use best professional judgement in choosing the sediment and tissue criteria for evaluation and listing purposes. The water quality objectives, sediment guidelines, and fish/mussel tissue screening values used to evaluate data for Santa Ana Water Board staff's Metals Impairment Assessment are summarized below and shown in Table 4-3.

4.2.1.1 Water data

For this Metals Impairment Assessment, exceedances of the CTR saltwater criteria (acute & chronic) were evaluated for dissolved metals, including Cu, Zn, Cd, Cr, Ni, Pb, Hg, As, Ag (Table 4-3), to determine impairment based on the Listing Policy. These are the same metals that were evaluated in the Newport Bay Toxics TMDLs (USEPA 2002).

4.2.1.2 Sediment data

The State Listing Policy requires the regional water boards to use the methods and procedures that were adopted to interpret applicable sediment quality objectives. The State Water Board's Sediment Quality Objectives (SQOs; Sediment Quality Provisions; see 4.1.3, above) requires three lines of evidence –sediment chemistry, sediment toxicity and benthic community assessment, and requires the analyses of paired samples for both metals and organics in the sediment chemistry analysis. The Sediment Quality Provisions integrate chemical and biological measures to determine if the sediment-dependent biota are protected or degraded as a result of exposure to toxic pollutants in sediment in order to protect benthic communities in enclosed bays and estuaries, human health, wildlife, and resident finfish.

Since these TMDLs address only Cu (and the Impairment Assessment addresses only metals), and there are no corresponding organic data or benthic community analyses for each site, it was not possible to assess sediments by the SQO methodology. As provided in the State Listing Policy, if insufficient data exist to evaluate data by the SQOs methodology, a regional water board may base its sediment assessment on sediment quality guidelines published in the peer-reviewed literature or by state or federal agencies. The regional water boards have used ERMs (Effects Range Median) and ERLs (Effects Range Low) in marine waters to determine sediment contamination by metals and other pollutants (Long et al 1998, NOAA SQuiRTS 1999, 2008). Exceedances of the ERMs along with sediment toxicity in paired samples, are currently used to list marine areas with impaired sediments. (For saltwater sediments, ERMs and ERLs were constructed by the National Oceanic Atmospheric Administration (NOAA), which examined biological effects and chemistry from bioassay results and field data (Long et al 1998)). ERM values represent the 50th percentile of the ranked data and the point above which adverse effects are expected, while ERL values represent the 10th percentile and the point below which adverse biological effects are not expected to occur.)

While ERMs indicate probable impairment and are used along with sediment toxicity in paired samples to list a waterbody, ERLs indicate low probability of impairment and are more protective of benthic organisms. ERLs have been used as conservative numeric targets for TMDLs by other regional water boards.

For this Metals Impairment Assessment, exceedances of the ERM (Effects Range Median) sediment guidelines for metals along with sediment toxicity were evaluated to determine impairment, based on the State Listing Policy, since both ERM exceedances and sediment toxicity are required to consider a waterbody as impaired. Metals assessed include Cu, Zn, Cd, Cr, Ni, Pb, Hg, As, Ag (Table 4-3). These are the same metals that were evaluated in the Newport Bay technical Toxics TMDLs (USEPA 2000). Exceedances of the ERL (Effects Range Low) sediment guidelines for metals were also evaluated to determine the metals that should continue to be monitored since ERLs are commonly used as conservative numeric targets in metals TMDLs.

4.2.1.3 Toxicity data

For this metals assessment, toxicity data were used in addition to metal exceedances of the ERM sediment guidelines to determine impairment based on the State Listing Policy.

4.2.1.4 Fish/Mussel Tissue data

For this metals assessment, exceedances of the human health guidelines (OEHHA, USEPA) and the wildlife guidelines (U.S Fish & Wildlife Service (USFWS)) were evaluated to determine impairment based on the State Listing Policy (Table 4-3). Median International Standards (MIS, Nauen 1983) for fish tissue for human health are also shown in Table 4-3 and were only used if no other human health criteria were available. Fish tissue criteria for human health from the Toxics TMDLs (USEPA 2002) are also shown in Table 4-3 but were not used unless they were verified. Criteria that were used for this analysis are highlighted in Table 4-3.

Fish tissue data for arsenic, mercury, cadmium, chromium, copper, lead and zinc are discussed below.

Arsenic

Arsenic speciation. Arsenic (As) exists in the environment and in fish tissue as several different chemical species. Inorganic As species, AsIII (arsenite) or AsV (arsenate), are the more toxic forms of As and the fraction of inorganic As ranges from <1 to 20% of the total arsenic in fish tissue (USEPA 2000a). Most As in fish tissue occurs as organic species (mostly as arsenobetaine) which are inert and nontoxic. While the preferred measurement for As in fish tissue is the measurement of inorganic As, as recommended by USEPA, it is an expensive analysis; therefore, most studies measure total As in fish tissue and estimate inorganic As from the total As concentration. USEPA states that approximately 85-90% of arsenic in fish tissue is organic, and the rest is inorganic (USEPA 2003b). The literature shows that inorganic As in fish and shellfish tissue is generally lower than the 10% described above: < 4% by Donahue and Abernathy 1999; <3% by Vazquez 2005; 1.2% by Greene et al 2011a, Greene 2011; 1% by Creed 2011 and Peshut et al 2007. This assessment used 10% of the total As to represent the inorganic As fraction, as a conservative value, which is similar to the As analysis conducted in the Toxics TMDL (USEPA 2002).

Arsenic (As) guidelines. In addition to speciation issues, there are several recommended guidelines for As in fish tissue. For human health, several guidelines exist for total As; however, total As guidelines will not be used in this assessment since inorganic As has been shown to be the toxic form of As (USEPA 2000a). Consumption guidelines for inorganic As in fish tissue for human health have been outlined by USEPA including a noncarcinogen guideline of 1.2 µg/g wet weight (ww) and a carcinogen guideline of 0.026 µg/g ww (wet weight) (USEPA 2000a). While USEPA used the 1.2 µg/g ww guideline for inorganic As in the Toxics TMDL, there was insufficient explanation as to why the carcinogen guideline was not used to assess As impairment. Later studies, such as the National Lakes Study (USEPA 2009), used an even lower inorganic As carcinogen guideline (0.016µg/g ww) to assess fish tissue data for human health. This assessment evaluated inorganic As with both the 1.2 and the 0.026 µg/g ww guidelines to assess human health impacts.

For wildlife, there is no consensus on whether the fish tissue guideline should be for inorganic or total As since there is not enough data to show that organic As species are nontoxic to wildlife (pers. communication K. Zeeman, PhD, USFWS). The fish tissue guideline shown in the Toxics TMDLs is 0.25 µg/g ww; however, this value could not be verified in the reference document. Stanley et al (1994) showed sublethal effects in mallards exposed to 100µg/g dw (25 µg/g ww). This assessment evaluated total As in fish tissue for wildlife with the 25 µg/g ww guidelines since Stanley et al's study evaluates total As effects on a waterfowl species. (Estimates from K. Zeeman suggest using a fish tissue guideline for wildlife consumption of 3 to 6 µg/g ww for total As; however, this value range is based on risk assessment methodology and is unpublished).

Mercury
For mercury (Hg), the organic form, methylmercury (methyl Hg), is more toxic than inorganic Hg. However, since the analysis of methylmercury is expensive, USEPA recommends measuring total mercury in fish tissue and using a conservative assumption that all mercury is equal to methylmercury to be protective of human health (USEPA 2000a). The USEPA fish tissue guideline for methylmercury is 0.3 µg/g ww (USEPA 2002, Toxics TMDLs); however, OEHHA has recommended a somewhat lower fish tissue guideline of 220ng/g ww. To be protective, this assessment will use the OEHHA guideline of 220 ng/g ww as a human health guideline for methyl Hg.

Since Hg is commonly analyzed as total Hg, the San Francisco Bay Hg TMDL states numeric targets for total Hg based on USEPA's methyl Hg guideline (Johnson and Looker 2004). The human health guideline for total Hg is 200 ng/g ww. This assessment used the human health guideline in the SF TMDL for total Hg in fish tissue, and the OEHHA guideline of 220 ng/g ww for methyl Hg in fish tissue.

For wildlife, the fish tissue guideline for methyl Hg of 30ng/g ww should be protective of the California least tern, an endangered bird species found in Newport Bay (Russell 2003). The number for the California least tern is for small fish (<5 cm). In addition, Russell gives a methyl Hg guideline of 55ng/g ww for the protection of the sea otter. This number was used to assess larger fish (>5 cm). Both guidelines were used in this assessment based on fish size.
The fish tissue guideline for total Hg is 30 ng/g ww (Johnson and Looker 2004). This assessment also used the total Hg wildlife guideline for total Hg fish tissue data.

Cadmium
For Cadmium (Cd), there are several recommended fish tissue guidelines for human health including 1.0, 3.0 and 4.0 µg/g ww (Yeardley et al 1998, OEHHA 1999, USDI 1998, respectively). To be conservative, this assessment used the 1.0 µg/g ww guideline by Yeardley et al.
For wildlife, Eisler (1985) recommends a not to exceed fish tissue guideline of 0.1 µg/g ww. This assessment used this value to evaluate fish tissue for wildlife.

Chromium
For Chromium (Cr), the Toxics TMDLs used a fish tissue guideline for human health of 1.0 µg/g ww (MIS value). This assessment used this value to determine impairment for human health.
For wildlife, the fish tissue guideline in the Toxics TMDLs is 0.2 µg/g ww, a fish tissue target used in the Rhine Channel (USEPA 2002, Table 7-1); however, the reference for this value could not be located. Eisler (1986) recommends a not to exceed fish tissue guideline of 10 µg/g dw (2.5 µg/g

ww) for Cr^{3+}. This assessment used the value of 2.5 µg/g ww to evaluate fish tissue for wildlife since there was no value for total Cr, and the lower value in the Toxics TMDLs could not be verified.

Copper
For Copper (Cu), there are currently no fish tissue guidelines for human health by USEPA or OEHHA; however, there are MIS guidelines from Australia, New Zealand, and Zambia (Nauen 1983). This assessment used fish tissue guidelines from Australia (10 and 70 µg/g ww for fish and mussels). For wildlife, the fish tissue guideline in the Toxics TMDLs is 15 µg/g ww; however, this guideline could not be verified in the reference document. Puls (1988) recommends a not to exceed guideline of 200 µg/g dw (50 µg/g ww) based on his study with waterfowl. This assessment used the guideline of 50 µg/g ww to evaluate fish tissue for wildlife since the lower guideline could not be verified.

Lead and Zinc
For Lead (Pb) and Zinc, the human health guidelines in the Toxics TMDLs (2.0, 45 fish/70 mussels µg/g ww could not be verified in the MIS fish tissue guidelines; however, there are MIS guidelines from a number of countries (Table 4-3 and Nauen 1983). This assessment used the guidelines of 1.5 and 2.5 µg/g ww for Pb in fish and shellfish, respectively, for human health, since these values were closest to the Toxics TMDLs guidelines. This assessment used the guideline of 40 µg/g ww for Zn.

Fish tissue guidelines for wildlife also include Nickel (Ni) 50 µg/g ww (200 µg/g dw), Lead (Pb) 10 µg/g ww, Silver (Ag) 50 µg/g ww (200 µg/g dw) and Zinc 45 µg/g ww (178µg/g dw) (Eisler 1998, 1988, 1996, 1993, respectively). This assessment used the above values to evaluate fish tissue for wildlife.

A summary table below shows the water quality criteria, and sediment and tissue guidelines used for this assessment (Table 4-3). Numerous tissue guidelines were found for human health and wildlife; however, not all the guidelines were used in this assessment. The guidelines used in this assessment are highlighted in Table 4-3. Data collected after 2002 (after USEPA established the Toxics TMDLs for Newport Bay) were evaluated using the following criteria/guidelines and the State Listing Policy methodology to determine whether waters, sediments and/or fish and mussel tissue showed impairment. The data assessment and studies evaluated are described in Section 4.2.2.

Table 4-3 Numeric Criteria/Guidelines for Metals in Saltwater, Sediment, Tissue

	Dissolved Metals Saltwater criteria[1] (µg/L)		Sediment quality guidelines (saltwater)[2] (µg/g)			Tissue guidelines* (µg/g ww)		
	Acute	**Chronic**	**ERL**	**ERM**		**Human health (µg/g ww) OEHHA[3,4] USEPA[5,6,7]**	**Human health (µg/g ww) MIS[9]**	**Wildlife (µg/g ww) DOI/FWS[10] HgTMDL[11] FWS[12]**
Arsenic (As)	69	36	8.2	70		1.0[3], 0.7[8]	1.4SF[9HK] 3.5FF,5.0F[9Z]	25[14]
Inorganic Arsenic[6,7] (As[i])						1.2[5,7] 0.026[5,7] 0.016[7]	1.0,1.5[9A] 3.5FF[9CA]	
Cadmium (Cd)	42	9.3	1.2	9.6		4.0[10], 3.0[3], 1.0[8]	0.2F,2.0M[9A] 0.5FF[9G] 2.0FSF[9HK]	0.1[13]
Chromium –total (Cr)	1100	50	81	370			1.0FSF[9HK]	2.5[13]
Copper (Cu)	4.8	3.1	34	270			10F[9A], 70/30M[9A] 30F[9NZ] 100F[9Z]	50[15]
Mercury (Hg)		51ng/L[1a]	0.15	0.71		200ng/g[11]		
Methyl Mercury (meHg)						300 (288) ng/g[5] 220ng/g[4]		30ng/g[12] 55ng/g[12]*
Nickel (Ni)	74	8.2	20.9	51.6				50[13]
Lead (Pb)	210	8.1	46.7	218			1.5F,2.5SF[9A] 0.5FF[9CA] 0.5FF[9G] 0.5FSF[9NE] 0.5F[9PH] 1.0F[9SW] 0.5FF, 10F[9Z]	10[13]*
Silver (Ag)	1.9	None	1.0	3.7				50[13]
Zinc (Zn)	90	81	150	410			150F[9A], 1000O[9A] 40F[9NZ] 100F[9Z]	45[13]

*Various tissue guidelines were found for human health and wildlife –the highlighted numbers are the values used in this assessment – light gray for HH, darker gray for WL (wildlife)
F=fish, SF=shellfish, M=mussels
[1] All dissolved metals saltwater criteria are from the California Toxics Rule (CTR) (USEPA 2000)
[1a]Dissolved mercury (Hg) saltwater criteria have units of ng/L, and are for the protection of human health (CTR) (USEPA 2000)
[2]Sediment guidelines are from Long et al 1998 (also in NOAA SQuiRTS 1999, 2008) (ERM =effects range median, ERL =effects range low)
[3]OEHHA tissue guidelines 1999
[4]OEHHA tissue guidelines, Klasing & Brodberg 2008, guideline for methyl Hg is 220ng/g
[5]USEPA 2000a Fish consumption guidance Volume 1 (Table 5-3)
Recommended guidelines for Cd (4.0µg/g) and methyl Hg (0.3µg/g) are higher than OEHHA guidelines and were not used for this analysis.
(USEPA methyl Hg guideline is also in USEPA 2001 Water quality criteria for the protection of human health: methyl mercury. EPA-832-R-01-001. January 2002. U.S.EPA, Office of Water, Washington, D.C. http://water.epa.gov/scitech/swguidance/standards/criteria/health/methylmercury.cfm
[6] Note that according to USEPA, inorganic arsenic (As) is the most toxic form of As and ranges from <1 to 20% of the total As in fish tissue, while most As found in fish tissue is in the organic form (arsenobetaine), which is nontoxic (USEPA 2000a). (Another USEPA paper states that there is a consensus in the literature that 85 to 90% of As found in the edible portions of marine fish and shellfish is in an organic form, and approximately 10% of As is inorganic (USEPA 2003).) USEPA recommends that inorganic As, rather than total As, be measured in fish tissue. Since much of the As analyses for fish tissue measures total As rather than inorganic As, however, USFDA recommended measuring total As in fish tissue and estimating inorganic As as approximately 10% of the total As (USFDA, 1993). The data for this assessment included only total As; therefore, 10% of the total As was used to represent the inorganic fraction which is similar to this analysis in the Toxics TMDLs.
[7]In the Newport Bay Toxics TMDL (2002), USEPA used a fish tissue guideline for inorganic As of 1.2µg/g wet weight (ww) for recreational fishermen; however, the USEPA Guidance for Fish Advisories for human health includes a noncarcinogen guideline of 1.2 µg/g ww and a carcinogen guideline of 0.026 µg/g ww (USEPA 2000a). This assessment evaluates inorganic As for human health using both the 0.026 and 1.2 µg/g guidelines in fish tissue.
[8] Yeardley et al, 1998 (used formula from USEPA 1997)
[9] Median International Standards (MIS), Nauen 1983 (F=fish, FF=fish filets, SF =shellfish, M=mussels, O=oysters); A =Australia, 9CA =Canada, 9G =Germany, 9HK =HongKong, 9NZ =NewZealand 9NE =Netherlands, 9PH =Phillipines, 9SW =Sweden, 9Z =Zambia; German criteria is for freshwater fish filets
[10] DOI/FWS =US Department of the Interior Biological Effects Guidelines (NIWQP) 1998
[11] Johnson and Looker. Mercury in San Francisco Bay. Basin plan amendment and staff report (2004)
[12]Methyl Hg value from Russell 2003 (USFWS); this screening value is also used in the Newport Bay Toxics TMDL (Table 7-1 (USEPA 2002). The 30ng/g value should be protective of the California least tern (Russell 2003). The California least tern is an endangered species found in Newport Bay.
This Hg value was used for smaller fish (average of 5cm).
[12a]Methyl Hg value from Russell 2003 (USFWS) for larger fish (>100cm) for the protection of the southern sea otter.
[13]Eisler 1985 for Cd; Eisler 1986 for Cr; Eisler 1993 for Zn; Eisler 1996 for Ag; Eisler 1998 for Ni –for Cr, Zn, Ag, Ni, wet wt. conversion from dry wt. screening values (assumes fish contain 75% moisture)
Cr value is for Cr3+, no value could be found for total Cr
[13a]Eisler 1988 for Pb –value is for reproduction impairment not a no effects level
[14]Stanley 1994 for As –wet wt. conversion from dry wt. screening value (assumes fish contain 75% moisture)
[15]Puls 1988 for Cu, effects level –wet wt. conversion from dry wt. screening value (assumes fish contain 75% moisture)

4.2.2 DATA ANALYSIS Metals targeted in the Toxics TMDLs (USEPA 2002) include Cd, Cu, Pb and Zn in the Upper Bay; Cu, Pb and Zn in the Lower Bay; and Cd, Cu, Pb and Zn for San Diego Creek (Table 1).
In the 2008-2010 303(d) List, Cu and sediment toxicity are listed for both the Upper and Lower Bay, and no metals are listed for San Diego Creek.

In the 2014-16 303(d) List, both Upper and Lower Newport Bay were determined to be DO NOT DELIST for copper and toxicity, and the general category of "Metals" was finally DELISTED for the Upper Bay (Table 3-1, 3-4).
Since Cu continues to exceed the CTR criterion in both Upper and Lower Newport Bay and these water bodies are 303(d) listed, Cu TMDLs are required to address these exceedances.

Since the USEPA Toxics TMDLs were established in 2002, additional data have been collected and analyzed, and the 303(d) List was revised in 2006, 2010, and 2014-16. This Metals Impairment Assessment evaluated data used for the 2006 and 2010 assessments (data after the USEPA Toxics TMDLs were established in 2002) (Table 4-4). These data are also summarized in the sections below. The two largest data sets, the Cu-Metals Marina Study and County of Orange (OC) monitoring data are presented first, followed by discussions of the other studies listed in Table 4-4.

Table 4-4 Data Reviewed in this Assessment

Study/monitoring	***Water data***	***Sediment data***	***Sediment toxicity***	***Fish/Mussel tissue***
4.2.2.1 Copper Metals Marina Study (OC Coastkeeper & L.M. Candelaria 2007)	X	X	X	
4.2.2.2 County of Orange stormwater monitoring data (2006-09)	X	X	X	
4.2.2.3 Copper Reduction in Lower Newport Bay study (319(h) grant) (OC Coastkeeper & L.M. Candelaria 2013)	X			
4.2.2.4 Sediment Evaluation for Lower Newport Bay Dredging study (New Fields 2009)		X		
4.2.2.5 Food Web Study in Fish (Allen *et al* 2008)		X		X
4.2.2.6 Dept. of Fish & Game (DFG) monitoring data (Frueh & Ichikawa 2007)		X		X
4.2.2.7 Bioaccumulation Fish Tissue study (Allen *et al* 2004)				X
4.2.2.8 Newport Bay Sediment Toxicity study (Bay *et al* 2004)	X	X	X	
4.2.2.9 Newport Bay and San Diego Creek -Chemistry study (Bay & Greenstein 2003)	X	X	X	
4.2.2.10 Metals Sediment Study in Lower Newport Bay (Post-dredging) (OC Coastkeeper & L.M. Candelaria 2014)	Bottom water	X	X	

X = data collected
ND = no data at this time (data will be available at a later date)

4.2.2.1 Copper-Metals Marina study and 4.2.2.2 County of Orange (OC) stormwater monitoring data (OC Coastkeeper and L.M. Candelaria 2007; OC Stormwater data 2006-09, 2009-11)

For studies after 2002, the two largest data sets in Newport Bay are from the Cu-Metals Marina Study (OC Coastkeeper 2007), available at http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/docs/newport/finalcufinal_report.pdf) and OC monitoring data (OC Stormwater data 2006-09, 2009-11). They are summarized together in Table 4-5, and discussed below. Additional details of these two studies are shown in Appendix 4. Additional studies with smaller data sets were also analyzed and are discussed individually below. The Bay Protection and Toxics Cleanup Study, an older but important study, (Phillips 1998) is summarized in Appendix 5.

For both the Marina study and OC monitoring, USEPA priority metals were analyzed including Cu, Zn, Cd, Cr, Ni, Pb, Hg, As, Ag). These metals are normally the metals of highest concern since they are the most common metals and may be toxic at elevated concentrations.

Results
Metals that exceeded the CTR saltwater criteria and/or the ERM/ERL sediment guidelines are discussed below and shown in Table 4.5 OC monitoring data for 2009-11 was analyzed separately to show a more recent data set in comparison to 2006-09.
Water Of the metals analyzed, only Cu exceeded the dissolved CTR saltwater criteria in water samples in all sets of data (Marina study, OC data). Dissolved Cu exceeded the acute or chronic CTR saltwater criteria in 13/27 and 53/78 samples in the Upper and Lower Bay, respectively (Marina study), in 5/88 and 7/44 samples in the Upper and Lower Bay, respectively (OC data 2006-09), and in 48/68 and 22/34 samples in the Upper and Lower Bay, respectively (OC data 2009-11). Note that the percent exceedances were higher for the Marina study data and OC data 2009-11)
Sediment In sediments, Cu, Zn and Hg exceeded the ERM sediment guidelines in the Lower Bay (16/78, 12/78, 24/78 samples, respectively), and the highest exceedances were found in the Turning Basin area of the Lower Bay (14/48, 12/48, 22/48 samples, respectively) (Marina study). Sediment Ag exceeded the ERM guideline in only one sample in the Turning Basin (Marina study). In the OC monitoring data, there were 2/11 exceedances of the Hg ERM in the Turning Basin area in 2006-09, and 1/8 exceedance in 2009-11.
(Note that the number of dissolved Cu exceedances and sediment metal exceedances are higher in the Marina study compared to OC monitoring data of 2006-09; this is likely due to inclusion of marina sites in the Marina study compared to OC monitoring sites which do not include marinas.)
In addition, many metals exceeded the ERL sediment guidelines including Cu, Zn, Cd, Ni, Pb, Hg, As and Ag in all data sets. (The ERL sediment guidelines are generally used as targets in sediments in metals TMDLsin California.)
Sediment toxicity Sediment toxicity was also found at most sites (12/14) tested in the Marina study, and in 22/60 sites tested in OC monitoring data (2006-09). Sediment toxicity was determined with *Eohaustorius estuarius* in both data studies. It is interesting to note that in the Marina study, the relative proportion of toxic sites was only slightly higher in the Upper vs Lower Bay (6/6, 6/8, respectively); while in OC monitoring, the proportion of toxic sites in the Upper Bay was almost double that of the Lower Bay (16/38 6/22, respectively). This is likely due to the higher number of and wider distribution of sites sampled in the Upper Bay for OC monitoring compared to the limited number of Upper Bay sites sampled in the Marina study. In addition, the Marina study showed a higher percent of toxic sites compared to OC sites. This is likely due to the testing within marinas in the Marina study. Further details on the Marina study and OC monitoring data are provided in Appendix 4.

Turning Basin area of Lower Newport Bay. The Turning Basin area exceeded the dissolved Cu CTR saltwater criteria in all data sets. In addition, the Turning Basin area exceeded both the ERM sediment guidelines for Cu, Hg, and Zn in the Marina study, and demonstrated sediment toxicity in Marina study and OC monitoring samples. Because of the ERM exceedances and the sediment toxicity, the Turning Basin area in particular needs future action including continued monitoring. The City of Newport Beach has been dredging parts of Lower Newport Bay in 2012; however, these dredge sites did not include the Turning Basin area.

Marinas. It is also evident from the data that marinas in Newport Bay generally have both higher concentrations of dissolved Cu and higher sediment concentrations of metals compared to the main channels of the Bay (Marina Study). Marinas also need future actions and need to be monitored as part of the routine monitoring by OC.

Impairment shown in this study: Copper (Cu) in water in the Upper and Lower Bay, Sediment toxicity
Monitoring of sediments should continue due to ERM exceedances of Cu, Zinc (Zn), Mercury (Hg) in the Lower Bay

***Water** The data above demonstrate that both Upper and Lower Newport Bay waters are still impaired for Cu. Bay waters tested exceed the dissolved Cu CTR saltwater criteria. Bay waters tested include marina waters within the Bay (Marina study).
Sediment Sediments exceeded the ERM sediment guidelines, and the majority of sediments analyzed were positive for sediment toxicity. The Turning Basin area showed the highest exceedances in Lower Newport Bay* and the presence of sediment toxicity; therefore, the Turning Basin area in particular needs continued monitoring and evaluation.
Sediment toxicity Sediment toxicity is present in both the Upper and Lower Bay at a majority of the sites tested.
**Rhine Channel data were not evaluated for these studies since 1) no Rhine Channel data were collected in the Cu-Metals Marina Study, and 2) Rhine Channel monitoring data collected by the County prior to dredging in 2011 are not valid to determine impairment.*

Table 4-5 Summary of Cu-Metals Marina study and County of Orange (OC) monitoring data in Newport Bay

Water data -Exceedances of acute and/or chronic CTR saltwater criteria						
	Marina Study (2006-07)			**OC monitoring data (2006-09, 2009-11)**		
Metal**	**Upper Bay (n=27)**	**Lower Bay (n=78)**	**Turning Basin^ (n=48)**	**Upper Bay (n=88, 68)**	**Lower Bay (n=44, 34)**	**CTR criteria (acute, chronic) (µg/L)**
***Cu**	13	53	43	5, 48	7, 22	(4.8, 3.1)
***Zn**	0	0	0	0, 0	0, 0	(90, 81)
Hg	0	0	0	0, 0	0, 0	(1.8, 0.94)
***Cd**	0	0	0	0, 0	0, 0	(42, 9.3)
***Pb**	0	0	0	0, 0	0, 0	(210, 8.1)
Ni	0	0	0	0, 0	0, 0	(74, 8.2)
Ag	0	0	0	0, 0	0, 0	(1.9, -)
As	0	0	0	0, 0	0, 0	(69, 36)
+Cr	0	0	0	0, 0	0, 0	(1100, 50)
Water Toxicity[1]	0/2	0/8	0/6			

Sediment data –Exceedances of ERM (ERL) sediment quality guidelines							
	Marina Study (2006-07)[2]			**OC monitoring data (2006-09, 2009-11)**			
Metal**	**Upper Bay (n=27)**	**Lower Bay (n=78)**	***Turning Basin^ (n=48)***	**Upper Bay (n=45,28)**	**Lower Bay (n=28,16)**	***Turning Basin^ (n=13,8)***	**Sediment ERM (ERL)[3] (ug/g)**
***Cu**	0 (25)	16 (60)	*14 (33)*	(19, 12)	(24, 12)	*(13, 8)*	270 (34)
***Zn**	0 (19)	12 (58)	*12 (34)*	(9, 11)	(16, 7)	*(13, 4)*	410 (150)
Hg	0 (1)	24 (31)	*22 (17)*	(0/43)# (1/28)	2 (12/25)# 1 (9/16)	*2 (11/11)# 1 (7/8)*	0.71 (0.15)
***Cd**	0 (16)	0 (26)	*0 (15)*	(10, 9)	(4, 1)	*(1, 0)*	9.6 (1.2)
***Pb**	none	0 (24)	*0 (24)*	(0, 0)	(7, 1)	*(7, 1)*	218 (46.7)
Ni	0 (16)	0 (62)	*0 (40)*	(8, 6)	(13, 5)	*(13, 4)*	51.6 (20.9)
Ag	none	1 (2)	*1 (2)*	(1, 0)	(1, 0)	*(1, 0)*	3.7 (1.0)
As	0 (10)	0 (63)	*0 (43)*	(9, 9)	(14, 6)	*(13, 4)*	70 (8.2)
+Cr	0 (0)	0 (0)	*0 (0)*	(0, 0)	(0, 0)	*(0, 0)*	370 (81)
Sediment Toxicity[4]	6/6	6/8	*5/6*	16/38	6/22	*2/11*	
SWI[5]	0/2	3/8	*3/6*				
PW[6]	2/8	4/12	*3/8*				

n =number of samples for water or sediment analyses; number of samples for toxicity is shown in toxicity data cells, # n for Hg is different from other metals for OC data 2006-09

* Metals requiring TMDLs in the Newport Bay Toxics TMDLs (USEPA 2002)

**USEPA priority metals were analyzed including Cu, Zn, Cd, Cr, Ni, Pb, Hg, As, Ag

+ Cr was included in this table to demonstrate low water and sediment concentrations (even though fish tissue concentrations exceed guidelines –see Section 4.2.2.4)

^Turning Basin is part of the western Lower Bay; numbers are a subset of Lower Bay totals

1 Water toxicity determined using mussel embryo development test

2 In Marina study, most metals analyzed exceeded ERL sediment guidelines (see Section 4.2.2.1)

3 Sediment guidelines from Long et al 1998

4 Sediment toxicity was determined using *Eohaustorius estuarius*

5 SWI = sediment-water interface toxicity, determined using mussel embryo development

[6] PW =pore water toxicity, determined using mussel embryo development

4.2.2.3 Copper (Cu) Reduction in Lower Newport Bay (CWA 319(h) grant) January 2009 – March 2013 (OC Coastkeeper and L.M.Candelaria 2013)
The goal of this grant was to decrease the number of boats using Cu antifouling paints (Cu AFPs) in a target marina (Balboa Yacht Basin) by 50% and in the Lower Bay by 10%. In addition, dissolved Cu, and other metals, were monitored in the target marina and reference areas during the study. This three-year 319(h) grant was awarded to OC Coastkeeper in late 2008 and executed in January 2009. The grant work consisted of several major tasks: 1) conduct boater education, especially in the target marina; 2) provide an incentive program for the conversion of boats from Cu to non-biocide AFPs; 3) conduct water quality monitoring; and 4) promote the passage of a city resolution to promote the use of Cu-free AFPs.

Education Coastkeeper developed and conducted an education program in the target marina and baywide to educate boaters on why Cu is a problem in the Bay, and the viability of using alternative non-biocide AFPs. Boater education included the creation of educational materials on the toxicity of Cu to aquatic organisms and a list of alternative non-biocide boat paints. Coastkeeper also conducted dock walking events to contact boaters individually. This task also included working with boatyards to educate them and coordinate with them on the availability, application, and economics of non-biocide AFPs, so that non-biocide paints would be available to boaters.
Boat conversions Balboa Yacht Basin (BYB) was chosen as the target marina for a 50% conversion of boats from Cu to non-biocide AFPs. A 10% conversion of boats from Cu to non-biocide application was anticipated Baywide. A database was kept on boat conversions to non-biocide and Cu-free AFPs (OC Coastkeeper 2013).
Monitoring The target marina and several control sites were monitored throughout the project (Appendix 4, Figure 4-3). Water samples were collected and analyzed to determine potential changes in dissolved Cu concentrations. Monitoring occurred in summer and winter during dry weather so that storm drain runoff did not increase Cu concentrations.
City resolution Coastkeeper and Santa Ana Water Board staff also worked with the City of Newport Beach to pass a resolution promoting the use of nontoxic, Cu-free AFPs.

Results
Education Coastkeeper successfully developed a boater education program and education materials, and worked with the City of Newport Beach, boat owners, boatyard owners, paint manufacturers and divers to educate boaters and to convert boats from Cu to non-biocide AFPs. Coastkeeper conducted meetings with boat owners, and dock visits for one-on-one boater contact. Coastkeeper worked with boatyards to provide nontoxic, Cu-free AFPs or coatings to boaters. In addition, Coastkeeper continues to work with project partners from the Port of San Diego boat paint study to obtain current information on newly developed non-biocide AFPs.
Boat Conversions Coastkeeper worked with individual boaters and Newport boatyards to accomplish the conversion of boats from Cu to non-biocide AFPs with limited success. Ten (10) boats were converted from Cu to non-biocide AFPs or coatings during this project. Note that only three boats were converted in the first two years of the project due to non-cooperation of the boatyards; while seven boats were converted in the last six months of the project when Balboa Shipyard began supporting this project. This demonstrates that support from the boatyards is critical to the success of the conversion from Cu to non-biocide AFPs or coatings in Newport Bay. In addition, Coastkeeper worked with Dr. Katy Wolf, Institute for Research and Technical Assistance (IRTA), who worked with paint manufacturers to develop non-biocide AFPs that could be applied over old Cu AFPs and/or rolled on rather than sprayed on. These changes in application requirements of non-biocide AFPs or coatings reduced the cost of converting to nontoxics.

Water Monitoring Dissolved and total metal concentrations were monitored twice near the beginning of this project (October 2010, January 2011) and twice near the end (August 2012, January 2013) to determine if a relationship existed between number of boats converting to non-biocide or Cu-free AFPs and dissolved Cu concentrations. Since only ten boats were converted during this project, a relationship between boat conversions and dissolved Cu could not be determined, and Cu concentrations did not significantly decrease in the target marina during this project period. With respect to exceedances of water quality criterion, dissolved Cu concentrations exceeded the chronic and acute CTR saltwater criteria in all four marina stations in the target marina (BYB) in 15/16 and 6/16 samples, respectively, and in all three reference marinas in 10/15 and 5/15 samples, respectively. Dissolved Cu concentrations in the channel sites exceeded the CTR criterion much less than marina sites. The BYB channel site exceeded the dissolved Cu criterion in 1/4 samples; and there were no exceedances of the Cu criterion in 4 samples in the main channel sites. These data are further evidence that marinas consistently exceed the dissolved Cu criterion and are elevated in Cu with respect to channel sites, and this elevated Cu is due to the boats permanently docked at these marinas.

City Resolution Coastkeeper gave several presentations to the Coastal Bay Water Quality Committee and the City Council of Newport Beach. In June 2010, the City Council passed a resolution (Resolution No. 2010-53) promoting the discontinuation of Cu boat bottom paints and the use of nontoxic, Cu-free boat paints. Santa Ana Water Board staff sent a letter to the City of Newport Beach supporting the passage of this resolution. Coastkeeper continues to work with City staff to address the issue of Cu boat paints.

4.2.2.4 Sediment Evaluation for Lower Newport Bay Dredging (NewFields 2009)
Lower Newport Bay was analyzed in a pre-dredging study.

Results
Water No water samples were analyzed.
Sediment Sediment core samples were collected from 13 sites, homogenized and analyzed for multiple metals. Only Hg exceeded ERM sediment guidelines; Hg and other metals (Cu, Cd, Ni, As) exceeded ERL sediment guidelines (Tables 4-6, 4-7). Hg was also analyzed in multiple sediment samples at each site (Table 4-7). Several sites had multiple exceedances of the Hg ERM sediment guidelines. The highest number of exceedances was in the North and South Lido Isle Channels and the Yacht Anchorage Middle area. A map of sampling sites is in Appendix 4, Figure 4-4. These data demonstrate that Hg contamination in sediments is widespread in Lower Newport Bay and not just limited to the Turning Basin area of Lower Newport Bay.

Potential Impairment shown in this study: Mercury (Hg) in core sediments in the Lower Bay
*__Sediment__ The data demonstrate that sediments exceeded the ERM guidelines for Hg in the Lower Bay; however, these samples were homogenized cores and surface samples were not analyzed. Surface samples should be analyzed from these areas since impairment determination for sediments is based on surface sample data.

Table 4-6 Sediment Metals (except Hg) -Exceedances of ERMs (ERLs)

	Lower Bay - 13 sites
Cu	(12)
Cd	(7)
Hg	2 (11)
Zn	none
Ni	(6)
Pb	none
Ag	none
As	(1)

Table 4-7 Sediment Hg - Exceedances of ERM, (ERL) by site

	n	Hg
Balboa Reach	10	(9)
Harbor Isld Reach	10	(9)
Lido Isle Reach –N	8	5 (3)
Lido Isle Reach –S	7	3 (4)
W Lido Area B	8	2 (6)
Balboa Isld/Collin Isld	9	2 (5)
Balboa Isld Channel	8	2 (5)
Upper Newport Channel	7	1 (2)
Yacht Anchorage –North	5	(4)
Yacht Anchorage –Middle –U	8	(1)
Yacht Anchorage -Middle –L	8	4 (3)
Yacht Anchorage -South –U	7	none
Yacht Anchorage –South-L	7	(3)

n = number of samples

4.2.2.5 Assessment of Food Web Transfer of Organochlorine Compounds and Trace Metals in Fishes in Newport Bay, California (Allen *et al.* 2008)

This purpose of this study was to determine trace metal and organochlorine concentrations in fish tissue and compare to fish tissue guidelines for human health and wildlife; to determine pollutant sediment concentrations and compare them to sediment guidelines; to calculate bioconcentration, bioaccumulation, biomagnification and trophic transfer factors for target fish species; to determine fish species that could be used to assess water quality; and to identify Bay locations in which prey or sediment have elevated concentrations of contaminants of concern.

Multiple fish species were collected in Newport Bay and analyzed for trace metals and organochlorines; sediments were also collected and analyzed for trace metals and organochlorines. Trace metals examined included copper (Cu), zinc (Zn), cadmium (Cd), lead (Pb), arsenic (As), chromium (Cr), nickel (Ni), mercury (Hg) and silver (Ag). Whole fish were analyzed for seven species including topsmelt, California killifish, California halibut, deepbody anchovy, striped mullet, cheekspot goby and shadow goby; while filets were only analyzed for large striped mullet. No fish or sediment samples were collected in the Turning Basin area of the Lower Bay (an area shown in other studies to have elevated sediment concentrations of Cu, Zn and Hg).

Results
Sediment Only mercury (Hg) exceeded the sediment ERM guideline in 1/19 samples (Lower Bay sample). Sediment ERL guidelines were exceeded by copper (Cu), zinc (Zn), mercury (Hg), arsenic (As) and nickel (Ni) in 3/19, 1/19, 2/19, 1/19 and 1/19 sediment samples, respectively (Table 4-8). Mean and maximum sediment concentrations are shown in Table 4-8b. All sediment metal exceedances in the Lower Bay were found in the S. Lido Channel area (southwestern Newport Bay).

Fish/Mussel Tissue
Fish tissue guidelines and exceedances in fish species examined are shown in Table 4-8. Human health guidelines for inorganic arsenic (As), mercury (Hg), cadmium (Cd), copper (Cu), chromium (Cr), lead (Pb) and zinc (Zn) were evaluated only in striped mullet filets. Wildlife guidelines for Cu, Hg, Zn, Pb, As, Cr, Ni and Ag were evaluated in whole fish. Mean and maximum fish tissue concentrations are shown in Table 4-8b.

For human health, two guidelines for inorganic arsenic (As) in fish tissue were evaluated (1.2 and 0.26 µg/g ww). Ten percent (10%) of the total As in fish filets was used to represent inorganic As and evaluated against the guidelines. There were no exceedances of the 1.2 µg/g ww guideline, and 7/7 exceedances of the 0.026 µg/g ww guideline in striped mullet filets. The lower value is a reasonable guideline since USEPA's Lakes Study used an even lower fish tissue guideline for inorganic As of 0.016 µg/g ww. Total As was also compared to a fish tissue guideline for total As of of 1.0 µg/g ww; there were 5/7 exceedances in striped mullet filets. The human health guideline was also exceeded for chromium (Cr) in 7/7 filets. All striped mullets were caught in the Upper Bay.

Wildlife guidelines in whole fish were exceeded for chromium (Cr) and zinc (Zn). The Cr guideline of 2.5 µg/g ww was exceeded in 26/31 and 18/32 fish in the Upper Bay and Lower Bay, respectively. The Zn guideline of 45 µg/g ww was exceeded in 2/31 and 10/32 fish in the Upper Bay and Lower Bay, respectively. Fish tissue Hg may have exceeded the guideline of 30ng/g ww in 3/32 fish in the Lower Bay; however, since the data were rounded to 0.03µg/g it is unclear whether Hg actually exceeded the guideline. Wildlife guidelines in whole fish were not exceeded for Cu, As, Cd, Pb, Ni and Ag. Many samples were non-detects for Cd, Hg and Ag.

Metal concentrations were also determined in algae (fish food) and exceedances of the fish tissue guidelines for wildlife were found for Cu (1/8), Zn (8/8), Hg (3/8), Cd (7/8), Cr (8/8).

For the species examined, the California killifish, cheekspot goby, shadow goby and arrow goby are considered to be residents of Newport Bay (Allen personal communication 2011). Residency is an issue with fish tissue exceedances with respect to sources of contaminants in fish tissue. Since Cr and Zn exceeded the fish tissue guidelines in both resident and open water fish, it is likely that there are sources of Cr and Zn within or entering Newport Bay. Both Cr and Zn exceed the fish tissue guidelines in algae, and sediment Zn concentrations are known to exceed ERM guidelines especially in the Turning Basin area of the Lower Bay. In addition, more metals exceeded the wildlife guidelines in topsmelt than in other species.

Impairment shown in this study: Arsenic (As) and Chromium (Cr) in fish tissue (human health); Chromium (Cr) and Zinc (Zn) in fish tissue (wildlife)

Sediment One sediment sample exceeded the ERM sediment guideline for mercury (Hg). In addition to other data, this study adds to the findings of Hg exceedances in ~~the~~ Lower Bay and sediment monitoring should continue.

Fish/Mussel Tissue

Human health guidelines were exceeded for the lower inorganic As guideline of 0.026 µg/g ww and for Cr in all 7 fish filet samples (striped mullet). The total As guideline was also exceeded in 5/7 fish filets.

Wildlife guidelines were exceeded for Cr in most (43/63) samples in the both ~~the~~ Upper and Lower Bay, and for Zn in 10/32 samples in the Lower Bay.

Table 4-8a Sediment and Fish Tissue Exceedances and Mean Concentrations (data from Allen et al, 2008)

Sediment exceedances of ERL guidelines*[1] (µg/g)									
	Cu	**Zn**	**Cd**	**Pb**	**As**	**Cr**	**Ni**	**Hg**	**Ag**
ERL guidelines (µg/g)	*34*	*150*	*1.2*	*46.7*	*8.2*	*81*	*20.9*	*0.15*	*1.0*
(Samples 9U, 10L)** [2]	2U, 1L	1L	0	0	1L	0	1L	2L	0
Mean total concentration (µg/g)	**25**	**52.5**	**0.3**	**7.1**	**4.2**	**11.2**	**6.6**	**1.3**	**0.2**

Fish tissue exceedances (wet weight concentrations)									
	Cu	**Zn**	**Cd**	**Pb**	**As**	**Cr**	**Ni**	**Hg**	**Ag**
OEHHA/USEPA guidelines (hh) (µg/g ww)	*10F, 70M*	*40F*	*1.0*	*1.5F, 2.5SF*	*1.2[i], 0.026[i], 1.0[Total]*	*1.0FSF*		*0.2*	
Wildlife guidelines (wl) (µg/g ww)	*50, 15*	*45*	*0.1*	*10*	*25*	*2.5*	*50*	*0.03*	*50*
CA halibut[tf] (2U, 1L)**	0, 0	0	nd	0	0	2U	0	0	nd
CA killifish[tf] (3U, 8L)	0, 0	0	nd	0	0	3U	0	nd	nd
Cheekspot goby[tf] (1L)	0, 0	0	nd	0	0	1L	0	nd	nd
Shadow goby[tf] (1U)	0, 0	0	nd	0	0	1U	0	nd	nd
Deepbody anchovy[o] (2U)	0, 0	0	nd	0	0	2U	0	nd	nd
Topsmelt[tf,o] (23U, 22L)	0, 0	2,10	0	0	0	18U, 17L	0	wl 3L?	0
Striped mullet[o] (7U -filets)^	0	0	nd	0	hh 0,all,5	hh all	n/a	nd	n/a
TOTAL hh (7U filets) wl (31U, 32L)	**hh 0 wl 0, 0**	**hh 0 wl 2,10**	**hh 0 wl 0**	**hh 0 wl 0**	**hh 0,7,5 wl 0**	**hh 7U wl 26U/ 18L**	**0**	**hh 0 wl 3L?**	**0**
Mean concentration (µg/g ww)	**2.38**	**46.8**	**0.05**	**0.07**	**1.91**	**6.58**	**0.95**	**0.03**	**nd**

*Data from Allen et al were compared to guidelines from Table 4-3
**Numbers in parentheses = number of samples analyzed; U =Upper Bay, L =Lower Bay
[1]Sediment criteria from Long et al 1998 (ERL =effects range low, ERM =effects range median)
[2]All sediment metal exceedances in the Lower Bay were in S. Lido Channel
nd =non detects, n/a = nonapplicable, F =fish, M = mussels, SF =shellfish, ? =data unclear (Hg)
[tf]Fish found in tidal flats, [o]Fish found in open water
^Fish filets were collected for only one species (striped mullet)

i =inorganic As; 10% of the total As (measured in this study) was used to represent the inorganic As fraction in fish tissue and compared to the inorganic As human health guidelines of 1.2µg/g and 0.026µg/g
Total =total As
Various tissue guidelines were found for human health and wildlife –the highlighted numbers are the guidelines used in this assessment – light gray for HH.
F=fish, SF=shellfish, M=mussels

Table 4-8b Sediment Metals and Tissue data* (data from Allen et al, 2008)

Sediment metals mean, maximum concentrations (µg/g)									
	Cu	**Zn**	**Cd**	**Pb**	**As**	**Cr**	**Ni**	**Hg**	**Ag**
ERL guidelines	*34*	*150*	*1.2*	*46.7*	*8.2*	*81*	*20.9*	*0.15*	*1.0*
(Sites 9Upper, 10Lower)	25.0, **217.6^**	52.5, **279.2**	0.3, 1.2	7.1, 40.4	4.2, **13.9**	11.2, 44.9	6.6, **26.0**	0.1, **1.3**	0.0, 0.2
Fish/Mussel (F, M) tissue mean, maximum concentrations* (µg/g)									
	Cu	**Zn**	**Cd**	**Pb**	**As**	**Cr**	**Ni**	**Hg**	**Ag**
OEHHA/USEPA guidelines (hh) (µg/g ww)	*10F, 70M*	*40F*	*1.0*	*1.5F, 2.5SF*	*1.2[i], 0.026[i]*	*1.0*		*0.2*	
Wildlife guidelines (wl) (µg/g ww)	*50, 15*	*45*	*0.1*	*10*	*25*	*2.5*	*200*	*0.03*	*50*
CA halibut[tf] (2U, 1L)**	0.4, 0.4	14.3, 18.0	nd	0.08, 0.23	**1.2+, 2.1**	**4.8, 7.9**		0.01, 0.02	nd
CA killifish[tf] (3U, 8L)	2.3, 2.9	24.4, 27.6	nd	0.03, 0.04	**1.7, 2.1**	**2.6, 9.5**		nd	nd
Cheekspot goby[tf] (1L)	2.1, 2.1	27.5, 27.5	nd	0.01, 0.02	**2.4, 2.4**	**11.0, 11.0**		nd	nd
Shadow goby[tf] (1U)	0.8, 0.8	18.0, 18.0	nd	nd	**2.2, 2.2**	**14.4, 14.4**		nd	nd
Deepbody anchovy[o] (2U)	0.6, 0.7	16.1, 17.5	nd	nd	**1.8, 2.0**	**6.0, 6.9**		nd	nd
Topsmelt[o] (18)	1.5, 2.2	26.7, 43.0	0.03, 0.06	0.04, 0.09	**1.4, 2.0**	**5.5, 10.2**		0.01, 0.02	nd
Topsmelt[tf,o] (23U, 22L)	2.3, 5.7	27.8, 41.4	0.01, 0.06	0.05, 0.12	**1.3, 2.1**	**4.1, 7.9**		0.004, 0.02	nd
Striped mullet[o] (7U -filets)^	0.3, 0.8	3.3, 4.9	nd	0.01, 0.05	**0.8, 1.1**	**2.6, 4.4**		nd	nd
Algae mean, maximum concentrations[3] (µg/g)									
	6.9, 15.8"	31.7, **110.9**	0.06, **0.14**	1.4, 1.9	**1.4, 1.8**	**5.1, 11.2**	1.0, 1.4	0.01, 0.02	0.03, 0.16

*Data from Allen et al were compared to guidelines from Table 4-3
**Numbers in parentheses = number of samples analyzed; U =Upper Bay, L =Lower Bay
^Bold numbers for sediments indicate exceedances of the ERL sediment guidelines
*Bold numbers for fish tissue indicate exceedances of the fish tissue wildlife guidelines
"Bold numbers for algae indicate exceedances of the wildlilfe guidelines
tfFish found in tidal flats **o**Fish found in open water
tfFish found in tidal flats **o**Fish found in open water
^Fish filets were collected for only one species (striped mullet)

nd =non detects, n/a = nonapplicable
+One sample –not a mean value
i =inorganic As; 10% of the total As (measured in this study) was used to represent the inorganic As fraction in fish tissue and compared to the inorganic As human health guidelines of 1.2µg/g and 0.026µg/g
Various tissue guidelines were found for human health and wildlife –the highlighted numbers are the guidelines used in this assessment – light gray for HH
F=fish, SF=shellfish, M=mussels

4.2.2.6 California Department of Fish and Game (CDFG) Monitoring Data* -Tissue, Sediment and Water Quality Monitoring for Bioaccumulative Contaminants and Metals in the San Diego Creek and Newport Bay Watershed (2005-2006 data) (Frueh and Ichikawa 2007)
*(CDFG is now the California Department of Fish and Wildlife (CDFW).)
CDFG conducted monitoring in Newport Bay and the major tributaries (San Diego Creek and Santa Ana Delhi) for metals in sediments and fish and mussel tissue in 2006-07. There were 2 sites in the Upper Bay, 2 sites in the Lower Bay and 3 sites in the 2 major tributaries. Sediment and fish samples were collected in July and August 2006. Mussels were transplanted from northern California to Bay sites in October 2006, then collected in early February 2007.

Results
Sediment Only sediment methyl mercury (methyl Hg) in the Turning Basin area exceeded the ERM sediment guidelines. Sediment copper (Cu), cadmium (Cd) and methyl Hg exceeded the ERL guidelines in the Upper Bay at the Jamboree and Dunes sites; and 5 sediment metals (Cu, zinc (Zn), nickel (Ni), arsenic (As) and methyl Hg) exceeded the ERL guidelines in the Lower Bay at the Turning Basin site (Table 4-9). The Turning Basin results are similar to those of the Marina Study in that the majority of the sediment exceedances were in the Turning Basin area. There were no exceedances of the ERM or ERL guidelines at the Police Docks site in the Lower Bay (Appendix 4, Figure 4.2, NW channel near Harbor Towers Marina and Lido Village Marina). Note that Zn, Ni and As exceeded the ERL guidelines only in the Turning Basin area, and Cd exceeded the ERL guidelines only in the Upper Bay, while Cu and methyl Hg exceeded the ERL guidelines in both the Upper and Lower Bay.

Fish/Mussel Tissue For tissue analysis, the data were compared to the guidelines in Table 4-3. Fish tissue guidelines and exceedances are shown in Table 4-9.

Human health guidelines for inorganic arsenic (As), mercury (Hg), cadmium (Cd), copper (Cu), chromium (Cr), lead (Pb) and zinc (Zn) were evaluated only in the California halibut filets since this was the only fish denoted as a filet. Wildlife guidelines for copper (Cu), mercury (Hg), zinc (Zn), lead (Pb), arsenic (As), chromium (Cr), nickel (Ni) and silver (Ag) were evaluated in all fish.

For human health, inorganic As exceeded the lower guideline of 0.026 µg/g ww in the one fish fillet sample (California halibut) in the Upper Bay (Dunes), but did not exceed the higher guideline of 1.2 µg/g ww. In mussels, inorganic As exceeded the 0.026 µg/g ww guideline in all (4/4) mussel samples (2 Upper, 2 Lower Bay), but did not exceed the higher inorganic As guideline of 1.2 µg/g ww. All 4 mussels exceeded the total As guideline for human health. The human health guidelines were also exceeded for Zn in 4/4 mussels (Upper and Lower Bay) and for Cd in 1/2 mussel (Upper Bay). More fish filets and mussels are needed to assess exceedances of the human health guidelines since the data set was limited.

The wildlife guidelines were exceeded for methyl Hg in 6/12 fish (Upper and Lower Bay), but not in mussels. The wildlife guidelines were also exceeded for Cd in 4/4 mussels (Upper and Lower Bay) but not in fish, and for Zn in 1/4 mussels (Upper Bay). The wildlife guideline for total As in fish tissue (25 μg/g ww) was not exceeded in fish or mussel samples across all species sampled. DFG used somewhat different fish tissue guidelines and found human health exceedances of As, and wildlife exceedances of methyl Hg, Cr and As but not Zn.

For the species examined, the diamond turbot, spotted sandbass and shiner perch are considered to be residents of Newport Bay (Allen personal communication 2011). Residency is an issue with fish tissue exceedances with respect to sources of contaminants in fish tissue. Since As exceeded the fish tissue guideline in both resident and open water fish, it is likely that there are source(s) of As within Newport Bay. These may include sediments and algae for As (Allen 2008). Zinc exceeded the wildlife guideline in all fish species. Sediment Zn concentrations are known to exceed ERM guidelines especially in the Turning Basin area of the Lower Bay.

Impairment shown in this study: Arsenic (As), Cadmium (Cd), Methyl Mercury (methyl Hg) and Zinc (Zn) in fish tissue

Sediment The data show that sediments exceeded the ERM guideline for Hg in the Lower Bay Turning Basin in only 1/1 sample. In addition to other data, this study adds to the findings of Hg exceedances in the Lower Bay and sediment monitoring should continue.

Fish/Mussel Tissue The lower human health guideline for inorganic As (0.026 μg/g ww) was exceeded in all 4 mussels (2 Upper, 2 Lower Bay) and the only fish filet (California halibut) using 10% of total As as inorganic As. (If 1% total As is used as inorganic As, The human health guideline for total As was also exceeded in 3/4 mussels but not in the one filet. Zn and Cd also exceeded the human health guidelines in 2/4 and 1/4 mussels, respectively. More fish filets and mussels are needed to assess exceedances of the human health guidelines for fish tissue.

Wildlife guidelines were exceeded by methyl Hg in most fish (6/12) but no mussel samples, and by Cd and Zn in 4/4 and 1/4 mussels, respectively, but not in fish. Note that the data set for mussels was limited and included only one mussel sample at each site.

Table 4-9 Sediment Metals and Tissue data – California Department of Fish and Game (2006)

Sediment metals concentrations[1,2] (µg/g)									
1 sample/site	**Cu**	**Zn**	**Cd**	**Pb**	**As**	**Cr**	**Ni**	**Methyl Hg**	**Ag**
UNB – Jamboree	(50.4)[2]	149	(1.66)	19.6	7.41	35.5	17.8	(0.17)	0.41
UNB –Dunes	(50.7)	147	(1.67)	21.1	7.23	38.9	17.5	(0.37)	0.40
LNB –Turning Basin	(81.7)	(159)	1.11	25.8	(10.1)	54.0	(23.0)	**1.04[1]**	0.36
LNB –Police Docks	21.0	35.2	0.25	16.1	4.19	14.4	6.1	0.04	0.20
Fish, Mussel (F, M) tissue concentration exceedances (µg/g)									
	Cu	**Zn**	**Cd**	**Pb**	**As**	**Cr**	**Ni**	**Methyl Hg**	**Ag**
OEHHA[4] /USEPA guidelines (hh)	*10F, 70M*	*40F*	*1.0*	*1.5F, 2.5 SF*	*1.2^{i}, 0.026^{i}, 1.0^{Total}*	*1.0FSF*		*0.2*	
Wildlife guidelines[5] (wl)	*50, 15*	*45*	*0.1*	*10*	*25*	*2.5*	*50*	*0.03*	*50*
UNB –Jamboree 4F, 1M	0	0	wl 1M	0	hh^{i} low-1M[3], hh^{T} 1M[3] wl 0	0	0	wl 2F	0
UNB –Dunes 5F(1 filet), 1M	0,0	hh1M wl 1M	hh 1M wl 1M	0,0	hh^{i} low-1F1M, hh^{T} 1M wl 0	0	0	wl 2F	0
LNB –Turning Basin 1F, 1M	0	hh1M	wl 1M	0	hh^{i} low-1M wl 0	0	0	wl 1F	0
LNB –Police Docks 3F, 1M	0	0	wl 1M	0	hh^{i} low-1M, hh^{T} 1M wl 0	0	0	wl 1F	0
Totals 1filet, 8F2M U 4F2M L	0,0	hh2M wl1M	hh 1M wl 4M	0,0	hh^{i} low-1F4M hh^{T} 3M	0,0	0,0	wl 6F	0,0

Data from DFG were compared to guidelines from Table 4-3
F=fish, M =mussel, NF =no filets. wl =wildlife, hh-low =human health low guideline (0.026µg/g)
i =inorganic As; 10% of the total As in fish tissue and mussel tissue (measured in this study) was used to represent the inorganic As fraction in fish tissue and mussel tissue, both were compared to the As human health guidelines of 1.2 and 0.026µg/g (USEPA 2000a)
As wildlife guideline of 1.4 µg/g ww (USEPA 2002) and is for total As.
[1] Sediment concentrations in bold exceed the ERM sediment guideline (only for Hg)
[2] Sediment concentrations in parentheses exceed ERL sediment guidelines
[3] For fish and mussel tissue data, the numbers show the number of fish/mussel (#F, #M) samples exceeding the wildlife guidelines
*Methyl Hg value is for the most sensitive population (OEHHA 1999)
^Only one filet was analyzed in this data set
Various tissue guidelines were found for human health and wildlife –the highlighted numbers are the guidelines used in this assessment and the results – light gray for HH, darker gray for WL (wildlife).

F=fish, SF=shellfish, M=mussels

4.2.2.7 Bioaccumulation of Contaminants in Recreational and Forage Fish in Newport Bay, California in 2000-2002 (Allen *et al* 2004)

Multiple fish species were collected in Newport Bay (recreational fish (2000-01) and forage fish (2002)) to compare to human health guidelines and wildlife guidelines, respectively. Recreational fish tissue was analyzed for total As, total Hg and Se; forage fish tissue was analyzed for total As, Hg, Cd and Se.

Results

Fish (Recreational) tissue There were no exceedances of the human health guideline (OEHHA) for metals in fish tissue.

Fish (Forage) tissue There were no exceedances of the wildlife criteria in fish tissue for metals.

Impairment shown in this study: No impairment for metals was found in fish tissue

4.2.2.8 Newport Bay Sediment Toxicity Studies (Bay *et al* 2004)

The purpose of these studies was to assess the extent of sediment toxicity in Newport Bay, to determine the influence of contaminated sediments on water qualty, and to identify the sediment contaminants responsible for adverse biological effects. Nine locations were sampled for chemistry and toxicity analyses in Newport Bay in September 2000 and May 2001. The summaries below do not include results for the Rhine Channel since this channel was dredged in 2011. *Rhine Channel data were not evaluated for these studies since the Rhine Channel was dredged in 2011; therefore, data collected before 2011 are no longer valid to determine impairment.*

1) Spatial sampling results (September 2000, May 2001)
Water Chemistry Cu exceeded the CTR criteria in 2/2 stormwater samples in the Upper Bay.
Sediment Chemistry Only Hg exceeded the ERM sediment guideline in the Turning Basin area (1/9 sites) in both September 2000 and May 2001. Metals that exceeded the ERL guidelines were Cu, Zn, Cd, Ni and Pb.
Water Toxicity Sea urchin fertilization tests and development tests showed toxicity at 5/9 and 1/9 sites, respectively, in September 2000; and 6/9 and 0/4 sites, respectively, in May 2001.
Sediment Toxicity Reduced amphipod survival was found at 7/10 sites (3/5 in Upper Bay, 4/5 in Lower Bay) for both sampling events, and NB10 (mouth of San Diego Creek) had the highest amphipod toxicity for both sampling events.

2) Stormwater sampling results (January 2001, Limited number of samples)
Three runoff samples (2 in Upper Bay, 1 in Lower Bay) were collected and analyzed for metals and toxicity. Water toxicity was demonstrated by reduced mysid survival and growth in both Upper Bay samples, and dissolved Cu exceeded the CTR criteria at the Upper Bay-Jamboree and middle Lower Bay sites; however, since water samples were collected on one day only, data are limited.

3) Sediment Toxicity/Toxicity Identification Evaluation (TIE) Testing (November 2001, March 2002, Limited number of samples)
Water and sediment samples were collected from 2 areas in the Upper and Lower Bay (NB10 –near the mouth of San Diego Creek and NB3 –Rhine Channel, respectively). Since the one Lower Bay site was the Rhine Channel site, which was dredged in 2011, data collected prior to 2011 are no longer valid to determine impairment; therefore, only the Upper Bay site will be discussed below. Water and sediment samples were tested for metals and toxicity.

Results for Upper Bay site (NB10)
Water Chemistry No metals exceeded the CTR saltwater criteria in the Upper Bay samples in November 2001 or March 2002.
Sediment Chemistry No metals exceeded the ERM sediment guidelines in November 2001 or March 2002 (1 sample for each event). The ERL guidelines were exceeded in the Upper Bay Cu, Zn and Cd; and in the Lower Bay by Cu, Zn, Cd, Pb, Hg, As and Ni.
Water Toxicity No toxicity was found in the sea urchin fertilization test in one water sample in November 2001 or in 3 samples in March 2002.
Sediment Toxicity The sediment was highly toxic; no amphipods survived in one sample in November 2001, or in 3 samples in March 2002.
Sediment-water interface Toxicity – (November 2001) The sea urchin fertilization test showed moderate toxicity. EDTA and C-18 column extractions (TIE test) removed toxicity.

4) Major conclusions for all studies
1 Sediment toxicity is prevalent throughout Newport Bay, and the amphipod toxicity test results suggest that toxicity can be found year-round in the Bay. (Reduced amphipod survival was found in 12/18 samples and 6/9 sites).
2 The results of the spatial studies shown above (2000-01) confirm the findings of the 1998 Southern California Bight regional monitoring survey (Bay et al 2000 –not shown) that sediment toxicity in Newport Bay is more extensive and severe than in other developed Bays in southern California. In the spatial studies, toxicity was present at 70% of all stations, and 80% of the Lower Bay stations.
3 Sediment contamination [determined by chemistry] was also prevalent throughout Newport Bay. *[Hg exceeded the ERM sediment guidelines, and several metals (Cu, Cd, Zn, Hg, Pb) exceeded the ERL guidelines.]*
4 Sediment chemistry had a low correlation with sediment toxicity; however, most metals were negatively correlated with sediment toxicity, and a decrease in survival occurred as metal concentrations increased. Trace metals were highly correlated with each other (in particular Cu, Zn, Pb). Trace metals were also correlated with grain size (%fines) or iron (Fe).
5 Water column toxicity was also widespread throughout Newport Bay.
6 The sediment was highly toxic; no amphipods survived in 4/4 samples from the Upper Bay station. TIE tests suggest that nonpolar organics were likely the dominant toxic contaminant. Sediment-water interface tests also showed toxicity in 4/5 samples.
7 The TIE tests indicated that multiple contaminants are present at each site. TIEs were not sufficient to determine which chemicals were related to toxicity.

Impairment shown in this study: Sediment toxicity in the Upper and Lower Bay
Sediment The data demonstrate that 1/9 sediments exceeded the ERM guideline for Hg in the Lower Bay at the Turning Basin. In addition to other data, this study adds to the findings of Hg exceedances in the Lower Bay and sediment monitoring should continue.
Sediment toxicity Sediment toxicity is present in both the Upper and Lower Bay and the sediments were highly toxic.

4.2.2.9 Newport Bay and San Diego Creek -Chemistry Results for Water, Sediment, Suspended Sediment (Bay and Greenstein 2003)

Water and sediment samples were collected for water analyses (dissolved and total metals including methyl Hg, organics), sediment analyses (chemistry, toxicity) and sediment-water interface (SWI) analyses. Water and sediment sampling was conducted in November 2001 and

March 2002 in the Upper Bay and the Rhine Channel (1 site each). Additional sediment sampling was conducted in May 2002 at the Upper Bay site and in the Lower Bay Turning Basin/ S. Lido Channel area. *Rhine Channel data were not evaluated for these studies since the Rhine Channel was dredged in 2011, therefore, data collected prior to 2011 are no longer valid to determine impairment.*

Results
Water No metals exceeded the dissolved metals CTR saltwater criteria in 2 samples in the Upper Bay for the metals analyzed (Cu, Zn, Hg, Cd, Cr, Ni, Pb, As, Ag). No Lower Bay sites were tested except the Rhine Channel. (Only Cu exceeded the dissolved Cu CTR saltwater criteria in 2/2 samples in the Rhine Channel, which was dredged in 2011, therefore these data are no longer valid to determine impairment.)
Sediment Upper Bay. No metals exceeded the ERM sediment guidelines. Cu, Hg, Zn, Ni and Cd exceeded the ERL sediment guidelines in 2/2 samples.
Lower Bay (May 2002). Hg exceeded the ERM guideline in 1/3 samples, and Cu exceeded the Probable Effects Level (PEL) sediment guidelines (NOAA SQuiRTS, 1999, 2008) in 1/3 samples (both exceedances were in Lido Yacht area). Cu, Hg, Ni, Zn and Pb exceeded the ERL guidelines in 3/3, 3/3, 3/3, 2/3, 2/3 sites, respectively.
Sediment Water Interface test (November 2001 only). No metals exceeded the dissolved metals CTR saltwater criteria in one sample collected in the Upper Bay. (Only Cu exceeded the CTR saltwater criteria in 1 samples in the Rhine Channel, which was dredged in 2011, therefore these data are no longer valid to determine impairment.)

Potential Impairment shown in this study: Mercury (Hg) in sediments in the Lower Bay (Turning Basin area)
Sediment The data show that 1/3 sediment samples exceeded the ERM guideline for Hg in the Lower Bay (Lido Yacht site –Turning Basin area). In addition to other data, this study adds to the findings of Hg exceedances in the Lower Bay and sediment monitoring should continue.

4.2.2.10 Metals Sediment Study in Lower Newport Bay (Post-dredging)

Surface sediment and bottom water sampling in post-dredge and marina sites (OC Coastkeeper & L.M.Candelaria 2014)

Surface sediments were collected in post-dredge sites throughout Lower Newport Bay to determine metal concentrations in new surface sediments. In addition, three marina sites that exceeded the copper (Cu), mercury (Hg), and zinc (Zn) ERMs in the Cu Metals Marina study (4.2.2.1) were sampled to determine current concentrations of sediment metals. Bottom water samples were also collected to determine metal exceedances of the CTR criteria. Sediment samples were collected in October 2012, and March and August 2013. Bottom water samples were collected in October 2012 and March 2013. Sediment toxicity was determined in a subset of samples in August only.
http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/tmdl_toxics.shtml

Results
Sediment Sediment copper (Cu), mercury (Hg), and zinc (Zn) exceeded the ERM sediment guidelines. All ERM exceedances were in or near the marina sites (Harbor Marina, Lido Village, Lido Yacht Anchorage) and Balboa Island Channel which was just outside of Balboa Yacht Basin. Exceedances of the ERL sediment guidelines were common. Sediment Cu exceeded the ERL in *all samples at all sites* throughout the Lower Bay. Sediment Hg, Zn, arsenic (As) and nickel (Ni) exceeded the ERLs at most sites. Other ERL exceedances include sediment cadmium (Cd) at half

the sites, sediment chromium (Cr) and lead (Pb) at the three marina sites, and sediment Pb at three additional sites.

Bottom water Only dissolved Cu exceeded the metals CTR criteria, and exceedances occurred only in October 2012 at less than half the sites. There were no metal exceedances in March 2013. These few exceedances suggest that most metals are not desorbing from the sediments into the bottom water, and that Cu exceedances found in surface waters in the marina study (4.2.2.1) are likely due to Cu discharges from boats.

Sediment toxicity No toxicity to *Eohaustarius* survival was determined at any site tested, and percent survival ranged from 95 to 98%. These toxicity results differ from those in the marina study where toxicity was found in the majority of the sediments tested.

Potential Impairment shown in this study: Copper (Cu), Zinc (Zn), Mercury (Hg) in sediments in parts of the Lower Bay
Sediment This study demonstrates that sediment Cu, Zn and Hg exceeded the ERM guidelines in marinas in the Turning Basin area and just outside Balboa Yacht Basin. These findings demonstrate the need for continued monitoring and evaluation.

4.2.3 SUMMARY OF DATA ANALYSIS AND IMPAIRMENT ASSESSMENT

The data analyses from current studies (2002 -2014) show impairment for dissolved Cu tin Newport Bay, and sediment toxicity, and potential impairment of sediments by copper (Cu), mercury (Hg), and zinc (Zn). Data are presented in summary tables (Tables 4-10, 4-12). Impairment analyses in fish and/or mussel tissue are also shown (Table 4-11).

Water Upper and Lower Newport Bay are both impaired for Cu based on exceedances of the dissolved Cu CTR saltwater criteria (Table 4-10). No other metals exceeded the dissolved metals CTR saltwater criteria.

Sediment Sediment Cu, Zn and Hg exceeded the ERM sediment guidelines and sediment toxicity was present in the areas of ERM exceedances; therefore, continued monitoring and evaluation of sediments is required (Table 4-10). Most of the ERM exceedances were found in the Turning Basin area of the Lower Bay.

In addition, multiple metals, including Cd, Ni, Pb and As exceeded the ERL sediment guidelines in both the Upper and Lower Bay (Table 4-12). ERLs are generally used as targets for metals TMDLs in California. While exceedances of the ERL guidelines do not indicate impairment, these results do indicate the need for continued monitoring in both the Upper and Lower Bay.

Fish/Mussel Tissue
Human health. The lower human health guideline of 0.026 µg/g ww for inorganic arsenic (As) was exceeded in all (7/7, 1/1) fish filets (Upper Bay) and (4/4) mussel samples (Upper and Lower Bay) (Allen 2008, DFG 2006). The human health guideline for total As was also exceeded in 5/7 filets (Upper Bay) and 3/4 mussels (Upper and Lower Bay). The human health guideline for Cr (1.0 µg/g ww) was exceeded in 7/7 fish filets (Allen 2008). No fish filets were collected in the Lower Bay for either study. The number of filets and mussel samples collected was also limited. The human health guidelines for cadmium (Cd) and Zn were both exceeded in 1/2 mussels (Upper Bay).

Wildlife. The wildlife guidelines were exceeded for Cr (2.5 µg/g ww) in most fish (26/31, 18/32) in the Upper and Lower Bay (Allen 2008), but there were no exceedances in fish or mussels in DFG's study (2006). The wildlife guideline was exceeded for Zn in 2/31 and 12/63 fish in the Upper and Lower Bay, respectively (Allen 2008), and in 2/4 mussels but not in fish in the Upper and Lower Bay (DFG 2006). Cd exceeded the fish tissue guideline (0.1 µg/g ww) in 3/4 mussels in the Upper and Lower Bay (DFG 2006), but not in fish in Allen's study (Table 4-11). Methyl Hg exceeded the 55 ng/g ww guideline in only 2/12 fish and not in mussels in the Upper and Lower Bay (DFG 2006).

Table 4-10 Summary of Metals Exceedances in Water and Sediments and Impairment Assessment for Newport Bay (2002-2010)

Upper Bay		
Water	**Impaired for Copper (Cu) based on exceedances of the dissolved Cu CTR saltwater criteria**	**Reference**
Cu	48/68, 13/27, 2/4 samples >CTR criteria	1, 4, 5
	2/2 stormwater samples >CTR	6
Sediment	**No Impairment based on exceedances of ERM* sediment guidelines**	
Toxicity	**Impaired for Water, Sediment Toxicity**	
Water	toxicity in 8/10 samples (sea urchin fertilization)	6
Sediment	toxicity in 6/6 samples (amphipod survival)	4
	toxicity in 16/38 samples (amphipod survival)	2
	toxicity in 6/10 samples (amphipod survival) (high toxicity in 4/4 samples at one site)	6
Sed-Water Interface	toxicity in 2/4 samples (sea urchin fertilization) toxicity in 1/2 samples (sea urchin development)	6
Lower Bay		
Water	**Impaired for Copper (Cu) based on on exceedances of the dissolved Cu CTR saltwater criteria**	
Cu	22/34, 53/78, 7/52 samples >CTR criteria 25/31 marina samples, 1/10 channel samples > CTR	1, 4, 2 3
	4/29 > CTR (bottom water samples)	11
Sediment	**Exceedances of ERM - mercury (Hg) –parts of Lower Bay, Exceedances of ERMs - Cu, zinc (Zn) –Turning Basin area in Lower Bay (+ sediment toxicity)**	
Cu	16/78 samples, 7/44 (7/9 marina samples) >ERM*	4, 11
Zn	12/78 samples, 2/44 (2/9 marina samples) >ERM*	4, 11
Hg	24/78, 2/8, 1/3, 1/2, 1/19 samples 6/44 (6/9 marina samples) >ERM* 19/102 samples (7/13 sites) >ERM*	4, 6, 7, 9, 8 11 10 (core samples)
Toxicity	**Impaired for Water, Sediment Toxicity**	
Water	toxicity in 3/8 samples (sea urchin fertilization), toxicity in 1/8 samples (sea urchin development)	6
Sediment	toxicity in 6/6 samples (amphipod survival)	4
	toxicity in 6/22 samples (amphipod survival)	2
	toxicity in 8/10 samples (amphipod survival)	6
Sed-Water Interface	toxicity in 1/4 samples (sea urchin fert.)	6

*ERM = Effects Range Median sediment guidelines (Long et al 1998)
The majority of the sediment ERM exceedances were in the Turning Basin area.
References: [1]County of Orange 2009-2011, [2]County of Orange 2006-2009, [3]OC Coastkeeper 2013, [4]OC Coastkeeper & Candelaria 2007, [5]USEPA 2004, [6]Bay et al 2004, [7]Bay & Greenstein 2003, [8]Allen 2008, [9]Frueh & Ichikawa 2007 (DFG), [10]NewFields 2009, [11]OC Coastkeeper & Candelaria 2014

Table 4-11 Summary of Metals Exceedances in Fish Tissue and Impairment Assessment for Newport Bay (2002-2010)

Upper Bay			
Fish Tissue	**Impaired for arsenic (As) and chromium (Cr) based on exceedances of human health (hh) and/or wildlife (wl) guidelines***		**Reference**
As (inorganic)	7/7 filets, 1/1 filet +2/2 mussels > 0.026µg/g (lower hh)	LIST	1, 2
As (total)	5/7 filets, 2/10 (2/2 mussels, 0/8 fish > 1.0 µg/g hh		1, 2
Cd	1/3 (1/2 mussels, 0/1 filet) > 1.0 µg/g hh 0/31 fish, 2/10 (2/2 mussels, 0/8 fish) > 0.1 µg/g wl	DNL	2 1, 2
Cr	7/7 filets > 1.0 µg/g (hh) 26/31 fish, 0/10 fish/mussels > 2.5 µg/g wl	LIST	1 1, 2
Hg **methyl Hg**	0/31 small fish, 0/2 mussels > 30 ng/g wl 1/8 larger fish > 55 ng/g wl	DNL	1,2 2
Zn	1/3 (1/2 mussels, 0/1 filet) > 40 µg/g hh 2/31 fish, 1/12 (1/2 mussels, 0/8 fish) > 45 µg/g wl	DNL	2 1, 2
Lower Bay			
Fish Tissue^	**Impaired for As, Cr and Zn based on exceedances of human health (hh) and/or wildlife (wl) guidelines**		
As (inorganic)	2/2 mussels > 0.026µg/g (lower hh)	LIST	2
As (total)	1/2 mussels > 1.0 µg/g ww hh (need more data)		2
Cd	0/32 fish, 2/6 (2/2 mussels, 0/4 fish) > 0.1 µg/g wl	DNL	1, 2
Cr	18/32 fish, 0/6 fish/mussels > 2.5 µg/g wl	LIST	1, 2
Hg **methyl Hg**	0/32 small fish, 0/2 mussels > 30 ng/g wl 1/4 larger fish > 55 ng/g wl	DNL	1,2 2
Zn	10/32 fish, 1/6 (1/2 mussels, 0/4 fish) > 45µg/g wl	LIST	1, 2

References: [1]Allen et al 2008, [2]Frueh & Ichikawa 2007

*There were no fish/mussel tissue exceedances for Cu or Pb in the Upper or Lower Bay

^No fish filets were collected in Lower Bay, so there is no human health analysis for fish tissue

Table 4-12 Summary of Metals Exceedances of Sediment ERL* Guidelines for Newport Bay (2002-2010)

Upper Bay		
Sediment	**Exceedances of ERLs**	
Cu	25/27, 31/73, 4/10, 2/2 samples >ERL	1, 2, 3, 4
Zn	19/27, 20/73, 2/10, 2/2 samples >ERL	1, 2, 3, 4
Cd	16/27, 19/73, 2/10, 2/2 samples >ERL	1, 2, 3, 4
Hg	1/27, 0/10, 2/2 samples >ERL	1, 3, 4
Ni	16/27, 14/73, 1/10, 2/2 samples >ERL	1, 2, 3, 4
As	10/27, 0/10 samples >ERL	1, 3
Lower Bay		
Sediment	**Exceedances of Target ERLs**	
Cu	60/78, 36/44, 8/10, 3/3, 44/44 samples >ERL	1, 2, 3, 4, 5
Zn	58/78, 23/44, 6/10, 2/3, 34/44 samples >ERL	1, 2, 3, 4, 5
Hg	31/78, 21/41, 4/10, 3/3, 32/44 samples >ERL	1, 2, 3, 4, 5
Cd	26/78, 5/44, 4/10, 11/44 samples >ERL	1, 2, 3, 5
Cr	7/44 samples >ERL	5
Ni	62/78, 18/44, 6/10, 3/3, 34/44 samples >ERL	1, 2, 3, 4, 5
Pb	24/78, 8/44, 4/10, 2/3, 11/44 samples >ERL	1, 2, 3, 4, 5
As	63/78, 20/44, 3/10, 31/44 samples >ERL	1, 2, 3, 5
Ag	2/78, 1/73 samples >ERL	1, 2

*ERL = Effects Range Low sediment guidelines (Long et al 1998)
References: [1]OC Coastkeeper & Candelaria 2007, [2]County of Orange 2006-2009, [3]Bay et al 2004, [4]Bay & Greenstein 2003, [5]OC Coastkeeper & Candelaria 2014

4.2.4 COMPARISON BETWEEN SANTA ANA WATER BOARD STAFF'S IMPAIRMENT ASSESSMENT (2002-2014) AND USEPA'S 2002 TOXICS TMDLS DATA ASSESSMENT

This Impairment Assessment used somewhat different methodology than the assessment conducted by USEPA for the Toxics TMDLs (Section 4.2.1, Table 4-3). USEPA used a Tier 1, Tier 2 approach with the triad of water, sediment, and fish tissue exceedances to determine whether metals TMDLs were needed (USEPA 2002).

The findings of this assessment differ from USEPA's assessment conclusions that TMDLs were required for cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) in Upper Newport Bay, and Cu, Pb and Zn in Lower Newport Bay. This assessment confirms that TMDLs are required for Cu in the Upper and Lower Bay. Additional evaluation of Zn, mercury (Hg), arsenic (As) and lead (Pb) is warranted. Differences in impairment findings are summarized below and detailed in Table 4-14.

Water and Sediment Impairment/Potential Impairment
Copper This assessment found that dissolved Cu is the only metal that exceeded the applicable CTR criteria in the Upper and Lower Bay; therefore, Cu TMDLs are required.
Cu also exceeded the sediment ERM guideline in parts of the Lower Bay.
Sediment toxicity is also present in the Upper and Lower Bay.

Other Metals This assessment found no water or sediment impairment for Cd, Pb or Zn in the Upper Bay, and no water or sediment impairment for Pb in Lower Bay water or sediments.
This assessment found exceedances of the sediment ERMs in parts of the Lower Bay for Zn and mercury (Hg) especially in the Turning Basin and South Lido Channel.
(Sediment Cu, Zn and Hg exceedances mostly occurred together in these areas of the Lower Bay which are near/in marinas (Cu-Metals Marina study-Section 4.2.2.1 and Metals Sediment study-Section 4.2.2.10).) Since a subset of marinas were sampled in the above studies, a more extensive marina survey is indicated to fully assess the extent of sediment Cu, Zn and Hg exceedances and sediment toxicity in marina and boatyard areas in Newport Bay.

Water column impairment by metals was determined by exceedances of the dissolved metals CTR saltwater criteria in this and USEPA's assessments (Table 4-3).
The evaluation of sediment impairment determined by USEPA was based on exceedances of the sediment guidelines including TELs + ERLs, or PELs, ERMs, which differs from the State Listing Policy guidelines (Section 4.2.1 & Appendix 3). Sediment Cu, Zn and Hg assessment was based on exceedances of the ERM sediment guidelines plus sediment toxicity per the interpretation of the State Listing Policy at the time (Table 4-3).

This assessment supports the 303(d) Listing of Cu in Upper and Lower Newport Bay but does not support the listing of the general category of metals in the Upper Bay as discussed in Section 3.3. Zn and Hg should continue to be monitored in the Lower Bay based on exceedances of the sediment guidelines. The general category of metals in the Upper Bay was finally delisted in the 2014-16 303(d) list.

Fish Tissue Impairment
This assessment found impairment in fish and/or mussels for arsenic (As) and chromium (Cr), in the Upper Bay; and As, Cr and Zn in the Lower Bay based on exceedances of the fish tissue guidelines shown in Table 4-3. Cd impairment was also found in mussels in the Upper and Lower Bay, but not in fish.

Santa Ana Water Board staff consulted with experts on Hg, As and Cr to determine the most appropriate and current fish tissue guidelines. The fish tissue guidelines for human health were chosen from guidelines in the literature, and the fish tissue guidelines for wildlife were chosen from the literature in coordination with USFWS staff (pers. communication, K. Zeeman, PhD). With the exception of mercury, there are no state recommended guidelines for fish tissue at this time. In the Toxics TMDLs, USEPA determined fish tissue exceedances for Cr (1/10 UNB, 2/10 LNB), Hg (1/10 UNB), Zn (1/10 UNB) but did not promulgate TMDLs based on this small sample set (USEPA 2002).

Table 4-13 Comparison of This Metals Impairment Assessment and USEPA's Assessment (modified from Table 4-2)*

Upper Newport Bay Metals	***Impairment Assessment and TMDL Decisions***
Copper (Cu) (USEPA assessment)	*Water:* many exceedances of CTR criteria *Tier 2* *Sediments:* 17% (7/42) > ERL (34 µg/g) *Tier 2* *Tissue:* no exceedances in last 5 yrs (prior to 2002) *Actions: USEPA established a Cu TMDL for Upper Newport Bay in 2002*
*RB assessment** *TMDL required*	*Water and Sediments: RB staff assessment found exceedances of the dissolved Cu CTR criterion in water, and toxicity* *RB staff assessment found exceedances of the sediment ERMs for Zn, Pb and Cd* *Fish Tissue: No tissue exceedances* *Cu was LISTED for Upper Newport Bay in 2006 based on the State Water Board's 303(d) assessment, and the State Water Board's 303(d) assessment for 2014-16 determined Cu to be Do Not Delist* *Based on this impairment assessment and State Water Board's approved 303(d) list for 2014-16, a TMDL is required for Cu in the Upper Bay* *Recommendations: Do Not Delist, TMDL required* *Actions: A revised Cu TMDL, including an implementation plan and schedule, is needed for Cu based on exceedances of the dissolved Cu criteria, this TMDL should supersede USEPA's Cu TMDL; monitoring of Cu in water, sediment and fish/mussel tissue should continue*
Lead (Pb) (USEPA assessment)	*Sediments* 5% (2/42) >ERL (46.7µg/g) No water or tissue exceedances Potential threat to UNB based on sediment data, and impairment in Rhine Channel (exceedances of sediment ERM) *Actions: USEPA established a Pb TMDL for Upper Newport Bay in 2002*
RB assessment *DNL, no TMDL*	*Water and Sediments: RB staff assessment found no exceedances of the dissolved Pb CTR criterion nor the sediment Pb ERM guideline* *Fish tissue: There were no exceedances of the Pb fish tissue guidelines* *Based on the State Water Board's 303(d) assessment in 2006, Pb was determined to be Do Not List (DNL), and the State Water Board's 303(d) assessment for 2014-16 again determined Pb to be Do Not List* *Rhine Channel was dredged in 2011* *Based on this impairment assessment and State Water Board's approved 303(d) list for 2014-16, no listing (DNL) or TMDL is recommended for Pb in the Upper Bay* *Recommendations: DNL, no TMDL required* *Actions: Monitoring of Pb in water, sediment and fish/mussel tissue should continue,* *USEPA's Pb TMDL for Upper Newport Bay is no longer necessary*

Zinc (Zn) (USEPA assessment)	*Water* many exceedances of CTR criteria *probably Tier 2* *Sediments* 17% (8/48) > ERL (150 µg/g) *Tier 2* *Tissue* 10% (1/10) > screening value *Tier 2* *Actions: USEPA established a Zn TMDL for Upper Newport Bay in 2002*
RB assessment DNL, no TMDL	*Water and Sediments: RB staff assessment found no exceedances of the dissolved Zn CTR criterion nor the sediment Zn ERM guideline* *Fish tissue: There were a small number of exceedances of the Zn fish tissue guideline for wildlife (2/39 fish, 1/2 mussels)* *Based on the State Water Board's 303(d) assessment in 2006, Zn was determined to be Do Not List (DNL), and the State Water Board's 303(d) assessment for 2014-16 again determined Zn to be Do Not List* *Rhine Channel was dredged in 2011* *Based on this impairment assessment and State Water Board's approved 303(d) list for 2014-16, no listing (DNL) or TMDL is recommended for Zn in the Upper Bay* *Recommendations: DNL, no TMDL required* *Actions: Monitoring of Zn in water, sediment and fish/mussel tissue should continue:* *USEPA's Zn TMDL for Upper Newport Bay is no longer necessary*
Cadmium (Cd) (USEPA assessment)	**Sediments* 21% (8/42) > ERL (1.2 µg/g) *Tier 2* No water or tissue exceedances Potential threat to UNB based on sediment data, and evidence of impairment in San Diego Creek (exceedances of the CTR criteria, sediment guidelines) *TMDL needed based on adjacent water analyses (SD Creek)* *Actions: USEPA established a Cd TMDL for Upper Newport Bay in 2002*
RB assessment DNL, no TMDL	*Water and Sediments: RB staff assessment found no exceedances of the dissolved Cd CTR criterion nor the sediment Cd ERM guideline* *Fish tissue: There were a small number of exceedances of the Cd fish tissue guideline for wildlife (0/39 fish, 2/2 mussels)* *Based on the State Water Board's 303(d) assessment in 2006, Cd was determined to be Do Not List (DNL), and the State Water Board's 303(d) assessment for 2014-16 again determined Cd to be Do Not List* *Based on this impairment assessment and State Water Board's approved 303(d) list for 2014-16, no listing (DNL) or TMDL is recommended for Cd in the Upper Bay* *Recommendations: DNL, no TMDL required* *Actions: Monitoring of Cd in water, sediment and fish/mussel tissue (especially mussels) should continue,* *USEPA's Cd TMDL for Upper Newport Bay is no longer necessary*
Mercury (Hg) (USEPA assessment)	No water or sediment exceedances *Tissue* 10% (1/10) > screening value *Tier 2* *No TMDL*
RB assessment DNL, no TMDL	*Water and Sediments: RB staff assessment found no exceedances of the dissolved Hg CTR criterion nor the sediment Hg ERM guideline* *Fish tissue: There was 1/8 exceedance of the higher methyl Hg fish tissue guideline for wildlife* *The State Water Board's 303(d) assessment for 2014-16 determined Hg to be Do Not List*

	Based on this impairment assessment and State Water Board's approved 303(d) list for 2014-16, no listing (DNL) or TMDL is recommended for Hg in the Upper Bay *Recommendations: DNL, no TMDL required* *Actions: Monitoring of Hg in water, sediment and fish/mussel tissue should continue*
Arsenic (As) (USEPA assessment)	*Sediments* 12% (1/8) > ERL *Tier 2* No water or tissue exceedances *No TMDL*
RB assessment *LIST, no TMDL* *Action Plan*	*Water and Sediments: RB staff assessment found no exceedances of the dissolved As CTR criterion nor the sediment As ERM guideline* *Fish tissue: There were exceedances of the lower inorganic As fish tissue guideline for human health in all fish filets and mussels in a small data set* *Based on this impairment assessment, As should be LISTED for fish tissue exceedances in the Upper Bay; no TMDL is recommended as As does not exceed criteria/guidelines in water or sediment and sources of As to fish are not well-defined* *The State Water Board's 303(d) assessment for 2014-16; determined As to be Do Not List but did not use the same data that was used for this impairment assessment.* *Recommendations: LIST, no TMDL required Actions: Further investigation, including a source analysis and continued monitoring, is recommended for As based on exceedances of the fish tissue guideline for human health monitoring of As in water, sediment and fish/mussel tissue should continue*
Chromium (Cr) (USEPA assessment)	No water or sediment exceedances *Tissue* 10% (1/10) > screening value *Tier 2* *No TMDL*
RB assessment *LIST, no TMDL* *Action Plan*	*Water and Sediments: RB staff assessment found no exceedances of the dissolved Cr CTR criterion nor the sediment Cr ERM guideline* *Fish tissue: There were exceedances of the Cr fish tissue guideline for wildlife in a majority of fish samples* *Based on this impairment assessment, Cr should be LISTED for fish tissue exceedances in the Upper Bay; no TMDL is recommended as Cr does not exceed criteria/guidelines in water or sediment and sources of Cr to fish are not well-defined* *The State Water Board's 303(d) assessment for 2014-16; determined Cr to be Do Not List but did not use the same data that was used for this impairment assessment.* *Recommendations: LIST, no TMDL required* *Actions: Further investigation, including a source analysis and continued monitoring, is needed for Cr based on exceedances of the fish tissue guideline for wildlife; monitoring of Cr in water, sediment and fish/mussel tissue should continue*
Lower Newport Bay Metals	***Impairment Assessment and TMDL/Action Plan Decisions***

Copper (Cu) (USEPA assessment)	*Water* many exceedances of CTR criteria *Sediments* 33% (9/27) > ERL (34 µg/g) *Tier 2* *Porewater* 5/10 with elevated Cu *Tier 2* *Tissue* no exceedances in last 5 yrs *Actions: USEPA established a Cu TMDL for Lower Newport Bay in 2002*
RB assessment TMDL required	*Water and Sediments: RB staff assessment found exceedances of the dissolved Cu CTR criterion in water, and exceedances of the sediment Cu ERM guideline plus sediment toxicity in parts of the Lower Bay* *No tissue exceedances* *Cu was LISTED for Lower Newport Bay in 2006 based on the State Water Board's 303(d) assessment, and the State Water Board's 303(d) assessment for 2014-16 determined Cu to be Do Not Delist* *Based on this impairment assessment and State Water Board's approved 303(d) list for 2014-16, a TMDL is required for Cu in the Lower Bay* *Recommendations: Do Not Delist, TMDL required* *Actions: A revised Cu TMDL, including an implementation plan and schedule, should be developed for Cu based on exceedances of the dissolved Cu criteria, this TMDL should supersede USEPA's Cu TMDL; a more extensive marina survey is needed to fully assess the extent of sediment Cu exceedances & sediment toxicity in marina and boatyard areas; monitoring of Cu in water, sediment and fish/mussel tissue should continue*
Lead (Pb) (USEPA assessment)	*Sediments* 12% (5/30) > ERL (46.7µg/g) *Tier 2* No water or tissue exceedances Potential threat to LNB based on sediment data, and adjacent water impairment in Rhine Channel (exceedances of sediment ERM) *Actions: USEPA established a Pb TMDL for Lower Newport Bay in 2002*
RB assessment DNL, no TMDL	*Water and Sediments: RB staff assessment found no exceedances of the dissolved Pb CTR criterion nor the sediment Pb ERM guideline* *Fish tissue: There were no exceedances of the fish tissue guidelines* *Based on the State Water Board's 303(d) assessment in 2006, Pb was determined to be Do Not List (DNL), and the State Water Board's 303(d) assessment for 2014-16 again determined Pb to be Do Not List* *Rhine Channel dredged in 2011* *Based on this impairment assessment and State Water Board's approved 303(d) list for 2014-16, no listing (DNL) or TMDL is recommended for Pb in the Lower Bay. (No TMDL is recommended for Pb as there were no exceedances of the criteria in water and sediment impairment could not be determined.)* *Recommendations: DNL, no TMDL required* *Actions: Monitoring of Pb in water, sediment and fish/mussel tissue should continue,* *USEPA's Pb TMDL for Lower Newport Bay is no longer necessary*
Zinc (Zn) (USEPA assessment)	*Water* many exceedances of CTR criteria *probably Tier 2* *Sediments* 37% (14/48) > ERL (150 µg/g) *Tier 2* No tissue exceedances *Actions: USEPA established a TMDL for Zn for Lower Newport Bay in 2002*

RB assessment *LIST, no TMDL* *Action Plan*	*Water: RB staff assessment found no exceedances of the dissolved Zn CTR criterion* *Sediments: RB staff assessment found exceedances of the sediment Zn ERM plus sediment toxicity in parts of the Lower Bay* *Fish tissue: There were exceedances of the Zn fish tissue guideline for wildlife (10/36 fish, 1/2 mussels)* *Based on the State Water Board's 303(d) assessment in 2006, Zn was determined to be Do Not List (DNL), and the State Water Board's 303(d) assessment for 2014-16 again determined Zn to be Do Not List* *(Note that State Water Board did not use the same data as that used for this impairment assessment.)* *Based on this impairment assessment, Zn should be LISTED for fish tissue exceedances in parts of the Lower Bay;* *(No TMDL is recommended for Zn as there were no exceedances of the criteria in water and the finding of sediment impairment was based on older analysis methodology. In addition, sources to fish are not well-defined.)* *Note that USEPA's allocation for Zn in the Toxics TMDLs is an order of magnitude lower than Zn loads to Newport Bay* *Recommendations: LIST, no TMDL required* *Actions: Further investigation is needed for Zn based on exceedances of the sediment ERM and fish tissue guideline for wildlife in the Lower Bay and should include a source analysis;* *a more extensive marina survey to fully assess the extent of sediment Zn exceedances & sediment toxicity in marina and boatyard areas;* *monitoring of Zn in water, sediment and fish/mussel tissue especially the monitoring of sediments (in and near marinas and boatyards);* *other actions such as an assessment of Zn loads from Zn anodes,* *USEPA's Zn TMDL for Lower Newport Bay is no longer necessary*
Cadmium (Cd) (USEPA assessment)	**Sediments* 30% (8/27) >low SQGs (ERL) (1.2 µg/g) *Tier 2* No water or tissue exceedances *No TMDL*
RB assessment *DNL, no TMDL*	*Water and Sediments: RB staff assessment found no exceedances of the dissolved Cd CTR criterion nor the sediment Cd ERM guideline* *Fish tissue: There were a small number of exceedances of the Cd fish tissue guideline for wildlife (0/36 fish, 2/2 mussels)* *Based on the State Water Board's 303(d) assessment in 2006, Cd was determined to be Do Not List (DNL), and the State Water Board's 303(d) assessment for 2014-16 again determined Cd to be Do Not List* *Based on this impairment assessment and State Water Board's approved 303(d) list for 2014-16, no listing (DNL) or TMDL is recommended for Cd in the Lower Bay* *Recommendations: DNL, no TMDL required* *Actions: Monitoring of Cd in water, sediment and fish/mussel tissue (especially mussels) should continue*
Mercury (Hg) (USEPA assessment)	*Sediments* 36% (5/14) >ERL *Tier 2* No water or tissue exceedances *No TMDL*

RB assessment LIST, no TMDL Action Plan	*Water: RB staff assessment found no exceedances of the dissolved Hg CTR criterion* *Sediments: RB staff assessment found exceedances of the sediment Hg ERM plus sediment toxicity, especially in parts of the Lower Bay* *Fish tissue: There was one exceedance of the higher fish tissue guideline for methyl Hg for wildlife in a small data set* *The State Water Board's 303(d) assessment for 2014-16 determined Hg to be Do Not List* *Based on this impairment assessment and State Water Board's approved 303(d) list for 2014-16, no listing (DNL) or TMDL is recommended for Hg in the Lower Bay. (No TMDL is recommended for Hg/methyl Hg as there were no exceedances of the criteria in water and sediment impairment could not be determined.)* *Recommendations: DNL, no TMDL required* *Actions: Further investigation is needed for Hg based on exceedances of the sediment ERM and fish tissue guideline for wildlife in the Lower Bay and should include a source analysis;* *a more extensive marina survey to fully assess the extent of sediment Hg exceedances & sediment toxicity in marina and boatyard areas;* *monitoring of Hg in water, sediment and fish/mussel tissue s especially the monitoring of sediments (in and near marinas and boatyards);* *other actions such as dredging to remediate sediment Hg impairment*
Arsenic (As) (USEPA assessment)	*Sediments* 68% (17/25) > ERL *Tier 2* No water or tissue exceedances *No TMDL*
RB assessment LIST, no TMDL Action Plan	*Water and Sediments: RB staff assessment found no exceedances of the dissolved As CTR criterion nor the sediment As ERM guideline* *Fish tissue: There were exceedances of the lower inorganic As fish tissue guideline for human health in mussels in a small data set* *Based on this impairment assessment, As should be LISTED for fish tissue exceedances in the Lower Bay; no TMDL is recommended as As does not exceed criteria/guidelines in water or sediment and sources of As to fish are not well-defined.* *The State Water Board's 303(d) assessment for 2014-16; determined As to be Do Not List but did not use the same data that was used for this impairment assessment.* *Recommendations: LIST, no TMDL required* *Actions: Further investigation, including a source analysis and continued monitoring, is recommended for As based on exceedances of the fish tissue guideline for human health; monitoring of As in water, sediment and fish/mussel tissue should continue*
Chromium (Cr) (USEPA assessment)	No water exceedances *Sediment* 4% (1/27) >ERL *Tissue* 20% (2/10) > screening value *Tier 2* *No TMDL*
RB assessment LIST, no TMDL Action Plan	*Water and Sediments: RB staff assessment found no exceedances of the dissolved Cr CTR criterion nor the sediment Cr ERM guideline* *Fish tissue: There were exceedances of the Cr fish tissue guideline for wildlife in a majority of fish samples*

	No TMDL. Based on this impairment assessment, a TMDL is not needed for Cr *Based on this impairment assessment, Cr should be LISTED for fish tissue exceedances in the Lower Bay; no TMDL is recommended as Cr does not exceed criteria/guidelines in water or sediment and sources of Cr to fish are not well-defined* *The State Water Board's 303(d) assessment for 2014-16; determined Cr to be Do Not List but did not use the same data that was used for this impairment assessment.* *Recommendations: LIST, no TMDL required* *Actions: Further investigation, including a source analysis and continued monitoring, is needed for Cr based on exceedances of the fish tissue guideline for wildlife; monitoring of Cr in water, sediment and fish/mussel tissue should continue*

*Actual numbers of exceedances are shown in Tables 4-10, 4-11, 4-12 and Section 4.2.2

Table 4-14 Summary of Recommendations for Metals in Upper and Lower Newport Bay for 303(d) List and TMDL actions

Upper Newport Bay	
Metals	**Recommended Actions**
Copper (Cu)	**DO NOT DELIST for dissolved Cu** TMDL is required for the Upper Bay (dissolved Cu exceedances in water) TMDL should supersede USEPA's Cu TMDL for the Upper Bay
Lead (Pb)	Do Not List, No TMDL required (no exceedances in water, sediment, fish tissue) USEPA's Pb TMDL for the Upper Bay is no longer necessary
Zinc (Zn)	Do Not List, No TMDL required (no exceedances in water, sediment; fish tissue exceedances insufficient to list) USEPA's Zn TMDL in the Upper Bay is no longer necessary
Cadmium (Cd)	Do Not List, No TMDL required (no exceedances in water, sediment; fish tissue exceedances insufficient to list) USEPA's Cd TMDL for the Upper Bay is no longer necessary
Mercury (Hg)	Do Not List, No TMDL required (no exceedances in water, sediment; fish tissue exceedances insufficient to list)
Arsenic (As)	LIST (fish tissue –human health) No TMDL required (no exceedances in water, sediment) Further investigation, including monitoring and source analysis
Chromium (Cr)	LIST (fish tissue -wildlife) No TMDL required (no exceedances in water, sediment) Further investigation, including monitoring and source analysis
Lower Newport Bay	
Metals	**Recommended Actions**
Copper (Cu)	**DO NOT DELIST for dissolved Cu** TMDL is required for the Lower Bay (exceedances in water) TMDL should supersede USEPA's Cu TMDL in the Lower Bay
Lead (Pb)	Do Not List, No TMDL required (no exceedances in water, sediment, fish tissue) USEPA Pb TMDL for the Lower Bay is no longer necessary
Zinc (Zn)	LIST (fish tissue) No TMDL required (sediment exceedances of ERM guideline but not paired with toxicity (and not based on new SQO guidelines) also USEPA Zn allocations are much higher than Zn inputs) Further investigation, including monitoring and source analysis USEPA's Zn TMDL for the Lower Bay is no longer necessary
Mercury (Hg)	Do Not List No TMDL required (sediment exceedances of ERM guideline but not paired with toxicity (and not based on new SQO guidelines) Further investigation
Arsenic (As)	LIST (fish tissue –human health) No TMDL required (no exceedances in water, sediment) Further investigation, including monitoring and source analysis
Cadmium (Cd)	Do Not List, No TMDL required (no exceedances in water, sediment; fish tissue exceedances insufficient to list)
Chromium (Cr)	LIST (fish tissue -wildlife) No TMDL required (no exceedances in water, sediment) Further investigation, including monitoring and source analysis
San Diego Creek	
Copper, Lead, Zinc, Cadmium	Cu, Pb, Zn, Cd were delisted in 2010* USEPA's TMDLs for Cu, Pb, Zn, Cd in San Diego Creek are no longer necessary

*Based on the SB assessment, Reaches 1 and 2 were delisted for metals and no individual metals were listed in 2010. USEPA should rescind TMDLs for Cd, Cu, Pb, Zn in San Diego Creek. (see Section 3.3, 3.4)

4.3 PROBLEM STATEMENT AND IMPAIRMENT ASSESSMENT CONCLUSIONS AND RECOMMENDATIONS

4.3.1 Problem Statement

Newport Bay was listed as an impaired water body for metals on the State's 2002 303(d) list based on water quality monitoring data and state mussel watch data; and in 2002 USEPA established TMDLs for copper (Cu), lead (Pb), zinc (Zn) and cadmium (Cd) in the Upper Bay and Cu, Pb and Zn in the Lower Bay. Sediment metal concentrations exceeded the Effects Range Median (ERM) sediment guidelines (NOAA 1999, 2008), and sediment toxicity was found in sediment samples across the Upper and Lower Bay (Bight 1998, 2003). Increased Cu and Zn concentrations were found in mussels in the Lower Bay. Cadmium (Cd), Cu, ~~lead (Pb)~~ and Zn are known to bioaccumulate in benthic organisms, but do not generally biomagnify up the food chain; however, more recent studies have shown that sublethal Cu concentrations in water can be harmful to salmonids. The concentrations of heavy metals in aquatic plants in Newport Bay have not been documented, although Allen et al (2008) tested concentrations in algae (section 4.2.2.5).

In 2006, the State Water Board assessed individual metals in Newport Bay and listed the Upper and Lower Bay as impaired for dissolved Cu. *No other individual metals were listed based on the State Water Board assessment*, although USEPA's 2002 TMDLs are still in place.
Newport Bay continues to be listed as impaired for dissolved Cu in both the 2014-2016 and 2018 303(d) Lists. Both the Upper and Lower Bay have been delisted for the general metals category.

4.3.2 Impairment Assessment Conclusions and Recommendations

This metals impairment assessment for Newport Bay is based on data collected after 2002 and will result in a revision of the Cu TMDLs established by USEPA in the Newport Bay Toxics TMDLs (2002) (Table 4-14). A summary of impairment is shown below and in Table 4-14 above.

Metals causing impairment in water.

Metals exceeding the dissolved metals CTR saltwater criteria include only dissolved copper (Cu) in both Upper and Lower Newport Bay (Table 4-10). This finding agrees with the 2014-16 303(d) determination of Do Not Delist for dissolved Cu in both Upper and Lower Newport Bay. TMDLs are required for Cu.

Metals causing impairment/potential impairment in sediments.

Metals exceeding the ERM sediment quality guidelines (plus sediment toxicity), include Cu, Zn and mercury (Hg) in parts of Lower Newport Bay, particularly in the Turning Basin/South Lido Channel areas (Table 4-10). In addition, sediment toxicity is present in areas where Cu, Zn and Hg exceed the ERM guidelines. The presence of toxicity was not paired with ERM exceedences; therefore, sediments were not determined to be impaired[4]. Since sediments were evaluated using an older methodology, monitoring and evaluation are required pursuant to the Enclosed Bays and Estuaries Plan –Sediment Quality Provisions.
In addition, a more extensive marina survey is needed to fully assess the extent of sediment Zn exceedances and sediment toxicity in marina and boatyard areas.

Note that all sampling sites (except two County monitoring sites) were in marinas and areas of the Lower Bay that were not dredged in 2012. A post-dredge study in the Lower Bay showed that sediment Cu exceeded the ERM guideline in up to 20.5% of the samples and exceeded the ERL guideline at ALL sites and for ALL sampling periods (October, March, August) in both post-dredge sites and marina/Turning Basin sites sampled (Metals Sediment Study in Lower Newport Bay,

[4] State Water Board staff's interpretation of the State Listing Policy now determines impairment of sediments by SQO methodology or the exceedance of the ERM(s) plus sediment toxicity.

Coastkeeper and Candelaria 2014). In addition, sediment Cu exceeded the ERM guideline in the marina/Turning Basin sites. Note that only a subset of marinas from the Cu-Metals Marina Study was sampled in this study. A more extensive marina survey is needed to fully assess sediment quality and sediment Cu concentrations in marina and boatyard areas in Newport Bay.

Metals causing impairment in fish and/or mussel tissue.

Metals that exceeded guidelines for fish and/or mussel tissue include arsenic (As), and chromium (Cr) in the Upper Bay; and As, Cr and Zn in the Lower Bay (Table 4-11). (As) exceeded the lower human health guideline, while Cr and Zn exceeded the wildlife guidelines.

Cadmium (Cd) also exceeded the wildlife guideline in a small data set of mussels in the Upper and Lower Bay but not in fish; and no listing is recommended at this time.

Human health

Arsenic (As) exceeded the lower human health guideline (0.026 µg/g ww) in all fish filets (8) and mussels (4/4 samples). Fish filets were collected in the Upper Bay only.

Wildlife

The wildlife guidelines were exceeded for Cr (2.5 µg/g ww) in most fish (26/31, 18/32) in the Upper and Lower Bay, respectively, in Allen's study (2008) but not in DFG's study (2006); and for Zn in 10/36 fish and 1/2 mussel samples in the Lower Bay (Allen 2008, DFG 2006) (Table 4-11). Cd exceeded the fish tissue guideline (0.1 µg/g ww) in 4/4 mussel samples in the Upper and Lower Bay, but not in fish.

Cr exceeded the guideline for wildlife in both resident and open water fish that were collected in Newport Bay. Residency is an issue with fish tissue exceedances with respect to sources of contaminants in fish tissue. Zn exceeded the guideline for wildlife in topsmelt and mussels. Sources may include sediments for As, Cr and Zn in the Lower Bay, and algae for Cr and As (Allen 2008).

Table 4-14 shows an impairment summary and recommended actions by metal.
Actions include 303(d) listing (LIST) or do not list (DNL), source analysis, and monitoring and action recommendations. Based on this impairment assessment, Cu is the only metal that requires a TMDL. Further investigations are recommended for Zn, Hg, As and Cr since these metals are recommended for 303(d) listing but sources are not well-defined and TMDLs are infeasibleat this time).

Zn and Hg also require further investigation due to sediment exceedances and sediment toxicity in parts of the Lower Bay; however, a TMDL is not recommended at this time since sediments are not considered to be impaired (since the data were insufficient to assess by SQO methodology (Sediment Quality Provisions). The data do exceed the ERM guidelines for Zn and Hg, however, and continued monitoring and evaluation are required. In addition, Zn should be listed for fish tissue exceedances in the Lower Bay.

As and Cr require 303(d) listing due to fish tissue exceedances of the lower human health guideline (As) and the wildlife guideline (Cr). TMDLs are not recommended at this time since there are no As nor Cr exceedances of the water or sediment criteria/guidelines, and a source analysis is needed for both As and Cr.

4.4 NEWER COPPER (Cu) DATA

4.4.1 State Water Board's 303(d) Assessment (2014-2016, 2018)

The 2014-2016 303(d) list of impaired waters approved by the State Water Board and the USEPA is the most recent and applicable list of those waters. *This assessment shows that dissolved copper (Cu) continues to exceed the CTR chronic criterion and confirms the need for Cu TMDLs for both Upper and Lower Newport Bay.*

Based on the 2014-16 303(d) State Water Board assessment, both Upper and Lower Newport Bay were determined to be DO NOT DELIST for Cu and toxicity (Table 3-4). (The 2018 303(d) list did not include updates for the Santa Ana Region, but Newport Bay continues to be listed as impaired due to dissolved Cu.) The weight of available data and information demonstrates that both the Upper and Lower Bay should continue to be included on the CWA section 303(d) List. The 303(d) listing of both Upper and Lower Newport Bay for dissolved Cu alone requires Cu TMDLs for both the Upper and Lower Bay.

Since Cu continues to exceed the CTR chronic criterion in both Upper and Lower Newport Bay and these water bodies are 303(d) listed, Cu TMDLs are required to address these exceedances/listings.

4.4.2 Department of Pesticide Regulation (DPR) Monitoring Study (Summer 2019)

DPR's latest monitoring study (August 2019) also showed impairment for dissolved Cu in Lower Newport Bay since dissolved Cu exceeded the CTR criterion in 50% of the samples.

DPR established a regulation for a maximum allowable leach rate (9.5 µg/cm^2/d) for Cu antifouling paints (AFPs) on recreational boats that went into effect on July 1, 2018 (DPR 2018). Since the regulation went into effect, DPR has been~~is~~ conducting a monitoring study in marinas across California to determine dissolved Cu concentrations and evaluating those data with respect to the dissolved Cu CTR chronic criterion (3.1 µg/L). The study will also determine the temporal and spatial trends within and across marina sites and determine the potential toxicity of samples using the saltwater Biotic Ligand Model. Eight Marina sites were selected in both northern and southern California, and include Lower Newport Bay harbor, Marina del Rey (Los Angeles) and Shelter Island Yacht Basin.

The first monitoring event was conducted in summer 2019. In Lower Newport Bay, dissolved Cu concentrations ranged from 1.49 to 6.02 µg/L, and 8/16 samples (50%) exceeded the dissolved Cu CTR criterion. These data demonstrate continued impairment in the Lower Bay for dissolved Cu. Future monitoring events will be scheduled when the COVID-19 danger is better contained. .

4.4.3 Anchor QEA Study for City of Newport Beach (2015 - 2016, 2019)

Anchor QEA's studies for the City of Newport Beach also showed that the Lower Bay continues to be impaired for dissolved Cu, since approximately 30% and 14% of the samples exceeded the CTR chronic criterion in the 2015-2016 and 2019 studies, respectively.

Anchor QEA's Newport Bay Cu studies~~y~~ were~~was~~ conducted on behalf of the City of Newport Beach. Water samples were collected in the Lower Bay in June 2015 and February 2016. Water samples were collected at mid-depth from 40 random water sites and analyzed for dissolved Cu.

The June 2015 data showed that dissolved Cu exceeded the CTR criterion in 18/40 samples (Attachment 4, City of Newport Beach October 2016). The February 2016 study resampled the 40 sites from June 2015, and water samples were again collected at mid-depth. The February 2016 data showed that dissolved Cu exceeded the CTR criterion in 10/40 samples (Attachment 5, City of Newport Beach Comments, October 2016).

The combined data set from February 2016 and June 2015 showed that 28/80 samples exceeded the dissolved Cu CTR chronic criterion. The SLP requires only 7 exceedances in 80 to determine impairment and place a waterbody on USEPA's 303(d) list; therefore, ***these data show that Lower Newport Bay is still impaired for dissolved Cu.***

The 2016 study also included 14 water samples taken at several distances from 2 boats and collected at a depth of 1 ft. from the surface. (Note that samples are not normally collected at a depth of 1 ft. from the surface since samples can be affected by surface disturbances such as wind and debris.) The data from these water samples showed no exceedances of the dissolved Cu CTR criterion.

Anchor's QEA 2019 data show continued impairment for dissolved Cu in Lower Newport Bay, since 4/29 samples exceeded the CTR chronic criterion. This study was conducted concurrently with DPR's sampling in Lower Newport Bay, and Anchor did not collect duplicate samples from the sites that DPR collected samples.

5.0 COPPER (Cu) TMDLS

Dissolved Copper (Cu) impairment was found in water in Upper and Lower Newport Bay; therefore, TMDLs are required for dissolved Cu in Upper and Lower Newport Bay (Sections 4.2.3 and 4.3). When approved, these Cu TMDLs will supersede the Cu TMDLs established by the U.S. Environmental Protection Agency (USEPA) in 2002 as part of the Toxics TMDLs for San Diego Creek and Newport Bay. These Cu TMDLs must include both dissolved and sediment Cu targets to supersede USEPA's Cu TMDLs. The Cu TMDLs only address Cu impairment in Newport Bay as San Diego Creek is no longer listed for the general category of metals (and Cu was never listed individually) (Appendix 2); however, San Diego Creek and the Santa Ana Delhi will both be addressed as sources of Cu to Newport Bay. Note that sediment Cu also exceeded the ERM guideline, but exceedances were not paired with toxicity; therefore, sediment impairment could not be determined without further sampling.
The Cu TMDLs include the required TMDL components 1) Problem Statement, 2) Numeric Targets for Cu, 3) Source Analysis, 4) Loading Capacity and Linkage Analysis, 5) WLA and LA Load Allocations, Seasonal Variations and a Margin of Safety, 6) Implementation Plan, and 7) Monitoring and Evaluation Plan.

These Cu TMDLs will allow time to implement the tasks with an interim schedule and are to be achieved *as soon as possible but no later than 12 years from the date of approval by USEPA*. These TMDLs include an implementation plan with a schedule to achieve compliance with the TMDLs. A monitoring and evaluation program will be included as part of the implementation plan to determine the progress of achieving these TMDLs.

5.1 PROBLEM STATEMENT

The Problem Statement is described in Section 4.3 and summarized below.

Santa Ana Water Board staff conducted an Impairment Assessment and evaluated more recent data (2002-2012) than the data assessed by USEPA. Santa Ana Water Board staff's Implairment Assessment showed that Upper and Lower Newport Bay are still impaired for dissolved Cu in water based on exceedances of the California Toxics Rule (CTR) saltwater chronic criterion (3.1µg/L). Sediment Cu concentrations exceeded the ERM (Effects Range Median) guideline of 270µg/g in the Lower Bay (Metals Impairment Assessment -Section 4.0). Sediment Zn and Hg also exceeded their respective ERMs. In addition, sediment toxicity was present in areas where sediment Cu exceeded the ERM but sediment chemistry samples were not paired with toxicity samples; therefore, sediment impairment could not be determined. (Paired chemistry and toxicity data are necessary to list for impairment based on ERM/toxicity results (State Listing Policy).) More recent data, including studies by DPR (2019) and Anchor QEA (for the City of Newport Beach) (2015-2016, 2019) showed continued impairment for dissolved Cu in Lower Newport Bay.

These Cu TMDLs address dissolved Cu impairment and exceedances of the sediment Cu ERM guideline (Table 4-10), and, if approved, will supersede the Cu TMDLs for Upper and Lower Newport Bay established by USEPA (2002). Continued monitoring and evaluation of Cu are required by these TMDLs.

Impairment Assessment Results (Staff Report 2022)

Water. Both Upper and Lower Newport Bay, including marinas, are impaired for dissolved Cu based on exceedances of the dissolved Cu California Toxics Rule (CTR) saltwater chronic and acute criteria (USEPA 2000); therefore, Cu TMDLs continue to be required.

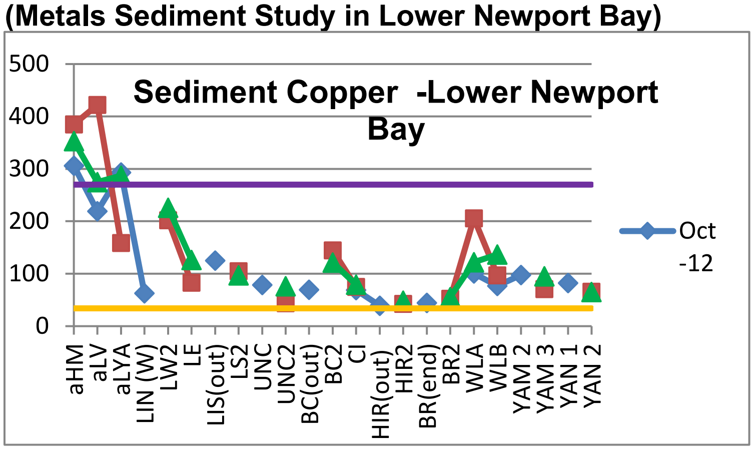
Sediments. Sediment Cu exceeded the Cu ERM (Effects Range Median) sediment guideline in surface sediments in the Lower Bay, particularly in marinas and the Turning Basin/South Lido

Channel areas (Table 4-10, Figure 5-1). Sediment toxicity was also found in the Upper and Lower Bay in multiple studies, but toxicity data were not paired with exceedances of the sediment Cu ERM. Since only a subset of marinas was sampled in the Cu-Metals Marina Study (4.2.2.1), a more extensive marina survey is needed to fully assess the extent of sediment Cu exceedances and sediment toxicity in marina and boatyard areas in Newport Bay.

A post-dredge study in the Lower Bay showed that sediment Cu exceeded the ERM guideline in up to 20.5% of the samples and exceeded the ERL guideline at ALL sites and for ALL sampling periods (October, March, August) in both post-dredge sites and marina/Turning Basin sites sampled in this study (Metals Sediment Study in Lower Newport Bay, Coastkeeper and Candelaria 2014. Note that only a subset of marinas from the Cu-Metals Marina Study was sampled in this study. A more extensive marina survey is needed to fully assess sediment quality and sediment Cu concentrations in marina and boatyard areas in Newport Bay.

Fish tissue. Cu did not exceed the fish/mussel tissue guidelines for human health or wildlife.

Figure 5.1 Sediment Copper (Cu) exceedances of ERM and ERL guidelines (Metals Sediment Study in Lower Newport Bay)



Marina sites =aHM (Harbor Marina, aLV (Lido Village), aLYA (Lido Yacht Anchorage)
Sediment guidelines Purple line =ERM (270 µg/g), Yellow line =ERL (34 µg/g)

Recommendations to address Copper (Cu) impairment

303(d) Listing. Upper and Lower Newport Bay are both 303(d) listed for dissolved copper (Cu).

TMDLs. Copper (Cu) TMDLs are required for both Upper and Lower Newport Bay. Revised Cu TMDLs for the Upper and Lower Bay have been developed by Santa Ana Water Board staff and include an Implementation Plan and Schedule. If approved, the revised Cu TMDLs will supersede the Cu TMDLs established by USEPA in 2002.

Actions. Monitoring of Cu should continue in both water and sediments.
Cu from antifouling paints (AFPs) on boats is the largest source of Cu to Newport Bay; therefore, Cu discharges from boats must be reduced to achieve these Cu TMDLs.
DPR's regulation for a maximum leach rate for Cu AFPs went into effect on July 1, 2018, and was required to be implemented by ~~in~~ mid-2020. Some reduction of Cu discharges from Cu AFPs on boats should result if Cu AFPs with higher leach rates are replaced with lower leach rate Cu AFPs as required by DPR (DPR 2018). In addition, some boats may need to be converted from Cu to non-biocide AFPs.

Recommendations are further discussed in the Implementation Section of these Cu TMDLs (Section 5.6).

5.2 NUMERIC TARGETS FOR DISSOLVED COPPER (Cu), AND NUMERIC AND ALTERNATIVE TARGETS FOR SEDIMENT Cu

These Copper (Cu) TMDLs include both dissolved Cu targets, and sediment Cu numeric and alternative targets, shown in the tables below.

1) The numeric targets for dissolved Cu are the California Toxics Rule (CTR) saltwater criteria for dissolved Cu (chronic 3.1µg/L and acute 4.8 µg/L) (USEPA 2000). (See Table 5-1a below.)

2) The targets for sediment Cu are both numeric and alternative targets; the alternative sediment quality objectives (SQOs) target may be achieved as an alternative to the numeric sediment Cu target. (See Table 5-1b below.)

The sediment Cu targets are as follows:
(2-1) The sediment Cu numeric target is the Effects Range Low (ERL) guideline (34 µg/g) from NOAA SQuiRTS (1999, 2008), and
(2-2) the alternative sediment Cu SQOs target is the sediment quality condition of Unimpacted or Likely Unimpacted, determined by chemistry, toxicity and benthic analyses (per the SQOs methodology specified in the State Water Board's Sediment Quality Provisions (SWRCB 2018)). If the condition of Unimpacted or Likely Unimpacted is met, the alternative sediment Cu SQOs target is achieved. If the condition of Unimpacted or Likely Unimpacted is not demonstrated, then stressor identification analyses must be conducted per the SQOs methodology (Sediment Quality Provisions) to determine whether Cu is the cause of the impacted condition. If Cu is not shown to be the cause of the impacted condition, the alternative sediment Cu SQOs target is achieved. (See also Table 5-8 – Implementation Plan, Tasks 1.1.2, 2.0, 2.1.)

Table 5-1a Numeric Targets for Dissolved Copper (Cu) in Newport Bay (Table 1 in the BPA)	
Dissolved Cu CTR saltwater criteria[1]	
acute	**chronic**
4.8 (µg/L)	**3.1 (µg/L)**

[1]The numeric targets are the dissolved Cu California Toxics Rule (CTR) saltwater criteria. Compliance with these TMDLs requires that the more restrictive chronic numeric target (3.1 µg/L) is achieved, per State Listing Policy methodology. The CTR saltwater criteria assume a Water Effects Ratio (WER) of 1 (USEPA 2000). (If a different WER is approved for Newport Bay, these criteria and numeric targets for dissolved Cu will change accordingly. The numeric targets will also change accordingly if a dissolved Cu chronic site-specific objective (SSO) is approved.)

Table 5-1b Numeric and Alternative Targets for Sediment Copper (Cu) in Newport Bay (Table 2 in the BPA)	
Sediment Cu Numeric Target **Effects Range Low (ERL)** [1]	***Alternative Sediment Quality Objectives (SQOs) Target***
34 (µg/g)	**Sediment Quality Condition of Unimpacted or Likely Unimpacted**[2]

[1]The sediment Cu numeric target is the Effects Range Low (ERL) from NOAA SQuiRTS (1999, 2008).
[2]The alternative sediment Cu SQOs target is the sediment quality condition of Unimpacted or Likely Unimpacted determined by conducting a sediment assessment using the multiple lines of evidence approach (SQOs methodology) specified in the State Water Board's Sediment Quality Provisions (2018). If the condition of Unimpacted or Likely Unimpacted is not demonstrated, further analyses must be conducted per the SQOs methodology to determine whether Cu is the cause of the impacted condition. If Cu is not shown to be the cause of the impacted condition, the alternative sediment Cu SQOs target is achieved.

5.3 SOURCE ANALYSIS FOR COPPER (Cu)

Known sources of Cu include 1) Cu antifouling paints (AFPs) on boat hulls and runoff from boatyards, 2) tributary runoff (i.e., direct discharges of runoff (urban and agricultural) from major tributaries, and upstream sub-watersheds into the Bay), 3) storm drain runoff (i.e. urban runoff from storm drains that empty directly into Newport Bay), and 4) air deposition. Cu AFPs are the largest sources of Cu to the Bay, and Cu discharges from Cu AFPs are six (6) times higher than the second largest source which is runoff from the major tributaries. Cu loads in storm drain runoff are small compared to the two largest sources but may be important in localized areas near storm drains. Bay sediments may also be a source of Cu to Bay waters although their contribution was not quantified in this report or USEPA's Toxics TMDLs for metals as no studies have been conducted on Cu loads from Bay sediments (Table 5-2). In addition, algae and other vegetation may contain Cu; however, these sources have not been quantified.

5.3.1 Recreational boats and boatyards

Dissolved Cu. According to USEPA's Toxics TMDLs, Cu AFPs are the largest sources of Cu to Newport Bay, and their estimated contribution was calculated to be approximately 50,000 lbs of dissolved Cu per year to Newport Bay from both passive leaching and hull cleaning[5] (Table 5-2, USEPA 2002). Passive leaching occurs when a boat is docked in the water since Cu AFPs are designed to leach Cu into the water to reduce the fouling of boat bottoms with barnacles and algae. Cu is also discharged into the water when boat hulls are cleaned by divers, usually by scrubbing with soft or abrasive pads (BMPs[6] vs non-BMPs, respectively). This cleaning creates a plume of Cu, both dissolved and particulate, with more abrasive pads resulting in a higher discharge of Cu. In addition, the passive leaching of Cu from Cu AFPs increases for a time right after the hull cleaning until the hull surface becomes slightly fouled again. Santa Ana Water Board staff calculated the contribution of Cu from Cu AFPs to be approximately 18,000 lbs of dissolved Cu per year in these Cu TMDLs based on a count of approximately 5,000 boats in Lower and lower Upper Newport Bay. (See Appendix 6 for all calculations.)

[5]This estimate is based on a boat count of approximately 10,000 boats in Newport Bay (USEPA 2002).
[6] BMPs = best management practices.

The dissolved Cu loading from boats calculated by USEPA for passive leaching and hull cleaning was approximately 55 and 45%, respectively, of the total Cu loading to the Bay, and Santa Ana Water Board staff's original calculations for these Cu TMDLs followed USEPA's equations (Appendix 6.1.2). A recently published study by the U.S. Navy, however, determined that the contribution of dissolved Cu from hull cleaning was much smaller than that shown in the Toxics TMDLs (Earley et al, 2013). The Earley study measured Cu discharges from passive leaching and hull cleaning together and determined a three-year life cycle Cu load for two paints (a Cu epoxy and Cu ablative AFP). Note, however, that while the Cu loading from a cleaning event is a fraction of the total Cu loading from Cu AFPs, a cleaning event results in a fresh hull surface which then leaches Cu at a higher leach rate than when the hull is fouled. These Cu TMDLs followed the calculations of the Earley study since this study used the most up-to-date scientific methodology (Appendix 6.1.1).

Particulate Cu. Boat hulls are also a source of particulate Cu during hull cleaning; however, the loading of particulate Cu was not calculated for these Cu TMDLs since the CTR criteria are based on dissolved Cu. Note, however, that particulate Cu may contribute to the dissolved Cu load through dissolution and re-equilibration, especially during hull cleaning. Particulate Cu also contributes to Cu loading in general, as particles settle to the sediments. This results in increased sediment Cu concentrations that may also cause toxicity to aquatic and benthic organisms.

A study in Shelter Island Yacht Basin showed that estimates of particulate Cu, compared to dissolved Cu, discharged during hull cleaning events may be up to 6 times higher for modified epoxy paints, and up to 28 times higher for hard vinyl paints from hulls cleaned after one month of application (Brown and Schottle 2006). Particulate Cu discharges were even higher for hulls cleaned after 3 months compared to 1 month, and particulate Cu was estimated to be approximately 2 pounds per boat per year. The Earley et al. study, described above, showed that particulate Cu discharged from epoxy paints increased from 16 to 25% for BMPs and non-BMPs, respectively.

Passive leaching may be reduced by using slip liners or storing boats in dry dock; and discharges from hull cleaning may be reduced by divers using soft pads for cleaning boat hulls or the container/filter method for hull cleaning, or by decreasing the frequency of cleaning or by cleaning boat hulls out of the water.

Boatyards. Boatyards are another potential source of Cu to Newport Bay since boat hulls are cleaned, scraped and sandblasted, and there is a potential for the discharge of particulates and runoff into the Bay; however, the discharge of these process wastes is prohibited under the State Water Board's Industrial General Permit (IGP). The IGP specifies requirements to control pollutants, including Cu, in stormwater discharges from boatyards and other industrial facilities. Common metal containing products used in boat activities include AFPs, pesticides and wood preservatives. Cu can also enter the Bay during uncontrolled pressure washing, painting, antifouling or fueling activities.

Table 5-2 Summary of Copper (Cu) Loads to Newport Bay			
	Dissolved Cu (lbs/yr) Cu TMDLs	**Percent (%) of Total^ Cu TMDLs**	**Cu (lbs/yr) (USEPA's Toxics TMDLs)***
Boats[1]	*18,000[1a]*	81.1	50,114[1a]
Tributary runoff [2]	*3005 (548)*	13.5	7020
Storm drain runoff [3]	*303*	1.4	ND
Air deposition[4]	101	0.46	101
Ambient seawater[5]	777	3.5	777
Bay Sediments[6]	Unknown	-	Unknown
Total	**22,186**	**100%^**	**58,012[7]**

*Data from USEPA's Toxics TMDLs are included for comparison only. (See Table E-11 -Part E, USEPA's Toxics TMDLs, (USEPA 2002)).
Numbers in italics are different from those estimated by USEPA (Toxics TMDLs, 2002).
ND = no data
^Percents for separate loads do not total to exactly 100% due to rounding.
[1]Estimates of dissolved Cu load from boats (from passive leaching and hull cleaning) (Staff Report 2022 & USEPA Toxics TMDLs 2002).
[1a]Cu load estimate for boats is based on 5,000 boats/slips and an average boat size of 40 ft. (USEPA used an estimate of 10,000 boats/slips.)
[2]Dissolved Cu load in tributary runoff (freshwater) was estimated from total Cu in storm water samples from San Diego Creek and Santa Ana Delhi for 2009-10 and 2010-11 monitoring data (County of Orange). (Dissolved Cu =Total Cu x 0.80). Number in parentheses indicates dissolved Cu load in runoff for the two driest years (2006-07, 2007-08). USEPA's estimate was from County of Orange monitoring data for San Diego Creek and Santa Ana-Delhi (OCPFRD 2000).
[3]Dissolved Cu loads from storm drains (mean of 139lbs (2007), 468lbs (2008) at runoff coefficient of 0.9) were calculated from Lower Newport Bay Storm drain study data.
[4]Estimate for direct deposition of Cu to surface waters of Newport Bay (USEPA's Toxics TMDLs, Part E, sect. IV 2002).
[5]Estimate of dissolved Cu loads from ocean based on local data (R. Gossett) x approximate ocean volume into Newport Bay (USEPA 2002).
[6]Cu load to waters from bay sediments is unknown at this time, but it is likely lower than contributions from recreational boats and major tributaries.
[7]Cu Total was corrected from Total shown in Table E-11-Part E, USEPA's Toxics TMDLs (USEPA 2002).

5.3.2 Tributaries to Newport Bay (Freshwater)

Urban runoff enters the Bay via tributaries, storm drains or surface runoff. Metal loads to the Bay from storm water runoff can be significant in winter. In USEPA's Toxics TMDLs, urban runoff from the two largest tributaries (San Diego Creek and Santa Ana Delhi), was calculated to be the second largest source of dissolved Cu to Newport Bay (Table 5-2). In the Cu TMDLs, the dissolved Cu loads from San Diego Creek and Santa Ana Delhi were calculated from the total Cu loads from the County of Orange monitoring data for 2009-10 and 2010-11 (total Cu x 0.80), and tributary runoff was still the second largest source of dissolved Cu to Newport Bay (Table 5-2 and Appendix 6-2). Note that 2009-10 and 2010-11 were relatively wet years. Estimates for Cu loading from the tributaries are lower in drier years (Table 6.2.1, Appendix 6-2). Note also that the amount of dissolved Cu entering the Bay from tributaries is six times lower than dissolved Cu loads from boats (Table 5-2).

Calculations for these TMDLs show that Cu loads from the tributaries have decreased somewhat compared to USEPA's estimates in 2002 (Table 5-2). It is likely that these decreases are due to the decrease in sediment load to Newport Bay from these tributaries. Note that while the total Cu *loads* from San Diego Creek are several times larger than those from Santa Ana Delhi in storm water discharges and most dry discharges for respective years, total Cu *concentrations* in most storm and dry discharges are higher in the Delhi compared to the Creek (Appendix 6-2).

Storm water data show that significant amounts of metals enter the Bay with sediments, as well as in the dissolved form, but the fate and transport of metal-contaminated sediments carried in storm water and the movement of sediments within the Bay by tidal action is not well documented.

5.3.3 Storm drains (Freshwater)

Urban runoff from over 200 storms drains, mostly in Lower Newport Bay, also empties directly into Newport Bay. Dissolved Cu loads from storm drains were measured and are low compared to Cu loads discharged from boats and tributary runoff (Table 5-2). Dissolved Cu loads from storm drains were approximately 90 and 252lbs for 2007 and 2008, respectively (Storm Drain Study, Appendix 6.3).

5.3.4 Bay sediments

Dissolved Cu may adsorb to suspended particles and settle, form salt precipitates, or be flushed out of the Bay. Filter feeders, such as mollusks, may accumulate Cu from the water, while benthic organisms may ingest Cu in sediments. Cu may also cause toxicity in the sediments and/or pore water causing both lethal and sublethal reactions. Sediments serve as a sink for Cu and other metals but may also be a source releasing Cu back into the water if/when they are resuspended. Cu contributions to the water column from resuspended contaminated bay sediments are unknown, although a recent sediment study in the Lower Bay showed that dissolved Cu in bottom water samples did not exceed the CTR criterion in most samples (OC Coastkeeper and Candelaria, 2014).

Parts of the Lower Bay (3 areas) were dredged in Fall 2003, and parts of the Upper Bay were dredged in 2006. In addition, the Army Corps of Engineers (Corps) dredged a number of areas in Lower Newport Bay in 2012 and early 2013 (Appendix 4, Figure 4-3). Pre-dredging analyses were conducted for Lower Bay sediments; however, the Corps analyzed only homogenized cores and there are no data on Cu concentrations at specific depths for the cores examined. Originally, dredging was scheduled to occur down to clean sediment, but due to limited funds the dredge elevations were reduced. The result of these reduced dredge areas is that newly exposed sediments (now surface sediments) may be contaminated with metals, in particular Cu and mercury (Hg). These surface sediments are the sediments that will resuspend and potentially contribute contaminants, such as Cu, to the water column. A post-dredging study, to determine sediment and bottom water metals concentrations, was completed in Lower Newport Bay. This study was conducted in 2012 through early 2014 (OC Coastkeeper and Candelaria 2014).

Other data reviewed for these TMDLs include surface sediment data (Section 4.2.2); however, there are no studies in Newport Bay that measured the desorption of Cu (or other metals) from resuspended sediments.

5.3.5 Air deposition

Air deposition is also a source of Cu to Newport Bay, however, direct contributions to the Bay's surface are small (3.5lbs/yr, USEPA 2002). Deposition to the land surface that enters the Bay with runoff is likely to be larger; however, Cu loads from air deposition onto land surfaces enter the Bay in urban runoff from tributaries and storm drains and are included in the freshwater tributary loads (Table 5-2).

5.3.6 Algae and other vegetation

In Allen's Food Web Study (Allen 2008), it was demonstrated that some metals, including Cu, exceeded the fish tissue guidelines (for wildlife) in algae. Metal concentrations are not regularly determined in algae and plants that are food for wildlife and should be examined to determine whether algae and plants are a source of metals to wildlife.

5.4 LOADING CAPACITY AND LINKAGE ANALYSIS FOR COPPER (Cu)

In the 2002 Newport Bay Toxics TMDLs, USEPA outlined two methods, concentration and mass loading approaches, to define the metal loading capacity and the TMDLs for Cu.

Mass-based load allocations are used to set an upper limit on the **mass** of metals that are discharged into Newport Bay to prevent an accumulation of metals in the sediments which may then cause sediment or pore water toxicity. The mass-based allocations will assist in protecting benthic communities. Concentration-based load allocations are defined to prevent discharges of high pulses of metals in the short term so that water quality criteria are met on a regular basis. The concentration-based loading capacities are equivalent to the saltwater acute and chronic targets (CTR criteria) for dissolved metals.

The mass and concentration-based loading capacity for these Cu TMDLs are shown in Tables 5-3 and 5-4. Waste load allocations and load allocations were determined from the total mass-based allocations (Table 5-5). These Cu TMDLs use the same methodology that USEPA used in the Toxics TMDLs (USEPA 2002) to calculate loads, and the equations used in these TMDLs to calculate the mass-based loading capacity are based on USEPA's bathtub model approach (below). The bathtub model used by USEPA to determine the total loading capacity used parameters ~~is~~ from RMA's finite element ~~bathtub~~ model (RMA 1998).

The total allowable dissolved Cu by mass was calculated by multiplying the numeric target (CTR saltwater chronic criterion) by the volume of water in the Bay. The *mass loading capacity* of dissolved Cu was calculated as the mass of Cu that leaves the Bay minus the mass of Cu remaining in the Bay (Table 5-3). The *concentration-based loading capacity* of dissolved Cu is equivalent to the CTR saltwater acute and chronic criteria for dissolved Cu (Table 5-4).

Total allowable Dissolved Cu by mass =Bay volume x Criteria (C_c)
=129,850.09lbs

Dissolved Cu Mass Loading Capacity =$Mass_{out} - Mass_{in}$
=(Criteria *$Volume_{out}$) – $Mass_{in}$
$L_f + L_i = C_c * (Q_b + 1.25Av_sF_p) - Q_oC_o$
=14,473.056 g/d
=11,646.09 lbs/yr

Where
L_f =Dissolved Cu in Freshwater Inflow (lbs/yr)

L_i =Dissolved Cu Loading from Boats (lbs/yr)
C_c = -CTR Saltwater Chronic Criterion for Dissolved Cu
Q_b =Volume Mixed Water Leaving the Bay
A =Newport Bay Surface Area
v_s =Net Settling [as a velocity]
F_p =Particulate Fraction – *Estimated*
Q_o =Volume Ocean Water Entering the Bay
C_o =Dissolved Cu in the Ocean
Values and equations are found in USEPA's Toxics TMDLs – Part E, pp.19-20 (USEPA 2002)

Table 5-3 Mass-based Loading Capacity for Dissolved Copper (Cu) in Newport Bay

Dissolved Cu Loading Capacity	11,646 lbs/yr

Table 5-4 Concentration-based loading capacity* for Dissolved Copper (Cu) in Newport Bay

	Dissolved Cu saltwater acute loading capacity (µg/L)	**Dissolved Cu saltwater chronic loading capacity (µg/L)**
	4.8	3.1

*These concentration-based loading capacity values are equivalent to the CTR saltwater criteria for dissolved Cu and were used as numeric targets in USEPA's Toxics TMDLs (2002). These criteria assume a WER of 1 (USEPA 2000). If a different WER is approved for Newport Bay, the criteria and concentration-based loading capacity values will change accordingly. The loading capacity values will also change accordingly if a dissolved Cu chronic site-specific objective (SSO) is approved.

5.5 TMDLS, WASTE LOAD AND LOAD ALLOCATIONS, SEASONAL VARIATIONS AND MARGIN OF SAFETY FOR COPPER (Cu)

Sources of Cu loads into Newport Bay include recreational and commercial boats, storm water, urban runoff, and agricultural runoff. Cu loads are defined both as Cu concentrations and as mass-based loads. Mass-based loads for waste load allocations (WLAs) were estimated for urban runoff, CalTrans, other NPDES discharges (although the USEPA's Toxics TMDLs noted that there were insufficient data to develop accurate estimates to separate discharges in the "other" category), and boats. Mass-based loads for load allocations (LAs) were calculated for agricultural runoff, air deposition, and unidentified sources.

In USEPA's Toxics TMDLs, mass-based loads for dissolved metals were based on data prior to 2002. The total loading capacities were calculated using parameters from RMA's finite element model (RMA 1998). A margin of safety of 20 percent (%) was subtracted from the total loading capacity and the remaining loading capacity was divided between the waste load allocations (WLAs) and the load allocations (LAs).

In these Cu TMDLs, Cu load estimates for Newport Bay are based on data obtained since 2002 (in particular, the Cu freshwater loads from the major tributaries). The total loading capacity for dissolved Cu was calculated by RMA's finite element model as 11,646 pounds of dissolved Cu per year (lbs/yr), and is the same total loading capacity used by USEPA in the Toxics TMDLs (USEPA 2002, RMA 1998). A margin of safety (MOS) of 10 percent (%)[7] (revised from USEPA's 20%) was subtracted from the total loading capacity, and the remaining loading capacity was divided between the WLAs and the LAs (Table 5-5a). If new data were not available for designated sources for WLAs and LAs, the Cu allocations from USEPA's Toxics TMDLs were used (Tables E-10, E-11, USEPA 2002). Agricultural runoff and air deposition were calculated as 80% of USEPA's allocations using USEPA's dissolved/total translator of 80%, since some of USEPA's allocations were reported as total Cu rather than dissolved Cu concentrations.

For freshwater discharges into the Bay, the mean Cu discharge from San Diego Creek and Santa Ana Delhi Channel was calculated to be approximately 3005 pounds of dissolved Cu per year for wet years (2009-10, 2010-11 monitoring years County of Orange monitoring data) (Appendix 6.2). (Cu loads from tributaries during wet years were used in these TMDLs to be conservative, as larger loads are discharged during wet years compared to dry years. With respect to Cu discharges from boats, however, it is assumed that discharges from passive leaching plus hull cleaning do not change drastically with wet or dry rainfall years.) The mean Cu discharge from storm drains was approximately 303 pounds of dissolved Cu per year (mean of 2007, 2008 - Storm Drain Metals Study, Coastkeeper & Candelaria 2010).

The mass-based allocations were divided into WLAs and LAs for tributary and storm drain allocations, WLAs for process water from boatyards (allocation = 0), WLAs for boats, and LAs for ~~boats and~~ air deposition. (Note that stormwater runoff from boatyards is covered under the Industrial General Permit (IGP)). The allocation for open space is part of the MS4 permit allocation as open space runoff enters the MS4 system and mixes with other runoff; therefore, there are no Cu data specific to open space runoff, and Cu concentrations in open space runoff are likely to be low compared to urban runoff.

The dissolved Cu allocations were calculated as follows:

Dissolved Cu Mass Loading Capacity - MOS =
[Tributary/Storm drain allocations (WLAs+LAs) + (boats/air deposition(LAs)](lbsCu/yr)

11,646 - 1,165 = 3,176 + 7,305 (lbs Cu/year)

The Dissolved Cu Mass Loading Capacity minus the MOS (Margin of Safety) is equal to the Tributary and Storm drain allocations (WLAs and LAs) plus the WLAs/LAs for boats and air deposition. *Note that the MOS was revised to 10% from 20% in the original BPA.* There is no LA for open space, as in USEPA's allocations, since much of the runoff from open space goes into San Diego Creek, Santa Ana Delhi or smaller storm channels, and is accounted for in the WLAs for urban runoff.

These mass- and concentration-based allocations specified in the tables below apply to the receiving waters of Newport Bay at all times of the year, regardless of the volume of freshwater flow from all tributaries, including San Diego Creek, Santa Ana Delhi, Costa Mesa Channel and other tributaries to Newport Bay.

Assumptions and Requirements of Mass-Based Allocations (See Tables 5-5a and b, below)

1. The allocations for MS4 and CalTrans, shown in the tables below, apply to tributary/and

[7] The margin of safety for the proposed TMDLs was revised to 10% from 20% (used in USEPA's TMDLs) based on stakeholder comments.

storm drain inputs to the water column in Upper Newport Bay (defined from San Diego Creek at Jamboree Rd. down to Pacific Coast Highway Bridge), Lower Newport Bay (defined from PCH Bridge to the Newport Jetty) and the Rhine Channel (confined by line drawn from 20th St. across to Lido Beach St. to channel end). These allocations apply to the receiving waters of Newport Bay at all times of the year, regardless of freshwater flow from San Diego Creek, Santa Ana Delhi, Big Canyon Wash, Costa Mesa and Santa IsabelChannels and other tributaries into Newport Bay. Compliance with these allocations is to be assessed in the aggregate at representative sampling points just upstream of major tributary and storm drain discharges into Newport Bay.

2. It is expected that the waste load allocations for the NPDES Industrial Stormwater General Permit, NPDES Construction Stormwater General Permit, and NPDES Scrap Metal Stormwater General Permit will be implemented through a best management practice-based iterative process such as corrective actions or numeric action levels. The limits in the permit shall be written in terms of total Cu, using USEPA's dissolved/total translator of 80% (such that dissolved Cu/total Cu = 0.80, and total Cu = 1.25 x dissolved Cu).
3. The load allocation for air deposition applies to deposition directly to Bay waters.
4. The Cu load from tributary and storm drain runoff is 3176 pounds of dissolved Cu per year is for a wet year. (This load is less in dry years.)
5. The allocation for process water discharges from boatyards is zero. Stormwater discharges from boatyards are regulated under the Industrial General Permit (IGP) for stormwater and are included in the mass-based allocation for "Other NPDES Permittees" (156 lbs/yr).
6. Commercial vessels 79 ft. or greater in length are regulated under the federal Vessel General Permit (VGP) and will be regulated under the Vessel Incidental Discharge Act (VIDA) once it is implemented. The number in this table ~~represents~~ is an allocation for approximately 15 commercial boats (79 ft. or greater- in length), and is based on an average boat size of 100 ft. Cu discharges from those 15 boats are approximately 134 lbs/yr. (The approximate number of commercial boats 79 ft. or greater in length was obtained from the U.S. Coast Guard (pers. communication USCG, Feb. 2022).
7. The category of Boats includes all recreational boats, and commercial boats < 79 ft. in length.
8. If compliance with the dissolved Cu CTR chronic criterion of 3.1 µg/L (or compliance with a dissolved Cu CTR chronic criterion adjusted by a Water Effects Ratio (WER) other than 1, or compliance with an approved dissolved Cu chronic site-specific objective (SSO)) is achieved in the Bay (i.e. no impairment is demonstrated per the assessment methodology in the State Listing Policy (SLP)), then no further reduction in Cu discharges from boats will be required even if the Cu wasteload or load allocation for boats is not yet achieved.
9. The margin of safety was reduced from 20 to 10% since conservative assumptions were used throughout the TMDLs (similar to the Marina del Rey Toxics TMDLs approved by the Los Angeles Regional Water Board).

Table 5-5a Mass-Based Allocations for Copper (Cu) in Newport Bay*

Category	**Type**	**Dissolved Copper (lbs/year)**
Tributary and Storm drain WLAs	MS4 permittees[1]	2,501
	CalTrans[1]	348
	Other NPDES Permittees (including Industrial General Permit (IGP), Construction General Permit (CGP), Scrap Metal General Permit (SMGP)	156[2]
Tributary and Storm drain LAs	Agricultural runoff	171[3]
	Open space runoff	(part of MS4 WLA)
	Sub-total	**3,176[4]**
Boatyards WLAs	Boatyards	0[5]
Boats (WLAs)	Commercial boats (79 ft. or greater)	134[6]
	Boats (all recreational & commercial <79 ft.)	7090[7,8]
Air deposition (LA)	Air deposition	81[3]
	Sub-total	**7,305**
Margin of Safety (MOS) 10%[9]		**1,165**
Total TMDL		**11,646**

[1] These allocations apply to tributary and storm drain inputs to the water column in Upper Newport Bay (defined from San Diego Creek at Jamboree Rd. down to Pacific Coast Highway Bridge), Lower Newport Bay (defined from PCH Bridge to the Newport Jetty) and the Rhine Channel (confined by line drawn from 20th St. across to Lido Beach St. to channel end). These allocations apply to the receiving waters of Newport Bay at all times of the year, regardless of freshwater flow from San Diego Creek, Santa Ana Delhi, Big Canyon Wash, Costa Mesa and Santa Isabel Channels, and other tributaries into Newport Bay. Compliance with these allocations is to be assessed in the aggregate at representative sampling points just upstream of major tributary and storm drain discharges into Newport Bay. Tributary and storm drain runoff are further defined in the Source Analysis for Cu (Section 5.3 above).

[2] It is expected that the waste load allocations for the NPDES Industrial Stormwater General Permit, NPDES Construction Stormwater General Permit, and NPDES Scrap Metal Stormwater General Permit will be implemented through a best management practice based iterative process such as corrective actions or numeric action levels. The limits in the permit shall be written in terms of total Cu, using USEPA's dissolved/total translator of 80% (such that dissolved Cu/total Cu = 0.80, and total Cu = 1.25 x dissolved Cu).

[3]LAs for agricultural runoff and air deposition were calculated from total Cu numbers in Table E-10 in the Toxics TMDLs (total Cu x 0.80) (USEPA 2002). The load allocation for air deposition applies to deposition directly to Bay waters.

[4] The Cu load from tributary (3,005 lbs/yr) plus storm drain (171 lbs/yr) runoff is for a wet year. (Tributary load is less in dry years (<1000 lbs/yr)) (Total allocation is equivalent to the load.)

[5]The allocation for process water discharges from boatyards is zero. Stormwater discharges from boatyards are regulated under the Industrial General Permit (IGP) for stormwater and are included in the mass-based allocation for "Other NPDES Permittees" (156 lbs/yr).

[6] Commercial vessels 79 ft. or greater in length are regulated under the federal Vessel General Permit (VGP) and will be regulated under the Vessel Incidental Discharge Act (VIDA) once it is implemented. The number

in this table is an allocation for approximately 15 commercial boats (79 ft. in length or greater), and is based on an average boat size of 100 ft. Cu discharges from those 15 boats are approximately 134 lbs/yr. (The approximate number of commercial boats 79 ft. or greater in length was obtained from the U.S. Coast Guard (pers. communication USCG, Feb. 2022).
[7]The category of Boats includes all recreational boats, and commercial boats < 79 ft. in length.
[8] If compliance with the dissolved Cu CTR chronic criterion of 3.1 µg/L (or compliance with a dissolved Cu CTR chronic criterion adjusted by a Water Effects Ratio (WER) other than 1, or compliance with an approved dissolved Cu chronic site-specific objective (SSO)) is achieved in the Bay (i.e. no impairment is demonstrated per the assessment methodology in the State Listing Policy (SLP)), then no further reduction in Cu discharges from boats will be required even if the Cu wasteload allocations for boats is not yet achieved.
[9]The margin of safety was reduced from 20 to 10% since conservative assumptions were used throughout the TMDLs (similar to the Marina del Rey Toxics TMDLs).

Table 5-5b NPDES Permittees and Permit Numbers

Category	Permittees	Name /Permit number[1]
Tributary or Storm drain WLAs	***MS4 permittees***	Waste Discharge Requirements for Areawide Urban Storm Water Runoff for the County of Orange, Orange County Flood Control District and the incorporated cities of Orange County within the Santa Ana Region, NPDES No. CAS 618030, Order R8-2009-0030 as amended by Order R8-2010-0062
	CalTrans	Statewide Storm Water Permit, Waste Discharge Requirements (WDRs) for State of California Department of Transportation, NPDES No. CAS000003, Order 2012-0011-DWQ.
	Other NPDES Permittees Industrial General Permit	General Permit for Storm Water Discharges Associated with Industrial Activities, Order 2014-0057-DWQ amended by Order 2015-0122-DWQ and Order 2018-0028-DWQ, NPDES No. CAS000001
	Construction General Permit	General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ amended by Order 2010-0014-DWQ and Order 2012-0006-DWQ, NPDES No. CAS000002
	Scrap Metal Permit	Sector-Specific General Permit for Storm Water Runoff Associated with Industrial Activities from Scrap Metal Recycling Facilities within the Santa Ana Region NPDES Permit No. CAG618001, Order No is R8-2018-0069
Boatyards WLAs	**Boatyards**	Boatyards are regulated under the IGP above.
Boats (WLAs)	**Commercial boats (79 ft. or greater)**	Vessel General Permit for Discharges Incidental to the Normal Operation of a Vessel (VGP) – Authorization to Discharge Under the National Pollutant Discharge Elimination System

[1]Order numbers will change as permits are updated/renewed.

Table 5-6 Concentration-based Allocations for Copper (Cu) in Newport Bay*

Metal	**Dissolved Cu saltwater Acute TMDL and Allocation (µg/L)**	**Dissolved Cu saltwater Chronic TMDL and Allocation (µg/L)**
Cu	**4.8**	**3.1**

[1]These concentration-based allocations are equivalent to the CTR saltwater criteria for dissolved Cu, which assume a WER of 1, and are the same as those used in USEPA's Toxics TMDLs (USEPA 2000). (If a different WER is approved for Newport Bay, the criteria and the concentration-based allocations will change accordingly. The concentration-based allocations will also change accordingly if a dissolved Cu chronic site-specific objective (SSO) is approved.) These allocations apply to and are assessed in the receiving waters of Newport Bay where the salinity is equal to or greater than 10 parts per thousand 95% or more of the time. These allocations apply to the receiving waters of Newport Bay at all times of the year, regardless of freshwater flow from San Diego Creek, Santa Ana Delhi, Costa Mesa Channel and other tributaries into Newport Bay. Concentration based and flow data for tributary runoff shall be used to determine compliance with the mass-based allocations specified in Table 6 and not as the basis for compliance with the concentration-based allocations specified in Table 8.

5.6 IMPLEMENTATION PLAN FOR THE COPPER (Cu) TMDLS

5.6.0 Introduction and Summary

States are required by federal regulations to incorporate TMDLs into water quality management plans (40 CFR 130.6). In California, water quality management plans include Regional Water Quality Control Plans (Basin Plans) and statewide water quality control plans. Under state law, a TMDL incorporated into the Basin Plan must include an implementation plan. The Implementation Plan recommended for these Cu TMDLs is presented in this section.

Sources of Copper (Cu)
As discussed in Section 5.3, the known sources of Cu include Cu AFPs on boats, tributary runoff, storm drains, air deposition, and ambient seawater (Table 5.2). Potential sources of Cu not quantified include Bay sediments, algae and other vegetation (no volume data collected). Of the known sources, Cu AFPs on boats are the largest source of dissolved Cu to Newport Bay (approximately 18,000 lbs per year), and this source is larger than all other sources combined.

The second largest source of Cu to the Bay is storm water and dry weather runoff from the major tributaries (San Diego Creek and Santa Ana Delhi) (Table 5-2). Smaller sources include storm drain runoff, which is low compared to the two largest sources, but which may have local impacts, and air deposition. In addition, Bay sediments, which are a sink for Cu, and algae/vegetation may also be a source of Cu during resuspension of sediments.

Implementation Strategy

Compliance with the CTR chronic criterion for dissolved Cu (3.1 ug/L) is the goal of these Cu TMDLs.
The highest priority of these Cu TMDLs' Implementation Plan is to reduce Cu discharges from Cu AFPs on recreational and commercial boats since Cu discharges from boats are the largest source of Cu to Newport Bay.
These Cu TMDLs cannot be met unless Cu loading from boats is reduced or eliminated.

The second priority is to continue to monitor and evaluate sediments in the Lower Bay and lower Upper Bay*, including areas that previously exceeded the sediment Cu ERM guideline and areas with no or limited SQOs or sediment Cu data (in particular, marinas). This evaluation is necessary since sediment Cu exceeded sediment guidelines in Newport Bay studies and there is evidence of sediment toxicity in areas where the sediment guidelines were exceeded.
**(The lower Upper Newport Bay is defined as the area from North Star Beach to Pacific Coast Highway along its northwest side and from the Back Bay Science Center south to Pacific Coast Highway along its southeast side and includes the Newport Dunes resort and recreation area. Lower Upper Newport Bay does not extend into the Upper Newport Bay Ecological Reserve.)*

The third priority of this plan is to meet/continue to meet the Cu allocations for tributary and storm drain runoff since tributary runoff is the second largest source of Cu to the Bay. (Cu inputs from storm drains are small compared to boats and tributaries but may be important locally.)

These Cu TMDLs include a compliance schedule that allows time to implement and adaptively manage the tasks/strategies to ensure effectiveness, efficiency and fairness. ***Final compliance with these Cu TMDLs must be achieved as soon as possible but no later than 12 years from the date of approval of these Cu TMDLs by USEPA.***
The compliance schedule approach recognizes that responsible parties may elect to pursue investigation(s) and adoption of site-specific objectives (SSOs) (or Water Effects Ratio (WER)

adjustments of the CTR criteria) for Cu in Newport Bay that, if approved, would supersede the CTR criteria for dissolved Cu, and thereby necessitate reconsideration of the dissolved Cu numeric targets identified for these TMDLs. The adoption of WER adjustments or SSOs might affect the findings of Cu impairment and the need for and nature of the Cu TMDLs. The compliance schedule for these Cu TMDLs allows for such investigation to proceed and for future revision of these TMDLs if site-specific objectives are ultimately approved by the Santa Ana Water Board, the State Water Board, and USEPA.

Implementation tasks and schedules are summarized below and described in Section 5.6.3 and Table 5-8.

Compliance with the Copper (Cu) TMDLs shall be determined through water and sediment monitoring and evaluation.

Summary of Implementation Plan Tasks

1) Reduce Copper (Cu) discharges from Cu antifouling paints (AFPs) on recreational and commercial boats (Section 5.6.3.1)

The highest priority is to reduce Cu discharges from Cu antifouling paints (AFPs) on boats since Cu AFPs on boats are the largest source of Cu to Newport Bay. These Cu TMDLs cannot be met unless Cu discharges from boats are reduced*.*
Compliance with the CTR chronic criterion for dissolved Cu* (3.1 µg/L) is the goal of these Cu TMDLs. **(or a dissolved Cu CTR chronic criterion adjusted by a WER other than 1), or an approved dissolved Cu chronic SSO). The compliance schedule is shown in Table 9 and the text below.*

The largest source of Cu to Newport Bay is Cu antifouling paints (AFPs; therefore, these TMDLs require the reduction of Cu discharges from Cu AFPs to meet the TMDLs.
This may be accomplished by: 1) the use of BMPs for hull cleaning, including soft cloths or hull cleaning container/filter methods; 2) diver certification/education and boater education programs; 3) the conversion of boats from current Cu AFPs to lower leach rate Cu AFPs and/or non-biocide AFPs; 4) the cleaning of boats according to manufacturer's label instructions (and reducing cleaning frequency where feasible); and, 5) the use of dry docks or boat lifts.

2) Monitor and evaluate Cu in sediments with the sediment quality objectives (SQOs) methodology for compliance with the sediment Cu numeric or SQOs target and evaluate the sediment Cu SQOs data using the ERM guideline plus toxicity analyses for trend analyses. (Section 5.6.3.2)

The second priority of these Cu TMDLs is to monitor and evaluate Cu in sediments with the SQOs methodology (including chemistry, toxicity, benthic community analyses) per *the Sediment Quality Provisions (SWRCB 2018) to determine the sediment condition and compliance with the sediment Cu numeric (ERL) or alternative SQOs target and evaluate the sediment Cu SQOs data using the ERM guideline (270 µg/g) and toxicity analyses in paired samples for trend analyses. Sampling should be conducted in ~~the~~ Lower Newport Bay and lower Upper Newport Bay, including marinas and the Turning Basin/South Lido Channel areas that previously exceeded the sediment Cu ERM guideline and areas with no or limited SQOs or sediment Cu data (in particular marinas).*
If the alternative SQOs sediment target is used for compliance, conduct stressor identification studies using the SQOs methodology if the sediment condition is not Unimpacted or Likely

Unimpacted to determine whether Cu is the cause of the impacted condition. If Cu is not shown to be the cause of the impacted condition, the alternative sediment Cu SQOs target is achieved.- (See Table 5-1b Numeric and Alternative Targets for Sediment Copper (Cu) in Newport Bay.)

Compliance with the sediment Cu target may be achieved by 1) meeting the ERL sediment Cu target; or 2) demonstrating that the sediment quality condition of Unimpacted or Likely Unimpacted is met per the SQOs methodology (interpretation and integration of multiple lines of evidence as defined in the Sediment Quality Provisions). If the sediment quality condition of Unimpacted or Likely Unimpacted is not demonstrated, further monitoring/analyses pursuant to the SQOs methodology shall be completed to determine whether or not impairment exists, and whether that impairment is due to Cu, before a determintation of non-compliance with the sediment Cu target is made. (See Table 5-1b Numeric and Alternative Targets for Sediment Copper (Cu) in Newport Bay.)

3) Meet Copper (Cu) mass-based allocations for tributary and storm drain runoff - continue to monitor and evaluate Cu concentrations in runoff (Section 5.6.3.3)

The second highest source of Cu to Newport Bay is tributary runoff, and the third priority of these TMDLs is to meet the Cu allocations for tributary and storm drain runoff. Cu loading from storm drains is small compared to boats and tributaries but may be important locally. This task includes the continued monitoring and evaluation of Cu in tributary and storm drain runoff.

The Santa Ana Water Board regulates storm water and dry weather discharges to surface waters tributary to Newport Bay under Waste Discharge Requirements and federal NPDES permits. These requirements will be revised as necessary to implement these TMDLs, once approved. Dischargers responsible for meeting the allocations for Cu discharges from tributaries and storm drains include the City of Newport Beach, the County of Orange and other municipal separate storm sewer system (MS4) permittees in the drainage area, and CalTrans.

4) Evaluate local impacts of Copper (Cu) discharges from larger storm drains (Section 5.6.3.4)

The fourth priority is to evaluate the local impacts of storm drain runoff from larger storm drains. This task includes the monitoring and evaluation of Cu in larger storm drain discharges, and in-Bay receiving waters and sediments below storm drain outlets for compliance with the numeric targets for dissolved Cu (CTR chronic and acute criteria) and the sediment Cu numeric or SQOs targets.

Monitoring and evaluation of sediments shall be conducted using the SQOs methodology and shall include chemistry, toxicity and benthic community analyses. SQOs data shall be used to determine the sediment condition and compliance with the sediment Cu numeric or SQOs target. The data shall also be evaluated using the sediment Cu ERM guideline and toxicity analyses in paired samples.

The plan(s) proposed by dischargers shall include monitoring and evaluation of dissolved and total Cu in larger storm drain discharges (Task 3), and in-Bay receiving waters near storm drains, and include water quality parameters (DOC, pH, salinity, temperature, TSS). The proposed plan shall also include monitoring and evaluation of in-Bay sediments near storm drain outlets for compliance with the sediment Cu numeric or SQOs target, and assessment of sediment Cu SQOs data using the ERM guideline and toxicity analyses in paired samples for trend analysis.

Implementation tasks and schedules are summarized in Table 5-8, below, along with the parties responsible for TMDL implementation in Newport Bay (listed by task). These tasks are also described in Section 5.6.3 below.

The Santa Ana Water Board intends to implement these requirements through appropriate orders issued to the dischargers, e.g., waste discharge requirements, conditional waiver(s) of waste discharge requirements, Water Code Section 13267 investigative orders and, where necessary, cleanup and abatement or other enforcement orders. The dischargers are encouraged to coordinate their efforts to implement these TMDLs to optimize efficacy and the use of resources.

Sections 5.6.1 and 5.6.2 (below) describe the regulatory authorities for TMDLs implementation and identify the dischargers responsible for implementation, respectively.

5.6.1 Regulatory Authorities

This section describes the legal authorities for the actions prescribed in the Cu TMDLs Implementation Plan. These include the regulatory agencies and laws governing the sale and use of copper antifouling paints (Cu AFPs) in California (DPR, USEPA -Section 5.6.1.1), and the authority to regulate: 1) the discharges of Cu from legal Cu AFPs (USEPA, Section 5.6.1.2, Santa Ana Water Board -Section 5.6.1.3), 2) the continued monitoring and evaluation of sediments (Santa Ana Water Board-Section 5.6.1.4), and 3) the discharges of Cu in tributary and storm drain runoff (Santa Ana Water Board -Section 5.6.1.5).

5.6.1.1 Authority to Regulate the Sale and Use of Copper Antifouling Paints (Cu AFPs) (DPR, USEPA)
5.6.1.2 Authority to Regulate Copper (Cu) Discharges from Boats (USEPA)
5.6.1.3 Santa Ana Water Board Authority to Regulate Copper (Cu) Discharges from Boats
5.6.1.3.1 Regulatory Options: Individual or General WDRs, Conditional Waiver of WDRs, Waste Discharge Prohibition, Cleanup and Abatement Orders
5.6.1.4 Santa Ana Water Board Authority to Compel Action to Continue Monitoring and Evaluation of Sediment Copper (Cu)
5.6.1.5 Santa Ana Water Board Authority to Regulate Copper (Cu) Discharges from Tributaries and Storm Drains

5.6.1.1 Authority to Regulate the Sale and Use of Copper Cu AFPs (DPR, USEPA)
Copper antifouling paints (Cu AFPs) are legal pesticides subject to registration and regulation by the USEPA pursuant to the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) (7 U.S.C. 136) and by the California Department of Pesticide Regulation (DPR) pursuant to Division 7, commencing with section 12500, of the California Food and Agriculture Code (FAC). These agencies have the authority to take direct regulatory actions on pesticides, including the imposition of restrictions on the sale and use of Cu AFPs in Newport Bay, and/or cancellation of particular uses or registration. Regulatory action was already taken to ban the sale and use of tributyltin AFPs (partial ban by USEPA 1988, followed by a global ban in 2008). On July 1, 2018, DPR issued a regulation for a maximum allowable leach rate for Cu AFPs for sale and use on recreational boats (DPR 2018).

United States Environmental Protection Agency (USEPA)
USEPA is the federal agency responsible for registering pesticides for sale or distribution within the United States pursuant to FIFRA. A pesticide cannot be legally used in the United States if it has not been registered by USEPA's Office of Pesticide Programs. Pesticide registration is the process through which USEPA examines the ingredients of a pesticide; the site or crop on which it is to be

used; the amount, frequency and timing of its use; and storage and disposal practices. Through the registration process, USEPA evaluates the pesticide to ensure that it will not have unreasonable adverse effects on humans, the environment, or non-target species when used in accordance with label specifications. Under FIFRA, USEPA also establishes a nationally uniform labeling system to regulate pesticide use. Pesticide label language is under the sole jurisdiction of USEPA.

USEPA is currently engaged in a review of the registration of Cu-based pesticides, which includes Cu AFPs. USEPA sent notice to registrants in March 2019 to submit leach rate data by July 2019. USEPA is currently reviewing the data received and will send the data evaluation and regulatory letter to registrants as data is reviewed. The timing is then dependent on comment review and potential revisions.

California Department of Pesticide Regulation (DPR)

The California Department of Pesticide Regulation (DPR) is the lead state agency regulating the registration, sales, and use of pesticides in California. The legal authority for California's pesticide regulatory program is found primarily in the (FAC).

DPR is required by law to protect the environment, including surface waters, from environmentally harmful pesticides by prohibiting, regulating, or controlling the uses of such pesticides. This is accomplished through a licensing process called "registration." As part of the pesticide registration process, DPR evaluates data submitted by registrants to ensure that a product used according to label instructions will cause no harm or adverse impacts to non-target organisms that cannot be reduced (or "mitigated") with protective measures or use restrictions. Registrants are required to submit data on the effects of pesticides on target pests (efficacy) as well as effects on non-target organisms. Non-target effects include effects on plants (phytotoxicity), fish and wildlife (ecotoxicity), endangered species, and the environment, in addition to a pesticide's environmental fate, breakdown products, leachability and persistence. Pesticides that pass this scientific, legal, and administrative process are granted a license that permits their sale and use according to requirements set by DPR to protect human health and the environment in California.

Pesticides must be registered by both USEPA and DPR before distribution in California. Because USEPA has sole responsibility for label language, DPR cannot require a manufacturer to make changes to its labels but can request registrants to modify label language with USEPA approval. By refusing to allow registration, however, and hence the possession, sale and use of any pesticide not meeting California standards, DPR can place more restrictive requirements on pesticides above those required by USEPA. DPR can cancel the registration of a pesticide, or refuse to register a pesticide, if DPR finds that the pesticide "has demonstrated serious uncontrollable adverse effects either within or outside the agricultural environment." (FAC 12825[8]). DPR also has the authority to restrict the sale and use of pesticides, such as Cu AFPs, on a regional basis.

DPR began a reevaluation of the registration of Cu AFPs in June 2010. As part of this reevaluation effort, DPR required paint manufacturers to determine the Cu loading from Cu AFPs, and the paint manufacturers funded a study by the U.S. Navy (Earley et al., 2013). This study measured the 3-year Cu loading for two Cu AFPs (one epoxy and one ablative) under different cleaning scenarios: no cleaning, cleaning with BMPs (i.e. using soft pads) and cleaning with non-BMPs (i.e., using abrasive pads). Cu discharges increased during the cleaning events, and Cu leaching remained elevated after cleaning due to the "refreshed" surface. (A "refreshed" hull surface is a surface where the fouling has been removed, whether by hull cleaning or moving through the water.) As time passes, the leach rate decreases due to fouling growth on the hull surface. In addition, Cu discharges were higher when non-BMPs were used for hull cleaning compared to BMPs.

[8] FAC 12825 specifies additional bases for cancellation/refusal to register by DPR.

While reevaluation efforts continued, a new California law (AB425) was passed on October 4, 2013 that states that "No later than February 1, 2014, the Department of Pesticide Regulation (DPR) shall determine a leach rate for copper-based antifouling paint [Cu AFPs] used on recreational vessels and make recommendations for appropriate mitigation measures that may be implemented to address the protection of aquatic environments from the effects of exposure to that paint if it is registered as a pesticide".

After completion of the Earley et al. study, DPR conducted a modeling study using MAMPAC (the marine antifoulant model to predict environmental concentrations) to determine a maximum allowable leach rate for Cu AFPs used in California (Zhang and Singhasemanon 2014). The leach rates determined by the model for Cu AFPs were based on 5 marina scenarios (based on numbers of boats and other physical parameters) and a dissolved Cu target of 3.1µg/L (the California Toxics Rule (CTR) saltwater chronic criterion). (DPR acknowledged that the CTR Cu criteria are the applicable water quality objectives for dissolved Cu in most California waters). (Site-specific objectives for Cu that differ from the CTR saltwater criteria have been approved in some California waters). The leach rates determined by the model for the 5 marina scenarios were then adjusted by data from the Earley et al study to account for the use of BMPs and reduced cleaning frequency. The maximum allowable leach rate of 9.5 $\mu g/cm^2/d$ for Cu AFPs was then chosen from scenario 2 of the adjusted model leach rates.

As of July 1, 2018, per the requirements of AB425, DPR issued a regulation for a maximum allowable leach rate of 9.5 $\mu g/cm^2/d$ for Cu AFPs and a set of mitigation measures for the use of lower leach rate Cu AFPs (DPR 2018). Cu AFP registrants are required to reformulate Cu AFPs with leach rates above this maximum allowable leach rate. In addition, DPR recommends the following measures to be implemented by registrants and agencies other than DPR:

- require in-water hull cleaners to use BMPs;
- reduce the hull cleaning frequency to once per month;
- include hull cleaning information on product labels;
- develop hull maintenance brochures for boaters;
- increase boater awareness of alternatives to Cu AFPs;
- create incentive programs to convert boats with Cu AFPs to alternative AFPs; and
- consider site-specific objectives for some marinas/harbors.

DPR's determination letter (DPR 2014) states that the use of Cu AFPs with leach rates < 9.5 $\mu g/cm^2/d$ (for recreational boats) combined with the implementation of the recommended mitigation measures should result in compliance with the CTR criterion of 3.1 µg/L in most marinas in California, except for the most impaired marinas (i.e. Marina del Rey, Shelter Island Yacht Basin, Newport Bay). DPR also recognizes that in the marinas most impaired for Cu from Cu AFPs, a large number of boats may need to be converted from Cu AFPs to non-biocide and/or non-Cu paints.

Section 13247 of the California Water Code requires state agencies to comply with water quality control plans (basin plans) "in carrying out activities which may affect water quality." Under this provision, DPR has an obligation to ensure that the registration and use conditions for pesticides, including Cu antifouling paints (Cu AFPs), will not cause or contribute to the violation of applicable Cu water quality objectives nor to the violation of the Cu TMDLs for Newport Bay, once the TMDLs are incorporated into the Basin Plan. Since aquatic pesticides (or terrestrial pesticides that reach surface waters) may cause exceedances of water quality objectives, such as those specified in the California Toxics Rule (CTR) for dissolved Cu, and because such exceedances may cause or contribute to the impairment of beneficial uses, the State Water Board and DPR entered into a

Management Agency Agreement (MAA) in 1997. This agreement was updated in 2019. The MAA acknowledges that both agencies "have responsibilities to protect water quality from the potential adverse effects of pesticides" and that "[b]oth agencies concur that the State will benefit from a unified and cooperative program to protect water quality related to the use of pesticides." The MAA also states as part of its purpose that the State Water Board and DPR will "[c]oordinate respective authorities to solve water quality problems related to pesticide use by promoting the development of practices that reduce or eliminate impacts on water quality or prevent pesticide use that may impact water quality" (task 1(g) in the MAA), and "[will] work cooperatively to address the discharge of pesticides that may cause or contribute to surface water or groundwater pollution, including surface water toxicity" (task 3(c) in the MAA). The State Water Board and DPR also developed a management plan to implement the MAA.
http://www.waterboards.ca.gov/publications_forms/publications/general/docs/ca_pesticide_mgmt_planwq.pdf

Consistent with this MAA and Management Plan, Santa Ana Water Board staff have had numerous consultations with DPR staff with respect to the appropriate mitigation measures needed to address Cu AFPs in Newport Bay and other waters in the Region. Further, Santa Ana Water Board staff have carefully reviewed DPR's maximum allowable leach rate and mitigation recommendations in response to AB425 and have provided detailed comments, in conjunction with Los Angeles Water Board staff, who are also addressing state waters impaired by Cu discharges from Cu AFPs. In a joint comment letter to DPR dated August 15, 2014, Santa Ana and Los Angeles Water Board staff noted support for the establishment of a maximum allowable leach rate with mitigation measures, but identified concerns that the implementation of these measures may not be sufficient to meet the water quality objective for dissolved Cu (3.1 µg/L) in the largest marinas in southern California waters, including Newport Bay.
http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/tmdl_toxics.shtml)

The reduction in Cu loading achievable by implementing the 9.5 $\mu g/cm^2/d$ leach rate is also highly dependent on the leach rates of the Cu AFPs currently in use (i.e., if most Cu AFPs currently in use have leach rates below the 9.5 $\mu g/cm^2/d$ set by DPR, little reduction in Cu loading will be achieved as the result of implementing DPR's maximum allowable leach rate).

Santa Ana Water Board staff generally agree with DPR's recommended mitigation measures, including the use of BMPs by all hull cleaners, boater education, changes to product labels, the distribution of hull-cleaning brochures and incentive programs for the conversion of boats from Cu to non-biocide or non-Cu AFPs. DPR's recommendation of reduced cleaning frequency, however, may not be practical to implement. Cleaning frequency is a matter of boater preference and the needs dictated by hull fouling conditions, which vary widely in waters where boats are moored, the length of time that boats are in the water, and boat usage. In general, boaters want to clean their boats when the hulls have light fouling so that the fouling does not become hard and require hard scrubbing. (Harder scrubbing releases more Cu during hull cleaning and may cause indentations in the paint resulting in higher Cu discharges after hull cleaning and ultimately more frequent repainting.)

5.6.1.2 Authority to Regulate Copper (Cu) Discharges from Boats (USEPA)

5.6.1.2.1 Recreational Vessels – Clean Boating Act (USEPA)

Recreational boats that use Cu AFPs are regulated pursuant to the federal Clean Boating Act (CBA), which was passed in 2008. This law, an amendment of the Clean Water Act (CWA), provides that recreational vessels shall not be subject to the requirement to obtain a CWA permit

(NPDES) to authorize discharges incidental to their normal operation and regulates such discharges from recreational vessels.

The CBA creates a new section 402(r) of the CWA that excludes discharges incidental to the normal operation of recreational vessels from National Pollutant Discharge Elimination System permitting requirements. In addition, the CBA added a new section 312(o) to the CWA, directing USEPA to "determine the discharges incidental to the normal operation of a recreational vessel for which it is reasonable and practicable to develop management practices to mitigate adverse impacts on the waters of the United States...".

The CBA affects owners or operators of recreational vessels, from the smallest kayak to the largest yacht. Each such vessel owner/operator will be responsible for implementing the management practice or practices associated with each type of discharge that their vessel creates. Discharges incidental to the normal operation of a recreational vessel include those from antifouling and corrosion control agents, aquatic nuisance species, bilge water, cleaning and maintenance (such as oil fuel), fishing waste, and graywater. The CBA does not address sewage because vessel sewage is currently regulated under the Clean Water Act.

The CBA applies to recreational vessels in all "waters of the United States," as defined in the CWA, and waters of the contiguous zone which extend to 12 miles from shore. This means that the CBA applies to recreational vessels using internal waters, coastal waters, and waters out to 12 nautical miles from shore.

The CBA includes 3 phases of implementation to develop regulations for recreational boaters.

> Phase 1. USEPA will determine the discharges incidental to the normal operation of recreational vessels for which it is "reasonable and practicable" to develop management practices and develop these practices.
>
> Phase 2. USEPA will enact regulations establishing performance standards for each management practice. This process will take 18-24 months to complete.
>
> Phase 3. The United States Coast Guard (USCG) has enforcement authority under the CBA. The USCG will enact regulations that specify the design, construction, installation or use of management practices to meet USEPA's performance standards.

After Phases 1 through 3 are completed, recreational boaters will be required to conduct the management practices developed by USEPA and the USCG. In addition, state and local governments may establish practices that are broader in scope and/or more stringent than those established under the CBA. Vessel owners must comply with the most stringent laws.
As of the date of this report, USEPA has not identified a time schedule for the implementation of the CBA (for recreational vessels) since it is focused on the implementation of the Vessel Incidental Discharge Act (VIDA) (for commercial vessels).
http://water.epa.gov/lawsregs/lawsguidance/cwa/vessel/CBA/about.cfm

5.6.1.2.2 Commercial (non-recreational, non-military) vessels –Vessel/Small Vessel General Permits (VGP, small VGP) and Vessel Incidental Discharge Act (VIDA) (USEPA)

Commercial vessels are considered to be point sources of copper (Cu). USEPA currently regulates discharges incidental to the normal operation of commercial vessels 79 feet or greater in length, and operating as a means of transportation, primarily through the Vessel General Permit (VGP). The first VGP was issued in 2008 and was effective until December 19, 2013. On March 28, 2013,

USEPA reissued the VGP for another five years. The reissued permit, the 2013 VGP, took effect December 19, 2013 and supersedes the 2008 VGP. (http://cfpub.epa.gov/npdes/vessels/vgpermit.cfm#2008.)
The State Water Board issued a Clean Water Act Section 401 certification of the VGP in California with specific conditions that USEPA attached to the VGP and that constitute enforceable conditions of the VGP.

For commercial fishing vessels and other commercial vessels less than 79 feet in length, except for ballast water discharges, NPDES permits are not required for any discharges incidental to normal operation (CWA section 502(25)). The moratorium from the requirement to obtain permit coverage for incidental discharges from these vessels expired December 18, 2014. In anticipation of the end of the moratorium, USEPA published a draft small Vessel General Permit (sVGP) in 2013 to provide for permit coverage for these incidental discharges. The small Vessel General Permit was finalized and published in the Federal Register on September 10, 2014. The State Water Board also issued a CWA Section 401 Certification for the sVGP.

The 2013 VGP (and formerly the 2014 sVGP) include requirements pertaining to the use of Cu and other antifouling paints (AFPs) in VGP-Sections 2.2.4 (Anti-Fouling Hull Coatings/ Hull Coating Leachate) and 2.2.23 (Underwater Ship Husbandry and Hull Fouling Discharges). Broadly, these provisions require that owners/operators of vessels that spend considerable time (greater than 30 days per year) in Cu-impaired waters or that use these waters as their home port consider using antifouling coatings that rely on a rapidly biodegradable biocide or another alternative to Cu-based coatings. If after consideration of alternative biocides, vessel owners/operators in impaired waters continue to use Cu AFPs, they must document the rationale for this decision. (It may be noted that the VGP explicitly prohibits the use of any antifouling coating that contains tributyltin or any other organotin compound used as a biocide. This is consistent with the worldwide ban on tributyltin use.) The VGP specifies that vessel owners/operators must minimize the release of Cu AFPs during vessel cleaning operations and provides recommended BMPs. The hulls of vessels to which Cu AFPs are applied must not be cleaned in Cu-impaired waters within the first 365 days after paint application unless there is a significant visible indication of hull fouling by organisms.

The VGP also includes additional water quality-based effluent limits (VGP-Section 2.3), including limits on discharges to water quality impaired waters with and without an approved TMDL (VGP, Section 2.3.2). These provisions require, in part, that the discharges from the vessels be controlled as necessary to meet applicable water quality standards in the receiving waters impacted by the discharges. Where an applicable TMDL and wasteload allocation have been established, discharges from the vessel must be consistent with the assumptions and requirements of the TMDL/WLA. In certifying the VGP and sVGP, the State Water Board included the requirements that vessel discharges must comply with the applicable statewide and regional water quality control plans. The State Water Board also specified the condition that vessel discharges shall comply with the California State Lands Commission requirements for hull fouling and ballast water discharges to control and prevent the introduction of nonindigenous species.

The Vessel Incidental Discharge Act (VIDA), enacted in 2018, established a framework to regulate incidental discharges for normal operations of commercial vessels under Section 312(p) (a new section) in the CWA. It applies to commercial vessels 79 ft. or greater in length, other non-recreational, non-Armed Forces vessels (such as research and emergency rescue vessels), and ballast waters from small vessels (less than 79 feet) and fishing vessels of all sizes.

VIDA repealed the sVGP and maintains existing vessel discharge requirements in the 2013 VGP and the US Coast Guard ballast water regulations until USEPA and the U.S. Coast

Guard adopt regulations to implement VIDA. By December 2020, USEPA is required to develop national standards of performance for approximately 30 incidental discharges (these discharges are similar to the discharges named in USEPA's 2013 VGP). These standards will for the most part be at least as stringent as the 2013 VGP requirements and will be technology-based.
https://www.epa.gov/vessels-marinas-and-ports/vessel-incidental-discharge-act-vida
Once the U.S. Coast Guard's VIDA regulations are final and effective, USEPA's VGP will be repealed.

5.6.1.3 Santa Ana Water Board Authority to Regulate Copper (Cu) Discharges from Boats

The "discharge of copper (Cu)" refers to "residual Cu", which is defined as any Cu species that leaches, dissolves, ablates, or erodes from boat hull antifouling paints (AFPs) into receiving waters such as Newport Bay and does not reach a target fouling organism. This includes residual Cu that results from legally registered Cu AFPs used in accordance with label instructions in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Residual Cu is a waste subject to regulation by the Regional Water Boards under the provisions of the California Water Code, including those provisions that implement applicable requirements of the federal Clean Water Act. As discussed in Section 5.3, residual Cu that results from Cu AFPs used on boats is the principal source of Cu impairment in Newport Bay.

Note that the 2002 USEPA Metals TMDLs (part of the Toxics TMDLs) included an independent impairment assessment that found that Newport Bay was impaired for Cu based on exceedances of the dissolved Cu CTR criteria for saltwater. USEPA also found that Cu AFPs were the principal source of the Cu exceedances. USEPA's load allocation for boats requires an approximate 92% reduction of the Cu load from boats. If/when adopted, the Cu TMDLs will supersede the existing Cu TMDLs established by USEPA in 2002.

The regulatory options available to the Santa Ana Water Board to address this source of impairment are discussed below.

5.6.1.3.1 Regulatory Options: Individual or General WDRs, Conditional Waiver of WDRs, Waste Discharge Prohibition, Cleanup and Abatement Orders

The Porter-Cologne Water Quality Control Act (California Water Code (CWC), division 7) provides that "all discharges of waste into the waters of the state are privileges, not rights" (CWC 13263(g)). Furthermore, all discharges are subject to regulation under the Porter-Cologne Act, including both point and nonpoint source discharges (CWC § 13260, 13376). In authorizing the State and Regional Water Boards to regulate discharges of waste that can affect water quality, the legislature provided the State and Regional Water Boardswith regulatory authority in the form of waste discharge requirements (WDRs), waivers of WDRs, and Basin Plan waste discharge prohibitions to address ongoing and proposed waste discharges. All current and proposed waste discharges must be regulated under WDRs, waivers of WDRs, ~~or~~ a prohibition, or some combination of these regulatory tools.

Further, Section 13304 of the Water Code authorizes the Regional Water Boards to issue a cleanup and abatement order (CAO) to any person who has discharged or discharges waste into the waters of the state that creates or threatens to create a condition of pollution or nuisance. A cleanup and abatement order would require the discharger(s) to clean up the waste or abate the effects of the waste.

The discharge of Cu from Cu AFPs, including passive leaching and hull cleaning, and other sources, such as tributaries and storm drains, is a discharge of waste pursuant to CWC section 13050(d), and subject to Santa Ana Water Board issuance of WDRs or a waiver of WDRs, adoption of a waste discharge prohibition, or issuance of CAO. The Board's regulatory options are described below.

1) Issuance of Waste Discharge Requirements

The Santa Ana Water Board can issue individual or general WDRs requiring dischargers to meet the copper (Cu) reductions specified in the Cu TMDLs. The largest contributors of residual Cu from Cu AFPs in Newport Bay are boats. The Santa Ana Water Board is authorized to issue waste discharge requirements to address Cu discharges from recreational and commercial boats (except to the extent preempted by VIDA) into the state's waters. Such requirements may be issued to individual boat owners, marina owners/operators, agencies responsible for permitting/licensing marinas (City of Newport Beach, the County of Orange) and underwater hull cleaners[9] (Section 5.6.2). Alternately, the Santa Ana Water Board could issue general waste discharge requirements to regulate Cu discharges resulting from Cu AFPs and require that all responsible parties enroll in and implement those general WDRs.

There are also a small number of commercial vessels 79 ft. or greater in length~~than~~ (approximately 15 vessels with an average length of 111 ft.) that spend greater than 30 days per year in Newport Bay or that use the Bay as their home port. These are considered to be point sources of pollutants and are subject to the requirements of the Vessel General NPDES permit issued by USEPA (Section 5.6.1.2). As previously discussed, this permit incorporates conditions regarding Cu AFPs that were identified by the State Water Board as part of CWA Sec. 401 certification of the VGP and will be replaced by regulations adopted under VIDA.

For both recreational and commercial boats, (except to extent preempted by VIDA), the WDRs would include requirements to reduce residual Cu discharges from boat hulls to meet the waste load and load allocations (WLA and LA) specified in these TMDLs. The waste load/load allocations for Cu discharges from Cu AFPs require a 60% reduction from the current inputs (Table 5-5). This reduction may be achieved in part by the conversion to lower leach rate Cu AFPs, and/or non-biocide AFPs/coatings (non-Cu biocide AFPs are not recommended), by requiring underwater hull cleaners to employ BMPs that reduce Cu discharges, as well as the implementation of other BMPs. The conversion to Cu AFPs at or below DPR's maximum allowable leach rate (9.5 $\mu g/cm^2/d$) may reduce Cu discharges from Cu AFPs but *only if boats are currently using Cu AFPs with leach rates above DPR's leach rate*. The conversion of boats from Cu AFPs to non-biocide AFPs/coatings (and lower leach rate Cu AFPs) will require continued public education concerning the effects of Cu AFPs, the availability and cost-effectiveness of alternative AFPs, and the use of hull cleaning BMPs.

While the issuance of individual WDRs and/or the enrollment of large numbers of dischargers (including all individual boat owners) in general WDRs are regulatory options, Board staff believe that these strategies would be too time consuming and inefficient for both the Santa Ana Water Board and boat owners. Significant Santa Ana Water Board resources would be required to first

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[9] Discharges from boatyard operations are regulated under the General Industrial Storm Water NPDES permit (Water Quality Order No. 2014-0057-DWQ, as amended by Order WQ 2015-0122-DWQ, NPDES No. CAS000001). This Order requires the preparation of new, or the review and update of existing, Storm Water Pollution Prevention Plans (SWPPPs), and prohibits unauthorized non-storm water discharges to the facility's storm drain system. It should be noted that boatyard operations conducted in accordance with these requirements are not considered to be significant *ongoing* sources of Cu to Newport Bay. A zero discharge for boatyards is required in the permit; however, boatyards have contributed Cu and other metals, including mercury (Hg), to sediments in the Bay as a result of their historic activities.

enroll all dischargers in the requirements, and then oversee implementation of the requirements, including potential enforcement actions. For these reasons, the issuance of individual WDRs is not a preferred option for the TMDLs; however, this option may be considered if compliance with these TMDLs is not achieved.

2) Issuance of Conditional Waiver of Waste Discharge Requirements

A second potential regulatory option is for the Santa Ana Water Board to adopt a conditional waiver of waste discharge requirements for Cu discharges from Cu AFPs on boat hulls in Newport Bay. The Board would waive waste discharge requirements for individual boat owners, marina owners/operators, the City of Newport Beach, ~~and~~ County of Orange, and other responsible parties provided that these responsible parties, individually or collectively, develop and implement one or more Santa Ana Water Board approved strategies designed to meet the Cu load allocation. These strategies are expected to include the conversion of boats to lower leach rate Cu AFPs and/or the conversion of some boats from Cu AFPs to alternative non-biocide AFPs, the implementation of BMPs to reduce Cu discharges during hull cleaning with diver certification, and boater/boatyard staff education. Monitoring and evaluation to assess the efficacy of the implemented strategies and progress towards TMDL compliance would be required.

Santa Ana Water Board staff recommend the issuance of a Conditional Waiver of Waste Discharge Requirements as the appropriate regulatory tool to implement the Cu reduction strategies identified in the Implementation Plan for these Cu TMDLs (Section 5.6.3). Board staff envisions a strategy whereby the City of Newport Beach, and the County of Orange will be the initial enrollees and play a lead role in the development and implementation of Cu reduction strategies on behalf of the boating community. This strategy is intended to avoid the resource consequences associated with the significant effort that would be necessary to enroll all responsible dischargers initially. If the lead agencies fail to identify and implement Cu reduction strategies, enrollment may be required for others, including individual boats owners and marina owner/operators. If the Conditional Waiver does not result in sufficient Cu reductions to meet the TMDLs, then an alternative regulatory strategy, including the adoption of a prohibition of the discharge of Cu from Cu AFPs, will need to be considered.

3) Adoption of a Prohibition on the Discharge of Residual Copper from Cu AFPs

A third regulatory option is for the Santa Ana Water Board to consider the adoption of a prohibition on the discharge of residual Cu, as defined above, from commercial and recreational boats in Newport Bay. Such a prohibition would require that boat hulls be painted with alternative, non-biocide AFPs. However, Santa Ana Water Board staff do not recommend pursuing a prohibition at the present time. This conclusion was determined since the TMDL wasteload allocation for boats requires a significant (60%) reduction in Cu discharges from boats but not the complete elimination of such discharges that would be expected to result from implementation of a prohibition. As noted, Water Board staff's recommended regulatory strategy is to adopt a conditional waiver of waste discharge requirements to ensure compliance with the TMDL wasteload allocations for boats.

4) Issuance of Cleanup and Abatement Orders

A fourth regulatory option is the issuance of CAO pursuant to Section 13304 of the Water Code. Impairment of Newport Bay waters by Cu from Cu AFPs constitutes a condition of pollution, for which CAOs may be issued by the Santa Ana Water Board, CAOs could be issued to those parties responsible for Cu discharges that cause or contribute to this pollution, including individual boat owners, the City of Newport Beach, the County of Orange, marina owners/operators and other responsible parties.

This approach is fraught with the same resource considerations as the issuance of individual waste discharge requirements. Changes in the established practice of using Cu AFPs will be necessary to achieve these TMDLs (and would also be necessary to achieve the 2002 TMDLs established by USEPA), but it is appropriate to effectuate the new practices by establishing new regulatory requirements, such as waste discharge requirements or a conditional waiver, that are consistent with and necessary to implement these TMDLs. The issuance of CAOs ~~leanup and Abatement Order~~s remains an option for the Santa Ana Water Board should compliance with the TMDLs not be achieved via these other regulatory tools.

5.6.1.4 Santa Ana Water Board Authority to Compel Action to Continue Monitoring and Evaluation of Sediment Copper (Cu)

Based on the available data, sediments in the Bay are not considered to be impaired at this time. However, the data show multiple exceedances of sediment guidelines, as well as sediment toxicity, particularly in certain areas of the Bay. These findings demonstrate the need for continued monitoring and evaluation of sediments. The Santa Ana Water Board has and will utilize the authority provided pursuant to Water Code Section 13267 to require this monitoring and evaluation. Sediments should be monitored and evaluated using the SQOs methodology in the State's Sediment Quality Provisions to determine the sediment condition and compliance with the sediment Cu numeric or SQOs target, and Cu should also be evaluated using the ERM guideline (270 µg/g) and toxicity analyses in paired samples for trend analyses. Sediments shall be evaluated in Lower Newport Bay and lower Upper Newport Bay in areas that previously exceeded the Cu ERM sediment guideline, and in areas with no or limited SQO or sediment Cu data (in particular marinas).

5.6.1.5 Santa Ana Water Board Authority to Regulate Copper (Cu) Discharges from Tributaries and Storm Drains

Storm water and dry weather discharges from urban areas to Newport Bay via surface water tributaries and storm drains are currently regulated under the municipal separate storm sewer (MS4) NPDES permit issued by the Santa Ana Water Board to the County of Orange, Orange County Flood Control District and the incorporated cites of Orange County within the Santa Ana Region (Order No. R8-2009-0030, NPDES CAS618030, as amended by Order No. R8-2010-0062). These storm water and dry weather discharges may combine with other types of discharges, including discharges from dewatering, groundwater cleanup activities, agriculture, and open space lands in the watershed. Existing NPDES permits and waste discharge requirements issued by the Santa Ana Water Board to regulate these types of discharges are listed in Table 5-7*. These permits will be revised to incorporate relevant requirements of these Cu TMDLs, when appropriate, based on the potential of these discharges to contribute Cu to Newport Bay (Section 5.6.3.2).
*(*Table 5-7 is now Table 5-5b NPDES Permittees and Permit Numbers in Section 5.5, above.)*

5.6.2 Dischargers Responsible to Achieve TMDL Load and Waste Load Allocations, and to Monitor and Evaluate Water and Sediments for Copper (Cu)

5.6.2.1 Dischargers Responsible to Reduce Copper (Cu) Discharges from Cu Antifouling Paints (AFPs)
5.6.2.2 Dischargers Responsible to Monitor and Evaluate Sediments for Copper (Cu)
5.6.2.3 Dischargers Responsible to Meet Copper (Cu) Allocations for Tributary and Storm Drain Runoff
5.6.2.4 Dischargers Responsible to Evaluate Local Impacts of Copper (Cu) Discharges from Larger Storm Drains

5.6.2.1 Dischargers Responsible to Reduce Copper (Cu) Discharges from Cu Antifouling Paints (AFPs) on Boats

The proposed Implementation Plan requires that responsible dischargers propose implementation plans whereby Cu discharges from boats will be reduced. The dischargers are required to implement those plans upon Santa Ana Water Board approval. Potential strategies that may be identified by the dischargers to achieve the requisite reductions are identified in the proposed Implementation Plan for these TMDLs.

As described in the Problem Statement/Watershed Description, Cu antifouling paints (AFPs) are the largest source of Cu to Newport Bay (approximately 18,000 lbs/yr). There are approximately 5,000 vessel slips in Newport Bay, mostly in the Lower Bay. These slips are congregated largely in 73 marinas or moored at offshore and onshore moorings, residential docks and public docks. In addition, there are approximately 15 large commercial vessels (79 ft. or greater in length) and numerous smaller commercial vessels (approximately 90 boats less than 79 ft. in length[10]). There are 5 major boatyard facilities currently operating in the Bay and numerous smaller land-based boatyards near the Bay. Many of the boatyard facilities have been in operation for decades. Boatyards provide for repair and maintenance of the vessels in the Bay, including boat hull cleaning and repainting.

Marinas, docks, moorings, boatyards and onshore facilities are located on tidelands granted in trust by the State Lands Commission to the City of Newport Beach, the County of Orange, and private parties. The State Lands Commission maintains residual oversight authority over the granted lands, but the Commission is not involved in the day-to-day management of granted lands. The owners and operators of these boats and/or facilities, the City of Newport Beach and the County of Orange are all considered responsible dischargers for the purposes of the Cu TMDLs. Underwater hull cleaners (divers) are also considered to be responsible for discharges of Cu to the Bay from Cu AFPs.

The majority of the boats in Newport Bay use Cu AFPs on their hulls to prevent fouling. The high density of boats, especially in the Lower Bay, has resulted in Cu concentrations in Newport Bay that exceed the chronic and acute dissolved Cu water quality criteria and sediment Cu guidelines. Furthermore, because recreational boats are moored in marinas most of the time, the majority of Cu from Cu AFPs is discharged within the marinas. As discussed in Section 5.3, a reduction in Cu discharges of approximately 60% is needed to achieve the Cu waste load/load allocations for boats.

The dischargers, including the City of Newport Beach, the County of Orange, marina owners/operators, and individual boat owners in Newport Bay have been made aware of the Cu problem in Newport Bay:

[10] The commercial vessel count is from the U.S. Coast Guard (personal communication, Feb. 2022).

- Cu impairment in the Bay (based on exceedances of the CTR criteria) have been discussed in Santa Ana Water Board and CEQA meetings, various conferences, workshops, studies and outreach efforts related to Cu AFPs, including an intense outreach effort as part of a 319(h) project conducted by Orange County Coastkeeper to educate and assist boaters in the conversion of boats from Cu to non-biocide AFPs or coatings.
- Santa Ana Water Board staff have had discussions on the Cu TMDLs with the City of Newport Beach and the County of Orange and have sought input regarding the proposed implementation plan.
- Articles have also appeared in local newspapers regarding Cu water quality issues due to Cu AFPs.

(1) City of Newport Beach
(2) County of Orange
(3) Marina owner/operators
(4) Individual recreational boat owners
(5) Commercial vessel owners/operators
(6) Underwater hull cleaners
(7) Boatyards
(8) Others using/mooring vessels on a transient basis
(Ownership/management agency maps are provided (Appendices 8A, 8B))

(1), (2) City of Newport Beach, County of Orange

The Santa Ana Water Board has the discretion to hold persons accountable for discharges of waste that occur or occurred on their property based on ownership of the land on which an activity occurs that results or resulted in a discharge of waste, knowledge of the activity that causes the discharge, and the ability to control the activity and the affected land.[11]

(1) City of Newport Beach, and (2) the County of Orange
In 1919, the State initially granted the City of Newport Beach the management of the trust of Newport Bay, including the tidelands and submerged lands located within its municipality. Subsequent statutory changes were made but reaffirmed the grant to the City with all of the rights, title and interest of the State of California held by the state by virtue of its sovereignty to tidelands and submerged lands within the corporate limits of the City in 1919. At the same time, the State also granted the County of Orange a trust to manage “that portion of tidelands and submerged lands bordering upon and under Newport Bay outside the corporate limits of the City of Newport Beach”. This grant was most recently amended in 1975 to authorize the County to transfer a portion of the lands to the Commission to be operated as an ecological reserve or wildlife refuge. The City of Newport Beach and the County of Orange thereby assumed the duties of the State for the management of these lands. The City works with the County in managing these lands and uses through the Harbor Patrol and the County Parks Department. Projects that may affect the

[11] These principles on the issue of landowner liability under both waste discharge requirements and enforcement orders were established in a series of orders adopted by the State Water Resources Control Board (State Board) and in memoranda issued by the State Board Office of Chief Counsel. (See e.g., State Board Orders No. WQ 87-6, 87-5, 86-18, 86-16, 86-15, 86-11, 84-6, 90-03; Memorandum dated May 8, 1987 from William R. Atwater to Regional Board Executive Officers entitled “Inclusion of Landowners in Waste Discharge Requirements and Enforcement Orders”.)

management and use of these lands are subject to review by the State Lands Commission to ensure that they are consistent with the grant and the public trust doctrine.

Boatyards, marinas, docks, piers and offshore moorings, as well as onshore facilities, are located upon tidelands/submerged lands that are managed by the City and County in Lower Newport Bay and the lower portion of Upper Newport Bay. Discharges of Cu from Cu AFPs on boats moored and/or maintained in these facilities have occurred and continue to occur, affecting both water column and sediment concentrations of Cu.

The City and County (and in some limited instances, potentially private parties in a similar position with tideland ownership) have the rights and responsibilities of land owners as grantees of the tidelands and submerged lands and exercise their authority over the lands through permits and/or leases for all commercial and noncommercial uses upon these tidelands/submerged lands. Lessees and permittees are required to ensure compliance with all applicable laws, which include the California Environmental Quality Act (CEQA), and "any other Federal, State or local statute, law, ordinance, resolution, code, rule, regulation, order or decree as any of the same now exist or may hereafter be adopted or amended"[12]. Commercial uses of tidelands/submerged lands also require business licenses. The City and County are aware that Cu discharges from boats moored in marinas and have the authority to impose controls on the nature of the activities and practices at commercial and noncommercial facilities to control the discharges of Cu. Accordingly, the City and County can be held accountable for discharges of residual Cu from Cu AFPs to Newport Bay and are thus considered responsible parties for the purpose of these Cu TMDLs.

(3) Marina Owners/Operators

The Santa Ana Water Board has the discretion to hold Newport Bay marina owners/operators accountable for discharges of waste that occur or occurred within the marina leasehold. This authority is based on their status as owners or operators of the marina facility in which an activity occurs that results or resulted in a discharge of waste, and the marina owner/operators' ability to control the activity.

Marina owners/operators own or operate the Newport Bay marina facilities where boats are congregated and moored. Marina owners/operators have knowledge that discharges of residual Cu occur and have occurred from Cu AFPs used on the hulls of these boats. Marina owners/operators could exercise control over these discharges by placing appropriate conditions in lease/rental agreements with the individual boat owners who utilize their facilities. The conditions written into these contract agreements are the key to the marina's legal authority to exercise control over residual Cu discharges from boat hulls within the marina leasehold. By way of these conditions, marina owners/operators can control the number of moored boats, the types of boats allowed (including the types of AFPs used), and hull cleaning activities allowed within the marina. Marina owners/operators can also require the use of best management practices (BMPs) by boat owners and hull cleaners and require boat owners to provide proof of hull coating composition. These facts establish that the Santa Ana Water Board can hold marina owners/operators accountable for discharges of Cu waste from Cu AFPs to Newport Bay; therefore, marina owners/operators are considered responsible parties for the purpose of the Cu TMDLs.

(4) Individual Recreational Boat Owners

Persons who own recreational boats that are painted with Cu AFPs and moored in Newport Bay are responsible for Cu discharges from Cu AFPs which are continuously generated whenever such a boat hull is exposed to water. Individual boat owners also engage in underwater cleaning of boat

[12] Excerpt of definition of "Applicable Laws" contained in "Final Commercial Pier Template", January 29, 2013, City of Newport Beach.

hulls, or hire underwater hull cleaners to clean boat hulls, and these activities result in the additional release of dissolved and particulate Cu from Cu AFPs into the surrounding waters. The Santa Ana Water Board can therefore hold each individual who owns a boat moored in Newport Bay as a responsible discharger for the purpose of these TMDLs.

(5) Commercial Vessel Owners/Operators
Commercial vessels 79 ft. or greater in length are considered to be point source discharges and currently are regulated as such under the USEPA's Vessel General Permit (VGP) (Section 5.6.1.2). Smaller commercial vessels (less than 79 ft. in length) were regulated by the small VGP; however, VIDA repealed the small VGP and exempted small commercial vessels from NPDES permitting requirements as of December 19, 2014. Persons who own commercial boats that are painted with a Cu AFP and moored in Newport Bay are responsible for Cu discharges from Cu AFPs, including passive leaching and hull cleaning. (Underwater cleaning of boat hulls results in the release of both dissolved and particulate Cu into the surrounding waters.) The Santa Ana Water Board can therefore hold each individual who owns a commercial vessel moored in Newport Bay as a responsible discharger for the purpose of these TMDLs, except to the extent preempted by VIDA. As noted above in Section 5.6.1.2., once the U.S. Coast Guard's regulations implementing VIDA are final and effective, they will apply to commercial vessels 79 feet or greater in length and the VGP will be repealed.

(6) Underwater Hull cleaners
Underwater hull cleaners, who clean boat hulls coated with Cu AFPs in Newport Bay, are also responsible for discharges of Cu waste. Underwater hull cleaning is performed by divers using various manual and mechanical means to remove fouling on hulls. The physical process of underwater hull cleaning of fouling from boat hulls painted with Cu AFPs results in the discharge of dissolved and particulate Cu into surrounding Newport Bay waters. The Santa Ana Water Board can therefore hold underwater hull cleaners as responsible dischargers for the purpose of these TMDLs.

(7) Boatyards
Recreational and commercial boats using Cu AFPs must be repainted on a periodic basis, typically, about once every 2 to 3 years, as the integrity and efficacy of the paint declines over time. Approximately once every 5 to 7 years, the hull surface must also be stripped before the application of a new Cu AFP.

Currently, there are approximately 7 major boatyards in Lower Newport Bay. Many of these facilities have been in operation for decades, though ownership and/or operation of the facilities have changed over time. The Santa Ana Water Board has regulated boatyard operations since the 1970's. The early permits required the implementation of approved Water Pollution Control Plans to prevent the discharge of process wastewater (generated during boat cleaning and painting operations) to the Bay. In 1994, the Santa Ana Water Board issued a general boatyard permit that, in part, prohibited the discharge of process wastewater to the Bay. Subsequently, all the boatyard operations have enrolled in the State Water Board's General Industrial Storm Water Permit (Water Quality Order No. 2014-0057-DWQ, as amended by Order WQ 2015-0122-DWQ, NPDES No. CAS000001 and as amended in 2015), which prohibits the discharge of unauthorized non-storm water discharges, such as process wastewater, to storm drain systems that discharge to surface waters. This permit requires that BMPs be employed to reduce or eliminate pollutants in stormwater discharges.

(8) *Others using/mooring vessels on a transient basis*
Recreational and commercial boats that are not permanently moored in Newport Bay may enter/moor in the Bay on a transient basis. If the hulls of these boats are painted with one of many

Cu AFPs, which are commonly used, discharges of residual Cu to the waters of the Bay will occur. The magnitude of Cu discharges resulting from this type of use is unknown, but it is expected to be small relative to the large number of vessels used and permanently moored in the Bay.

Control of such transient discharges would be difficult and impractical. It would likely require that a program be developed and implemented by the Harbor Patrol to check boats entering the Bay to confirm whether or not a Cu AFP is used on the boat. If so, restrictions on entrance and/or the length of the boat's stay in the Bay may be necessary. Enforcement of such restrictions by the Harbor Patrol would be onerous, and counter to local economic and recreational interests.

5.6.2.2 Dischargers Responsible to Monitor and Evaluate Sediments for Copper (Cu)

(1) City of Newport Beach
(2) County of Orange
(3) Marina owner/operators
(4) Individual recreational boat owners
(5) Commercial vessel owners/operators
(6) Underwater hull cleaners
(7) Boatyards
(8) Boat owners of transient vessels

The dischargers responsible to monitor and evaluate sediments in Newport Bay are the same dischargers identified in section 5.6.2.1. Continued monitoring and evaluation are required by these TMDLs for compliance with the sediment targets.

Per the proposed Implementation Plan, the Santa Ana Water Board will use the authorities in Section 5.6.1.4, if necessary, to require that responsible parties, including the City of Newport Beach, the County of Orange, other marina owners/operators, boatyard owners/operators and individual boat owners, develop and implement one or more approved plans to continue to monitor and evaluate sediments that exceeded the sediment guidelines, and to monitor and evaluate sediments in areas of the Bay with limited or no current sediment Cu data.

5.6.2.3 Dischargers Responsible to Meet Copper (Cu) Allocations for Tributary and Storm Drain Runoff

(1) County of Orange and other MS4 permittees, including the City of Newport Beach
(2) CalTrans
(3) Agricultural dischargers
(4) Other NPDES permittees

Tributary runoff includes urban, agricultural, and open space runoff, and permitted waste discharges resulting from groundwater dewatering and cleanup activities. The source analysis showed that tributary runoff is the second largest source of Cu to Newport Bay (approximately 3005 lbs/yr in a wet year) after Cu discharges from Cu AFPs on boat hulls. Because tributary runoff is a source of dissolved and particulate Cu to the Bay, the above dischargers are responsible for Cu discharges from the major tributaries and storm water conveyance system into the Bay. A summary of existing waste discharge requirements under which these discharges are currently regulated is provided in Table 5-7*, including NPDES Order No. 2009-0030, as amended by Order No. R8-2010-0062, NPDES CAS618030, Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the Incorporated Cities of Orange County within the Santa Ana Region - Area-wide Urban Storm Water Runoff -Orange County, (MS4 permit). These requirements will be modified if, and as appropriate, to incorporate relevant requirements of these

Cu TMDLs, including water quality-based effluent limits that are consistent with the requirements of the wasteload allocations specified in these TMDLs. *(*Table 5-7 is now Table 5-5b NPDES Permittees and Permit Numbers in Section 5.5, above.)*

5.6.2.4 Dischargers Responsible to Evaluate Local Impacts of Copper (Cu) Discharges from Larger Storm Drains

(1) County of Orange and other MS4 permittees, including the City of Newport Beach
(2) CalTrans
(3) Agricultural dischargers
(4) Other NPDES permittees

Dischargers shall evaluate the local impacts of Cu discharges from the larger storm drains (48 to 78 inches in diameter) in the Upper and Lower Bay.

5.6.3 Implementation Plan Tasks and Schedules

The Implementation Plan for the Cu TMDLs detailed below has the following principal components: 1) reduce Cu discharges from Cu antifouling paints (AFPs) to Newport Bay; 2) monitor and evaluate sediment Cu in the Lower Bay and lower Upper Bay, including areas that previously exceeded the sediment Cu ERM guideline and areas with no or limited SQOs or sediment Cu data (in particular, marinas); 3) meet the Cu allocation for tributary and storm drain runoff; and 4) evaluate local impacts of Copper (Cu) discharges from larger storm drains.

Follow-up actions may be required for the above tasks. Cu discharges from Bay sediments, algae and other vegetation may also be sources of Cu to Bay waters but have not yet been quantified. Cu discharges from direct air deposition to Newport Bay waters are small compared to other sources and reductions are not required in these TMDLs. (The majority of Cu discharges from air deposition to the Bay watershed are accounted for in tributary runoff.)

A compliance schedule has been developed for these Cu TMDLs. In particular, this compliance schedule is applicable to the reduction of Cu discharges from Cu AFPs on boats. Final compliance is to be achieved as soon as possible but no later than 12 years from the date of approval of these TMDLs by USEPA. This approach allows for the implementation of prioritized tasks over time, evaluation of their efficacy, and adaptive management of implementation strategies to ensure that the TMDLs are implemented effectively, efficiently, and fairly. The maximum 12 -year time frame is considered to be sufficient to allow boats to be repainted with lower leach rate Cu AFPs or non-biocide AFPs/coatings as part of the routine maintenance of boats (Section 5.6.3.1.2). This compliance schedule also allows for the consideration of Newport Bay-specific Cu objectives for Newport Bay using the Water Effects Ratio (WER), as provided in the California Toxics Rule, or the Saltwater Cu Biotic Ligand Model (if this model is approved by USEPA for such use) if the dischargers choose to pursue this option. If such Newport Bay-specific objectives are approved, then reconsideration of the need for and nature of these TMDLs will be appropriate.

An implementation schedule with interim compliance dates has been developed for the Cu TMDLs. In particular, this compliance schedule is applicable to the reduction of Cu discharges from Cu AFPs on boats. The tributary and storm-drain mass-based wasteload allocations are already being achieved. as of the date of this Staff Report. Final compliance with these TMDLs is to be achieved as soon as possible but no later than 12 years from the date of approval of these TMDLs by USEPA.

The Implementation Plan tasks and schedules are shown in Table 5-8 and discussed below.

Table 5-8 Implementation Plan and Schedule for Copper (Cu) TMDLs

Implementation Task	***Schedule and Dischargers***
1) Reduce Copper (Cu) discharges from Cu antifouling paints (Cu AFPs) on recreational and commercial boats	*As soon as possible but no later than (12 years from date of USEPA approval of the Basin Plan amendment (BPA)), with the following interim schedule:* *No later than (4 years from the date of USEPA approval of the BPA): A minimum 20% reduction of Cu discharges from AFPs shall be achieved* *No later than (8 years from the date of USEPA approval of the BPA): A minimum 40% reduction of Cu discharges from AFPs shall be achieved* *No later than (12 years from the date of USEPA approval of the BPA): A minimum 60% reduction of Cu discharges from AFPs shall be achieved* *Compliance with the Cu TMDLs will be considered to be achieved if the dissolved Cu CTR criterion of 3.1 µg/L* is achieved, i.e. no impairment is demonstrated per the assessment methodology in the State Listing Policy (SLP), and no further reduction in Cu discharges will be required even if the Cu wasteload ~~or load~~ allocation for boats is not yet achieved. If, however, the Cu wasteload ~~or load~~ allocation for boats is achieved, but the CTR criterion* is not achieved, these TMDLs, including the allocations identified for boats and other sources, will be reviewed and revised as needed to ensure compliance with the dissolved Cu CTR criteria ~~compliance~~ and further reduction in Cu discharges from Cu antifouling paints (AFPs) and/or other sources may be required.* **(or a chronic CTR criterion adjusted by a Water Effects Ratio other than 1, or an approved dissolved Cu chronic site-specific objective (SSO)).* *The percent reductions and schedule for those reductions identified above shall become moot upon the demonstration that compliance has been achieved.*
1.1 Implementation Plan and Schedule from dischargers to reduce Cu discharges from Cu AFPs on boats	*<u>Dischargers</u>* *City of Newport Beach (City)* *County of Orange (County)* *Marina owners/operators*

1.1.1 The dischargers shall submit their own proposed implementation plan(s) and schedule(s) to achieve reductions of Cu discharges from Cu AFPs in accordance with the requirements identified in Task 1 above. *The proposed implementation plan(s) and schedule(s) shall include tasks to monitor and evaluate Cu in marinas, channels and open water sites in the Bay; identify actions to be taken to reduce Cu from boats; and determine the Cu load reduction from boats.* *The proposed plan(s) shall include tasks to monitor and evaluate dissolved and total Cu in water to determine compliance with the dissolved Cu CTR chronic criterion), and water quality parameters (DOC, pH, salinity, temperature, TSS)* *1.1.2 The dischargers shall implement their plan(s) and schedule(s), and submit an annual report that includes all monitoring data and assessment of that data including a determination of compliance with the dissolved Cu CTR chronic criterion; identifies actions implemented and the effectiveness of those actions; and evaluates progress towards meeting the CTR chronic criterion.* *Dissolved Cu data – determine compliance with the dissolved Cu CTR chronic criterion,* *Total Cu data and water quality parameters to evaluate trends over time.* *The report should also identify tasks implemented and the effectiveness of those actions; and evaluate progress towards meeting the dissolved Cu CTR chronic criterion,* *the TMDL allocations for Cu discharges from boats and the percent reduction requirements identified in 1) above.*	*Individual boat owners* *Underwater hull cleaners* *Boatyard owners/operators* *1.1.1 As soon as possible but no later than (3 months from date of USEPA approval of the BPA)* *1.1.2 Upon Santa Ana Water Board approval of the dischargers' implementation plan(s) and schedule(s) or upon Executive Officer approval.* *The report shall be submitted one year from date of Santa Ana Water Board or Executive Officer approval of the implementation plan, and annually thereafter. The Executive Officer is authorized to adjust the annual report submittal schedules based justification of the adjustments.*
1.2 Reduce Cu Discharges from Cu AFPs on Recreational and Commercial Boats (Recommended Implementation Tasks) *The implementation plan(s) and schedule(s) (not to exceed 12 years) proposed by the dischargers shall consider the recommended tasks listed below and provide justification for tasks that are not included in their plan. If the implementation plan(s) include tasks that are not among the recommended tasks, the discharger(s) must provide justification and documentation to demonstrate that selected tasks are expected to achieve the TMDLs.* ***1.2.1 Require underwater hull cleaners to use BMPs and develop and implement a diver certification program that includes education;***	

clean boats according to manufacturer's label instructions and consider a reduced cleaning frequency schedule if feasible. *The implementation plan(s) shall consider strategies to:* *1) Require underwater hull cleaners to use BMPs, such as soft cloth and/or container/filter methods;* *2) Develop and implement a diver certification, permit or licensing program, including education, training and enforcement.* *3) Use additional BMPs developed by dischargers to reduce hull cleaning discharges, including use of a container/filter method during cleaning, and dry dock cleaning and storage.* *4) Clean boats according to the manufacturer's label instructions and consider a reduced cleaning frequency where feasible.* ***1.2.2 Develop/Continue Education Program(s) for Boaters, and Boatyards and Marina owner/operators*** *The implementation plan(s) shall consider strategies to develop and/or continue education programs for boaters, and boatyard and marina owner/operators, that include the following:* *1) Cu water quality issues, Cu impairment and Cu TMDL requirements;* *2) BMP requirements for all underwater hull cleaners, including the use of soft cloths or container/filter methods, and BMP requirements for boatyards* *3) Conversion from current Cu AFPs to lower leach rate Cu AFPs or non-biocide AFPs including costs (application, maintenance and hull cleaning costs); availability and maintenance requirements including BMPs for hull cleaning (label use recommendations should be followed for these paints) (see 1.2.1 above);* *4) The use of non-Cu AFPs containing other biocides is not recommended; however, if non-Cu biocide AFPs are used, then recommended BMPs for hull cleaning and label use recommendations should be followed for these paints (see 1.2.1 above);* *5) Department of Pesticide Regulation (DPR) recommendations for reduced hull cleaning frequency;* *6) Alternative boat storage options, such as dry dock storage and/or slip liners (see Task 1.2.1 above); and* *7) Conditions and requirements instituted by the City of Newport Beach and Orange County to reduce Cu AFP discharges to achieve TMDL requirements by dischargers (such as hull cleaning certification, permits or licenses for divers that*	

include BMP requirements, or new conditions in City and County's (or other agency's) marina lease agreements and marina slip agreements with boaters). ***1.2.3 Convert from current Cu AFPs to lower leach rates Cu AFPS or non-biocide AFPs*** *(Lower leach rates for Cu AFPs include those at or below DPR's maximum allowable leach rate of 9.5 µg/cm²/d). (The conversion of Cu AFPs to non-Cu biocide AFPs is not recommended.)* *The implementation plan(s) shall consider strategies to:* *1) Convert boats from current Cu AFPs to lower leach rate Cu AFPs or non-biocide AFPs/coatings on recreational and commercial boats moored in the Bay permanently or intermittently for more than 30 consecutive days. The order of use preference for alternative AFPs/coatings is:* *1.1) Cu AFPs with leach rates at or below 9.5 µg/cm²/d (DPR's leach rate regulation),* *1.2) non-biocide AFPs/coatings,* *1.3) non-Cu biocide AFPs (The conversion of Cu AFPs to other biocide AFPs is not recommended.) Recommended BMPs for hull cleaning, and label use recommendations should be followed for these paints (see 1.2.1 above).* *2) Require new boats to use lower leach rate Cu AFPs (leach rates at or below 9.5 µg/cm²/d per DPR's regulation) or non-biocide AFPs/coatings. Recommended BMPs for hull cleaning, and label use recommendations should be followed for these paints (see 1.2.1 above).* *(The use of non-Cu biocide AFPs is not recommended);* *3) Determine the Cu AFPs currently in use, and Cu discharges to the Bay from those Cu AFPs, especially for commercial vessels.* *4) Provide incentives for marina owner/operators and individual boat owners in marina leases, permits or other mechanisms, such as the required use of BMPs and/or the use of incentives to boaters who convert to lower leach rate Cu AFPs or non-biocide AFPs.*	
2) Monitor and evaluate Cu in sediments using the sediment quality objectives (SQOs) methodology (including chemistry, toxicity, benthic community analyses) (required by the Sediment Quality Provisions), to determine the sediment condition and compliance with the sediment Cu numeric target (ERL) or the alternative SQOs target, and evaluate the sediment Cu SQOs data using the ERM	

guideline (270 µg/g) and toxicity analyses in paired samples to determine sediment Cu and toxicity trends. Sampling should be conducted in the Lower Bay and lower Upper Bay, including areas that previously exceeded the sediment Cu ERM guideline and areas with no or limited SQO or sediment Cu data (in particular, marinas). ***Compliance with the sediment Cu target may be achieved by 1) meeting the ERL sediment Cu target; or 2) demonstrating that the sediment quality condition of Unimpacted or Likely Unimpacted is met per the SQOs methodology (interpretation and integration of multiple lines of evidence as defined in the Sediment Quality Provisions).*** *If the sediment quality condition of Unimpacted or Likely Unimpacted is not demonstrated, conduct stressor identification studies using the SQOs methodology~~,~~ to determine whether Cu is the cause of the impacted condition. If Cu is not shown to be the cause of the impacted condition, the alternative sediment Cu SQOs target is achieved. (See Table 5-1b Numeric and Alternative Targets for Sediment Copper (Cu) in Newport Bay.)*	
2.1 Implementation Plan and Schedule from dischargers *Monitor and evaluate sediments with the SQOs methodology (including chemistry, toxicity, and benthic community analyses) to determine the sediment condition and compliance with the sediment Cu numeric target (ERL) or the alternative SQOs target; evaluate sediment Cu SQOs data using the ERM guideline (270 µg/g) and toxicity analyses in paired samples to determine sediment Cu and toxicity trends. Sampling should be conducted in the Lower Bay and lower Upper Bay, including areas that previously exceeded the sediment Cu ERM guideline and areas with no or limited SQOs or sediment Cu data (in particular, marinas).* *If using the alternative SQOs target for compliance conduct stressor identification studies if the sediment condition is not Unimpacted or Likely Unimpacted to determine whether Cu is the cause of the impacted condition.* *2.1.1 The dischargers shall submit proposed implementation plan(s) and schedule(s) to monitor and evaluate sediments with the SQOs methodology (chemistry, toxicity, and benthic*	<u>*Dischargers*</u> *City of Newport Beach (City)* *County of Orange (County)* *Marina owners/operators* *Individual boat owners* *Underwater hull cleaners* *Boatyard owners/operators* *2.1.1 As soon as possible but no later than (3 months from date of USEPA approval of the Basin Plan amendment)* *2.1.2 Upon Santa Ana Water Board approval of the dischargers' implementation plan or upon Executive Officer approval.* *The report shall be submitted one year from date of Santa Ana Water Board or Executive Officer approval of the implementation plan(s) and schedule(s), and annually thereafter. The Executive Officer is authorized to adjust annual report submittal schedules based on the demonstration that such adjustment is justified.*

community analyses) to determine the sediment condition and to determine compliance with the sediment Cu numeric target (ERL) or the alternative SQOs target; evaluate sediment Cu SQOs data using the ERM guideline (270 µg/g) and toxicity analyses in paired samples to determine sediment Cu and toxicity trends. Sampling should be conducted in the Lower Bay and lower Upper Bay, including areas that previously exceeded the sediment Cu ERM guideline and areas with no or limited SQOs or sediment Cu data (in particular, marinas). *If using the alternative SQOs target for compliance, ~~C~~conduct stressor identification studies if the sediment condition is not Unimpacted or Likely Unimpacted to determine whether Cu is the cause of the impacted condition.* *2.1.2 The dischargers shall implement their plan(s) and schedule(s),and submit an annual report that includes the data and assessment of that data with SQOs methodology to determine the sediment condition and determine if it is meeting the sediment Cu numeric target (ERL) or the alternative SQOs target; and evaluate the sediment Cu SQOs data using the ERM guideline (270 µg/g) and toxicity analyses in paired samples to determine sediment Cu/toxicity trends. If using the alternative SQOs target for sediment, conduct stressor identification studies if the sediment condition is not Unimpacted or Likely Unimpacted to determine whether Cu is the cause of the impacted condition.* *This annual report may be combined with the report required in 1.1.2. above.* ***<u>[Task 2.1.3 in the 2021 Basin Plan amendment (June 29) is now included in 2.1.1 and 2.1.2.]</u>***	
3) Meet Copper (Cu) mass-based allocations for tributary and storm drain runoff - continue to monitor and evaluate Cu concentrations and flow in runoff	
3.1 The Santa Ana Water Board will revise existing WDRs and NPDES permits *Existing permits, including the MS4 storm water permit and State Water Board general permits, will be revised as necessary to implement the Cu TMDLs requirements.* *New permits will implement applicable Cu TMDLs requirements.*	*Existing permits - Upon permit renewal (or earlier, if dictated by circumstances that require revisions to an existing permit) after (date of USEPA approval of the BPA) Recommend changes to permits issued by the State Water Board (e.g., the IGP).* *New permits. - As new permits are established*
3.2 Monitoring and evaluation by dischargers	*<u>Dischargers</u>* *County of Orange (County)*

3.2.1 The dischargers shall submit, individually or collectively, proposed implementation plan(s) and schedule(s) to monitor flow and Cu concentrations and determine the Cu loads from tributary and storm drain runoff to demonstrate compliance with the Cu mass-based wasteload and load allocations (WLAs, LAs). *The proposed plan(s) shall include monitoring and evaluation of dissolved (compliance with the Cu CTR criterion) and total Cu in water, and water quality parameters (DOC, pH, salinity, temperature, TSS). These plan(s) shall also include the determination of the Cu loads in tributary and storm drain runoff. (Existing monitoring for MS4 systems may be utilized for this task.)* *3.2.2 The dischargers shall implement their plan(s) and schedule(s) and submit an annual report that includes the data and an assessment of that data, with respect to achieving the TMDLs mass-based allocations.* *(Existing monitoring and reporting for MS4 systems may be utilized for this task.)* *3.2.3 If the Cu loads exceed the TMDLs allocations for urban and/or agricultural runoff, the dischargers shall develop and submit proposed plan(s) and schedule(s) to achieve the TMDLs allocations for Cu discharges from tributary and storm drain runoff. The proposed plan(s) and schedule(s) shall include a reporting program.* *3.2.4 The dischargers shall implement their plan(s) and schedule(s) and submit a report that identifies the actions taken and the effectiveness of those actions and evaluate progress towards meeting the TMDLs mass-based allocations for Cu discharges from tributary and storm drain runoff.*	*City of Newport Beach (City)* *Other MS4 permittees* *CalTrans* *Agricultural dischargers* *Other NPDES permittees* *3.2.1 As soon as possible but no later than (3 months from date of USEPA approval of the BPA)* *3.2.2 Upon Santa Ana Water Board approval of the dischargers' implementation plan(s) and schedules or upon Executive Officer approval. The report shall be submitted one year from the date of Santa Ana Water Board or Executive Officer approval of the implementation plan, and annually thereafter. The Executive Officer is authorized to adjust annual report submittal schedules based on the demonstration that such adjustment is justified.* *3.2.3 As soon as possible but no later than 3 months from the finding that the that WLAs or LAs have not been achieved, as determined by the Executive Officer.* *3.2.4 Upon Executive Officer approval of the plan(s)/schedule(s).*
4) Evaluate local impacts of Copper (Cu) discharges from larger storm drains	
While Cu discharges from larger storm drains discharging directly to the Bay (i.e., El Paseo, Carnation, Polaris, PCH West, Arches West and Arches East) are low compared to the largest sources of Cu (Cu AFPs on boats and tributary runoff), Cu loads from larger storm drains, such as the Arches drains, may have localized impacts in receiving waters near these storm drain outlets. *4.1 The dischargers shall submit proposed implementation plan(s) and schedule(s) to evaluate the local impacts of Cu discharges from the larger storm drains (48 to 78 inches in diameter) in the Upper and Lower Bay. (The six larger storm drains*	*<u>Dischargers</u>* *County of Orange (County)* *City of Newport Beach (City)* *Other MS4 permittees* *CalTrans* *Agricultural dischargers* *Other NPDES permittees* *4.1 As soon as possible but no later than (3 months from date of USEPA approval of the BPA)*

in the Bay include El Paseo, Carnation, Polaris, PCH West, Arches West and Arches East.) *The proposed plan(s) shall include monitoring and evaluation of dissolved and total Cu in larger storm drain discharges (Task 3), and in-Bay receiving waters near storm drains, and include water quality parameters (DOC, pH, salinity, temperature, TSS).* *The proposed plan shall include monitoring and evaluation of in-Bay sediments near storm drain outlets using the SQOs methodology (chemistry, toxicity, benthic community analyses) (per the Sediment Quality Provisions) to determine the sediment condition and compliance with the sediment Cu numeric (ERL) or alternative SQOs target and evaluate sediment Cu SQOs data using the ERM (270 µg/g) guideline and toxicity analyses in paired samples for trend analyses.* *Sampling should be conducted in the Lower Bay and lower Upper Bay, including areas that previously exceeded the sediment Cu ERM guideline and areas with no or limited SQOs or sediment Cu data (in particular, marinas).* *If using the alternative SQOs target for compliance, conduct stressor identification studies if the sediment condition is not Unimpacted or Likely Unimpacted to determine whether Cu is the cause of the impacted condition.* *The plan shall include a recommended reporting program.* *4.2 The dischargers shall implement their plan(s) and schedule(s) to determine the significance of localized Cu discharges from larger storm drain discharges, and submit a report includes the data and an evaluation of the data.* *4.3 If impairment is found in the water column (based on exceedances of the CTR criterion consistent with the assessment methodology in the State Listing Policy), the dischargers shall develop and submit a plan(s) and schedule(s) to reduce Cu discharges from storm drains to impacted areas, and correct the impairment. The proposed plan(s) and schedule(s) shall include a recommended reporting program.* *4.4 The dischargers shall implement their plan(s) and schedule(s) to correct impairment in the water column resulting from Cu discharges from storm drains in the Upper and Lower Bay. The reports submitted shall identify actions taken and the effectiveness of those actions and evaluate progress towards meeting the Cu CTR criterion and*	*4.2 Upon Santa Ana Water Board approval of the dischargers' implementation plan(s) and schedules (or upon Executive Officer approval.* *4.3 As soon as possible but no later than 3 months from the finding of impairment in the water column, or the finding that sediments are impacted as determined by the Executive Officer* *4.4 Upon Executive Officer approval of the plan(s) and schedule(s)*

the concentration-based TMDL allocation for Cu discharges from storm drain runoff, and/or numeric targets for sediments.	
5) The Santa Ana Water Board will issue new and revise existing orders to implement the Cu TMDLs	*As soon as possible after (the date of USEPA approval of the basin plan amendments)*
6) Submit Updated Cu TMDLs Report, and Reevaluate and Revise the TMDLs	*Within six months of the completion of implementation Tasks 1 through 5, an updated TMDL report shall be submitted by the dischargers. This report shall evaluate the efficacy of the implemented Cu reduction strategies and provide recommendations for revisions to those strategies and these Cu TMDLs.* *Subject to staffing and resource availability, the Santa Ana Water Board will reevaluate these TMDLs in (five years after the approval of the basin plan amendment by USEPA) or earlier if warranted by new data, the adoption of site-specific Cu objectives or the Updated TMDLs report.*

Implementation Plan Tasks and Schedules

5.6.3.1 Reduce Copper (Cu) Discharges from Cu Antifouling Paints (AFPs) on Recreational and Commercial Boats (Task 1, Table 5-8)

Compliance with the CTR chronic criterion for dissolved Cu is the goal of these Cu TMDLs. The highest priority is to reduce Cu discharges from Cu AFPs on boats since Cu AFPs on boats are the largest source of Cu to Newport Bay.
These Cu TMDLs cannot be met unless Cu discharges from boats are reduced.

Compliance Schedule These Cu TMDLs include compliance schedules that allow for thes implementation of prioritized Cu reduction strategies over time, evaluation of their efficacy, and adaptive management of these strategies to ensure effectiveness, efficiency, and fairness. *Final compliance with the Cu TMDLs must be achieved as soon as possible but no later than 12 years from the date of approval of the TMDLs by USEPA.* The compliance schedule approach also recognizes that dischargers may elect to pursue investigation(s) and adoption of a site-specific objective (SSO) (or Water Effects Ratio (WER) adjustment for Cu in Newport Bay that, if approved, may necessitate reconsideration of the dissolved Cu numeric targets identified for these TMDLs.

Again, it is recognized that time will be needed to implement reasonably foreseeable methods of compliance to achieve these TMDLs. (The Substitute Environmental Document (SED) 2022 for these TMDLs describes potential compliance strategies identified by Water Board staff.) In particular, time will be needed to implement and evaluate measures to reduce Cu discharges from Cu AFPs on boats. (As noted above, compliance with the allocations for tributary runoff is now being achieved.)
Accordingly, a phased schedule of Cu reductions from boats is proposed, as shown below and in Table 5-8.

A 60% reduction in Cu discharges from boats to be achieved as soon as possible but no later than ~~(~~ (12 years from the date of USEPA approval of the TMDLs Basin Plan Amendment (BPA)).
with the following *interim compliance schedule*:

A minimum 20% reduction of Cu discharges from Cu AFPs shall be achieved in no later than (4 years from the date of USEPA approval of the BPA)

A minimum 40% reduction of Cu discharges from Cu AFPs shall be achieved, no later than (8 years from the date of USEPA approval of the BPA)

A minimum 60% reduction of Cu discharges from Cu AFPs shall be achieved, no later than (12 years from the date of USEPA approval of the BPA)

Achieving the 60% reduction in Cu discharges from boats is expected to meet the CTR chronic criterion in the Bay. (Tributary runoff, the second ~~significant~~ highest source of Cu input to the Bay, is currently meeting the assigned allocations and no further reductions are necessary at this time. Monitoring is required to ensure that the allocations continue to be met.

Compliance with the Cu TMDLs will be considered to be achieved if the dissolved Cu CTR criterion of 3.1 μg/L is achieved (i.e. no impairment is demonstrated per the assessment methodology in the State Listing Policy (SLP)), and no further reduction in Cu discharges will be required even if the Cu wasteload allocation for boats is not yet achieved. If, however, the Cu wasteload allocation for boats is achieved, but the CTR criterion* is not achieved, these TMDLs, including the allocations identified for boats and other sources, will be reviewed and revised as needed to ensure CTR*

*compliance, and further reduction in Cu discharges from Cu antifouling paints (AFPs), and/or other sources, may be required. *(or a dissolved Cu chronic CTR criterion adjusted by a Water Effects Ratio (WER) other than 1, or an approved dissolved Cu chronic site-specific objective).*
The percent reductions and schedule for those reductions identified above shall become moot upon demonstration that compliance has been achieved.

It is anticipated that the 60% reduction will likely be accomplished by the use of BMPs during hull cleaning (with concurrent implementation of diver certification and boater education requirements), and boat conversions from current Cu AFPs to lower leach rate Cu AFPs or non-biocide AFPs. The phased schedule for reductions will allow for the transition to lower leach rate Cu AFPs or non-biocide AFPs/coatings as boats are due for routine maintenance and repainting. It is expected that all boats in the Bay will be repainted over a 12-year period as part of routine maintenance. Accordingly, a maximum 12-year schedule to achieve the requisite 60% reduction in Cu discharges from Cu AFPs is proposed. Public education and outreach will be a critical component of this effort to ensure that boaters are aware of TMDL requirements, schedules and methods of compliance, including the availability, cost and maintenance of non-biocide AFPs.

The use of BMPs and diver certification/education program(s) are likely the first ~~main~~ recommended strategies to accomplish the reduction of Cu discharges from boats. (All divers should be required to use BMPs for underwater hull cleaning including the use of soft cloths or hull cleaning container/filter methods.) Consistent with the goal of the Clean Water Act to eliminate pollutant discharges to waters of the United States, the requirement for the use of BMPs by *all* hull cleaners can and should be implemented immediately (even before these TMDLs are adopted). This should be accompanied by the development of diver certification/education programs and boater/boatyard education programs. In addition, as required by DPR's leach rate regulation, boats must convert from Cu AFPs to lower leach rate Cu AFPs (maximum leach rate of 9.5 $\mu g/cm^2/d$ for Cu AFPs, and some boats may be converted from Cu to non-biocide AFPs. As described below, compliance with the TMDL allocations for boats will likely require a combination of these strategies, implemented over time.

The percent reductions identified in the interim schedule are based on the time expected to be required to implement reasonably foreseeable measures to achieve the reductions. As described in more detail below, these measures include the use of BMPs during hull cleaning, such as the use of soft cloths or a container/filter method of hull cleaning, the development and implementation of diver (underwater hull cleaner) certification/education programs for hull cleaning, and boat owner/boatyard education programs. Since these measures are already in place in other areas where Cu TMDLs have been adopted due to impairment of the water column by Cu from boats (i.e., Shelter Island Yacht Basin, Marina del Rey), it is expected that comparable programs can be developed and implemented for Newport Bay in approximately 1-2 years, or less. Earley et al's study on the life cycle contributions of Cu from vessels (2013) demonstrated that an approximate 24% and 32% reduction in Cu discharges from hull cleaning (for epoxy and ablative paints, respectively) can be achieved by using BMPs compared to non-BMPs[13]. In addition, some reduction in Cu discharges is likely to occur as boats are repainted with lower leach rate Cu AFPs (per DPR's maximum Cu leach rate regulation of 9.5 $\mu g/cm^2/d$); however, the amount of this reduction depends on the extent of the current use of Cu AFPs with leach rates higher than the maximum allowable leach rate. Nevetheless, the expectation of a minimum 20% reduction as the result of the implementation of BMPs within 4 years after the effective date of the TMDLs is reasonable.

[13] Table 5, Earley et al 2013.

The additional reductions in Cu discharges that would be required pursuant to the interim compliance dates are similarly expected to be achievable, given the anticipated, continued and potentially enhanced use of BMPs. Dischargers may elect to pursue additional hull cleaning options, such as the use of a container/filter system, and/or dry docking, that could significantly reduce Cu discharges to the Bay from Cu AFPs. Dry docks and a container/filter system for hull cleaning are already available in the Bay, and container/filter system(s) are likely to be improved in the future. The proposed interim schedule for reductions allows ample time for the improvement and use of such systems. Further, Cu discharge reductions are likely to occur as the result of the ongoing use of BMPs, and conversion to lower leach rate Cu AFPs (per DPR's leach rate regulation) or other non-Cu AFPs.

These Cu TMDLs recognize that compliance with the CTR chronic criterion may be achieved in Newport Bay before the 60% reduction of Cu discharges from boats is achieved. If such compliance is achieved, no further reductions in Cu discharges will be required. The maximum 12-year time frame is considered to be sufficient to allow the development and implementation of BMPs for hull cleaning, and for boats to be repainted with lower leach rate Cu AFPs or non-biocide AFPs/coatings as part of the routine maintenance of boats (Section 5.6.3.1.2). This compliance schedule also allows for the consideration of Newport Bay-specific Cu adjustments/objectives for Newport Bay using the Water Effects Ratio, as provided in the California Toxics Rule, or the Saltwater Cu Biotic Ligand Model (if this model is approved by USEPA for such use). If such Newport Bay specific adjustments or objectives are approved, then reconsideration of the need for and nature of these TMDLs will be appropriate.

Cu discharges from boats must be reduced by approximately 60% to achieve the TMDL allocations assigned to boats (Table 5-5). This may be accomplished with the tasks shown below.

5.6.3.1.1 Implementation Plan and Schedule from Dischargers to reduce Cu discharges from Cu AFPs on Boats (Task 1.1, Table 5-8)

Dischargers are required to submit proposed plans and schedules whereby these reductions will be achieved. The dischargers are required to implement their plans/schedules upon Santa Ana Water Board approval. (Table 5-8, Task 1.1). The Implementation Plan identifies tasks that must considered by the dischargers in developing their TMDL implementation plans/schedules.

The dischargers' implementation plan(s) and schedule(s) shall include monitoring and evaluation of Cu in marinas, channels, and open water sites in the Bay; identify actions to be taken to reduce Cu from boats; and determine the Cu load reduction from boats. The proposed plan(s) shall include tasks to monitor and evaluate dissolved and total Cu in water to determine compliance with the Cu CTR chronic criterion), and water quality parameters (DOC, pH, salinity, temperature, TSS).

The implementation plan(s) and schedule(s) (not to exceed 12 years) proposed by the dischargers shall consider the recommended tasks listed below and provide justification for tasks that are not included in their plans.

5.6.3.1.2 Reduce Cu Discharges from Cu AFPs on Recreational and Commercial Boats (Recommended Tasks) (Task 1.2, Table 5-8)

1) Require all underwater hull cleaners to use BMPs and develop and implement a diver certification program that includes education; clean boats on a reduced frequency schedule.
2) Continue Education Program(s) for Boaters, and Boatyards and Marina owner/operators
3) Convert boats from current Cu AFPs to lower leach rate Cu AFPS or non-biocide AFPs. (Lower leach rates include those at or below DPR's maximum allowable leach rate of 9.5 µg/cm^2/d). (The conversion of Cu AFPs to non-Cu biocide AFPs is not recommended.)
4) Continue monitoring in marinas and channels (added to Task 5.6.3.1.1 above)

1) Require underwater hull cleaners to use BMPs and develop and implement a diver certification program that includes education; clean boats according to the manufacturer's label instructions and consider a reduced frequency schedule. (Task 1.2.1, Table 5-8)

Develop and implement a plan and schedule to identify, implement, and enforce the use of BMPs by all underwater hull cleaners by a permit, licensing or certification system that includes education, training and certification of all underwater hull cleaners. BMPs may include the use of soft cloths, hull cleaning container/filter methods and/or dry dock storage, or additional BMPs developed by dischargers.

BMPs
All underwater hull cleaners should use BMPs for hull cleaning to reduce Cu discharges from Cu AFPs . Based on Earley et al's study (2013), which calculated Cu loading for a 3-year paint cycle for two Cu AFPs, Cu loading was an average of 28% higher when non-BMPs were used compared to BMPs (24 and 32% higher for epoxy and ablative, respectively). (Non-BMPs use abrasive pads to clean boat hulls, while BMPs use soft pads.) If it is assumed that no BMPs are currently being used, then 24-32% is the percent range that Cu loading can be reduced if all divers switch to BMPs for Cu AFPs with leach rates similar to Earley et al.'s test paints. *(Earley et al. measured Cu loading for only two Cu AFPs with leach rates lower than DPR's required 9.5 µg/cm^2/d. If the Cu AFPs currently in use in Newport Bay have leach rates different from the test paints, it cannot be assumed that Cu loading for BMPs and non-BMPs will be the same as the loading for the test Cu AFPs. There are no data in Earley et al. to determine Cu loading for Cu AFPs with leach rates higher (or lower) than the test paints. Note that the discharge of particulate Cu (in addition to dissolved Cu) is also higher for ablative vs epoxy paints, and when non-BMPs (abrasive pads) rather than BMPs (soft cloths) are used for hull cleaning).* It is unlikely that no BMPs are used in any marina in the Bay; Cu TMDLs established in southern California estimate that the use of BMPs vs non-BMPs is approximately 50%/50%. This assumption is also employed in these Cu TMDLs. With a BMP/non-BMP usage of 50/50, the maximum reduction achievable by the elimination of non-BMPs would then be 24-3214% for epoxy vs ablative paints (again if Cu AFPs in use have leach rates that are similar to the test paints). Converting from the use of non-BMPs to BMPs, therefore, will reduce Cu loading to some degree, but will not be sufficient by itself to meet these Cu TMDLs.

The conversion to the use of BMPs (from non-BMPs) will result in some reduction to Cu loading, as shown in San Diego (K. Holman, San Diego Unified Port District, pers. communication, May 2021) will not be sufficient by itself to achieve these Cu TMDLs, it is reasonable and appropriate to require the consistent use of BMPs throughout the Bay to minimize the discharge of Cu to surface waters as the result of underwater hull cleaning.[14]BMPs are already required for facilities that clean boats. The implementation of BMP requirements for underwater hull cleaners need not and should not await the adoption of these Cu TMDLs. BMP training and requirements for BMP use are expected to be part of any strategy proposed by responsible parties to achieve the requisite Cu reductions from Cu AFPs.

In addition, a new BMP strategy for cleaning hulls consists of a container/filter method whereby the boat is cleaned inside a slip liner specifically made for hull-cleaning. After cleaning, the water is filtered through multiple filters to remove pollutants before the cleaner water is returned to the Bay. In addition, the particulates and fouling that settle to the bottom of the container are removed, dried and taken to an appropriate landfill. This cleaning method has the advantage over in-water hull cleaning since the particulates and fouling solids, that would normally settle to the sediments, are removed from the water body. This results in a cleaner environment whereby less dissolution of Cu may occur from resuspended sediments/particulates.

Diver Certification/Education Program(s)
A diver certification and education program should be developed and implemented (such as the one that the Port of San Diego implemented in the Shelter Island Yacht Basin in San Diego), whereby divers must use BMPs for hull cleaning. Dischargers should consider the California Professional Divers Association handbook of Best Management Practices (BMPs) for boat hull cleaning, developed in response to water quality concerns. Research by the University of California Cooperative Extension concluded that the BMPs used by the Association, including using a schedule of frequent cleanings with the softest tool possible, are effective at cleaning boat hulls with minimal release of copper and other marine biocides to the environment.

Strategies may include:
- *Permitting, certification or licensing of all underwater hull cleaners that includes a requirement to use BMPs for boat hull cleaning*
- *The use of less abrasive hull cleaning materials and methods on boats with Cu AFPs*
- *The use of container/filter methods, ~~such as~~ and slip liners, during hull cleaning*
- *Alternative boat storage options such as dry storage (e.g., hoists, lifts) or landside boat storage facilities for smaller boats*

2) Continue Education Programs for boaters, and boatyard and marina owner/operators (Task 1.2.2, Table 5-8)
A boater education program is also recommended to educate the boaters on the Cu issues in the Bay, the use of BMPs, the conversion of boats to lower leach rate Cu AFPs or non-biocide AFPs including availability, costs and maintenance requirements, and DPR's leach rate regulation and recommendations for BMPs and reduced cleaning frequency.

[14] As noted above, boatyard operations are regulated under the State Water Board's General Industrial Storm Water Permit, which requires the development and implementation of Storm Water Pollution Prevention Plans and prohibits the discharge of unauthorized non-storm water discharges (zero discharge), such as process wastewater generated at boatyards. In short, BMPs are already required at boatyard facilities.

Identify and evaluate existing boater, boatyard and marina owner/operator related education program(s) in the Bay, and revise those programs as necessary to include the following at a minimum:

(1) Cu water quality issues, Cu impairment, and TMDL requirements,
(2) BMP requirements for all underwater hull cleaners, including the use of soft cloths or container/filter methods, and BMP requirements for boatyards
(3) Conversion from current Cu AFPs to lower leach rate Cu AFPs (per DPR's leach rate regulation) or non-biocide AFPs including costs (application, maintenance and hull cleaning costs); and availability and maintenance requirements including BMPs for hull cleaning (label use recommendations should be followed for all paints);
(4) Note that the use of non-Cu biocide AFPs is not recommended; however, if non-Cu biocide AFPs are used, then use requirements on USEPA's labels and manufacturers' recommended BMPs for hull cleaning and frequency of cleaning should be followed;
(5) Department of Pesticide Regulation (DPR) recommendations for reduced hull cleaning frequency;
(6) Alternative boat storage options, such as dry dock storage and/or slip liners
(7) Conditions and requirements instituted by the City of Newport Beach and Orange County to reduce Cu AFP discharges to achieve TMDL requirements by dischargers (such as hull cleaning certification, permits or licenses for divers that include BMP requirements, or new conditions in City's marina lease agreements and marina slip agreements with boaters).

This program should also include work with boatyard staff and paint manufacturers to ensure that boatyards are using the correct equipment and methods to apply and maintain non-biocide AFPs for successful use of these paints.

The Port of San Diego has already conducted an alternative paint study to determine the efficacy and economics of non-Cu AFPs, which included non-biocide AFPs. The final study report includes a boater guide to help boaters choose a non-biocide or non-Cu AFP (SDUPD 2011). Dr. Katy Wolf (Institute for Research and Technical Assistance - IRTA), one of the principal investigators for the Port study, has continued to work with paint manufacturers to develop non-biocide AFPs that can be applied over Cu AFPs and/or rolled on rather than sprayed on. These modifications will result in lower costs to the individual boater.

In addition, Orange County Coastkeeper was awarded a 319(h) grant in 2009 to implement a Cu Reduction Project in Newport Bay that included a financial incentive program to convert boats from Cu to non-biocide AFPs in a target marina and baywide. This grant included a program to educate boaters on Cu-related water quality issues and the use of non-biocide AFPs, and a requirement to pass a City resolution to encourage the use of non-Cu and non-biocide AFPs. The education program was conducted primarily for the target marina but included workshops in other parts of the Bay. The education program included literature, mailouts, dock walking, and multiple meetings baywide. In spite of these efforts, only ten boats baywide were converted from Cu to non-biocide AFPs. (Coastkeeper staff reported that boaters were enthusiastic to try non-biocide AFPs to reduce Cu in the Bay; however, the initial boatyards enlisted for this project were turning boaters away, telling boaters not to use non-biocide AFPs and only 3 boats were converted in the first 2 years. Later in the project, the boatyard in Balboa Yacht Basin enlisted in the project and 7 boats were converted in approximately 6 months. Unfortunately, the project ended shortly after.) This grant ended in March 2013; therefore, this or a comparable education program should continue as part of the Cu TMDLs implementation strategy.

3) Convert boats from current Cu AFPs to lower leach rate Cu AFPs or non-biocide AFPs.
(Lower leach rates include those at or below DPR's maximum allowable leach rate of 9.5

μg/cm^2/d). (The conversion of Cu AFPs to non-Cu biocide AFPs is not recommended.) (Task 1.2.3, Table 5-8)

The implementation of DPR's leach rate regulation for Cu AFPs requires that higher leach rate Cu AFPs cannot be sold or used after 2020 and must be replaced by Cu AFPs with a maximum leach rate of 9.5 μg/cm^2/d. Conversions to lower leach rate Cu AFPs should result in some reduction in Cu discharges if at least some Cu AFPs currently in use have leach rates higher than DPR's maximum allowable leach rate. The use of BMPs by in-water hull cleaners for all boats using Cu AFPs should also reduce Cu discharges to the Bay. Some boats may also convert to non-biocide paints/coatings. If boaters choose to convert to non-biocide AFPs, BMPs shall be used with the Cu AFPs, until the non-biocide AFPs replace the Cu AFPs. The successful conversion from Cu to non-biocide AFPs depends on the availability and cost of non-biocide alternative paints. (*Note that non-biocide AFPs will not be as effective as Cu in preventing fouling; therefore, they should be cleaned according to paint manufacturer's instructions (which likely includes more frequent cleaning than Cu AFPs).*

Some studies on alternative paints have demonstrated that non-biocide AFPs or coatings are available and cost effective compared to traditional Cu AFPs (Section 5.6.1.3.1.5); however, the initial cost is likely to be higher. As discussed previously, the higher initial cost of the application of a non-biocide AFP is due to the cost of stripping the old Cu AFP prior to the application of a non-biocide AFP and the required spraying-on of the non-biocide AFP (compared to rolling on Cu AFPs). *Note that paint manufacturers are developing non-biocide formulas that can be rolled on rather than sprayed on, and/or applied over old Cu AFPs which will reduce the cost of the initial application of a non-biocide paint.*

The implementation plan(s) to be developed by the dischargers shall consider strategies to:
1) Convert boats from current Cu AFPs to lower leach rate Cu AFPs or non-biocide AFPs/coatings on recreational and commercial boats moored in the Bay permanently or intermittently for more than 30 consecutive days. The order of use preference for alternative AFPs/coatings is:
1.1) Cu AFPs with leach rates at or below 9.5 μg/cm^2/d (DPR's leach rate regulation),
1.2) non-biocide AFPs/coatings,
1.3) non-Cu biocide AFPs (The conversion of Cu AFPs to non-Cu biocide AFPs is not recommended.)
Recommended BMPs for hull cleaning, and label use recommendations should be followed for these paints (see Task 1.2.1 above);
2) Require new boats to use lower leach rate Cu AFPs (~~DPR's regulation~~ -leach rates at or below 9.5 μg/cm^2/d per DPR's regulation) or non-biocide AFPs/coatings. Recommended BMPs for hull cleaning and label use recommendations should be followed for these paints (see Task 1.2.1 above). (The use of non-Cu biocide AFPs is not recommended;
3) Determine the Cu AFPs currently in use, and Cu discharges to the Bay from those Cu AFPs, especially for commercial vessels.
4) Provide incentives for marina owner/operators and individual boat owners in marina leases, permits or other mechanisms, such as the required use of BMPs and/or the use of incentives to boaters who convert to lower leach rate Cu AFPs or non-biocide AFPs.

As previously discussed, the City of Newport Beach and County of Orange have the authority to oversee the activities, facilities and operations that are located or take place on granted tidelands and submerged lands. These facilities include marinas, public and private docks, and offshore and onshore moorings, which are designed and used by recreational and commercial boats. The City and County exercise this authority, through ordinances and permits, licenses and/or lease agreements issued to individuals, organizations and businesses. The City and County, as the owners of the land where discharges are occurring, thereby have the ability to exert control over Cu discharges from Cu AFPs due to passive leaching from boat hulls and/or hull cleaning activities. These controls may include: requirements that all divers use BMPs during hull cleaning (including soft cloths or hull cleaning container/filter methods), and a diver certification, pemit or licensing program; restrictions on the number of boats using Cu AFPs that are moored in marinas; and financial incentives for lessees to encourage the conversion from Cu AFPs to non-biocide AFPs.

Financial incentives may be used to facilitate the conversion from Cu to non-biocide AFPs and may include lower lease fees for Newport Bay marina owners/operators and onshore/offshore mooring lessees who restrict the use of Cu AFPs; lower slip fees for boat owners of boats using non-biocide AFPs.

Recommended Regulatory Action(s) to Reduce Cu Discharges from Cu AFPs on Boats
As described above (5.6.1.), the Santa Ana Water Board has a number of regulatory options to compel compliance with this phased approach to reduce Cu from Cu AFPs. These include: adoption and enforcement of Waste Discharge Requirements; issuance and enforcement of a Conditional Waiver of Waste Discharge Requirements; adoption and enforcement of a waste discharge prohibition; and issuance and enforcement of Cleanup and Abatement orders. For reasons previously discussed (Section 5.6.1.3.1), a conditional waiver of waste discharge requirements is the initial recommended approach.

Santa Ana Water Board staff expect that the Conditional Waiver of Waste Discharge Requirements recommended for adoption by the Santa Ana Water Board will include the conditions listed below at a minimum. These expected conditions are reflected in Task 1.2, Table 5-8. In brief, the responsible dischargers will be required to prepare and implement, upon Santa Ana Water Board approval, a plan whereby one or more strategies will be implemented to achieve the TMDL allocation for boats in accordance with the schedule shown above and in Task 1, Table 5-8). This plan(s) and schedule(s) shall consider the strategies to reduce Cu discharges from Cu AFPs described in 5.6.3.1, above.

Dischargers Responsible to Reduce Cu Discharges from Cu AFPs on Boats
Dischargers responsible for Cu discharges from Cu AFPs are identified above (Section 5.6.2.1) and include the City of Newport Beach, the County of Orange, marina owners/operators, individual boat owners, ~~and~~ underwater hull cleaners and boatyard owners/operators. It is strongly recommended that the City, County and marina owners/operators assume a leadership role in developing and implementing the Cu reduction strategies and monitoring proposal(s) on behalf of all responsible parties, given their knowledge of and responsibility for the oversight of tidelands/submerged lands and activities/facilities operated on those lands (Section 5.6.2.1).

Such a coordinated, collective approach would facilitate the identification and implementation of appropriate measures by the responsible parties, more clearly define the roles and responsibilities of each of the dischargers and allow for better and more timely adaptive management of control measures. In short, the coordinated, collective approach will enhance TMDL implementation leading to more timely achievement of the TMDL. It is expected that the conditional waiver will provide for this collaborative action but will also allow each responsible discharger to act independently to implement TMDL requirements. Independent implementation would likely be a far more costly and less effective approach to ensure timely compliance with these TMDLs. Again, the coordinated collective approach is strongly recommended.

The recommended Conditional Waiver would identify the expectations for an approvable implementation plan(s) and schedule(s) proposed by the dischargers to achieve the requisite Cu discharge reductions from Cu AFPs and should include *consideration of* the strategies discussed above.

5.6.3.2 Monitor and Evaluate Cu in Sediments using the sediment quality objectives (SQOs) methodology for compliance with the sediment Cu numeric target (ERL) or the alternative SQOs target and evaluate the sediment Cu SQOs data using the ERM guideline plus toxicity analyses for trend analyses. (Task 2, Table 5-8)

The second priority of these TMDLs is to monitor and evaluate sediments using the SQOs methodology (including chemistry, toxicity, benthic community analyses) (per the Sediment Quality Provisions) to determine the sediment condition and compliance with the sediment Cu numeric or *alternative SQOs target and evaluate the sediment Cu SQOs data using the ERM guideline (270 µg/g) and toxicity analyses in paired samples to determine sediment Cu and toxicity trends. Sampling should be conducted in the Lower Bay and lower Upper Bay, including marinas and the Turning Basin/South Lido Channel areas that previously exceeded the sediment Cu ERM guideline and areas with no or limited SQOs or sediment Cu data (in particular, marinas).*

Compliance with the sediment Cu target may be achieved by 1) meeting the ERL sediment Cu target; or 2) demonstrating that the sediment quality condition of Unimpacted or Likely Unimpacted is met per the SQOs methodology (interpretation and integration of multiple lines of evidence as defined in the Sediment Quality Provisions[15]). *If the sediment quality condition of Unimpacted or Likely Unimpacted is not demonstrated, conduct stressor identification studies using the SQOs methodology, to determine whether Cu is the cause of the impacted condition. If Cu is not shown to be the cause of the impacted condition, the alternative sediment Cu SQOs target is achieved. (See Table 5-1b Numeric and Alternative Targets for Sediment Copper (Cu) in Newport Bay.) (Task 2, Table 5-8)*

5.6.3.3 Meet Copper (Cu) Mass-Based Allocations for Tributary and Storm Drain Runoff - Continue to Monitor and Evaluate Cu Concentrations and Flow in Runoff (Task 3, Table 5-8)

The third priority of these Cu TDMLs is to meet/continue to meet the Cu allocations for tributary and storm drain runoff. This task includes the continued monitoring and evaluation of Cu (and other metals) in tributary and storm drain runoff.

The source analysis showed that discharges of Cu from major tributaries (storm and dry weather runoff) are the second largest source of Cu to Newport Bay (Table 5-2). While San Diego Creek is no longer 303(d) listed for metals, including Cu, the Creek and Santa Ana Delhi are sources of Cu to Newport Bay, which exceeds the CTR saltwater criteria for dissolved Cu in both the Upper and Lower Bay (Table 4-10). Cu discharges from tributaries must therefore be addressed in these TMDLs. (Cu loading from storm drains is small compared to Cu loads from boats and tributaries, but may be important locally.) (Note also that the CTR criteria for Cu in freshwater may be much higher than the saltwater CTR chronic criterion of 3.1 µg/L; therefore, Cu concentrations higher than the CTR saltwater criterion could enter the Bay in tributary runoff.)
This task includes the continued monitoring and evaluation of Cu (and other metals) in tributary and storm drain runoff.

Older monitoring by the County of Orange (2006-2009) showed that dissolved Cu exceedances throughout the upper Upper Bay are less extensive than exceedances in the Lower Bay; however, more recent monitoring data (2009-2011) showed exceedances of approximately 70% and 65% in the Upper and Lower Bay, respectively (Table 4-5).

1) ***Revise existing WDRs and NPDES permits, including the MS4 Storm Water Permit.***
The Santa Ana Water Board will modify the Orange County MS4 and CalTrans NPDES permits to include the new Cu TMDL allocations, once approved and in effect, since permit allocations are currently based on allocations in USEPA's Metals TMDLs (part of the Toxics TMDLs of 2002). The dischargers will be required to continue monitoring to ensure that Cu loads from tributary runoff remain at or below the Cu allocations in these Cu TMDLs.

[15] State Water Board's Water Quality Control Plan for Enclosed Bays and Estuaries of California – Sediment Quality Provisions (2018)

2) Continue monitoring and evaluation of tributary and storm water runoff – monitor Cu concentrations and flow.

The Cu allocations in Table 5-5 are based on the Cu loads to Newport Bay from tributary and storm drain runoff (3005 and 171 pounds of dissolved Cu per year, respectively) (Table 5-2); therefore, monitoring and evaluation must continue to ensure that the Cu allocations continue to be met. Cu load reductions in tributary and storm drain runoff will be required if Cu loads increase beyond the 3005 and 171 pounds of dissolved Cu per year for tributary and storm drain runoff, respectively.

Note that in 2010, a Brake Pad Bill (SB 346) was signed by the Governor. This bill phase**s** out the use of various heavy metals and other toxic substances in motor vehicle brake pads. This bill prohibits: 1) the sale of motor vehicle brake pads that contain cadmium, chromium VI, lead, mercury, and asbestiform fibers beginning January 1, 2014; 2) the sale of all brake pads that contain more than 5 percent copper by January 1, 2021; and 3) the sale of all brake pads that contain more than 0.5 percent copper by January 1, 2025. This bill should help to reduce Cu loads in freshwater runoff from tributaries.

5.6.3.4 Evaluate Local Impacts of Copper (Cu) Discharges from Larger Storm Drains (Task 4, Table 5-8)

The fourth priority is to evaluate the local impacts of storm drain runoff from larger storm drains. While Cu discharges from larger storm drains discharging directly to the Bay (i.e., El Paseo, Carnation, Polaris, PCH West, Arches West and Arches East) are low compared to discharges from Cu AFPs and tributary runoff, Cu loads from larger storm drains may have localized impacts in receiving waters near these storm drain outlets (Appendix 6 -Figure 6-1).

This task includes the monitoring and evaluation of Cu in larger storm drain discharges (Task 3), and in-Bay receiving waters and sediments below storm drain outlets for compliance with the numeric targets for dissolved Cu (CTR chronic and acute criteria) and the sediment Cu numeric or SQOs target. Monitoring and evaluation of sediments shall be conducted with the SQOs methodology and shall include chemistry, toxicity and benthic community analyses. SQOs data shall be used to determine the sediment condition and compliance with the sediment Cu numeric or SQOs target. The data shall also be evaluated using the sediment Cu ERM and toxicity analyses in paired samples.

Pursuant to the Cu TMDLs implementation plan, the dischargers, including the City of Newport Beach and the County of Orange, are required to develop and implement upon Santa Ana Water Board approval a plan and schedule to determine the significance of localized Cu loads in runoff from storm drains that directly enter Upper and Lower Newport Bay. The intent is to assess the effects of Cu in storm drain runoff on local receiving waters, sediment quality and beneficial uses. Requirements for this investigation will be incorporated in the revised MS4 permit.

5.6.3.5 The Santa Ana Water Board will issue new, and revise existing, orders to implement these Cu TMDLs (Task 3.1 & 5, Table 5-8)

TMDLs are not self-implementing. Requirements to implement and achieve the Cu TMDLs must be specified in orders issued by the Water Board to responsible dischargers. These orders may include state authorized Waste Discharge Requirements and federal NPDES permits, conditional waivers of Waste Discharge Requirements, and other orders issued pursuant to the Water Code to require dischargers to conduct monitoring and investigations (e.g., Section 13267 order). The Water Board has already incorporated requirements in Waste Discharge Requirements/NPDES permits to implement, in part, USEPA's Cu TMDLs. These orders will need to be revised to implement the Water Board's Cu TMDLs, when approved. The Water Board may elect to revise these requirements as they are due for renewal. New orders issued by the Water Board will be necessary to implement TMDL requirements to reduce Cu discharges to Newport Bay from Cu anti-fouling paint on boats. Such new orders will be recommended for approval by the Water Board expeditiously.

5.6.3.6 Submit Updated Cu TMDLs TMDL Report, and Reevaluate and Revise the TMDLs (Task 6, Table 5-8)

Within six months of completion of tasks 1 through 5 (Table 5-8), the dischargers shall submit a TMDL Evaluation Report that evaluates the efficacy of the implementation of the requisite plans and provide recommendations for (1) changes to these plans to address identified deficiencies, and (2) revisions to the TMDLs.

These TMDLs will be reevaluated in (five years after the approval of the basin plan amendment by USEPA) or earlier if warranted by new data, the adoption of site-specific Cu objectives or the TMDL Evaluation Report.

5.6.4 Studies that Support these Cu TMDLs
A number of studies have been completed or in progress and are included below for information purposes.

Completed
1) Cu reduction 319(h) grant in Newport Bay to convert boats from Cu to non-biocide AFPs, including an education program by Orange County Coastkeeper (OC Coastkeeper & Candelaria 2013)
2) Port of San Diego study on alternative AFPs (SDUPD 2011)
3) U.C. Seagrant studies on alternative AFPs (Carson et al 2002)
4) Navy study for DPR examining the leach rates and 3-year Cu loading for two representative Cu AFPs (Earley et al 2013)
5) DPR determination of a maximum allowable leach rate for Cu AFPs (February 2014).
6) Copper reduction 319(h) grant in San Diego to convert boats from Cu to non-biocide AFPs (Port of San Diego website)
7) DPR reevaluation of the registration of Cu AFPs, including implementation of a maximum allowable leach rate for Cu AFPs (Section 5.6.1.1)
8) Marina del Rey pilot and monitoring studies by the County of LA
--A report (*Marina del Rey Pilot Hull Paint Study – Final Report, May 2, 2019)* was submitted by LA County to Los Angeles Water Board staff.
--Four non-biocide paints were examined, and Intersleek was the only paint that showed potential as an alternative to Cu AFPs. Boats painted with Intersleek will be monitored.
--Monthly reports are also submitted by LA County to Los Angeles Water Board staff.

In progress
9) DPR monitoring study in California marinas to determine effects of the implementation of the required lower leach rate for Cu AFPs (started in summer 2019).
10) USEPA Office of Pesticide Programs reevaluation of Cu pesticides including Cu AFPs
--interim decision effective Dec. 4, 2018 (EPA-HQ-OPP-2010-0212)
--USEPA established leach rate cap of 9.5 ug/cm2/d for Cu AFPs on recreational boats (same as CDPR)
--registrants were required to submit leach rate data by July 2019
--currently USEPA is in the process of reviewing leach rate data

Future studies might include
1) An extensive Marina Study to fully assess the extent of sediment Cu (and Zn, Hg) exceedances and sediment toxicity in marina and boatyard areas
2) A Boat Fouling Study to determine the amount of Cu in boat fouling. This could be conducted as a hull cleaning study that determines the release of both dissolved *and* total Cu during hull cleaning. This study could potentially be paired with hull cleaning containment methods.
Cu concentrations in the solids removed during hull cleaning were determined as part of a Hull Cleaning Study in Lower Newport Bay (unpublished data 2017-2018).

Studies on Alternative Paints

Several studies on alternative paints have demonstrated that non-biocide AFPs/coatings are available and cost effective compared to traditional Cu AFPs. A key consideration of such conversions is the higher initial cost of the application of non-biocide AFPs due to the required stripping of the old Cu AFP prior to the application of the non-biocide AFP, and the required spraying-on of some non-biocide AFPs, compared to rolling on of Cu AFPs. Both the stripping and spraying-on of non-biocide AFPs are additional costs compared to the cost of applying a Cu AFP. Paint manufacturers are addressing these additional costs by developing formulas that can be rolled on rather than sprayed on, and/or applied over old Cu AFPs. In addition, there may be contaminants in non-bioicide AFPs that have not been studied with respect to effects on aquatic organisms, including fluoropolymers.

The studies on alternative paints include: An Alternative Antifouling Paint Study by the Port of San Diego; continued work with paint manufacturers by Katy Wolf, PhD after the conclusion of the Port study, and the Carson study. In addition, a 319(h) Cu Reduction Project (Coastkeeper & Candelaria, 2013) was conducted in Lower Newport Bay to convert boats from Cu to non-biocide AFPs/coatings.

State of Washington Department of Ecology (2017, 2019)

In 2011, the Washington State Legislature adopted legislation to phase out the use of copper-based AFPs (Cu AFPs) on recreational boats. The law directed the Department of Ecology to survey the types of AFPs sold in Washington, study the effects of these paints on marine life and report the Department's findings to the Legislature by the end of 2017.

The Department's 2017 report[16] concluded that there were insufficient data to conclude that any one of the 30 non-copper biocidal AFPs registered for use in Washington would be less harmful to the marine environment than copper-based AFPs; in fact, some of these non-copper biocidal AFPs might be more harmful to the environment. The 2017 Report also took note of the small number of non-biocidal AFPs available and found again that there were limited data and analyses available to assess the effects of non-biocidal AFPs on aquatic life and water quality.

In 2018, the Washington Legislature delayed the ban on Cu AFPs and directed the Department of Ecology to conduct additional research. The Department was directed to review risk assessments, scientific studies, and other relevant analyses regarding the toxicity and environmental impacts of antifouling paints. The Department was also directed to report back to the Legislature on the reviews, safer alternatives that might be available, and recommendations as to whether regulatory changes are needed.

The Department's 2019 report[17] reviewed available data and modeling results for certain Cu and other biocidal AFPs and evaluated a number of non-paint antifouling alternatives, including non-biocidal AFPs, sonic antifouling systems, and dry dock-type fouling avoidance options. The Department continued to find that non-Cu biocidal AFPs might pose greater harm to the marine environment than Cu-based AFPs. The Report recommended that the Legislature ban certain biocidal AFPs but continue to delay the ban on Cu AFPs pending the development of additional scientific information. The Report expresses the Department's belief that safer alternatives to

[16] Report to the Legislature on Non-copper Antifouling Paints for Recreational Vessels in Washington. December 2017, Publication 17-04-039

[17] Antifouling Paints in Washington State Report and Recommendations
Report to the Legislature Pursuant to SHB 2634 (2018), September 2019, Publication 19-04-020

biocidal AFPs include the use of boat lifts, liners, trailers, and other “dry dock”-like fouling avoidance options because they do not have the direct chemical effect on water quality and wildlife that toxic options produce. The Report also concludes that “Also preferable is painting boats with non-biocidal paints and using brushes or other washing systems to remove fouling organisms. This option also does not have the direct chemical effect on water quality and wildlife produced by toxic antifouling options.” The Report states that the Department was unable to opine about the safety of silicone-based and fluorine-based AFPs without substantially more data concerning the persistence and environmental impacts of these chemicals. The Report notes that such research appears to be ongoing.

Port of San Diego Study (2011)
A study completed by the Port of San Diego examined both the efficacy and economics of nontoxic and non-Cu AFPs to determine viable alternatives to Cu AFPs (San Diego Unified Port District 2011). (Non-Cu AFPs include non-Cu biocide (paints that do not contain Cu but do contain other toxins such as zinc and/or organic biocides); non-biocide AFPs (paints that do not contain known biocides/toxins.) The Port study examined the performance, longevity and cost of alternative paints, and concluded that viable alternatives to Cu AFPs do exist on the market today. (Viabilty includes availability and cost effectiveness.) The report details the evaluation of the AFPs tested and provides a list of alternative AFPs that both performed well and are cost effective. The report also includes a matrix to assist boaters in selecting a non-Cu AFP (SDUPD 2011, Section 7).

Katy Wolf, PhD, IRTA
Katy Wolf, PhD, was one of the principal investigators for the Port study (above) and director of Institute for Research and Technical Assistance (IRTA)). After the Port Study, Dr. Wolf continued to work with paint manufacturers to develop non-biocide paints that can be rolled on rather than sprayed on, and non-biocide paints that can be applied over old Cu AFPs. These new developments for non-biocide paints will bring down the cost of non-biocide paints to costs closer to the cost for repainting with Cu AFPs. Currently, Dr. Wolf is no longer working on alternative AFPs.

Carson Study (2002)
An earlier report from the University of California (Carson et al., 2002) examined the viability of transitioning from Cu to non-metal AFPs in San Diego Bay, with the following conclusions:

- Hard epoxy paints were determined to be an adequate substitute for traditional Cu AFPs, and silicone paints were determined to be well suited for specialized uses, such as racing boats;
- With respect to cost, Cu AFPs are more cost effective over the short term, but non-biocide epoxy AFPs [though more expensive at the outset] are more cost effective over the long-term life of the boat;
  Converting all boats in San Diego Bay, which contains approximately 8000 boat slips, from Cu to non-biocide AFPs in 15 years is possible without substantial economic hardship to the boating community;(This 15-year period allows boats to be converted from Cu to non-biocide AFPs when a boat typically needs repainting, and requires that all new boats be coated with non-biocide AFPs);
- Based on boater input, a future ban on Cu AFPs with a specific compliance date is necessary to achieve substantial Cu reduction; and
- Boater education and commercial demonstrations are also necessary to achieve the conversion of boats from Cu to non-biocide AFPs.

In addition, the study found that *low level Cu AFPs (25% cuprous oxide) failed to achieve a substantial reduction of Cu*: These AFPs lose similar amounts of Cu to the water as traditional Cu AFPs over time since low level Cu AFPs require more initial coats of paint and/or the low-level Cu AFPs require more frequent repainting.

Based on the above studies, a transition to non-biocide AFPs or coatings in San Diego Bay may be accomplished in 15 years without substantial economic hardship because non-biocide AFPs are available and more cost-effective than Cu AFPs over the long term.

Historically, and during the Port study, the cost to reapply Cu AFPs to boat hulls was less expensive than the application of non-biocide AFPs or coatings due to the stripping costs associated with the conversion from Cu to non-biocide AFPs, and the spraying cost required to apply some non-biocide AFPs. The non-biocide AFPs, however, last longer than Cu AFPs and some paint manufacturers are developing non-biocide AFPs that can be rolled on rather than sprayed on and/or applied over Cu AFPs. Both of these developments have reduced the costs of non-biocide AFPs to costs that are more comparable to the cost of Cu AFPs. In addition, non-biocide AFPs should last 5 to 7 years, while Cu AFPs last 2 to 3 years.

6.0 CEQA AND ANTIDEGRADATION ANALYSES

6.1 CEQA ANALYSIS (SUBSTITUTE ENVIRONMENTAL DOCUMENT (SED 2022))

Pursuant to the California Environmental Quality Act (CEQA) and implementing regulations, including those established by the State Water Board, environmental analyses were conducted of the potential effects of the proposed amendments on a variety of environmental factors. These analyses are presented in the draft *Substitute Environmental Document for Proposed Basin Plan Amendments for Total Maximum Daily Loads (TMDLs) for Copper (Cu) in Newport Bay, Orange County, California (SED 2022)).* This Staff Report 2022 is Appendix A of this SED.

6.2 ANTIDEGRADATION REQUIREMENTS AND ANALYSES

6.2.1 Antidegradation Requirements

When considering adoption of the recommended Cu TMDLs, the Santa Ana Water Board must ensure conformance with both federal and state antidegradation policies (40 CFR 131.12 and State Water Board Resolution No. 68-16, respectively[18]). The state policy applies to surface water and groundwater whose quality meets or exceeds water quality objectives and establishes the intent to maintain high quality waters of the State to the maximum extent possible. Whenever existing water quality is better than the quality established in applicable policies or plans, Resolution 68-16 provides that the high water quality must be maintained unless it can be demonstrated that any change in water quality will have the following results:

1) Present and anticipated beneficial uses will not be unreasonably affected;
2) Water quality will not be less than that prescribed in applicable water quality control policies or plans; and
3) Water quality will be consistent with maximum benefit to the people of the State.

Further, any activity that results in a discharge to high quality waters must use the best practicable treatment or control necessary to avoid a pollution or nuisance and to maintain the highest water quality consistent with the maximum benefit to the people of the state.

In addition, the State Water Board has provided guidance to the Regional Water Boards regarding implementation, in permitting and other contexts, of both federal and state antidegradation policies.[19] Consistent with this guidance, the Santa Ana Water Board may conduct a simplified antidegradation analysis where it finds that the lowering of water quality that would result from a proposed action would be insignificant in terms of magnitude, spatial extent and/or duration.

The federal antidegradation policy was included USEPA's first water quality standards regulation in 1975 (See 40 Fed. Reg. 55340-41, November 28, 1975). The federal antidegradation policy applies to surface water, regardless of the quality of the water. (40 C.F.R. § 131.12) Under the federal policy, "existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." (40 C.F.R. § 131.12, subd. (a)(1)) In addition, where the quality of waters exceeds levels necessary to support the protection and propagation of fish,

[18] The State Water Board has interpreted Resolution No. 68-16 to incorporate the federal antidegradation policy in situations, such as the surface waters of Newport Bay and its watershed, where the federal policy applies.
[19] Administrative Procedures Update (APU) 90-004 "Antidegradation Policy Implementation for NPDES Permitting"; Appendix I-4 to APU 90-004 – Memorandum re "Federal Antidegradation Policy" from William R. Atwater , Chief Counsel, to Regional Board Executive Officers, James W. Baetge and Ray Walsh, October 7, 1987; Questions and Answers, State Water Resources Control Board Resolution No. 68-16, February 16, 1995.

shellfish, and wildlife and recreation in and on the water, that quality of water must be maintained and protected unless the state finds that

1) allowing lower quality is necessary to accommodate important economic or social development in the area in which the waters are located;
2) water quality is adequate to protect existing beneficial uses fully; and
3) the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control are achieved. (40 C.F.R. § 131.12, subd. (a)(2).)

The federal regulations further require that if a state determines it is necessary to lower the water quality of high quality waters, this determination will be based on both an analysis of alternatives that would lessen or prevent degradation and an analysis related to economic or social development in the area in which the waters are located. (40 C.F.R. § 131.12, subd. (a)(2)(ii); 80 Fed. Reg. 51032 (August 21, 2015).) However, the federal policy applies to reductions in water quality after the policy was adopted in November 1975 (State Water Board 1994). The federal regulations also require that state water quality standards include an antidegradation policy consistent with the federal policy. (40 C.F.R. § 131.12, subd. (a).) The State Water Board has interpreted Resolution 68-16 to incorporate the federal policy where the federal policy applies under federal law.

6.2.2 Antidegradation Analysis

The Cu TMDLs identify numeric targets for water and sediment, and an alternative SQOs sediment target based on the state's Sediment Quality Provisions and specify waste load allocation (WLAs) and load allocations (LAs) to meet the TMDLs (Tables 5-1, 5-5, 5-6). Recommended implementation tasks and schedules for the Cu have also been detailed and require actions by the Santa Ana Water Board and regulated parties. The intent of these actions is to reduce discharges of Cu to the Bay to achieve the targets and allocations in the TMDLs and ultimately to improve water quality and correct impairment of beneficial uses.

A substantial decrease in dissolved Cu discharges from boats (60%) is required by the Cu TMDLs. A number of strategies may be employed to achieve this reduction, including the implementation of hull cleaning BMPs and a diver certification/education program, boater education programs, the use of slip liners or haul out when cleaning hulls, hull cleaning according to manufacturer's recommendations and reduced hull cleaning frequency where feasible, and conversions to lower leach rate Cu AFPs (consistent with DPR's leach rate regulation of July 1, 2018) and/or non-biocide AFPs (non-biocide AFPs rather than non-Cu biocide AFPs are recommended). The implementation of BMPs, diver certification and education and similar measures are expected to reduce Cu inputs to surface waters and thereby improve water quality. The conversion to lower leach rate Cu AFPs should also reduce Cu loads to state waters if Cu AFPs currently in use have higher leach rates than DPR's maximum leach rate (9.5 $\mu g/cm^2/d$). The water quality effects of non-biocide AFPs are not well studied. In addition, the chemicals in these paints are not registered biocides, and therefore not regulated by DPR. The use of non-biocide AFPs could result in the release of pollutants that may adversely impact water quality and biological resources. The use of non-Cu biocide AFPs is not recommended; however, some boaters may still choose to use these paints. Accordingly, the Cu TMDLs caution that care must be employed in the selection and application of such AFPs to prevent adverse water quality or other environmental effects that may be similar to, or potentially greater than, those of Cu AFPs. These considerations are expected to be a part of the implementation plan(s) and site-specific projects to be proposed by the dischargers to meet the Cu TMDLs.

Monitoring and evaluation are key parts of the Cu TMDLs. These activities can and should be coordinated with ongoing monitoring to reduce vehicle/vessel trips that may result in adverse impacts to water quality as the result of fuel use/spillage, and adverse impacts to air quality from motor emissions. Such impacts are expected to be temporary and insignificant in terms of magnitude, and spatial extent.

In conclusion, implementation of the Cu TMDLs will not result in a significant, long-term lowering of water quality, but should improve water quality by reducing Cu discharges to the Bay. The goal and anticipated effects of these TMDLs is to improve water quality and protect beneficial uses. The TMDLs are thus in conformance with both federal and state antidegradation policies.

7.0 SCIENTIFIC PEER REVIEW

Pursuant to Health and Safety Code Section 57004 proposed rules that have a scientific basis or components generally must be submitted for external scientific peer review. However, per the *Unified California Environmental Protection Agency Policy and Guiding Principles for External Scientific Peer Review (March 13, 1998),* this peer review is not required if a new application of an adequately peer-reviewed product does not depart significantly from its scientific approach. Regional Water Board management is responsible to determine whether or not a work product must be submitted for external scientific peer review (see Exhibit F, California Environmental Protection Agency (Cal/EPA) External Scientific Peer Review Guidelines, Gerald W. Bowes, PhD, November 2006).

The Cu TMDLs for Newport Bay applied the same scientific approach and peer reviewed methodology that were used in the peer reviewed *Total Maximum Daily Load for Dissolved Copper in Shelter Island Yacht Basin, San Diego* (SIYB Cu TMDL) (SDRWQCB 2005). External scientific peer review of the Draft SIYB Cu TMDL was conducted prior to adoption of the TMDL. (See Appendix 7, SIYB Cu TMDL 2005.) The *Marina del Rey Toxics TMDL Reconsideration* (MdR TMDL) (LARWQCB 2015) that includes Cu was not peer reviewed but was modeled after the SIYB Cu TMDL and used the same peer reviewed models and equations. For these reasons, the management of the Los Angeles Regional Water Quality Control Board determined that no additional peer review of the MdR Toxics TMDL Reconsideration was required, and the Los Angeles Regional Board concurred.

Santa Ana Water Board staff prepared a memorandum for Santa Ana Water Board management consideration, documenting the application of peer reviewed scientific work products, methods and approaches in developing the proposed Basin Plan amendments[20]. A supplemental peer review memo was prepared for Santa Ana Water Board management to address changes to the Basin Plan Amendments[21]. These memos demonstrates that no additional external scientific peer review of the proposed Basin Plan amendments is required. Santa Ana Water Board management

[20]Justification for No Additional Peer Review for the Proposed Basin Plan Amendments to Incorporate Copper (Cu) TMDLs and Action Plans for Zinc (Zn), Mercury (Hg), Arsenic (As) and Chromium (Cr) for Newport Bay, California. 2020.

[21] Justification for No Additional Peer Review for the Addition of a Sediment Copper (Cu) Numeric Target and an Alternative Sediment Cu Sediment Quality Objectives (SQOs) Target in the Proposed Basin Plan Amendments to Incorporate Copper (Cu) TMDLS for Newport Bay, California (Supplement to the November 2, 2020 Memo to Hope Smythe, Executive Officer, SARWQCB, Titled “Justification for No Additional Peer Review for the Proposed Basin Plan Amendments to Incorporate Copper (Cu) TMDLs and Action Plans for Zinc (Zn), Mercury (Hg), Arsenic (As) and Chromium (Cr) for Newport Bay, California”), 2022

concurred with Santa Ana Water Board staff's determination. In short, it was determined, pursuant to the applicable guidance cited above, that the proposed Basin Plan amendments do not require further external scientific peer review.

8.0 STAKEHOLDER PARTICIPATON

Two CEQA Meetings and a Santa Ana Water Board informational presentation were held in July 2015. A second informational workshop was held at the Santa Ana Water Board on October 28, 2016. A Santa Ana Water Board workshop was also held on September 17, 2021, for these Cu TMDLs.

Meetings and calls with responsible parties were held in September and October 2014; April, May, September and December 2018; January (2), February and June 2019.In addition, two public workshops were held in Newport Beach in May 2019. Meetings were also held with staff and managers from the Santa Ana Water Board and DPR in February and March 2019.

Santa Ana Water Board staff continue to participate in discussions with stakeholders concerning these Cu TMDLs and Implementation Plan(s). Technical meetings for these Cu TMDLs were held with the City, County and Irvine Company on August 26, September 21, and October 14, 2021, and there were additional calls with the stakeholders including Orange County Coastkeeper. Water Board staff continue to work with DPR on the implementation of their leach rate regulation for recreational boats.

Orange County and the City of Newport Beach requested an opportunity to prepare and submit an alternative Implementation Plan for the Cu TMDLs, intended to supplant the implementation language in Santa Ana Water Board staff's June 29, 2021 draft TMDLs. Water The County/City proposal was submitted on January 28, 2022. The proposal included two documents: a "Proposed Alternative Implementation Plan" and "Supplemental Fact Sheet Language for the Proposed Alternative Implementation Plan". Santa Ana Water Board staff reviewed this documentation and found that the proposal was not acceptable since it would not meet the necessary purpose to correct water quality impairment due to Cu nor achieve water quality standards in the Bay[22].

Santa Ana Water Board staff also attend stakeholder meetings such as the Newport Bay Watershed Management Committee, OC Coastal Coalition and others.
Staff have also attended the Statewide Marina Workgroup, and the Cu Workgroup Meetings with DPR and other state agencies, and Alternative Boat Paint Meetings.

[22] Response to City/County on Proposed Implementation Plan, SED - Appendix B-5

9.0 STAFF RECOMMENDATION

Santa Ana Water Board staff recommends that the Santa Ana Water Board adopt Resolution No. R8-2022-0012, thereby:

1. Concurring with the Findings and Statement of Overriding Considerations in Section 7.0 of the draft SED 2022, confirming the preliminary determination by ~~Regional~~ Santa Ana Water Board staff that the proposed amendments could have a significant adverse effect on the environment but that the benefits of the Cu TMDLs outweigh their potential adverse environmental effects, and that such potential adverse effects are acceptable under the circumstances;
2. Certifying the revised environmental checklist and analysis document (SED 2022); and,
3. Adopting the Basin Plan amendments delineated in Attachments A and B to Resolution No. R8-2022-0012.

REFERENCES

Allen, M. J, A. Z. Mason, R. Gossett, D. W. Diehl, V. Raco-Rands and D. Schlenk. 2008. "Assessment of the Food Web Transfer of Organochlorine Compounds and Trace Metals in Fishes in Newport Bay, California.", Southern California Coastal Water Research Project, 3535 Harbor Blvd., Ste. 110, Costa Mesa, CA 92626.

Allen, M.J., D.W. Diehl and E.Y. Zeng. 2004. Bioaccumulation of Contaminants in Recreational and Forage Fish in Newport Bay, California in 2000-2002.

Anchor QEA. 2016. Newport Bay Copper Study: Winter 2016. Memorandum to the City of Newport Beach.

Bay, S., D. Greenstein, and J. Brown. 2004. Newport Bay Sediment Toxicity Studies. Southern CA Coastal Water Research Project (SCCWRP).

Bay, S. and D. Greenstein. 2003. Newport Bay sediment toxicity identification/evaluation study (including seawater samples). Report prepared for Santa Ana RWQCB by Southern CA Coastal Water Research Project. Riverside, CA: Santa Ana RWQCB.

Bay, S.M., D. Lapota, J. Anderson, J. Armstrong, T. Mikel, A.W. Jirik, and S. Asato. 2000. Southern California Bight Regional Monitoring Program: IV Sediment Toxicity. Southern CA Coastal Water Research Project (SCCWRP).

Blossom, N. and C. Anderson. 2007. Review of the Southern California Coastal Water Research Project Report on Copper from In-Water Hull Cleaning. Unpublished report 2007, and personal communication February 2012).

Brown, P. and R. Schottle. 2006. Copper Loading Assessment from In-Water Hull Cleaning Following Natural Fouling, Shelter Island Yacht Basin, San Diego Bay, San Diego, California. AMEC Project Report No. 6151000502 for Port of San Diego.

Carson, R., M. Damon, L. Johnson, and J. Miller. 2002. Transitioning to Non-Metal Antifouling Paints on Marine Recreational Boats in San Diego Bay. University of California.

County of Orange monitoring data for San Diego Creek and Santa Ana Delhi (2009-10 and 2010-11, OCPFRD).

Creed, J. 2011. Pers. communication

Department of Pesticide Regulation. Burant, A., X. Zhang, N. Singhasemanon, and J. Teerlink. 2019. Study 319 Report: Monitoring of Copper in California Coastal Waterbodies. Dept. of Pesticide Regulation, Environmental Monitoring Branch.

Department of Pesticide Regulation. A. Burant, X. Zhang, N. Singhasemanon, and J. Teerlink. Study 319 Report: Monitoring of Dissolved Copper in California Coastal Waterbodies. (Data from 2019.)

Department of Pesticide Regulation. 2018. Final Decision Concerning Reevaluation of Copper Based Antifouling Paint Pesticides. CA Notice 2018-03.

Donahue, J. M. and C.O. Abernathy. 1999. Exposure to Inorganic Arsenic from Fish and Shellfish from Arsenic Exposure and Health Effects. Elsevier Science B.V.

Earley, P.J., B.L. Swope, K. Barbeau, R. Bundy, J.A. McDonald and I. Rivera-Duarte. 2013. Life cycle contributions of copper from vessel painting and maintenance activities. Biofouling.

Eisler, R. 1998. Nickel hazards to fish, wildlife, and invertebrates: A synoptic review. Contaminant Hazards Reviews, Report No. 34. U.S. Fish and Wildlife Service, Laurel, Maryland. 76pp.

Eisler, R. 1996. Silver hazards to fish, wildlife, and invertebrates: A synoptic review. Contaminant Hazards Reviews, Report No. 32. U.S. Fish and Wildlife Service, Laurel, Maryland. 63pp.

Eisler, R. 1993. Zinc hazards to fish, wildlife, and invertebrates: A synoptic review. Contaminant Hazards Reviews, Report No. 26. U.S. Fish and Wildlife Service, Laurel, Maryland. 63pp.

Eisler, R. 1988. Lead hazards to fish, wildlife, and invertebrates: A synoptic review. Contaminant Hazards Reviews, Report No. 14. U.S. Fish and Wildlife Service, Laurel, Maryland. 134pp.

Eisler, R. 1986. Chromium hazards to fish, wildlife, and invertebrates: A synoptic review. Contaminant Hazards Reviews, Report No. 6. U.S. Fish and Wildlife Service, Laurel, Maryland. 38pp.

Eisler, R. 1985. Cadmium hazards to fish, wildlife, and invertebrates: A synoptic review. Contaminant Hazards Reviews, Report No. 2. U.S. Fish and Wildlife Service, Laurel, Maryland. 46pp.

Frueh, B. and G. Ichikawa. November 2007. Tissue, Sediment and Water quality Monitoring for Bioaccumulative Contaminants and Metals in the San Diego Creek and Newport Bay Watershed. DFG DATA 2005-2006 Project Report for the TMDL Program –SARWQCB –Contract #05-279-250-0.

Greene, R. and E. Crecelius. 2011a. Total and Inorganic Arsenic in Mid-Atlantic Marine Fish and Shellfish and Implications for Fish Advisories. Integrated Environmental Assessment and Management, Volume 2, Number 4, pp. 344–354.

Greene, R. 2011b. Memo to SIRB and pers. communication.

Irwin, R.J., M. VanMouwerik, L. Stevens, M.D. Seese, and W. Basham. 1997. Environmental Contaminants Encyclopedia. National Park Service, Water Resources Division, Fort Collins, Colorado. Distributed within the Federal Government as an Electronic Document (Projected public availability on the internet or NTIS: 1998). http://www.nature.nps.gov/hazardssafety/toxic/list.cfm

Johnson, B. and R. Looker, 2004. Mercury in San Francisco Bay: Total Maximum Daily Load (TMDL) Proposed Basin Plan and Amendment and Staff Report. CRWQCB, Oakland, CA. 163pp.

Klasing, S. and R. Brodberg (OEHHA). 2008. Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment. Sacramento, CA. http://www.waterboards.ca.gov/water_issues/programs/swamp/lakes_study.shtml

Long, E.R., L.J. Field and D.D. MacDonald 1998. Predicting Toxicity in Marine Sediments with Numerical Sediment Quality Guidelines, Environ. Toxicol. Chem. 17:4, pp. 714-727.

McPherson and Peters. 1995. The effects of copper-based antifouling paints on water quality in recreational boat marinas in San Diego and Mission Bays. Report to San Diego Regional Water Quality Control Board.

Nauen, C.E. 1983. Compilation of legal limits for hazardous substances in fish and fishery products. Food and Agriculture Organization of the United Nations. FAO Fisheries Circular.

Neira, Carlos, Francisco Delgadillo-Hinijosa, Alberto Zirino, Guillermo Mendoze, Lisa A. Levin, Magali Porrachia and Dimitri D. Deheyn. Spatial distribution of copper in relation to recreational boating in a California shallow-water basin. 2009. Chemistry & Ecology, Vol.25, No. 6, pp417-433.

Netherlands Emissions Inventory. June 2008. Antifoulants in marine coatings, recreational boats.

NewFields. July 2009. Lower Newport Bay Sediment Evaluations for Dredging –Progress Report.

NOAA (SQuiRTs). 1999, 2008. National Oceanic and Atmospheric Administration. Screening Quick Reference Tables. National Oceanic and Atmospheric Administration, Coastal Protection and Restoration Division, Washington, D.C.

OEHHA tissue guidelines 2008. (see Klasing and Brodberg)

OEHHA 1999. Prevalence of Selected Target Chemical Contaminants in Sport Fish fro Two California Lakes: Public Health Designed Screening Study. Brodberg, R.K. and GA Pollack, Pesticide and Environ. Toxic. Sctn, Office of Environmental Health Hazard Assessment, Calif. EPA, Sacramento, Calif.

Orange County Coastkeeper and L.M. Candelaria. March 2014. Metals Sediment Study in Lower Newport Bay (Post-dredging) Final Report. Technical Report for Santa Ana Regional Water Board.

Orange County Coastkeeper. March 2013. Newport Bay Copper Reduction Study. Technical Report for Santa Ana Regional Water Board.

Orange County Coastkeeper and L.M. Candelaria. January 2010. Newport Bay Stormdrain Metals study. Technical Report for Santa Ana Regional Water Board.

Orange County Coastkeeper and L.M. Candelaria. July 2007. Lower Newport Bay Copper-Metals Marina Study. Technical Report for Santa Ana Regional Water Board.

Orange County Stormwater DATA 2006-09, 2009-11

Peshut, P.J., R.J. Morrison and B.A. Brooks. Arsenic speciation in marine fish and shellfish from American Samoa. article in press (2007). Chemosphere. (www.elsevier.com/locate/chemosphere)

Puls, R. 1988. Mineral levels in animal health –Diagnostic data. Sherpa International. Clearbrook, B.C., Canada. (in USDOI 1998).

RMA 1998, Upper Newport Bay Feasibility Report – Numerical model development and baseline conditional analysis (for US ACOE).

Russell, D. 2003. Evaluation of the Clean Water Act Section 304(a) Human Health Criterion for Methylmercury: Protectiveness for Threatened and Endangered Wildlife in California. US Department of Interior, Fish and Wildlife Service.

San Diego Regional Water Quality Control Board. 2005. Total Maximum Daily Load for Dissolved Copper in Shelter Island Yacht Basin, San Diego Bay. Technical Report. SDRWQCB, San Diego, CA.

San Diego Unified Port District. 2011. Safer Alternatives to Copper Antifouling Paints for Marine Vessels. Final Report –USEPA Project NP00947501-4.

San Francisco Regional Water Quality Control Board. 2006. Mercury in San Francisco Bay: Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL) and Proposed Mercury Water Quality Objectives. CRWQCB, Oakland, CA.

Santa Ana Water Board Staff. Substitute Environmental Document (SED) for Proposed Basin Plan Amendments for Total Maximum Daily Loads (TMDLs) for Copper (Cu) in Newport Bay, Orange County, California, 2022.

Schiff, K., J. Brown and D. Diehl. 2006. Extent and Magnitude of Copper Contamination in Marinas of the San Diego Region, California. Southern CA Coastal Water Research Project (SCCWRP). Technical Report #483

Schiff, K., D. Diehl and A. Valkirs. 2003. Copper emissions from antifouling paint on recreational vessels. Southern CA Coastal Water Research Project (SCCWRP). Technical Report #405.

Singhasemanon, N., E. Pyatt and J. Bacey. Monitoring for Indicators of Antifouling Paint Pollution in California Marinas. 2009. California Environmental Protection Agency. Environmental Monitoring Branch. California Department of Pesticide Regulation. Report No. EH08-05.

Southern California Coastal Water Research Project (SCCWRP). 1998. Southern California Bight 1998 Regional Monitoring Program. Southern California Coastal Water Research Project (SCCWRP). 2003. Southern California Bight 2003 Regional Monitoring Program.

Staff Report for Basin Plan Amendments for Copper TMDLs and Non-TMDL Action Plans for Zinc, Mercury, Arsenic and Chromium in Newport Bay, California, L.M. Candelaria, 2016.

Stanley, T.R., Jr., J.W. Spann, G.J. Smith and R. Rosscoe. 1994. Main and interactive effects of arsenic and selenium on mallard reproduction and duckling growth and survival. Arch. Environmental Contam. Toxicol. 26:444-451

State Water Resources Control Board (SWRCB). 2018. Water Quality Control Plan for Enclosed Bays and Estuaries of California –Sediment Quality Provisions.

State Water Resources Control Board (SWRCB). 2009. Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (EBE Plan-Part 1).

State Water Resources Control Board (SWRCB). 2004, amended 2015. Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. Resolution No. 2006-0063.

Stillway, M., D. Markiewicz, B. Anderson, and B. Phillips. 2012. Toxicity in California Waters: Santa Ana Region. Report for Surface Water Ambient Monitoring Program (SWAMP)

US Department of the Interior. 1998. Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. National Irrigation Water Quality Program (NIWQP) Information Report #3. U.S. Department of Interior (BOR, FWS, GS, BIA).

USEPA 2009. The National Study of Chemical Residues in Lake Fish Tissue. EPA-823-R-09-006. US Environment Protection Agency, Office of Water, Washinton DC.

USEPA 2005. (P. Kozelka) 2nd Update to 2003 Monitoring Report.

USEPA 2004a. (P. Kozelka) Update to 2003 Monitoring Report.

USEPA 2004b. Data from USEPA –split sample analysis, pers. comm. w/Peter Kozelka

USEPA 2003. (P. Kozelka) Monitoring Report for San Diego Creek and Newport Bay (per Newport Bay Toxics Settlement Agreement). Monitoring and Assessment Office, EPA Region 9, Water Division.

USEPA 2003. Technical Summary of Information Available on the Bioaccumulation of Arsenic in Aquatic Organisms. EPA-822-R-03-032. U.S. Environment Protection Agency, Office of Science and Technology, Office of Water, Washington DC.

USEPA 2002. Total Maximum Daily Loads for Toxic Pollutants, San Diego Creek and Newport Bay, California. U.S. Environmental Protection Agency, Region 9

USEPA 2001. Update of Ambient Water Quality Criteria for Cadmium. EPA-822-R-01-001. U.S. Environmental Protection Agency, Office of Water, Washington DC. http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/pollutants/cadmium/upload/2001_04_13_criteria_cadmium_cad2001upd.pdf

USEPA 2001. Water quality criteria for the protection of human health: methylmercury. EPA-823-R-01-001. January 2002. U.S. EPA, Office of Water, Washington, DC. http://water.epa.gov/scitech/swguidance/standards/criteria/health/methylmercury.cfm

USEPA 2000. *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 2000a. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol1: Fish Sampling and Analysis, 3rd ed. EPA-823-B-00-007. U.S. Environment Protection Agency, Office of Water, Washington DC.

USEPA 2000b. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol2: Risk Assessment and Fish Consumption Limits, 3rd ed. EPA-823-B-00-008. U.S. Environment Protection Agency, Office of Water, Washington DC.

USFDA 1993. Guidance Document for Arsenic in Shellfish. Center for Food Safety and Applied Nutrition. U.S, Food and Drug Administration, Washington DC.

US Fish and Wildlife Service. 2003. Evaluation of the Clean Water Act Section 304(a) Human Health Criterion for Methylmercury: Protectiveness for Threatened and Endangered Wildlife in California. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Environmental Contaminants Division. Sacramento, California.

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

US Fish and Wildlife Service. 1998. (see USDOI 1998)

US Fish and Wildlife Service. 1997. *Environmental Contaminant Encyclopedia.* see Irwin 1997.

Valkirs, A.O., P.F. Seligman, E. Haslbeck and J.S. Caso. 2003. Measurement of copper release rates from antifouling paint under laboratory and *in-situ* conditions: implications for loading estimation to marine water bodies. Marine Pollution Bulletin.

Vazquez, I. Food Standards Agency. October 2005. Arsenic in Fish and Shellfish. Report in Food Standards Library, London. (library&info@foodstandards.gsi.gov.uk)

[7]Yeardley Jr., R., J.M. Lazorchak, and S.G. Paulsen. 1998. Elemental Fish Tissue Contamination in Northeastern U.S. Lakes: Evaluation of an Approach to Regional Assessment. Env. Tox. and Chemistry, Vol. 17, No. 9, pp1875-1884.
shows Hg guidelines as 0.1, 0.2, 0.3 µg/g ww for wildlife, fish and human health, respectively

Zhang, X. and N. Singehasemanon. 2014. Modeling to determine the maximum allowable leach rate for copper-based antifouling products in California marinas. Appendix to DPR 2018.

Zirino, A. and P.F. Seligman. 2002. Copper Chemistry, Toxicity and Bioavailibility and Its Relationship to Regulation in the Marine Environment. Space and Naval Warfare Systems Center Technical Document 3140. San Diego, CA.

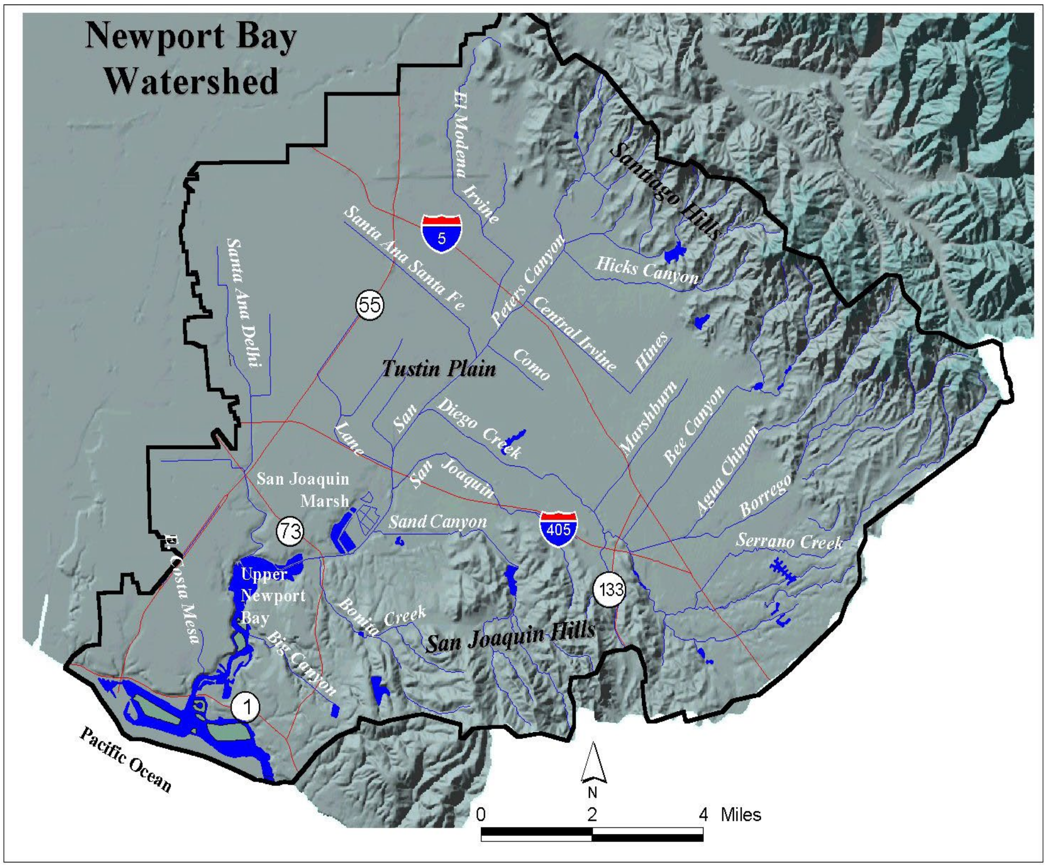
APPENDICES TO
COPPER (Cu) TMDLS
FOR NEWPORT BAY

TABLES IN APPENDICES

FIGURES IN APPENDICES

APPENDIX 1 - MAP OF NEWPORT BAY WATERSHED

Figure A1-1 Map of Newport Bay Watershed



APPENDIX 2 - 303(d) HISTORY AND SUMMARY FOR SAN DIEGO CREEK

Table A1-1 303(d) List Summary for Toxic Pollutants including Metals in San Diego Creek – Reaches 1, 2 (Summary as of 2010)

	San Diego Creek	
1986-87	SD Creek	no pollutant
1990	split into Reaches 1, 2	Elevated fish tissue levels, Elevated shellfish tissue levels no pollutants listed
1991	Reaches 1,2	same as 90
1994	Reaches 1,2	same as 91
1996	Reaches 1,2	same as 94, still no pollutants listed
	Reach 1	+ Sedimentation
1998	Reaches 1,2	pollutants added
	Reach 1	**metals,** sedimentation/siltation
	Reach 2	**metals,** unknown toxicity sedimentation/siltation
2002	Reach 1	**metals off R1** (USEPA's Toxics TMDL established)
	Reach 2	**metals,** unknown toxicity metals still on R2 (should have been removed w/R1)
2006	Reach 1	**individual metals data reviewed by SB (Cd, Cu, Cr, Pb, Ni are Do Not List (DNL)), (Zn is DNL but fact sheet is missing)**
	Reach 2	**metals** **request to delist metals was submitted w/ OC data** **–RB staff agrees w/request to delist Reach 2**
2010	Reach 1	**no metals listed**
	Reach 2	**no metals listed** **(unknown toxicity)**

*Reach 1 is downstream of Jeffrey Road, ^Reach 2 is upstream of Jeffrey Road to the headwaters
http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/docs/303(d) /2010_303(d) .pdf

APPENDIX 3 - INFORMATION FROM STATE LISTING POLICY FOR IMPAIRED WATERS
(Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List, SWRCB 2004)

Table A3.1 (Table 3.1 from the State Listing Policy) shows the number of exceedances needed to identify a waterbody as impaired.

Table 3.1 Minimum number of measured exceedances needed to place a water segment on the section 303(d) list for toxicants.

Null Hypothesis: Actual exceedance proportion < 3 percent.
Alternate Hypothesis: Actual exceedance proportion > 18 percent.
The minimum effect size is 15 percent.

Sample Size	List if the number of exceedances equal or is greater than
2 – 24	2*
25 – 36	3
37 – 47	4
48 – 59	5
60 – 71	6
72 – 82	7
83 – 94	8
95 – 106	9
107 – 117	10
118 – 129	11

*Application of the binomial test requires a minimum sample size of 16. The number of exceedances required using the binomial test at a sample size of 16 is extended to smaller sample sizes.

For sample sizes greater than 129, the minimum number of measured exceedances is established where α and $\beta < 0.2$ and where $|\alpha - \beta|$ is minimized.

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

APPENDIX 4 - ADDITIONAL DATA ANALYSIS FOR SOME INDIVIDUAL STUDIES, MAPS

4.2.2.1 Lower Newport Bay Copper-Metals Marina Study May 2005, Completed July 2007 (OC Coastkeeper, 2007)
http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/docs/newport/finalcufinal_report.pdf

The goal of this project was to determine if 1) Copper (Cu) and other metals were elevated in marinas compared to the channel outside each marina, 2) Cu and other metals exceeded the CTR saltwater criteria in marina and channel waters, 3) Cu and other metals exceeded sediment ERM and ERL guidelines, and 4) water and/or sediment toxicity was present. These data were also collected to provide additional data to the Department of Pesticide Regulation (DPR) on Cu concentrations and water and sediment toxicity in marina areas.
Water and sediment samples were collected in 8 marinas and in the channel outside each marina. Water samples were analyzed for dissolved and total metals (USEPA priority metals), DOC, TSS and salinity; sediment samples were analyzed for total metals and TOC. Samples were collected in May, August and December 2006, and a total of 105 water samples and 105 sediment samples were collected. In summer 2006 (August)**,** a subset of water and sediment samples was also analyzed for water and sediment toxicity and PCBs and PAHs; sediments were also analyzed for grain size.

Results
Water Dissolved Copper (Cu) was the only metal to exceed the acute and chronic CTR saltwater criteria (4.8, 3.1µg/L) (Table 4-1). Cu means were higher, in general, in marinas compared to their corresponding channels although not statistically significantly different because the Turning Basin area in the Lower Bay had elevated metals in both marina and channel waters (Table 4-2). Note that in the Turning Basin and S. Lido Channel areas, Cu in most samples in both marinas and channels exceeded the Cu CTR saltwater criteria (marinas 30/33, channels 11/12 exceedances). Outside the Turning Basin exceedances of the Cu CTR were higher in marinas compared to channels (marinas 22/27, channels 1/21 exceedances). These data demonstrate that Cu exceedances were similar in marinas and channels in the Turning Basin/S. Lido Channel areas, while marina waters in other parts of the Bay had higher Cu concentrations than the channels.
Sediment In sediment samples, Cu, Mercury (Hg), and Zinc (Zn) exceeded the ERM sediment guidelines in the Lower Bay, and most of the exceedances were in the Turning Basin area, which demonstrates that the Turning Basin area should be addressed as an area of concern (Table 4-1). Sediments also exceeded the ERL sediment guidelines for Cu, Zn, Hg, Cd, Ni, Pb, As, Ag (Table 4-1). (ERL sediment guidelines from Long et al. 1998, are commonly used as targets for metals TMDLs.) Sediment Cu concentrations exceeded the ERM, ERL sediment guidelines in 12/33, 22/33 marina and 0/12, 10/12 channel samples in the Turning Basin/S. Lido channel areas, and 0/9, 5/9 marina and 0/3, 1/3 channel samples outside the Turning Basin.
Toxicity No water toxicity was found in samples tested; however, sediment toxicity was found at most sites tested (Table 4-2). A map of sampling sites is shown in Figure 4-1.
This report was one of those evaluated by DPR during the decision process to reevaluate the registration of Cu boat bottom paints.

Impairment (Copper (Cu) in water; Cu, Zinc (Zn), Mercury (Hg) in sediments, Sediment Toxicity)
****Water** The data demonstrate that both Upper and Lower Newport Bay waters are still impaired for Cu. Bay waters tested exceeded the dissolved Cu CTR saltwater criteria; these include marina waters within the Bay.

Sediment The data also showed that sediments exceeded the ERM guidelines for Cu, Zn and Hg in the Lower Bay, especially in the Turning Basin area, and the majority of sediments analyzed were positive for toxicity.

Table A4-1 Newport Bay Marina Study –Data from 2006

Number of exceedances of CTR saltwater criteria, Sediment guidelines ERM (ERL)										
		Water*	**Sediment**							
	n	**Cu**	**Cu**	**Zn**	**Hg**	**Ag**	**Cd**	**Ni**	**Pb**	**As**
Criteria or Guideline ERM (ERL)		Acute, chronic 4.8, 3.1	270 (34)	410 (150)	0.71 (0.15)	3.7 (1.0)	9.6 (1.2)	51.6 (20.9)	218 (46.7)	70 (8.2)
Upper Bay										
Dunes	**12**	**0, 5**	**(12)**	**(8)**			**(10)**	**(6)**		**(3)**
DeAnza	**15**	**1, 8**	**(13)**	**(11)**	**(1)**		**(6)**	**(10)**		**(7)**
Lower Bay										
BYB	**15**	**3, 5**	**1 (14)**	**(14)**	**2 (14)**			**(13)**		**(12)**
Bahia	**15**	**0, 5**	**1 (15)**	**(12)**	**(5)**		**(11)**	**(9)**		**(8)**
Harbor	**12**	**5, 11**	**4 (11)**	**7 (11)**	**2 (4)**		**(10)**	**(9)**	**(11)**	**(10)**
Lido Villg	**12**	**8, 12**	**2 (12)**	**(11)**	**4 (11)**	**(2)**		**(11)**	**(9)**	**(11)**
Lido Yacht	**12**	**7, 12**	**8 (12)**	**4 (12)**	**12 (12)**		**(4)**	**(11)**	**(4)**	**(12)**
H & J	**12**	**2, 8**	**(12)**	**1 (12)**	**4 (12)**		**(1)**	**(9)**		**(10)**
Total –all sites	**105**	**26, 66**	**16 (102)**	**12 (91)**	**24 (59)**	**(2)**	**(42)**	**(78)**	**(24)**	**(73)**

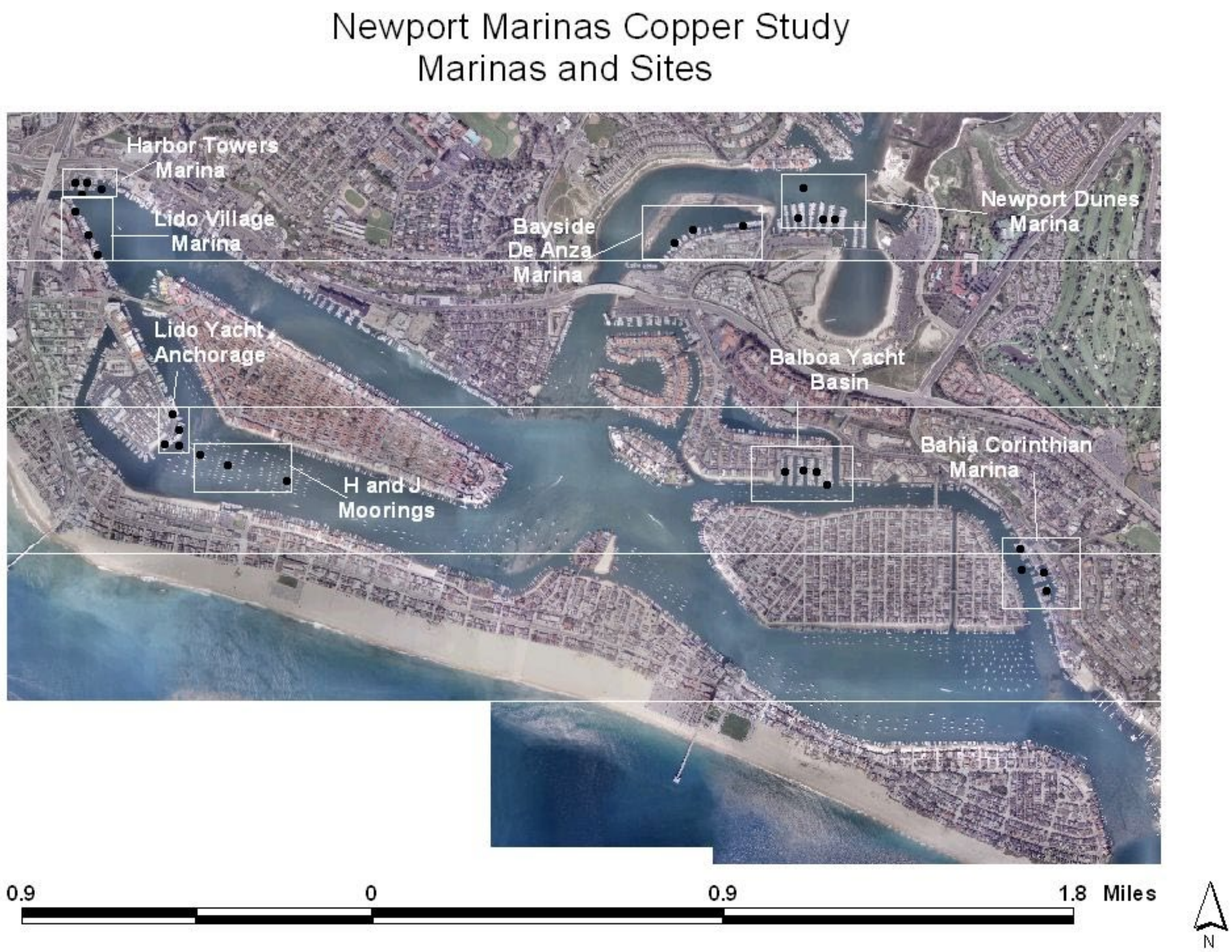
Results in blue are sites that exceeded the CTR criteria or sediment Cu ERM.
*other metals analyzed in water (Zn, Hg, As, Cd, Cr, Pb, Ni, Ag) have NO exceedances of CTR acute or chronic saltwater criteria
n =number of samples

Table A4-2 Mean Cu Concentrations in Water and Sediment + Sediment Toxicity (Marina study)

	Water –dissolved Cu (µg/L)			**Sediment (µg/g)**			**Sediment Toxicity***
	marina	**channel**	**max**	**marina**	**channel**	**max**	
Dunes	**3.1**	**2.1**	**4.0**	**82**	**44**	**121**	**X**
DeAnza	**3.7**	**2.3**	**6.8**	**111**	**32**	**169**	**X**
BYB	**3.9**	**2.2**	**5.6**	**155**	**110**	**279^**	**0**
Bahia	**3.0**	**2.0**	**4.4**	**184**	**79**	**350**	**X**
Harbor	**5.2**	**5.0**	**8.2**	**197**	**203**	**536^**	**X**
Lido Vill	**5.6**	**4.4**	**11.0**	**233**	**104**	**318**	**XX**
Lido Yacht	**5.8**	**4.9**	**10.0**	**317**	**175**	**365**	**0X**
H & J	**3.8**	**3.5**	**4.9**	**155**	**136**	**216**	**X**

^ maximum sediment concentration was near a storm drain outlet
*Sediment toxicity, X = toxic (all toxicity was < 70% survival)
Sites with XX or 0X = 2 samples at that site

Figure A4-1 Map of Lower Newport Bay Marina Sites (Marina Study 4.2.2.1)



*Note that the Northwest corner of the Bay, including Harbor Towers Marina and Lido Village Marina, is considered to be the Turning Basin area of Newport Bay

4.2.2.2 Orange County storm water/dry weather and sediment data in Bay monitoring

Monitoring is ongoing and quarterly (OC Stormwater data 2006-09).
Water samples are analyzed for dissolved metals, and sediment samples are analyzed for total metals and sediment toxicity.

Results

Water Dissolved Copper (Cu) concentrations exceeded the CTR acute and chronic saltwater criteria (4.8, 3.1µg/L) (Table 6 & Figure 4-2). No other metals exceeded the dissolved CTR saltwater criteria in water samples.
Sediment In sediment samples, only Mercury (Hg) exceeded the ERM sediment guidelines in two samples in the Lower Bay in the Turning Basin area; however, there were numerous exceedances of the ERL sediment guidelines for multiple metals (Cu, Zn, Hg, Cd, Ni, As) (Table 6). There was a higher percent of ERL exceedances in the Lower Bay compared to the Upper Bay for most metals, except for Cd, and a higher percent of exceedances in 2006-07 compared to other years.
Toxicity Sediment toxicity was found in 12/16, 3/6 and 1/16 samples in the Upper Bay, and in 6/8, 0/6 and 0/8 sites in the Lower Bay, for 06/07, 07/08 and 08/09, respectively. Note that more samples in the Upper Bay showed toxicity in this data set,

Impairment (Copper (Cu) in water, Sediment toxicity)
****Water** The data demonstrate that Lower Newport Bay waters are still impaired for Cu. Bay waters tested did not include marina waters in this study.

Sediment The data also show that sediments exceed the ERM guidelines for Hg in the Lower Bay, and the sediments analyzed were positive for toxicity.

Table A4-3 Exceedances of ERM (ERLS) Sediment Quality Guidelines by year

	(OCPFRD data 2006/07, 2007/08, 2008/09)		
Metal**	**Upper Bay**	**Lower Bay**	**Sediment guidelines ERM (ERL)**
***Cu**	(7/17, 5/12, 7/16)	(8/8, 9/12, 7/8)	270 (34)
***Zn**	(2/17, 3/12, 4/16)	(6/8, 6/12, 4/8)	410 (150)
Hg	(0/15, 0/12, 0/16)	1/7, 1/10, 0/8 (3/7, 4/10, 5/8)	0.71 (0.15)
***Cd**	(5/17, 1/12, 4/16)	(4/8, 0/12, 0/8)	9.6 (1.2)
***Pb**	(0/17, 0/12, 0/16)	(2/8, 3/12, 2/8)	218 (46.7)
Ni	(2/17, 1/12, 5/16)	(4/8, 5/12, 4/8)	51.6 (20.9)
Ag	(1/17, 0/12, 0/16)	(0/8, 0/12, 1/8)	3.7 (1.0)
As	(3/17, 1/12, 5/16)	(5/8, 5/12, 4/8)	70 (8.2)

* Metals requiring TMDLs in the Newport Bay Toxics TMDLs (USEPA 2002)

Figure A4-2

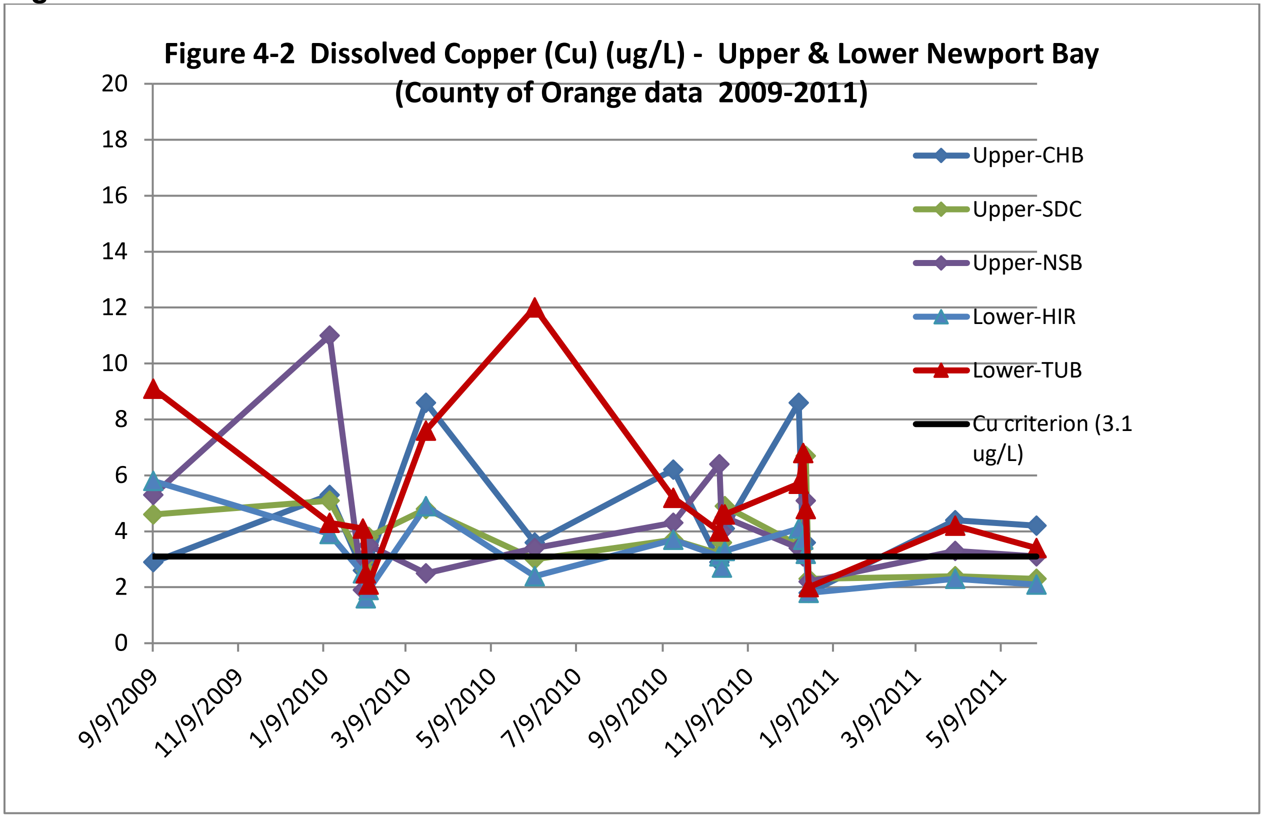


Figure 4-2 Dissolved Copper (Cu) (ug/L) - Upper & Lower Newport Bay
(County of Orange data 2009-2011)
20
18
16
14
12
10
8
6
4
2
0
9/9/2009
11/9/2009
1/9/2010
3/9/2010
5/9/2010
7/9/2010
9/9/2010
11/9/2010
1/9/2011
3/9/2011
5/9/2011
Upper-CHB
Upper-SDC
Upper-NSB
Lower-HIR
Lower-TUB
Cu criterion (3.1 ug/L)

Figure A4-3 Map of Lower Newport Bay Sites (Copper Reduction Study 4.2.2.3)

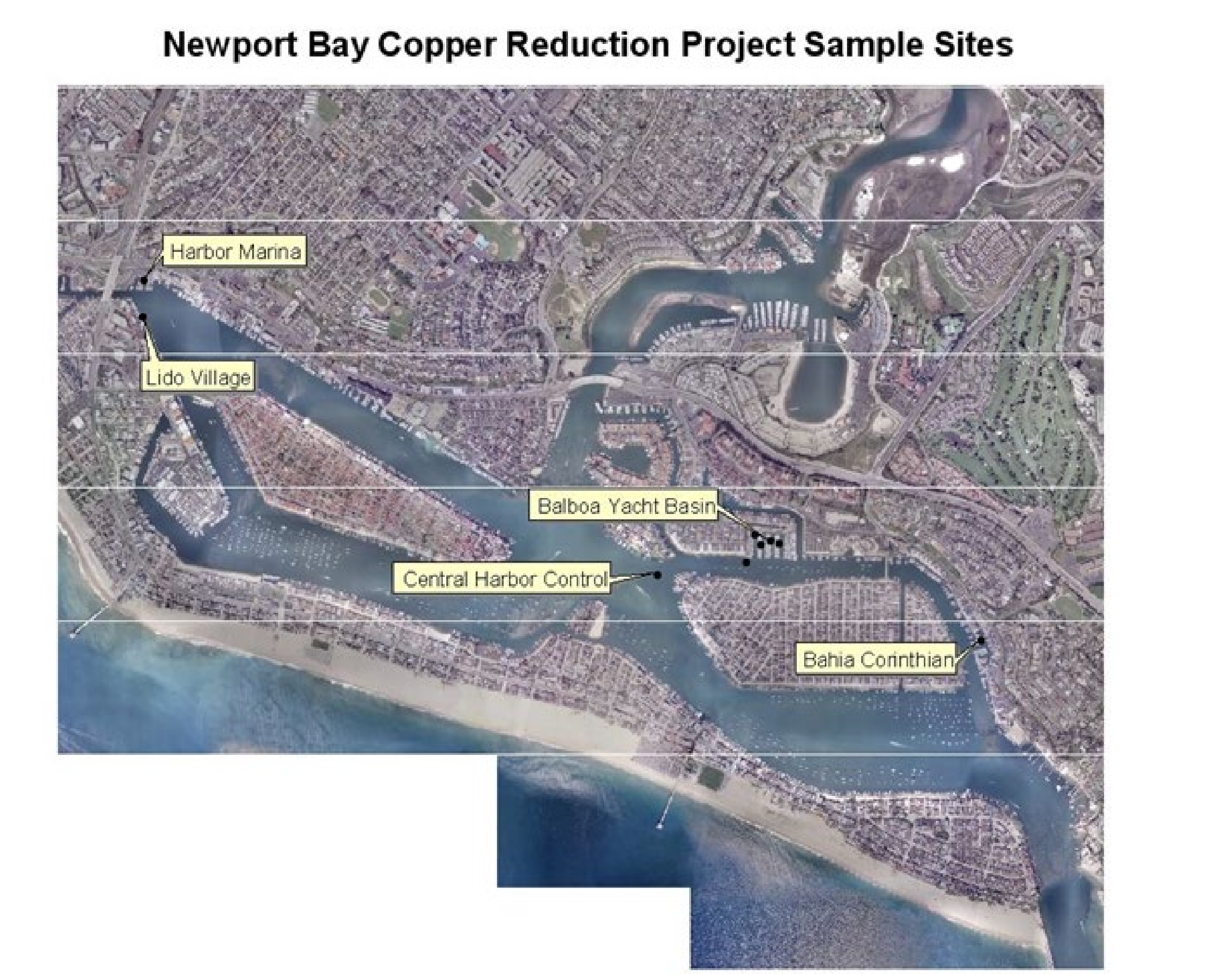


Figure A4-4 Map of Lower Newport Bay Sampling Sites (Dredging Study 4.2.2.4) (DMMT 2009)

APPENDIX 5 - Bay Protection and Toxic Cleanup Program(1998)
Sediment Chemistry, Toxicity and Benthic Community Conditions in Selected Water Bodies of the Santa Ana Region (BPTCP -Phillips et al '98)

This study was part of the Bay Protection and Toxic Cleanup Program (BPTCP) to monitor and assess the sediments in some California bays and estuaries using the Sediment Quality Triad approach to determine hot spots. This approach uses sediment chemistry, sediment toxicity, and benthic community data to determine the extent of contamination in a waterbody. In this study, samples were collected from Newport Bay, Anaheim Bay/Seal Beach and Huntington Beach/Bolsa Chica. Only Newport Bay results are discussed here. Eighteen sites were sampled in Newport Bay. Subsurface water, pore water, sediment and benthic samples were collected. Sediment chemistry was run, and toxicity tests were conducted with subsurface water, pore water and sediment; benthic community analyses were also conducted.

Results
Water No chemistry analyses were conducted on water samples except for pore water in the Rhine Channel (not discussed here).
Sediment Upper Bay- No metals exceeded the ERM sediment guideline in 6 sites (Cu, Zn, Hg, Cd, Cr, Ni, Pb, As, Ag). Cu, Zn, Ni and Ag exceeded the ERL guidelines in 4/6, 2/6, 2/6, 1/6 sites, respectively.
Lower Bay - Hg exceeded the ERM guideline in 3/11 sites. Zn exceeded the ERM guideline in 1/11 sites. Cu, Zn, Cd, Cr, Ni, Pb and As exceeded the ERL guidelines in 10/11, 9/11, 2/11, 6/11, 2/11, 6/11 sites, respectively.

Toxicity Upper Bay Sediment toxicity to amphipods and *Ampelisca* was found in 2/7 and 1/5 samples, respectively. Toxicity was found in Pore water and Sediment-water interface tests (purple urchin larval development) in 6/6 and 5/7 samples, respectively. Lower Bay - Sediment toxicity to amphipods and Ampelisca was found in 5/12 and 1/6 samples, respectively. Toxicity was found in Pore water and Sediment-water interface tests (purple urchin larval development) in 11/12 and 1/12 samples, respectively.

Benthic Community Testing
Upper Bay -2/6 samples were rated as Transitional, 0/6 samples were rated as Degraded.
Lower Bay –5/13 samples were rated as Transitional, 4/13 samples were rated as Degraded.
There were significant correlations between the benthic index and Cu, Cd, Cr, Ni and %fines in the Bay; however, the correlations were not separated for Upper vs Lower Bay.

Conclusions for Newport Bay
1 Hg exceeded the ERM sediment guideline in 3/11sites (Turning Basin, West Newport Bay (WNB)) and Zn exceeded the ERM sediment guideline in 1/11 sites (WNB).
2 Newport Bay had the highest ERMQ values of any regional water body sampled.
Within the Bay, the highest ERMQ values (excluding the Rhine Channel) were found at Newport Island (WNB) and Arches drain (Turning Basin), and were due to Hg, Zn and total PCBs exceedances of the ERM sediment guidelines. (The Rhine Channel had the highest overall ERMQ values.)
3 Toxicity –Amphipod survival was negatively correlated with metals, total chlordane and total PCBs in Newport Bay. Purple urchin larval development in Bay porewater tests and Ampelisca toxicity were also correlated with some metals (including tributyl tin) and organics.
4 Benthic community tests showed significant degradation in 4 stations in Newport Bay, and overall the RBI was significantly correlated with several metals, several DDT metabolites and fine-grained sediments.
The Benthic index and amphipod toxicity were significantly correlated.
5 Two stations in Newport Bay (in addition to the Rhine Channel) were placed in Category 5 –elevated chemistry, biological impacts, and the other stations were placed in categories 6 (biological impact, no elevated chemistry) and 7 (no biological impact or elevated chemistry.)

APPENDIX 6 - SOURCE STUDIES & CALCULATIONS

6.1 RECREATIONAL BOATS (and COMMERCIAL BOATS)

Copper antifouling paints (Cu AFPs) on boat hulls are the largest source of Cu to Newport Bay. Cu is discharged from Cu AFPs to prevent fouling while boats are sitting in the water (passive leaching). Cu is also discharged during hull cleaning, as both dissolved and particulate Cu, and the contribution from hull cleaning is greater if BMPs are not used while cleaning boat hulls. Most boaters in Newport Bay currently use Cu AFPs on their boat hulls.

6.1.1 Cu LOADING CALCULATIONS FOR RECREATIONAL BOATS (and COMMERCIAL BOATS 79 FT. OR GREATER)

For these Cu TMDLs, the Cu load calculations for boats initially followed those in USEPA's Toxics TMDLs for Newport Bay (Section 6.1.2); however, in 2013, the Navy conducted a new study on Cu loading from boat hulls (Earley et al, 2013). The Earley study determined the Cu loading for one epoxy and one ablative Cu AFP that were chosen as representative of each paint type by the paint manufacturers. *Note that the overall leach rates of the two 'representative' paints are lower than the maximum leach rate of 9.5 µg/cm²/d required by DPR's regulation (July 1, 2018); therefore, the loading estimates based on these paints may actually underestimate the Cu loading from Cu AFPs in Newport Bay.*

These Cu TMDLs will therefore use the Earley loading numbers modified to a leach rate of 9.5 µg/cm²/d to determine Cu loading from boats in the Bay. Note also that these calculations only revise the source numbers for Cu from boat hulls (Table 5-2), and do not impact the allocations for boat hulls (Table 5-5) as the allocation numbers are based on the loading *capacity* for Cu in the Bay calculated by RMA's bathtub model (Section 5.4).

Changes to USEPA's calculations. The Earley study measured Cu loading from both epoxy and ablative AFPs using three treatments: no treatment, BMPs and non-BMPs, and determined loading over a three year paint cycle, which is the life of most Cu AFPs. These loading numbers included initial leaching for a new Cu AFP, passive leaching and hull cleaning events. In addition, this study used a hull area of 41.062 m² (40ft boat, 13ft beam) compared to USEPA's hull area of 35.3 m² (40ft boat, 11ft beam).

6.1.1.1 Cu Loading based on Earley et al 2013 using a leach rate of 9.5 µg/cm²/d

The Earley study used one epoxy and one ablative paint chosen by the paint manufacturers as representative paints. Since the study was conducted, DPR has set a maximum allowable leach rate of 9.5 µg/cm²/d; therefore, the Cu loading calculations from the Earley study were adjusted for the higher leach rate.

Cu Loading Approximations per year using leach rate (LR) of 9.5 µg/cm²/d for BMPs (Earley's loading estimates adjusted to LR of 9.5 µg/cm²/d)

Epoxy *Loading/yr* *boat*

3505.1 µg/cm²/yr x 41.062m² x 5,000 slips x (10⁴cm²/m² x kg/10⁹µg)
= 7196.3 kg/yr x 2.20462 lbs/kg
= 15865.15 lbs/yr
15865 lbs/yr /5,000 slips ~ 3.17 lbs/boat/yr

Ablative *Loading/yr* *boat*

3499.7 µg/cm²/yr x 41.062m² x 5,000 slips x (10⁴cm²/m² x kg/10⁹µg)
=7185.2 kg/yr x 2.20462 lbs/kg
= 15840.7 lbs/yr
15840.7 lbs/yr /5,000 slips ~ 3.17 lbs/boat/yr

Cu loading from boats for BMPs = 80% epoxy + 20% ablative
= (15865 lbs/yr x 0.800) + (15841 lbs/yr x 0.20)
= 12692 lbs/yr + 3168 lbs/yr
= 15860 lbs/yr
15860 lbs/yr /5,000 slips ~ 3.17 lbs/boat/yr

Cu Loading Approximations per year using LR of 9.5 µg/cm²/d for non-BMPs
Epoxy (based on Earley et al, Cu loading from epoxy paints for non-BMPs over BMPs =25.6%)

15865.15 lbs/yr + 0.256(15865.15 lbs/yr) = 19926.63 lbs/yr

Ablative (based on Earley et al, Cu loading from ablative paints for non-BMPs over BMPs =31.9%)

15840.7 lbs/yr + 0.319(15840.7 = 20893.9 lbs/yr

Cu loading from boats for non-BMPs = 80% epoxy + 20% ablative
= (19926.63 lbs/yr x 0.800) + (20893.9 lbs/yr x 0.20)
= 15941.3 lbs/yr + 4178.8 lbs/yr
= 20120 lbs/yr
20120 lbs/yr /5,000 slips ~ 4.02 lbs/boat/yr

Total Cu loading from boats using LR of 9.5 µg/cm²/d
= 50% BMPs + 50% non-BMPs
= (15860 lbs/yr x 0.50) + (20120 lbs/yr x 0.50)
= 7930 lbs/yr + 10060 lbs/yr
= 17990 lbs/yr
17990 lbs/yr /5,000 slips ***~3.6 lbs/boat/yr***

Since these Cu loading estimations are higher using DPR's maximum leach rate over Cu loading values in the Earley et al study, this TMDL will use the Cu loading estimations as the Cu contribution from boats (Table 5-2).

6.1.1.2 Cu Loading based solely on Cu AFPs used by Earley et al 2013

Cu Loading per year for BMPs with a 40ft boat

Loading/yr *boat*
Epoxy 2361.33µg/cm²/yr x 41.062m² x 5,000 slips x (10⁴cm²/m² x kg/10⁹µg)
= 4848.05 kg/yr x 2.20462 lbs/kg
= 10688.1 lbs/yr
10688 lbs/yr /5,000 slips ~ 2.14 lbs/boat/yr

Loading/yr *boat*
Ablative 2501.33µg/cm²/yr x 41.062m² x 5,000 slips x (10⁴cm²/m² x kg/10⁹µg)
=5135.48 kg/yr x 2.20462 lbs/kg
= 11322 lbs/yr
11322 lbs/yr /5,000 ~ 2.26 lbs/boat/yr

Based on conversations with boatyards and a paint distributer in Newport Bay, the approximate percentages of Cu epoxy and ablative AFPs are 80 and 20%, respectively; therefore, the Cu loading to Newport Bay for BMPs is:

Cu loading from boats for BMPs = 80% epoxy + 20% ablative
= (10688 lbs/yr x 0.800) + (11322 lbs/yr x 0.20)
= 8550.4 lbs/yr + 2264.4 lbs/yr = 10815 lbs/yr
10815 lbs/yr /5000 slips ~ 2.16 lbs/boat/yr

Cu Loading per year for non-BMPs with a 40ft boat

Loading/yr *boat*
Epoxy 3172.33 μg/cm²/yr x 41.062m² x 5,000 slips x (10⁴cm²/m² x kg/10⁹μg)
= 6513.11 kg/yr x 2.20462 lbs/kg
= 14353.9 lbs/yr
14359 lbs/yr /5,000 slips ~ 2.87 lbs/boat/yr

Loading/yr *boat*
Ablative 3674.33 μg/cm²/yr x 41.062m² x 5,000 slips x (10⁴cm²/m² x kg/10⁹μg)
= 7543.77 kg/yr x 2.20462 lbs/kg
= 16631.1 lbs/yr
16631 lbs/yr /5,000 slips ~ 3.33 lbs/boat/yr

Cu loading from boats for non-BMPs = 80% epoxy + 20% ablative
= (14359 lbs/yr x 0.800) + (16631 lbs/yr x 0.20)
= 11487 lbs/yr + 3326 lbs/yr = 14813 lbs/yr
14813 lbs/yr /5000 slips ~ 2.96 lbs/boat/yr

For Newport Bay, if we assume that 50% of the boats use BMPs and 50% do not, the resulting Cu load to Newport is:

Total Cu loading from boats = 50% BMPs + 50% non-BMPs
= (10815 lbs/yr x 0.50) + (14813 lbs/yr x 0.50)
= 5407.5 lbs/yr + 7406.5 lbs/yr = 12814 lbs/yr
12814 lbs/yr /5000 slips ~ 2.56 lbs/boat/yr

6.1.2 Cu LOADING CALCULATIONS FOR COMMERCIAL BOATS GREATER THAN 79 FEET

The Cu loading calculations for commercial boats greater than 79 feet use the same equations in 6.1.1 (loading calculations for recreational boats). The differences include boat size and paints used, and there are approximately 15 large (79 ft. or greater) commercial boats in Newport Bay (USCG -personal communication, 2022). In addition, more commercial boats use ablative rather than epoxy paints.

These calculations also use the Earley et al loading numbers modified to a leach rate of 9.5 μg/cm²/d to determine Cu loading from large commercials boats in the Bay. Note also that these calculations only add source numbers for Cu from large commercial boat hulls (Table 5-2), and do not impact the allocations for boat hulls (Table 5-5) as the allocation numbers are based on the loading *capacity* for Cu in the Bay as calculated by the bathtub model (Section 5.4).

Cu Loading Approximations per year using LR of 9.5 µg/cm²/d for BMPs for commercial boats –(average boat length of 100 ft.)
– this may be an underestimation of Cu load from commercial boats if leach rates are higher than 9,5 µg/cm²/d

Epoxy *Loading/yr* *boat*
3505.1 µg/cm²/yr x 79.33 m² x 15 slips x (10⁴cm²/m² x kg/10⁹µg)
= 41.71 kg/yr x 2.20462 lbs/kg
= 91.95 lbs/yr
91.95 lbs/yr /15 slips ~ 6.13 lbs/boat/yr

Ablative *Loading/yr* *boat*
3499.7 µg/cm²/yr x 79.33 m² x 15 slips x (10⁴cm²/m² x kg/10⁹µg)
=41.64 kg/yr x 2.20462 lbs/kg
= 91.81 lbs/yr
91.81 lbs/yr /15 slips ~ 6.12 lbs/boat/yr

Cu loading from boats for BMPs = 20% epoxy + 80% ablative
= (91.95 lbs/yr x 0.20) + (91.81 lbs/yr x 0.80)
= 18.39 lbs/yr + 73.45 lbs/yr = 91.84 lbs/yr
91.84 lbs/yr /15 slips ~ 6.12 lbs/boat/yr

Cu Loading Approximations per year using LR of 9.5 µg/cm²/d for non-BMPs
Epoxy (based on Earley et al, Cu loading from epoxy paints for non-BMPs over BMPs =25.6%)
91.95 lbs/yr + 0.256(91.95 lbs/yr) = 115.49 lbs/yr

Ablative (based on Earley et al, Cu loading from ablative paints for non-BMPs over BMPs =31.9%)
91.81 lbs/yr + 0.319(91.81 lbs/yr) = 121.09 lbs/yr

Cu loading from boats for non-BMPs = 20% epoxy + 80% ablative
= (115.49 lbs/yr x 0.20) + (121.09 lbs/yr x 0.80)
= 23.10 lbs/yr + 96.87 lbs/yr = 119.98 lbs/yr
119.9 lbs/yr /15 slips ~ 7.99 lbs/boat/yr

Total Cu loading from boats = 50% BMPs + 50% non-BMPs
= (91.84 lbs/yr x 0.50) + (119.98 lbs/yr x 0.50)
= 45.92 lbs/yr + 59.99 lbs/yr = 105.9 lbs/yr ~7.06 lbs/boat/yr

Since the Cu loading approximations are higher using the new maximum leach rate over Cu loading in the Earley et al study, this TMDL will use these Cu loading approximations for the Cu source number for boats.

6.1.3 USEPA's Cu LOADING CALCULATIONS FOR BOATS (RECREATIONAL ONLY)

In the Toxics TMDLs (USEPA, Toxics TMDLs, TSD Part E), USEPA used some information and equations from the draft TMDL for Dissolved Copper in Shelter Island Yacht Basin (SDRWQCB 2005) to determine the Cu load from recreational boat hulls.

6.1.3.1 PASSIVE LEACHING CALCULATIONS

Passive leaching occurs when Cu is discharged from Cu antifouling paints (Cu AFPs) which mostly contain cuprous oxide. Cu AFPs are designed to leach Cu into the water to minimize the attachment of algae, barnacles, and other fouling onto the boat hull. This Cu release contributes to the dissolved Cu concentrations in Newport Bay and other waters.

Average passive leaching rates have been reported as 3.9 µg/cm^2/day (Zirino and Seligman 2002) and 8-22 µg/cm^2/day (Valkirs et al, 2003). USEPA used a Cu leach rate of 10µg/cm^2/day in the Newport Bay Toxics TMDLs and the draft Shelter Island Cu TMDL.

The calculations below are based on those used in the Toxics TMDLs (and the draft Shelter Island Cu TMDL). Values used in both the Newport Bay and draft Shelter Island TMDLs are in non-italic print, values used only for Newport are in italics.

Assumptions
Most boaters in Newport Bay use Cu AFPs on their boat hulls.
There are approximately 10,000 boat slips in Newport Bay.
(This conservative approach assumes that all slips contain a boat.)
The average leach rate for Cu AFPsis 10 µg/cm^2/day.
(Leach rates vary with the type of Cu AFP.)
Boats are painted with Cu AFPs approximately every 2 years.
Mean boat length is 40 ft and wetted surface area is approximately 35.3 m^2
Average wetted surface area = Boat length x beam height x 0.85 (Interlux 1999)
In Newport Bay, the majority of recreational vessels are both power boats and sail boats.

Equations from the Toxics TMDL (USEPA 2002). Additions or revisions to the original calculations are highlighted.

Copper loading from passive leaching is calculated as follows:

Annual copper load (kg/yr) = P*S*N, and S = L*B*0.85

Where:
P = Passive leaching rate
N = Number of boats
S = Wetted hull surface area = Overall length*Beam*0.85
L = Average length
B = Average beam height

Given:
P = 10 µg/cm^2/day
N = 10,000 (number of boat slips in Newport Bay)
L = 12.2 m (= 40 ft)
B = 3.4 m
Wetted hull surface area = (Overall length)*(Beam width)*(0.85)

Wetted hull surface area = (12.2 m)*(3.4 m)*(0.85) = 35.258 m^2 (EPA used 35.3 m^2)

Annual Copper load = (10 μg/cm^2/day)*(35.258 m^2)*(*10,000* boat slips)*(10,000 cm^2/m^2)*(kg/10^9 μg)(365 day/yr)

Estimates of Copper load from passive leaching in Newport Bay= 12,869.17 kg/year (35,258 g/day)

12,869.17 kg/year x 2.20462lbs/kg = 28371.6 lbs/year

6.1.3.2 HULL CLEANING

Although most boats are coated with antifouling paints, which are designed to reduce the build-up of marine growth (fouling) on boat hulls, fouling does occur on boat hulls and needs to be cleaned off periodically. This fouling is commonly removed by divers while the boat remains in the water; or the boat may be hauled-out and the fouling removed on land. Divers use soft cloths or scrub pads depending on the type of fouling, and a number of divers try to follow best management practices for hull cleaning. (In the San Diego area, some marinas even follow a Clean Marina program which specifies practices for hull cleaning by divers.) Most recreational boats in southern California have their hulls cleaned nearly once per month.

In-water hull cleaning results in a discharge of both dissolved and particulate Cu. The amount of copper released from hull cleaning depends on the type of paint, cleaning method and frequency, and whether the paint is new or old. In San Diego Bay, it was estimated that underwater hull cleaning occurs about ten times per year for most recreational boats, and that boats are painted with Cu antifouling paints approximately every two years (Conway and Locke 1994). The Shelter Island Cu TMDL estimated 14 hull cleaning events per year (SDRWQCB 2005). In Newport Bay, hull cleaning is estimated to be a little less than once per month. More abrasive cleaning methods will release a higher amount of dissolved and particulate Cu, and the leaching rate usually increases just after a hull is cleaned. In addition, it is likely that newer paints release more Cu; however, studies on the quantification of Cu release with various hull cleaning methods and the age of Cu antifouling paints are limited.

One study demonstrated that the average dissolved Cu concentration near boats was 12 µg/L; however, during hull cleaning dissolved Cu concentrations increased to approximately 56 µg/L (McPherson and Peters 1995). After hull cleaning, Cu concentrations decreased to background within ten minutes (due to movement and dispersion of the Cu plume). In this study the boat was relatively clean to start so the diver used a moderately abrasive pad with moderate pressure; therefore, this study may greatly *underestimate* the amount of Cu released during more aggressive hull cleaning.

A Navy study evaluating Cu concentrations during hull cleaning of Navy boats showed that total Cu concentrations increased during hull cleaning but that Cu^{+2} ion activity remained fairly constant; therefore, they concluded that most of the Cu discharged from hull cleaning was in the particulate form (Valkirs et al 1994). SCCWRP also conducted a passive leaching and hull cleaning study with 3 antifouling coatings on fiberglass panels and reported that by mass 95% of the dissolved Cu from boats is from passive leaching, while only 5% is from hull cleaning (Schiff et al 2006). Blossom and Anderson disagree since the SCCWRP study calculated the Cu discharge from hull cleaning for only one hour after cleaning although elevated Cu discharge from hull cleaning lasted for days, and they showed that in-water hull cleaning actually accounts for approximately 50% of the dissolved Cu concentrations discharged from boat hull paints (unpublished report, May 2007). These conclusions agree with USEPA's analysis in the Newport Bay Toxics TMDLs where passive leaching accounts for approximately 55% and hull cleaning accounted for approximately 45% of the dissolved Cu discharged from boats. USEPA's analysis of Cu discharges from hull cleaning were based on plume measurements following hull cleaning rather than a hull cleaning leach rate (McPherson and Peters 1995).

With respect to particulate Cu, estimates of 2 pounds per year per boat from hull cleaning were determined in Shelter Island Yacht Basin (Brown and Schottle 2006). This particulate Cu was shown to be higher for hard vinyl coatings compared to modified epoxy, and for boats with 3 months of accumulated fouling compared to 1 month.

The calculations below are revised from the Newport Bay Toxics TMDLs (USEPA 2002), which used different equations than the final Shelter Island Cu TMDL to calculate Cu discharge from hull cleaning. The Newport Bay TMDL used plume concentrations from the McPherson and Peters study (1995) and plume equations from PRC (1997) to determine Cu discharges from hull cleaning. Values used for both Newport Bay and the draft Shelter Island TMDLs are in non-italic print, values used only for Newport are in italics.

Assumptions
Most boaters in Newport Bay use Cu antifouling paints on their boat hulls.
There are approximately 10,000 boat slips in Newport Bay.
(This conservative approach assumes that all slips contain a boat.)
Boats are painted with Cu antifouling paints approximately every 2 years.
Boat hulls are cleaned underwater approximately 11 times per year (almost once per month) in Newport Bay.
More abrasive cleaning methods release a higher amount of dissolved and particulate Cu.
Newer Cu paints also release more Cu.

Equations from the Toxics TMDL (USEPA 2002). Additions or revisions to the original calculations are highlighted.

Plume concentration (P_c) = (Total plume concentration) – (Background concentration)

$$P_c = (56\ \mu g/L) - (12\ \mu g/L) = 44\ \mu g/L$$

Plume volume (P_v) = L_p*W_p*D_p

$$P_v = (L_b + 6\ m + 6\ m)*(W_b + 6\ m + 6\ m)*(6\ m)$$

$$P_v = (24.2\ m)*(15.4\ m)*(6\ m) = 2236\ m^3 \text{ per cleaning event}$$

Where:
P_c = Plume concentration
P_v = Plume volume
L_p = Average plume length
W_p = Average plume width
D_p = Average plume depth
L_b = Average boat length
W_b = Average boat width
D_p = Average plume depth

Given:
L_b = 12.2 m
W_b = 3.4 m

Annual copper load = N_h*P_v*P_c*N_v

Where:
N_h= Number of hull cleaning events/year
P_v = Plume volume
P_c = Plume concentration
N_v = Number vessels

Given:
N_h = 11/year
P_v = 2236 m^3
P_c = 44 μg/L
N_v =10,000 (number of boat slips in Newport Bay)

Annual Copper load = (11days/yr)*(2236 m^3)*(44 μg/L)*(*10,000* boat slips)*(kg/10^9 μg)*(1000 L/m^3)

Estimates of Copper load from hull cleaning in Newport Bay = 10,822.24 kg/year (29,650 g/day)
10,822.24 kg/year x 2.20462lbs/kg = 23858.9 lbs/year

Passive leaching (lbs/year) + Hull cleaning (lbs/year) = Total contribution from boats
28371.6 lbs/year + 23858.9 lbs/year = 52230.5 lbs/year

6.1.4 TMDL ALLOCATIONS for BOATS and ESTIMATED LEACH RATES* NEEDED TO MEET TMDLS

NewportBay (Region 8) (using 41.062m^2 hull area)
Cu Allocation for boats
approx 7090 lbs/yr ----> approx 3216 kg/yr ----> 3216 kg/yr/ 5,000 slips ----> 0.643 kg/boat/yr
LEACH RATE NEEDED approx 4.29 µg/cm^2/d
Shelter Island, San Diego (Region 9) (using 35.258m^2 hull area)
Cu input Allocation
2100kg/yr ----> 79% reduction ----> 447kg/yr/ 2363 slips ----> 0.19kg/boat/yr
LEACH RATE NEEDED approx 1.47µg/cm^2/d
Marina del Rey, Los Angeles (Region 4) (using 30.056m^2 hull area)
Cu input
3608.6kg/yr ---->84.6% reduction ----> 557 kg/yr/ 4754slips ----> 0.117 kg/boat/yr
LEACH RATE NEEDED approx 1.07 µg/cm^2/d
**Leach rates based on equations from Newport Bay Toxics TMDL*

$$LR = \frac{\text{allowable Cu load (kg/yr)}}{(\text{boat size})(\text{\#boatslips})(10^{-5}\text{cm}^2/\text{m}^2\text{kg}/\mu\text{g})(365\text{d/yr})}$$

The leach rates (LR) determined above were calculated directly from the Cu allocations for boats in the corresponding Cu TMDLs (Newport Bay, Shelter Island, Marina del Rey). These LRs are set as LR_0. The LR_0s were then adjusted upwards to account for 1) the use of BMPs by all (LR_1) and 2) the use of BMPs plus lower cleaning frequencies (LR_2) using the adjustment factors applied by DPR to their LR_0 in Table 6 of DPR's *MAM-PEC modeling study (table below).
*Marine Antifoulant Model to Predict Enironmental Concentrations

The LRs below demonstrate that the maximum allowable LR of 9.5 µg/cm^2/d determined by DPR *will NOT meet the TMDLs even when BMPs and lower cleaning frequencies are factored into the LRs*. This is likely due to assumptions of the MAMPEC model w/respect to Cu loading from marinas and the difference in DPR's approach compared to the Regional Boards' approach. The Board staff's LR calculations (below) are based on the allocations needed to meet the TMDLs for each water body, then adjusted upwards to account for BMPs and lower cleaning frequency. (The Cu allocations for boats in the TMDLs are determined from the *loading capacity of the water body*.) In addition, the Cu loading for Newport Bay's Cu TMDL is based on a Cu allocation for the entire Bay, which contains 10,000 boats, rather than specific marinas. This harbor scenario is not represented in DPR's modeling and there are no scenarios in DPR's modeling assessment that include more than 4754 boats.

Table A6-1 Cu antifouling paint leach rates needed to meet TMDLs in Newport Bay, Shelter Island Yacht Basin and Marina del Rey

Waterbodies	**LR_0 to meet allocations**	**LR_1 assuming BMPs (max'm 28% reduction in Cu loading over non-BMPs frm DPR model-Table6) ($LR_0 + 0.28LR_0$)**	**LR_2 assuming BMPs + lower cleaning freq. ($LR_1 + 0.20LR_1$)**
Newport Bay	4.29µg/cm^2/d	5.49 µg/cm^2/d	6.39 µg/cm^2/d
Shelter Island	1.47µg/cm^2/d	1.88 µg/cm^2/d	2.26 µg/cm^2/d
Marina del Rey	1.07µg/cm^2/d	1.37 µg/cm^2/d	1.64 µg/cm^2/d

6.2 TRIBUTARIES TO NEWPORT BAY (Freshwater)

County of Orange Monitoring Data for San Diego Creek, Santa Ana Delhi
(OC Stormwater data 2006-09)

Dissolved Cu loads from the major tributaries (San Diego Creek and Santa Ana Delhi) were calculated from the total Cu data from the County of Orange monitoring for the years (2006-11). The total daily discharge volumes were added to determine the total annual discharge by volume. The annual stormwater volume was then calculated as the sum of the discharge volumes >25cfs. (The threshold of >25cfs was used to represent storm events.) The total dry discharge volume was determined to be the difference between the total and stormwater discharge volumes.

Total Cu concentrations and dissolved Cu concentrations in stormwater and dry discharges were also calculated. For stormwater, an annual event mean concentration (annual SW EMC) was calculated from the separate EMCs measured during separate storms. For dry discharges, an annual mean Cu concentration was calculated by averaging the measured Cu concentrations of the dry discharges during the monitoring year. (Note that a monitoring year for the County of Orange extends from July 1 to June 30 of the following year.)

Annual Discharge Volume
SUM of daily discharge volumes = Total annual discharge volume (TAV)
SUM of daily discharge volumes >25cfs = Annual stormwater discharge volume (ASV)
TAV - ASV = Annual dry discharge volume (ADV)

Cu loads in stormwater and dry discharges

SUM of [Cu EMC per storm x storm volume] /(SUM of [storm volumes])
= Annual stormwater Cu EMC
Annual SW Cu EMC x annual stormwater volume (ASV) = annual Cu load from storms (lbs)

Mean Cu concentration in dry discharges x annual dry discharge volume (ADV)
= Annual Cu load from dry discharges
Annual Cu load from storms + Annual Cu load from dry discharges
= Annual Cu load (storms + dry)

Dissolved Cu loads were calculated from total Cu concentrations then converted by multiplying total Cu loads by 0.80 (USEPA's dissolved/total translator) to be conservative. Dissolved Cu loads were calculated from total Cu since actual dissolved/total ratios vary with metal, by year, by season (wet to dry) and possibly even by channel. (See Figure 6-1). Total Cu loads and total Cu concentrations in San Diego Creek and Santa Ana Delhi are shown in Tables 6.2.1 and 6.2.2, respectively.

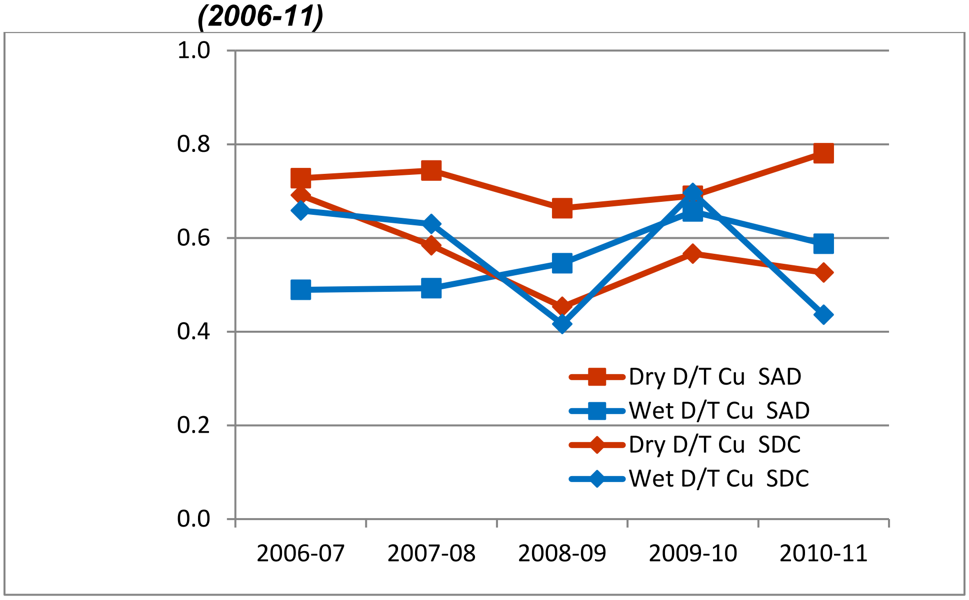
Table A6-2-1 Annual Total Copper (Cu) Loads (lbs per year) from San Diego Creek (SDC) and Santa Ana Delhi (SAD) (County of Orange monitoring data 2006-2011)

	San Diego Creek (lbs total Cu/year)			Santa Ana Delhi (lbs total Cu/year)			
	Storm	Dry	Total	Storm	Dry	Total	SDC+SAD
2006-07	60.493	126.154	186.647	10.686	62.714	73.400	260.047
2007-08	440.418	112.461	552.879	220.198	63.497	283.695	836.574
2008-09	962.408	56.681	1019.089	228.616	91.333	319.949	1339.038
2009-10	1856.388	175.501	2031.889	497.718	140.303	638.021	2669.910
2010-11	4104.864	187.269	4292.133	460.818	88.617	549.435	4841.568

Table A6-2-2 Annual Mean Total Copper (Cu) Concentrations (µg/L) in Stormwater and Dry Discharges from San Diego Creek (SDC) and Santa Ana Delhi (SAD) (County of Orange monitoring data 2006-2011)

	San Diego Creek		Santa Ana Delhi	
	Storm (µg/L)	Dry (µg/L)	Storm (µg/L)	Dry (µg/L)
2006-07	12.311	6.452	32.479	9.468
2007-08	10.168	6.576	39.868	9.365
2008-09	24.422	4.943	41.554	14.118
2009-10	21.996	14.491	38.707	23.790
2010-11	29.427	12.223	30.655	17.739

Figure A6-1 Mean Dissolved/Total Ratios for Copper in San Diego Creek & Santa Ana Delhi (2006-11)



6.3 STORM DRAINS

Storm drain data -Newport Bay Storm Drain Metals Study March 2006, Completed January 2010 (OC Coastkeeper 2010)
This project determined metal loads from a subset of storm drains in Lower Newport Bay, and estimated metal loads from all storm drains in Lower and Upper Newport Bay. Water samples were collected from 20 storm drains (more than 10% of the total storm drains), including all large storm drains. Samples were collected in winter during storms and one dry event and in summer during dry weather (late winter 2006 through 2008). Dissolved and total metals (USEPA priority metals) were analyzed and compared to CTR saltwater criteria since storm drain runoff discharges directly into Newport Bay.

Results
Water Concentrations Dissolved copper (Cu) and zinc (Zn) exceeded the acute CTR saltwater criteria (4.8, 90 µg/L) in 20/20 and 13/20 drains, respectively; dissolved Cu, Zn, nickel (Ni) and cadmium (Cd) exceeded the chronic CTR saltwater criteria (3.1, 81, 9.3, 8.2 µg/L) in 20/20, 13/20, 11/20 and 1/20 drains, respectively (Table A6-1). (Metal concentrations in storm water runoff were compared to the CTR saltwater criteria since the runoff is directly deposited into Bay waters.) In general, metal concentrations were higher in storm runoff than in dry weather runoff. Note that the highest amount of exceedances for Ni and Cd were from the Carnation drain. (Map below shows site locations.)

Table A6-3-1 Dissolved Metals* Exceedances of Acute, Chronic CTR Saltwater Criteria in Storm drain water

	>CTR Acute	>CTR Chronic	Mean Concentration	Mean Concentration Wet	Mean Concentration Dry
Cu	147/242	169/242	19.81	35.24	8.96
Zn	36/242	40/242	52.91	77.07	37.10
Ni	0/242	61/242	6.43	6.5	6.02
Cd	0/242	14/242	1.01	0.96	1.10

* Additional metals were analyzed (USEPA priority metals) but are not shown in this table.

Metal Loads in Water Dissolved Cu loads are low compared to USEPA's estimates in their Toxics TMDLs (USEPA 2002) for Cu discharged from boat bottom paints (18,000 vs >50,000 lbs/yr) or Cu in runoff from tributaries (3005 vs 7020 lbs/yr). Dissolved metal loads from other sources were also low compared to runoff from tributaries calculated in the Toxics TMDLs (Table 5-2). Dissolved metal loads from storm drains were originally calculated with a runoff coefficient of 0.5, and were 252lbs Cu, 612lbs Zn, 125lbs Ni, and 24lbs Cd for 2008, and 90lbs Cu, 207lbs Zn, 48lbs Ni, and 13lbs Cd for 2007 (Table 6-2). Metal loads were recalculated with a runoff coefficient of 0.9 (based on pers. communication w/City staff) (Table 6-2). (Total metals were measured with dissolved metals but total metal loads were not calculated as part of this project; however, dissolved/total (D/T) ratios were calculated (Table 6-2).

Table A6-3-2 Dissolved Metal Loads to Newport Bay from Storm Drains in 2007 and 2008 (Loads are reported as lbs, and based on a runoff coefficient of 0.9)*

	Wet 2007	Dry 2007	Dissolved 2007	Wet 2008	Dry 2008	Dissolved 2008	Mean Dissolved/ Total (D/T) ratio
Cu	131.53*	7.19	138.72	460.51	7.57	468.08	0.6
Zn	304.5	31.09	335.59	1089.48	34.0	1123.48	0.65
Ni	35.12	28.75	63.87	139.1	36.74	175.84	0.8
Cd	6.07	7.33	13.4	24.48	8.31	32.79	0.75

Revised table from the "Lower Newport Bay Stormdrain Metals Study" (Table 6 p18)
Cu =copper, Zn =zinc, Ni =nickel, Cd =cadmium
Dissolved metal loads for all drains were estimated from the actual loads from the 20 storm drains measured during this study; loads were based on a 0.9 runoff coefficient
* Additional metals were analyzed (USEPA priority metals) but are not shown in this table

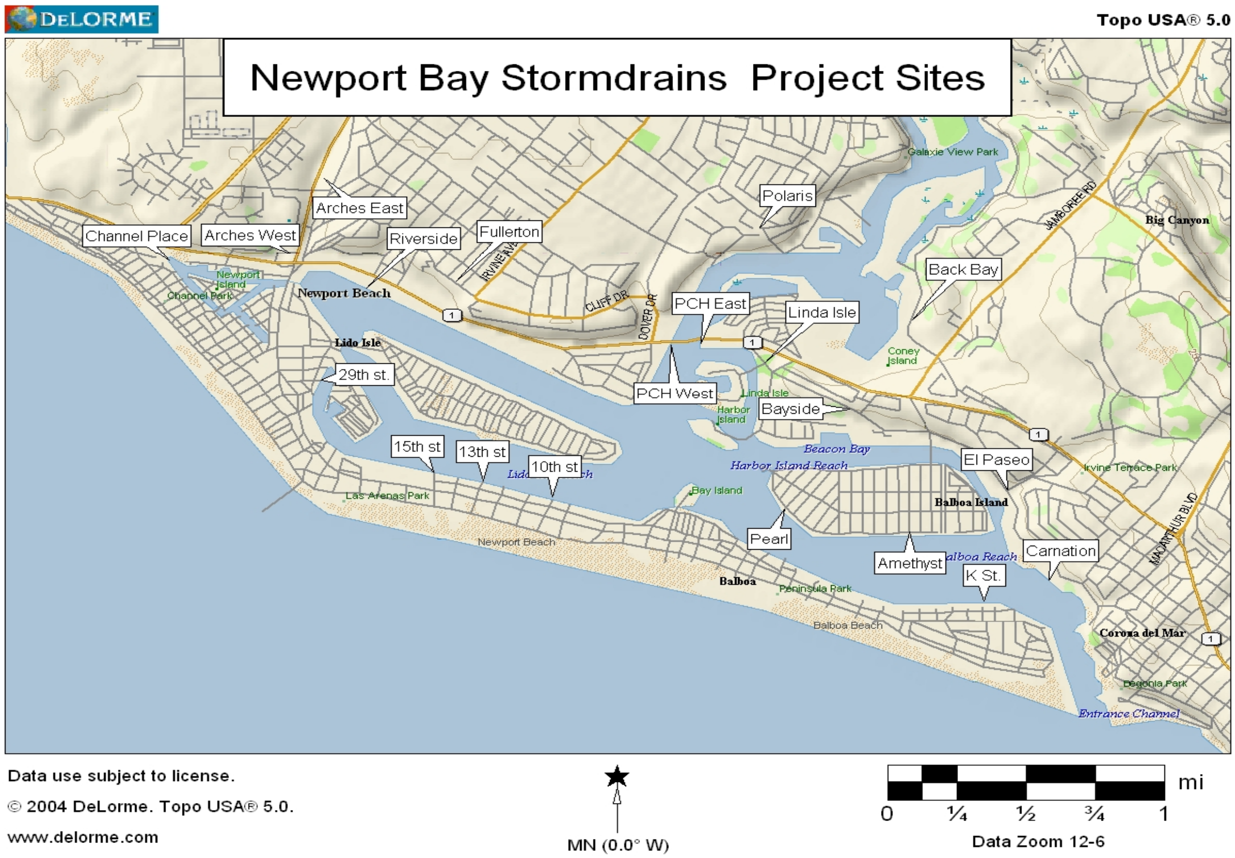
Dissolved metal loads from the 3 drains nearest to the Turning Basin were also calculated. These include Arches West, Arches East and Riverside. The largest loads for Cu, Zn and Cd were from the Arches West drain; Ni loads are similar in Arches West and Arches East.

Table A6-3-3 Dissolved Metal Loads to Turning Basin Area (TB) from Storm Drains in 2007 and 2008 (Loads reported as lbs)*

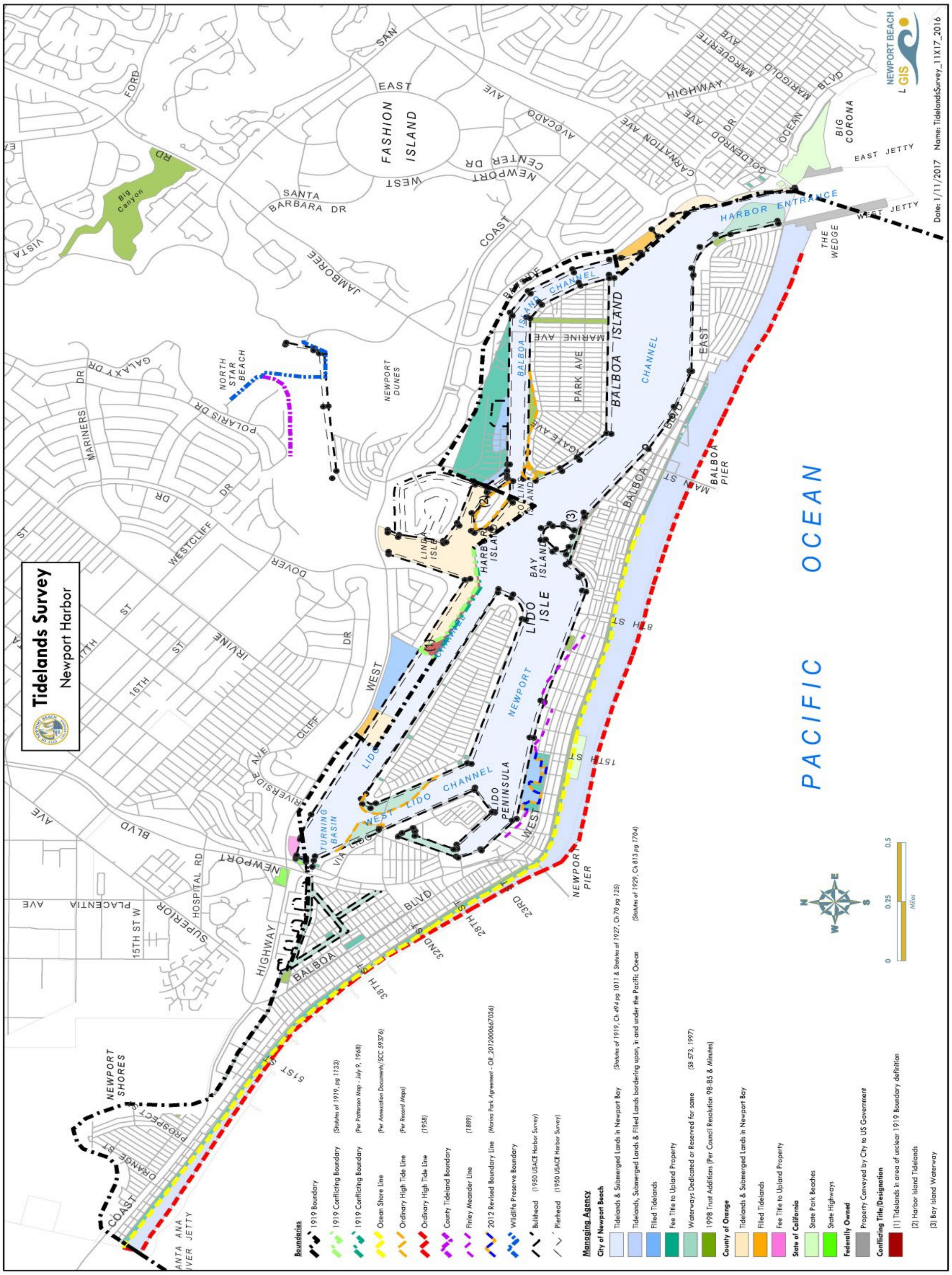
Metal	2007 data				2008 data			
	Arches West	Arches East	Riverside	Total load near TB	Arches West 2008	Arches East 2008	Riverside	Total load near TB
Cu	3.99	2.16	3.55	9.7	15.52	8.35	13.61	37.48
Zn	23.08	13.03	5.77	41.88	89.91	50.15	20.23	160.29
Ni	1.43	0.63	0.35	2.41	4.93	2.73	1.32	8.98
Cd	0.19	0.02	0.01	0.22	0.71	0.07	0.05	0.83

Cu =copper, Zn =zinc, Ni =nickel, Cd =cadmium
Dissolved metal loads for all drains were estimated from the actual loads from the 20 storm drains measured during this study; loads were based on a 0.9 runoff coefficient
* Additional metals were analyzed (USEPA priority metals) but are not shown in this table.
^Other drain near Turning Basin (TB) include Fullerton

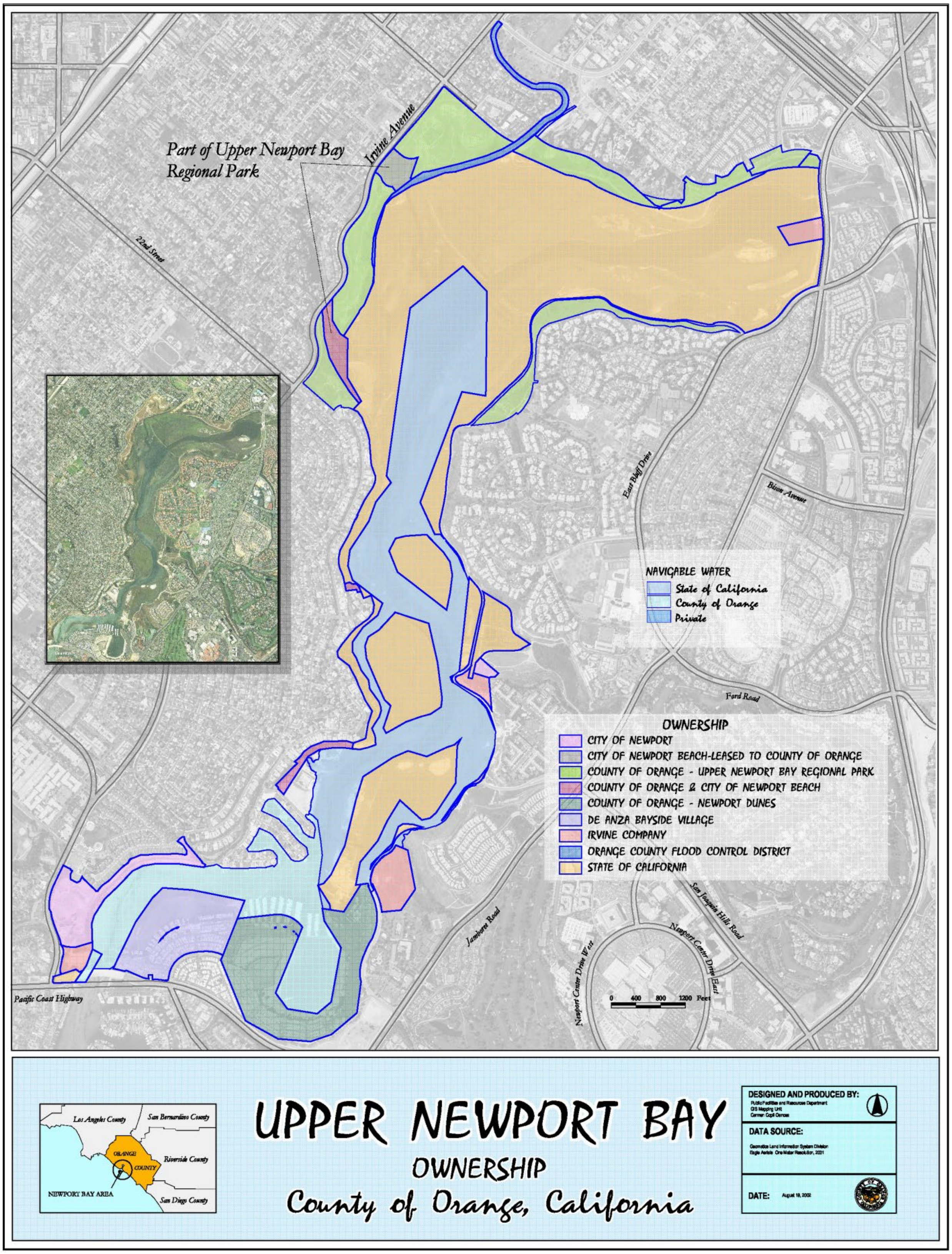
Figure A6-2 Newport Bay Storm Drain Project Sites



APPENDIX 7A - OWNERSHIP MAP FOR LOWER NEWPORT BAY



APPENDIX 7B - OWNERSHIP MAP FOR UPPER NEWPORT BAY



APPENDIX 8 - LIST OF MARINAS AND ANCHORAGES IN NEWPORT BAY

Customer Name	Service Address
Newport Dunes	101 N. Bayside Dr.,NB 92660
De Anza Bayside Village	300 Coast Hwy E, NB 92660
Cal Recreation - Bayside & BYC	1137 Bayside Dr., NB 92660
Bahia Corinthian Yacht Club	1601 Bayside Dr. CDM 92625
Balboa Yacht Club	1801 Bayside Dr., CDM 92625
Channel Reef Comm. Assn.	2525 Ocean Blvd., CDM 92625
Newport Bay Towers	310 Fernando, NB 92661
Balboa Pavilion Co.	400 Main St., NB 92661
Newport Landing Marina	503 Edgewater Ave. E, 92662
Balboa Boat Rentals - Vallely (Rodheim)	510 Edgewater Pl., Bal 92662
Fun Zone Boat Co.	600 Edgewater Pl. NB 92661
Fun Zone Boat Co.	600 Edgewater Pl, NB 92661
Hill's Boat Service	814 Bay Ave. E, BAL 92661
Balboa Angling Club	200 A St. Pier, BAL 92661
Newport Harbor Yacht Club	720 Bay Ave. W, BAL 92661
American Legion	215 15th Street, NB 92663
South Coast Shipyard	223 21st Street, NB 92663
Sullivan Trust	227 20th Street, NB 92663
Sea Spray Boat Yard	226 21st Street NB 92663
Etco Investments	2122 Newport Blvd., NB 92663
Woody's Wharf	2318 Newport Blvd., NB 92663
James, Steve	2406 Newport Blvd., NB 92663
Balboa Boat Yard	2414 Newport Blvd., NB 92663
Vista Del Lido	611 Lido Park Dr., NB 92663
Lido Park Place Marina	633 Lido Park Dr., NB 92663
Lido Sailing Club	3300 Via LidoNB 92663
Pamela Whitesides	3316 Via Lido NB 92663
Lido Marina Village - Marvin Eng.	3366 Via Lido, NB 92663
Elks Lodge #1767	3456 VIA Oporto, NB 92663
Waterfront Newport Beach LLC	2901 Coast Hwy W #200, NB 92663
Mariners Mile Professional Building	3101 Coast Hwy W, NB 92663
Newport Towers HOA	3121 Coast Hwy W, NB 92663
Villa Nova	3131 Coast Hwy W, NB 92663
Balboa Bay Club	1221 Coast Hwy W, NB 92663
OCC Intercollegiate Sailing & Rowing	1801 Coast Hwy W, NB 92663
Newport Sea Base	1931 Coast Hwy W, NB 92663
Duffy Electric Boat Company	2001 Coast Hwy W, NB 92663
Ardell Marina	2101 Coast Hwy W, NB 92663
VMA Mariners Mile LLC- Hornblower	2439 Coast Hwy W, NB 92663

VMA Mariners Mile LLC - Pedigree	2439 Coast Hwy W, NB 92663
VMA Mariners Mile LLC - Bayport	2505 Coast Hwy W, NB 92663
Goodin Family Trust	2527 Coast Hwy W, NB 92663
Viking's Port	2547 Coast Hwy W, NB 92663
Cal Rec - Bayshore Marina	2572 Bayshore Dr., NB 92663
Primm Family Trust	2601 Coast Hwy W, NB 92663
Marina Properties	2607 Coast Hwy W, NB 92663
Port Calypso	2633 Coast Hwy W, NB 92663
Newport Bay Management - Larson's Shipyard	2703 Coast Hwy W, NB 92663
Dick Dock LLC (Rusty Pelican)	2735 Coast Hwy W, NB 92663
Crow's Nest - Gordon Barienbrock	2751 Coast Hwy W, NB 92663
Crow's Nest - Gordon Barienbrock	2801 Coast Hwy W, NB 92663
Swales Anchorage	2888 Bayshore Dr., NB 92663
Cal Rec - Balboa Marina	201 Coast Hwy E, NB 92660
Newport Marina	919 Bayside Dr., NB 92660
Cal Recreation - Villa Cove	1001,1137, 1099 Bayside Dr., NB 92660
Cannery Village	700 Lido Park Dr, NB 92663
Blue Water Marina	630-670 Lido Park Dr, NB 92663
28th St. Marina	2600 Newport Blvd, NB 92663
Cannery Village Marina	2800 Lafayette Ave., NB 92663
Ridgeway Trust	2804 Lafayette, NB 92663
Herlihy, John	2806 Lafayette, NB 92663
Hall, Richard	2808 Lafayette, NB 92663
126 Properties LLC	2812 Lafayette, NB 92663
Morehart/Cervantes	2814 Lafayette, NB 92663
Le Quai	2816 Lafayette, NB 92663
Schock Boats	2818 Lafayette, NB 92663
Schock Boats	2900 Lafayette, NB 92663
Cannery Restaurant	3010 Lafayette, NB 92663
Bellport - Lido Peninsula Yacht Anchorage	717 Lido Park Dr., NB 92663
Harbor Marina	3333 Coast Hwy W, NB 92663
Island Marine Fuel & Ferry Landing	406 Bay Front S, BI 92662
Robert Teller	504 Bay Front S, BI 92662
Vivian Vallely	508 S Bay Front, BI 92662
Balboa Yacht Basin	829 Harbor Island Dr., 92660

APPENDIX 9 - RELEVANT MONITORING STUDIES
Metals Sediment Study in Lower Newport Bay (2014) vs Copper-Metals Marina Study (2007)

Sediment data from the Cu-Metals Marina study (2007) showed that sediment Cu, Zn and Hg exceeded ERM sediment guidelines in a number of marinas, particularly in the Turning Basin area of Lower Newport Bay.

In 2012, parts of the Lower Bay were dredged. A sediment study was then conducted in 2012-2013 to determine sediment metal exceedances of the ERM guidelines in the new surface sediment samples in post-dredge areas, and in some marinas originally sampled in the marina study. (Marina sites chosen for the 2012 sediment study were a subset of those that exceeded the Cu, Zn and Hg ERM guidelines in 2007). The newer sediment study data show that sediment Cu, Zn and Hg continue to exceed the ERM guidelines in the marinas tested but not in the post-dredge areas (Figures 9-1 through 9-4). Continued monitoring & evaluation of sediments is required by SQO assessment, and evaluation against the ERM guidelines.

Marina Study (2007). In addition to exceedances of the ERM guidelines by Cu, Zn and Hg, Lower Bay sediments also exceeded the ERL guidelines for cadmium (Cd), nickel (Ni), lead (Pb), arsenic (As) and silver (Ag). Upper Bay sediments exceeded the ERL guidelines for Cu, Zn, Hg, Cd, Ni, and As, but not Pb or Ag; *there were no exceedances of the ERM sediment guidelines in the Upper Bay*. In addition, the marina study showed sediment toxicity in 6/6 and 6/8 samples in the Lower and Upper Bay, respectively.

Post-Dredge Sediment Study (2014). Lower Bay sediments exceeded ERL guidelines for Cd, Ni, Pb, As and Cr. No samples were collected in the Upper Bay for this study. No sediment toxicity to *Eohastaruis* was found; sediment-water interface and pore water testing with *Mytilus* were not conducted due to insufficient funds.

These data sets show that marina sites in the Turning Basin and Balboa Channel exceeded the ERM sediment guidelines for Hg, Zn and Cu, and are the highest concern with respect to sediment metals. Non-marina sites in open parts of the Bay (post-dredge sites and OC monitoring sites) exceeded the ERL guidelines for a number of metals in both the Upper and Lower Bay, but rarely exceeded the ERM guidelines. The highest priority areas for sediment metals monitoring and evaluation (Cu, Zn, Hg) are, therefore, the marina sites in the Turning Basin area and Balboa Channel, and marina sites for which there is no data.

Table A9.1 Site locations in Metals Sediment Study and acronyms in Figures	
Marinas	
Harbor Marina	*aHM*
Lido Village	*aLV*
Lido Yacht Anchorage	*aLYA*
Dredge sites	
Lido Isle Reach North (West)	*LIN(W), LW2*
Lido Isle North East	*LE*
Lido Isle Reach South	*LIS(out), LS2*
Upper Newport Channel	*UNC, UNC2*
Balboa Island Channel	*BC(out), BC2*
Collins Island	*CI*
Harbor Island Reach	*HIR(out), HIR2*
Balboa Reach	*BR(end), BR2*
West Lido Area A	*WLA*
West Lido Area B	*WLB*
Yacht Anchorage Area Middle	*YAM2, YAM3*
Yacht Anchorage Area North	*YAN1, YAN2*

Figure A9.1 Sediment Zinc Exceedances of ERM and ERL Guidelines

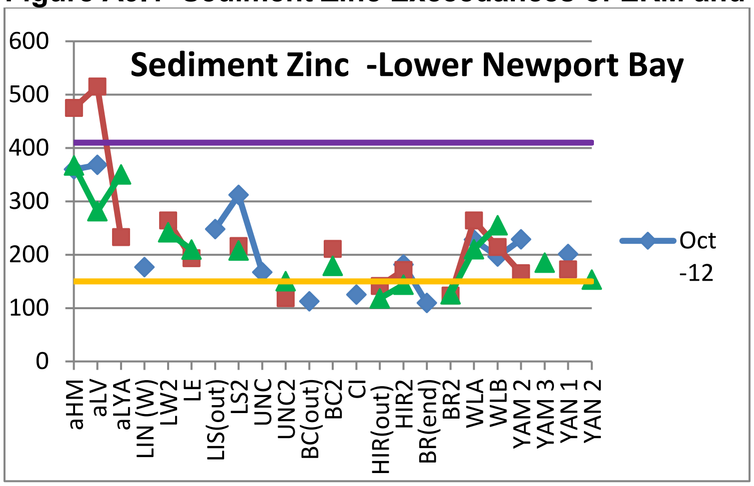


Figure A9.2 Sediment Mercury Exceedances of ERM and ERL Guidelines

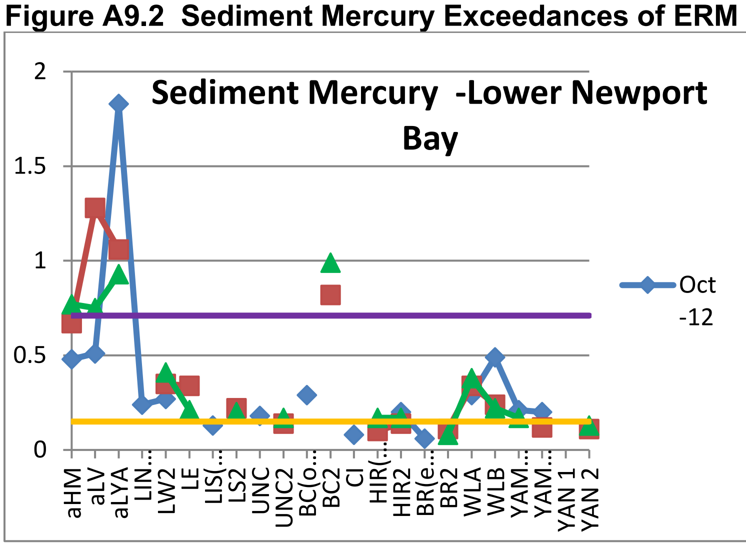


Figure A9.3 Sediment Arsenic Exceedances of ERL Guideline (no exceedances of the ERM guideline 70µg/g)

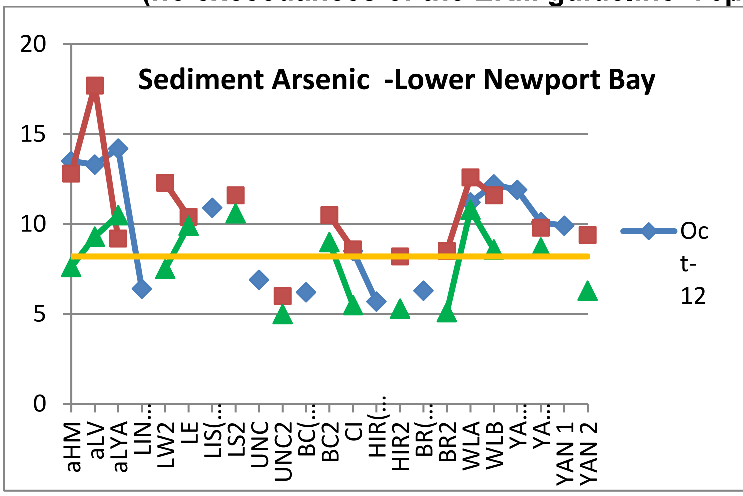
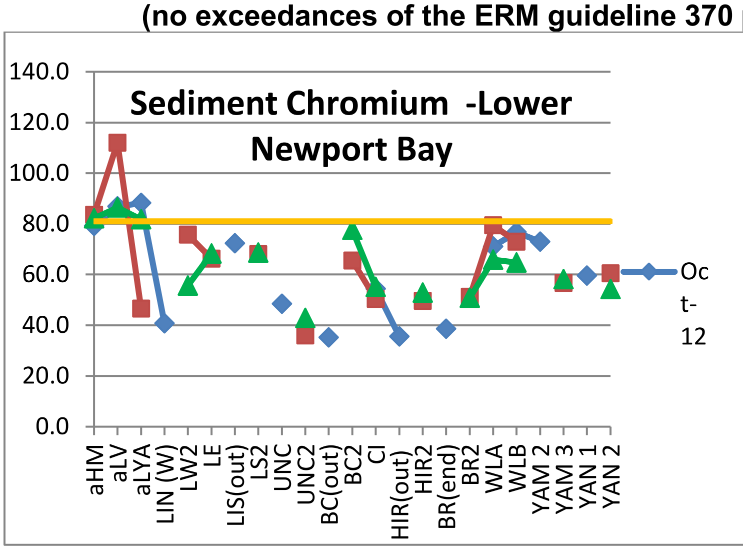


Figure A9.4 Sediment Chromium Exceedances of ERL Guideline (no exceedances of the ERM guideline 370 µg/g)



APPENDIX 10 - LIST OF BOATYARDS IN NEWPORT BAY

Marina Boat Rentals
www.newportbeachboatrentals.com
600 E Bay Ave
Newport Beach, CA
(949) 673-3372

Marina Sailing Newport Beach
www.marinasailing.com
333 Bayside Dr
Newport Beach, CA
(949) 548-8900

Basin Marine, Inc.
www.basinmarine.com
829 Harbor Island Dr # A
Newport Beach, CA
(949) 673-3533

Island Marine Fuel
www.islandmarinefuel.com
406 S Bay Front
Newport Beach, CA
(949) 673-1103

Bayside Marina
www.greatslips.com
1137 Bayside Dr
Corona Del Mar, CA
(949) 721-0111

Villa Cove Marina
www.greatslips.com
Bayside Dr
Newport Beach, CA
(949) 721-0111

California Recreation Co
www.greatslips.com
1137 Bayside Dr
Corona Del Mar, CA
(949) 721-0111

APPENDIX 11 - COPPER (Cu) IS A STATEWIDE PROBLEM

Copper (Cu) discharges from Cu antifouling paints (Cu AFPs) are not only an issue in Newport Bay, but are a statewide problem that was brought to attention by the Shelter Island Cu TMDL (San Diego Regional Water Board 2005). Since that time, additional studies have been conducted in water bodies with marinas including: Newport Bay (Section 3.1), San Diego Bay, and the California coast. These studies have demonstrated exceedances of the dissolved Cu CTR criteria and a relationship between elevated Cu concentrations and water toxicity in multiple marinas. These results demonstrate the necessity to regulate dissolved Cu in marine waters and gives impetus to the TMDL program.

In addition, studies have been conducted to examine leaching rates of Cu, the effects of hull cleaning on Cu concentrations in water, and the efficacy of non-Cu and non-biocide AFPs as alternatives to Cu boat paints. Many state and local agencies are involved in various studies and a Statewide Marina workgroup (IACC –Interagency Coordinating Committee) meets quarterly. In addition to these studies, the Department of Pesticide Regulation (DPR) conducted a reevaluation of the registration of Cu AFPs based on the marina studies mentioned above. The result of DPR's reevaluation was a regulation for a maximum leach rate for Cu AFPs (Section 5.6.1). Individual studies and actions are shown below.

- Newport Bay Marina study – Completed 2007 http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/docs/newport/finalcufinal_report.pdf
- San Diego Marina study – Completed March 2006
- Statewide Marina study by DPR, Singhasemanon – Completed June 2009 http://www.cdpr.ca.gov/docs/registration/reevaluation/chemicals/antifoulant_paints.htm appendices http://www.cdpr.ca.gov/docs/emon/surfwtr/caps.htm
- Alternative Paint Study, Port of San Diego – Completed 2011 http://www.portofsandiego.org/environment/alternative-hull-paints.html
- Leaching studies for boat paints (Earley et al 2013)
- Cu Biotic Ligand Model for Saltwater - Completed but in review by USEPA

IACC marina workgroup, Copper (Cu) workgroup, Statewide marina permit
The statewide marina workgroup and a Cu workgroup met quarterly to discuss nonpoint source (NPS) issues related to marinas and specifically Cu, respectively. A statewide marina permit to regulate discharges in marinas was drafted but shelved due to DPR's reevaluation of the registration of Cu antifouling paints.

DPR registration reevaluation of Copper (Cu) antifouling paints
DPR has reevaluated the registration of Cu antifouling paints
The reevaluation of Cu antifouling paints was initiated based on data from 3 marina studies since water toxicity was linked to Cu exceedances of the dissolved Cu CTR saltwater criteria. The marina studies included a Statewide Marina study (DPR), the Lower Newport Bay Marina study (Section 3.1), and a San Diego Bay Marina study. The DPR contact for Cu issues is Aniela Burant at Aniela.Burant at @cdpr.ca.gov.

Legislation
AB623 (2012) would have required a ban on Cu antifouling paints (AFPs) (and other biocides) if monitoring showed that dissolved Cu concentrations would not meet the CTR Cu criterion by 2019.

The bill was shelved pending DPR's reevaluation of Cu AFPs and USEPA's approval of the Cu Saltwater Biotic Ligand Model (Cu BLM).
AB425 was introduced in February 2013 to require DPR to finish their reevaluation of Cu antifouling paints by February 2014.
DPR completed its revaluation of the registration of Cu AFPs, and on July 1, 2018, DPR issued a regulation for a maximum allowable leach rate for Cu AFPs of 9.5 μg/cm^2/d for recreational boats.

International
In addition, Cu antifouling paints are a problem internationally. The Dutch have been monitoring Cu loading from Cu antifouling paints as one example (Netherlands Emission Inventory, June 2008).