U.S. Environmental Protection Agency

Los Angeles Area Lakes TMDLs
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U.S. Environmental Protection Agency
Region IX

Los Angeles Area Lakes Total Maximum Daily Loads for Nitrogen, Phosphorus, Mercury, Trash, Organochlorine Pesticides and PCBs

Photo: Puddingstone Reservoir

Approved by:

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26 March 2012

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Executive Summary

The Los Angeles Regional Board identified 10 lakes in the Los Angeles region as impaired by algae, ammonia, chlordane, copper, DDT, eutrophication, lead, organic enrichment/low dissolved oxygen, mercury, odor, PCBs, pH and/or trash and placed them on California's 303(d) list of impaired waters requiring a Total Maximum Daily Load (TMDL) (LARWCQB, 1998). The United States Environmental Protection Agency (USEPA) Region IX subsequently entered into a consent decree with several environmental groups on March 22, 1999 that required development of TMDLs for these waterbody pollutant combinations by March 2012 (Heal the Bay Inc., et al. v. Browner C 98-4825 SBA). To meet the consent decree deadline, USEPA is establishing Total Maximum Daily Loads (TMDLs) in nine of these lakes in the Los Angeles region. For several lakes, USEPA concluded that ammonia, pH, copper and/or lead are currently meeting water quality standards and TMDLs are not required at this time. In other lakes, recent chlordane and dieldrin data indicate additional impairment. USEPA is establishing 33 TMDLs in all, as follows:

Nitrogen and Phosphorus TMDLs

EPA is establishing eight total nitrogen and eight total phosphorus TMDLs for Peck Road Park Lake, Lincoln Park Lake, Echo Park Lake, Lake Calabasas, El Dorado Park Lakes, Legg Lakes, Puddingstone Reservoir and Santa Fe Dam Park Lake. The Los Angeles Regional Board identified eight lakes as impaired by algae, ammonia, eutrophication, organic enrichment/low dissolved oxygen, odor and/or pH. These various impairments stem from excess nitrogen and phosphorus in the lake, causing excess algae growth, which then impairs aquatic life and recreation uses. Chlorophyll *a* is used as an indicator of algal density and a target of 20 micrograms per liter was set in these TMDLs to protect beneficial uses. The impacts of nutrient loading on each impaired lake were estimated through scientific modeling of lake-specific conditions. This model generates site-specific nutrient loadings required to attain the chlorophyll *a* target at each lake. Data currently indicate Echo Park Lake, Peck Road Park Lake, Santa Fe Dam Park and the southern lake system of El Dorado Park Lakes are meeting the chlorophyll *a* target. In these lakes, USEPA is therefore assigning wasteload and load allocations to the responsible jurisdictions based on existing loading of nitrogen and phosphorus to each lake. Lake Calabasas, Legg Lakes, Lincoln Park Lake, Puddingstone Reservoir and the northern lake system of El Dorado Park Lakes are assigned wasteload and load allocations based on model outputs. To allow flexibility in implementing the nutrient TMDLs, responsible jurisdictions receiving required reductions have the option to submit a request to the Regional Board for alternative concentration-based wasteload allocations, with a Lake Management Plan to show how the water quality standards, chlorophyll *a* target and the concentration-based wasteload allocations will be achieved by improved lake management practices. These jurisdictions can receive alternative concentration-based wasteload allocations not to exceed 1.0 and 0.1 milligrams per liter total nitrogen and total phosphorus, respectively. For lakes not currently attaining the chlorophyll *a* target, this TMDL includes required reductions in total loading of 45 percent to 71 percent for total nitrogen and 23 percent to 62 percent for total phosphorus, depending on the lake.

Mercury TMDLs

EPA is establishing three mercury TMDLs for El Dorado Park Lakes, Puddingstone Reservoir and Lake Sherwood. Elevated fish tissue concentrations of methylmercury are impairing beneficial uses at Lake Sherwood, El Dorado Park Lakes and Puddingstone Reservoir. The concentrations of these pollutants in fish tissue exceed the State of California's Fish Contaminant Goals (FCGs) to protect human health. Mercury is a heavy metal that bioaccumulates and biomagnifies up the food chain. As fish grow, they accumulate more methylmercury in their tissue such that older and larger fish have higher concentrations of methylmercury than younger and smaller fish. The fish tissue target for these TMDLs, 0.22 parts per million methylmercury, is based on a 350 mm largemouth bass which is the most common size and the most common species caught by anglers in these lakes. These TMDLs assign wasteload and load allocations to responsible jurisdictions for total mercury as a mass per year. These TMDLs include a dissolved methylmercury target of 0.081 nanograms per liter based on a calculation of the maximum allowable concentration in the water column to attain the largemouth bass fish tissue target using nationally derived bioaccumulation factors. Required reductions in total mercury loading range from 47 percent to 72 percent, depending on the lake.

CHLORDANE, DIELDRIN, TOTAL DDTS, AND TOTAL PCBS TMDLS

EPA is establishing 11 TMDLs for chlordane, dieldrin, total DDTs and total PCBs at Peck Road Park Lake, Echo Park Lake and Puddingstone Reservoir. Elevated fish tissue concentrations of organochlorine pesticides and PCBs are impairing the beneficial uses at Echo Park Lake, Peck Road Park Lake and Puddingstone Reservoir. The concentrations of these pollutants in fish tissue exceed the State of California's FCG targets. These types of pollutants have low solubility and a high affinity for organic solids and lipids, and tend to bioaccumulate and biomagnify up the food chain from sediment to fish tissue. Water column concentrations of these pollutants are extremely low and currently attaining water quality criteria. Wasteload and load allocations are therefore assigned as a concentration of a pollutant associated with suspended sediments. USEPA set sediment targets by calculating the maximum allowable concentrations in sediment to attain the fish tissue targets and choosing the lower of this value or a target to protect benthic organisms. In all but one case, the sediment value calculated to attain the fish tissue targets is lower and wasteload and load allocations are assigned to responsible jurisdictions based on that calculated value. Additionally, if responsible jurisdictions demonstrate that fish tissue targets are being attained, alternative sediment wasteload allocations, based on the target used to protect benthic organisms, go into effect. Required reductions in pollutant concentrations in sediment range from 5.2 percent to 99 percent depending on the particular pollutant and lake.

TRASH TMDLS

EPA is establishing three trash TMDLs in Peck Road Park Lake, Lincoln Park Lake and Echo Park Lake. Trash in lakes causes water quality problems including reduced habitat for aquatic life, direct harm to wildlife from ingestion or entanglement, and health impacts to people recreating near trash potentially contaminated with human or pet wastes. Since any amount of trash causes impairment, wasteload and load allocations assigned to responsible jurisdictions are set at zero trash.

The following TMDLs are included in this document:

- Peck Road Park Lake: nitrogen, phosphorus, chlordane, DDT, dieldrin, PCBs, trash
- Lincoln Park Lake: nitrogen, phosphorus, trash
- Echo Park Lake: nitrogen, phosphorus, chlordane, dieldrin, PCBs, trash
- Lake Calabasas: nitrogen, phosphorus
- El Dorado Park Lakes: nitrogen, phosphorus, mercury
- Legg Lakes (North, Center and Legg): nitrogen, phosphorus
- Puddingstone Reservoir: nitrogen, phosphorus, chlordane, DDT, PCBs, mercury, dieldrin
- Santa Fe Dam Park: nitrogen, phosphorus
- Lake Sherwood: mercury

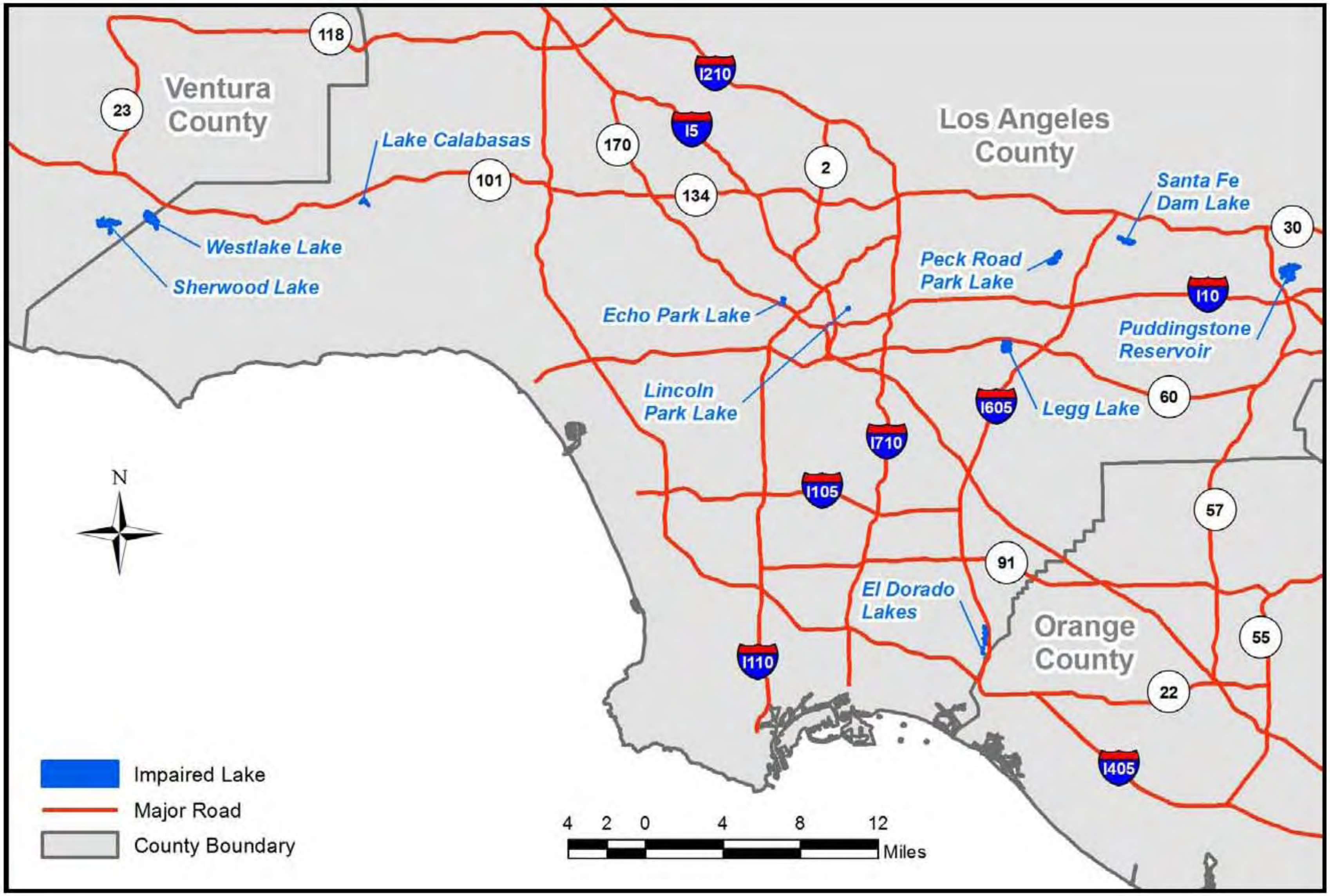

Figure ES-1. Location of Ten Lakes in the Los Angeles Region

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1 Introduction

The United States Environmental Protection Agency (USEPA) Region IX is establishing Total Maximum Daily Loads (TMDLs) in nine lakes in the Los Angeles Region. USEPA was assisted in this effort by the Los Angeles Water Quality Control Board (Regional Board). Tetra Tech produced the Technical Support Document to aid in the development of these TMDLs.

Numerous impaired lakes are addressed by these TMDLs. Each lake is located in the Los Angeles River Basin, San Gabriel River Basin, or Santa Monica Bay Basin (Figure 1-1). The identified pollutants are either categorized or individual; e.g., trash or mercury. Chlordane, dieldrin and DDT are organochlorine (OC) pesticides and have been grouped together with PCBs. Nutrient TMDLs are defined to address: algae, ammonia, eutrophication, low dissolved oxygen/organic enrichment, odor, and/or pH.

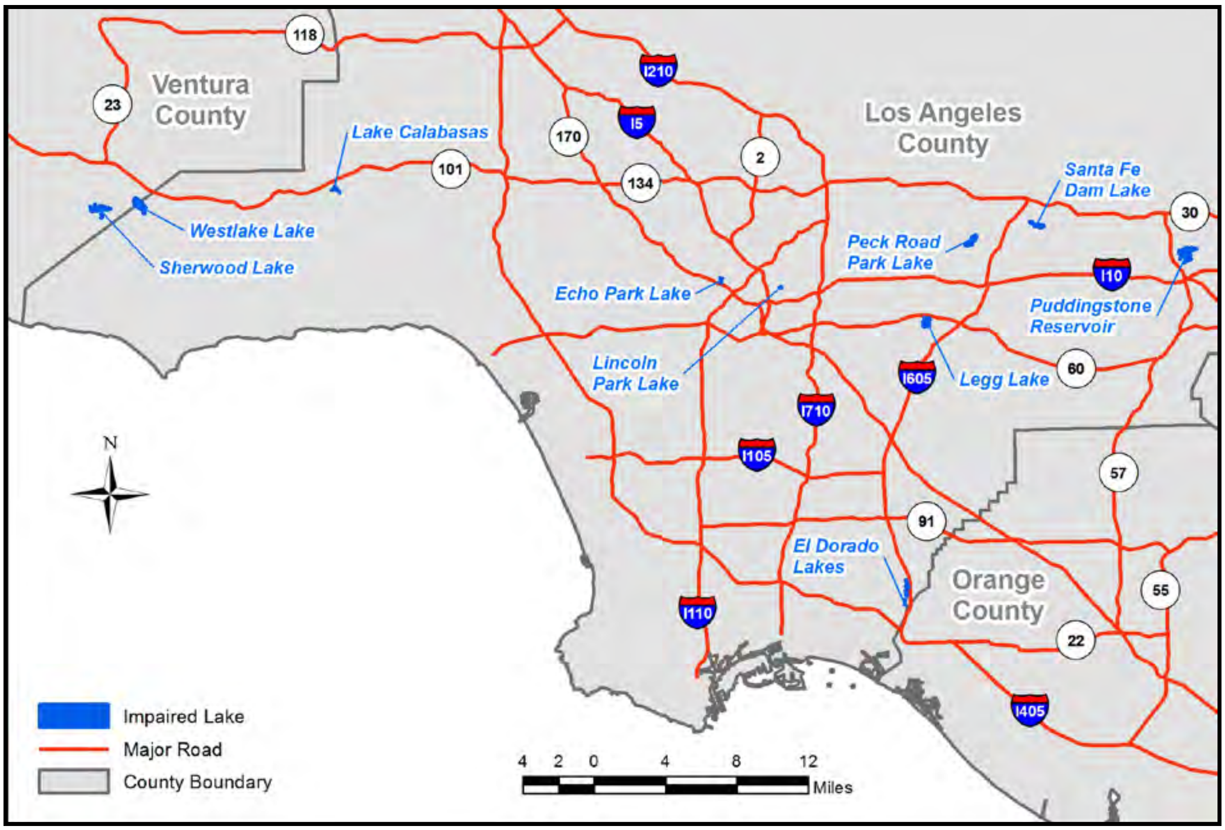

Figure 1-1. **Location of Ten Lakes in the Los Angeles Region**

The TMDLs included in this document are summarized below:

- Peck Road Park Lake: nitrogen, phosphorus, chlordane, DDT, dieldrin, PCBs, trash
- Lincoln Park Lake: nitrogen, phosphorus, trash
- Echo Park Lake: nitrogen, phosphorus, chlordane, dieldrin, PCBs, trash
- Lake Calabasas: nitrogen, phosphorus
- El Dorado Park Lakes: nitrogen, phosphorus, mercury

- Legg Lakes (North, Center and Legg): nitrogen, phosphorus
- Puddingstone Reservoir: nitrogen, phosphorus, chlordane, DDT, PCBs, mercury, dieldrin
- Santa Fe Dam Park: nitrogen, phosphorus
- Lake Sherwood: mercury

USEPA determined some lakes were not impaired for copper or lead, therefore we did not develop TMDLs for those metals. Information related to our findings of non-impairment is included within the lake specific sections as well as Appendix G (Monitoring Data). A full list of specific waterbody-pollutant combinations addressed by this document is included in Table 2-31.

This document is organized into the following sections and appendices to address the multiple lake/impairment combinations included in these TMDLs:

- Section 1 contains the introductory material, regulatory background, and description of the elements of a TMDL.
- Section 2 describes the problem statement in terms of water quality standards, beneficial uses, water quality objectives, and numeric targets. The 1998 basis of 303(d) listing and summary of impairments for each lake are also included in this section.
- Section 3 summarizes the approach that was used for the source assessment and linkage analysis for each impairment.
- Sections 4 through 13 contain the lake specific TMDL information including the environmental setting and the summaries of impairments, monitoring data, pollutant loading, and TMDL allocations.
- Section 14 contains references for this document.
- Appendix A (Nutrient TMDL Development) describes the model input and output for application of the NNE BATHTUB model in relation to the nutrient impairments.
- Appendix B (Internal Loading) describes the processes of internal loading, wind mixing, and bioturbation of the lake sediments.
- Appendix C (Mercury TMDL Development) explains the load allocation determinations for the mercury impairments.
- Appendix D (Wet Weather Loading) describes wet weather pollutant loading.
- Appendix E (Atmospheric Deposition) describes the estimation of pollutant loading from atmospheric deposition.
- Appendix F (Dry Weather Loading) describes dry weather pollutant loading.
- Appendix G (Monitoring Data) contains the monitoring data relevant to each lake and impairment.
- Appendix H (Organochlorine Compounds TMDL Development) describes the steady-state model for Organochlorine (OC) Pesticides (including chlordane, DDT, and dieldrin) and PCBs.

1.1 Regulatory Background

Section 303(d) of the Clean Water Act (CWA) requires that each state “shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters.” The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in U.S. Environmental Protection Agency (USEPA) guidance (USEPA, 2000b). A TMDL is defined as the "sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) 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.

The USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the State Water Resources Control Board (State Board) and the nine Regional 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 does not approve a TMDL submitted by a state, USEPA is required to establish a TMDL for that waterbody. The Regional Boards also hold regulatory authority for many of the instruments used to implement the TMDLs, such as National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

As part of its 1998 regional water quality assessments, the Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWCQB, 1998). These are referred to as "listed" or "303(d) listed" waterbodies. A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree approved between USEPA and several environmental groups on March 22, 1999 (Heal the Bay Inc., et al. v. Browner C 98-4825 SBA). For the purpose of scheduling TMDL development, the decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units.

This report addresses waterbody impairment combinations identified in Analytical Units 16, 17, 19, 20, 41, 42, 44, and 68 of the Consent Decree. Under the consent decree, USEPA must approve or establish these TMDLs by March 2012. The State is unlikely to complete adoption of these TMDLs in time to meet the consent decree deadline; therefore, USEPA is establishing these TMDLs.

USEPA performed a review and analysis of available monitoring data and information for pollutants and waterbodies within the analytical units in the consent decree described above. Historic data related to the 1998 list and current data related to the current 303(d) list were evaluated to determine if any water quality conditions had changed (either from impaired to non-impaired or vice versa). In certain cases, USEPA concluded that ammonia, pH, and metals (copper and lead) are currently achieving numeric targets and TMDLs are not required for these pollutants. These analyses and determinations of non-impairment are presented in the lake-specific chapters. Establishment of the TMDLs in this document thereby completes the requirement in the consent decree to address Analytical Units 16, 17, 19, 20, 41, and 42. It also partially addresses analytical units 44 and 68. In addition, these TMDLs incorporate impairments not included in the consent decree. There are several impairments for these waterbodies included on the 2008-2010 303(d) list (SWRCB, 2010), which was developed after the consent decree, as well as newly identified impairments not currently on the 303(d) list. USEPA is including TMDLs to address these additional impairments to more efficiently use agency resources and encourage expediency of restoration of water quality in these lakes.

Overall, this report includes an evaluation of available data to either confirm, establish, or refute impairment(s) for each waterbody. TMDLs have been developed to address the impairments. Table 2-31 summarizes the waterbody impairment combinations addressed by this report.

1.2 Elements of a TMDL

Guidance from USEPA (2000b) identifies seven elements of a TMDL. This report contains these seven elements in the following Sections or Appendices:

1. Problem Statement. Section 2 reviews the evidence used to include each waterbody on the 303(d) list. A description of the water quality standards, beneficial uses, water quality objectives, and numeric targets that form the basis for each listing was reviewed.

2. Numeric Targets. Section 2 also includes the numeric targets based on the numeric and narrative water quality objectives stated in the Basin Plan as well fish tissue guidelines and sediment quality guidelines. These targets are used for confirmation of impairments and calculation of TMDLs for mercury, OC Pesticides and PCBs, and trash. For the nutrient impairments, lake specific total nitrogen and total phosphorus targets are developed using the NNE BATHTUB model (described in Appendix A, Nutrient TMDL Development). Appendix C (Mercury TMDL Development) and Appendix H (Organochlorine Compounds TMDL Development) include additional details on the mercury and OC Pesticides and PCBs targets. Load reductions and pollutant allocations in these TMDLs are developed to ensure that these numeric targets for the impaired waterbodies are met.

3. Source Assessment. This step is a quantitative estimate of point sources and nonpoint sources of pollutant loading in each watershed. The source assessment considers seasonality and flow. The general approach for determining source assessments by pollutant is summarized in Section 3. Lake specific loading summaries by pollutant are included in the individual lake sections (Sections 4 through 13). More detailed information regarding modeling input and data sets used to quantify pollutant loading are described in Appendices B, C, D, F, and H.

4. Linkage Analysis. This analysis demonstrates how the sources of pollutant compounds in each waterbody are linked to the observed conditions in the impaired waterbody. The linkage analysis includes an assessment of critical conditions, which are periods when the changing pollutant sources and changing assimilative capacity of the waterbody combine to produce either extreme impairment conditions or conditions especially resistant to improvement. Section 3 describes the linkage analysis for each impairment, and more details are provided in the appendices.

5. TMDLs and Pollutant Allocations. The total loading capacity for each waterbody is determined as the amount of pollutant loading a waterbody can receive without causing impairment. A Margin of Safety (MOS) is set aside to account for inherent variability in modeling assumptions and datasets. The TMDL is set as the loading capacity minus the MOS. Each pollutant source is allocated an allowed quantity of pollutant loading that it may discharge. Allocations are designed such that the waterbody will not exceed numeric targets for any of the compounds or effects in any of its reaches. Point sources and areas draining to municipal separate stormwater systems (MS4s) are given waste load allocations, and nonpoint sources are given load allocations. TMDLs and pollutant allocations are described for each lake and impairment in Sections 4 through 13.

6. Implementation Recommendations. This element describes the plans, regulatory tools, or other mechanisms by which the waste load allocations and load allocations may be achieved. The Regional Board has responsibility to implement these TMDLs and incorporate them into permits. They may choose to develop implementation plans in a separate document(s) in the future.

7. Monitoring Recommendations. Monitoring each waterbody is recommended to ensure that the wasteload allocations and load allocations are achieved, that numeric targets are no longer exceeded, and that the secondary effects intended to be addressed by these TMDLs are being addressed.

2 Problem Statement

The lakes covered by this document are impacted by numerous impairments including nutrient-related impairments (algae, ammonia, eutrophication, low dissolved oxygen/organic enrichment, odor, pH), metals (copper and lead), mercury, trash, and OC Pesticides (chlordane, DDT, and dieldrin) and PCBs. This section describes the beneficial uses identified in the Water Quality Control Plan (Basin Plan) for each waterbody and discusses the applicable numeric targets for each beneficial use. It also includes water quality information (wherever possible) to describe the basis for each listing as provided by the Regional Board for the 1998 303(d) list. The reader will find discussion and summary of more recent monitoring data for each waterbody in the lake-specific chapters.

2.1 Water Quality Standards

California state water quality standards include of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives and numeric water quality criteria, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Boards in the Basin Plans. Numeric and narrative objectives are specified in each region's Basin Plan and numeric criteria are included in the California Toxics Rule (CTR), designed to be protective of the beneficial uses.

2.1.1 Beneficial Uses

The Water Quality Control Plan for the Los Angeles Region (LARWQCB, 1994) defines 11 beneficial uses for the 10 lakes addressed by this report:

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

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

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

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

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

RARE - Rare, Threatened, or Endangered Species. Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

REC1 - Water Contact Recreation. Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, waterskiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

REC2 - Non-contact Water Recreation. Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

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

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

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

These uses are identified as existing (E), potential (P), or intermittent (I) uses. Table 2-1 contains the beneficial use designations relevant to this report (LARWQCB, 1994). All 10 lakes are designated REC1, REC2, and WARM. The majority are also designated WILD and MUN. Other uses include WET, GWR, COLD, RARE, AGR, and NAV. Potential beneficial uses marked with an asterisk (P*) in the Basin Plan (and in the table below) are indicted as a conditional use. Conditional designations are not recognized under federal law and are not water quality standards requiring TMDL development at this time. (See letter from Alexis Strauss [US EPA] to Celeste Cantú [State Board], Feb. 15, 2002.)

Table 2-1. Beneficial Uses Designations for the Ten Lakes

Lake/Reservoir	REC1	REC2	WARM	WILD	MUN	WET	GWR	COLD	RARE	AGR	NAV
Peck Road Park Lake[1]	Pm	E	P	I	P*		I				
Lincoln Park Lake	P	E	P	E	P*						
Echo Park Lake	P	E	P	E	P*						
Lake Calabasas[2]	Pm	I	P	P	P*						
El Dorado Park Lakes	E	E	P	E	P*	E					
North, Center, and Legg Lakes	E	E	E	E	P*	E	E	E			
Puddingstone Reservoir	E	E	E	E	E*		E	E	E	E	
Santa Fe Dam Park Lake	P	I	I	E	P*	E	I				
Lake Sherwood	E	E	E	E	P*	E	E				E
Westlake Lake	E	E	E	E	P*						E

[1] Beneficial uses were not identified in the Basin Plan for Peck Road Park Lake. Therefore, the downstream segment's uses (Rio Hondo below Spreading Grounds) apply (Regional Board, personal communication, 12/22/2009).

[2] Beneficial uses were not identified in the Basin Plan for Lake Calabasas. Therefore, the downstream segment's uses (Arroyo Calabasas) apply (Regional Board, personal communication, 2/24/2009).

* Asterisked MUN designations are designated under SB 88-63 and RB 89-03. Some designations may be considered for exemptions at a later date.

m Access prohibited by Los Angeles County DPW in concrete-channelized areas.

E - Existing; P - Potential; I- Intermittent

2.1.2 Water Quality Objectives and Criteria

The Basin Plan describes numeric and narrative water quality objectives for beneficial uses in the Los Angeles Region (LARWQCB, 1994). The California Toxics Rule (CTR) includes numeric water quality criteria for certain human health and aquatic life designated uses. The objectives and criteria for the impairments addressed in this document are described below.

2.1.2.1 Ammonia

The Basin Plan establishes numeric objectives for ammonia which are protective of fish (COLD and WARM), and wildlife (WILD) (see Basin Plan Tables 3-1 through 3-4). The objective for chronic exposure is based on a four-day average concentration while the objective for acute toxicity is based on a one-hour average concentration. These objectives are expressed as a function of pH and temperature because un-ionized ammonia (NH_3) is toxic to fish and other aquatic life.

2.1.2.2 Bioaccumulation

The Basin Plan states that "toxic pollutants shall not be present at levels that will accumulate in aquatic life to levels which are harmful to aquatic life or human health." To implement this narrative objective, the fish contaminant goals defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) were used to set numeric targets for mercury, chlordane, DDTs, dieldrin, and PCBs.

2.1.2.3 Biostimulatory Substances (nutrients)

The Basin Plan addresses excess aquatic growth in the form of a narrative objective for nutrients. Excessive nutrient (e.g., nitrogen and phosphorous) concentrations in a waterbody can lead to nuisance effects such as algae, odors, and scum. The objective specifies, "waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses." To implement this narrative objective, the Numeric Nutrient Endpoint (NNE) BATHTUB model was used to define nitrogen and phosphorus target concentrations on a site specific basis that will not lead to nuisance conditions in the waterbody, such as excessive chlorophyll *a* concentrations.

2.1.2.4 Chemical Constituents

The Basin Plan states that "chemical constituents in excessive amounts in drinking water are harmful to human health" and "surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use." Specifically, waters designated MUN shall not have concentrations exceeding the following maximum contaminant levels: mercury, 0.002 mg/L; nitrate as NO_3, 45 mg/L; nitrate plus nitrite as N, 10 mg/L; nitrite as nitrogen, 1 mg/L; chlordane, 0.0001 mg/L; PCBs, 0.0005 mg/L. The Basin Plan provides maximum contaminant levels for additional pollutants; however, no others are relevant for these TMDLs. The CTR also includes criteria for some of these pollutants (see Section 2.1.2.5).

2.1.2.5 California Toxics Rule

The CTR includes numeric water quality criteria for certain human health and aquatic life designated uses. The strictest applicable targets from those identified in the Basin Plan and CTR apply to the waterbodies in this report. The CTR includes criteria applicable to these lakes for: chlordane, copper, dieldrin, DDT, lead, mercury and PCBs. The specific criteria are described in Section 2.2.

2.1.2.6 Dissolved Oxygen

Adequate dissolved oxygen levels are required to support aquatic life. Dissolved oxygen requirements are dependent on the beneficial uses of the waterbody. The Basin Plan states "At a minimum (see specifics below) the mean annual dissolved oxygen concentrations of all waters shall be greater than 7 mg/L, and no single determinations shall be less than 5.0 mg/L except when natural conditions cause lesser concentrations." In addition, the Basin Plan states, "the dissolved oxygen content of all surface waters designated as WARM shall not be depressed below 5 mg/L as a result of waste discharges" and "the dissolved oxygen content of all surface waters designated as COLD shall not be depressed below 6 mg/L as a result of waste discharges."

2.1.2.7 Floating Material (trash)

The Basin Plan specifies that "waters shall not contain floating materials including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses."

2.1.2.8 Pesticides

The Basin Plan states that "no individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life." To implement this narrative objective, the fish contaminant goals defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) were used to set numeric targets for chlordane, DDTs, and dieldrin. The CTR also includes criteria for some of these pollutants (see Section 2.1.2.5).

2.1.2.9 pH

The Basin Plan states that "the pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges. Ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge." This narrative objective will be achieved, in nutrient- impaired lakes, by applying the Numeric Nutrient Endpoint (NNE) BATHTUB model, which was used to define nitrogen and phosphorus target concentrations on a site specific basis that will not lead to fluctuations of pH due to excessive algal growth in the waterbody.

2.1.2.10 Polychlorinated Biphenyls (PCBs)

The Basin Plan states that "the purposeful discharge of PCBs to waters of the Region, or at locations where the waste can subsequently reach waters of the Region, is prohibited. Pass-through or uncontrollable discharges to waters of the Region, or at locations where the waste can subsequently reach water of the Region, are limited to 70 pg/L (30-day average) for protection of human health and 14 ng/L and 30 ng/L (daily average) to protect aquatic life in inland fresh waters and estuarine waters respectively." In addition, OEHHA (2008) has published fish consumption guidelines for PCBs that were used to set fish tissue targets. The CTR also includes a criterion for PCBs (see Section 2.1.2.5).

2.1.2.11 Taste and Odor

The Basin Plan states that "waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible aquatic resources, cause nuisance, or adversely affect beneficial uses." This narrative objective will be achieved, as it relates to nutrient-related odor impairments, by applying the Numeric Nutrient Endpoint (NNE) BATHTUB model, which was used to define nitrogen and phosphorus target concentrations on a site specific basis that will not lead to nuisance algal growth in the waterbody. Additionally, trash TMDLs will further address this impairment in applicable lakes.

2.1.2.12 Toxicity

The Basin Plan states that "all waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological response in human, plant, animal, or aquatic life."

2.1.2.13 Antidegradation

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

2.2 Numeric Targets

Numeric targets represent water column, sediment, or fish tissue concentrations that result in attainment of the water quality standards. For the TMDLs in this document, the targets are assigned based on either: 1) numeric water quality objectives outlined in the Basin Plan, 2) fish contaminant goals (FCG) defined by the Office of Environmental Health Hazard Assessment, 3) water concentrations defined by the California Toxics Rule (CTR), 4) consensus-based sediment quality guidelines defined by MacDonald et al. (2000), 5) bioaccumulation factor (BAF) or biota-sediment accumulation factor (BSAF) calculations to translate the FCGs into water and sediment targets respectively, or 6) interpretation of the Regional Board regarding narrative water quality objectives.

2.2.1 Ammonia

The Basin Plan expresses ammonia targets as a function of pH and temperature because un-ionized ammonia (NH_3) is toxic to fish and other aquatic life. In order to assess compliance with the standard, pH, temperature, and ammonia must be determined at the same time. The toxicity of ammonia increases with increasing pH and temperature; therefore, ammonia targets depend on the site specific pH and temperature as well as the presence or absence of early life stages (ELS) of aquatic life. For the purpose of this report, pH and temperature samples at the surface (less than 0.5 meters of depth) were used to determine the median temperature and 95th percentile pH, which were then used to calculate chronic targets. Acute values were based entirely on the 95th percentile pH. Any single day sample without a depth was assumed to be sampled at the surface and included within the target calculation.

A December 2005 Amendment to the Basin Plan assumes that ELS are present in any waterbody designated as COLD. Designated uses applied in the calculation of site-specific ammonia targets are presented in Table 2-2. The 30-day average target concentrations (criterion continuous concentration (CCC)) of ammonia for waterbodies with and without ELS can be calculated using Equations 2-1 and 2-2, respectively. Concentration targets are also presented in Tables 3-1 through 3-4 of the Basin Plan (LARWQCB, 1994). The four-day maximum average concentrations shall not exceed 2.5 times the 30-day average objective, while the one-hour acute level, with and without ELS, can be calculated with Equations 2-3 and 2-4, respectively (USEPA, 1999).

Table 2-2. Temperature and pH Dependent Acute and Chronic Total Ammonia Targets (un-ionized ammonia target)

Lake (designated use)	Median Temperature (n = number of samples)	95th% pH Values (n = number of samples)	Acute (1-hr Maximum Concentration) (mg-N/L)[1]	Four-day Ammonia Max Average (mg-N/L)[2]	Chronic Ammonia Target (mg-N/L)[3]
Lincoln Park (WARM, WILD)	19.0 (n=8)	9 (n=22)	1.32	0.91	0.36
Echo Park (WARM, WILD)	19.7 (n=44)	9.1 (n=60)	1.14	0.76	0.30
Calabasas (WARM)	21.8 (n=144)	9.4 (n=172)	0.78	0.46	0.19
El Dorado Park (WARM, WILD)	16.2 (n=46)	8.5 (n=46)	3.20	2.44	0.98
Legg (COLD)**	16 (n=14)	9.6 (n=30)	0.42**	0.56**	0.23**

Note: The median temperature and 95th percentile pH values were calculated from the observed surface depth data and used in the calculation of ammonia targets. These are presented as example calculations since the actual target is the water quality objective which is dependent on pH and temperature. When assessing compliance refer to the water quality objective as expressed in the Basin Plan.

[1] The acute criterion represents a short term one-hour maximum concentration.

[2] The four-day criterion is the maximum average concentration allowed in a four-day period.

[3] The chronic criterion is the maximum 30 day average.

**ELS assumed to be present.

Equation 2-1: 30-day average total ammonia concentration for waterbodies with ELS present.

$$\text{30-day Average Concentration} = \left(\frac{0.0577}{1+10^{7.688-pH}}+\frac{2.487}{1+10^{pH-7.688}}\right)*MIN\left(2.85, 1.45*10^{0.028*(25-T)}\right)$$

Equation 2-2: 30-day average total ammonia concentration for waterbodies with ELS absent.

$$\text{30-day Average Concentration} = \left(\frac{0.0577}{1+10^{7.688-pH}}+\frac{2.487}{1+10^{pH-7.688}}\right)*1.45*10^{0.028*(25-MAX(T,7))}$$

Equation 2-3: Acute criteria for total ammonia-nitrogen for waterbodies with ELS absent (USEPA, 1999).

$$\text{Acute Limit} = \left(\frac{0.41}{1+10^{7.204-pH}}\right)+\left(\frac{58.4}{1+10^{pH-7.204}}\right)$$

Equation 2-4: Acute criteria for total ammonia-nitrogen for waterbodies with ELS present (USEPA, 1999).

$$\text{Acute Limit} = \left(\frac{0.267}{1+10^{7.204-pH}}\right)+\left(\frac{39.0}{1+10^{pH-7.204}}\right)$$

2.2.2 Chlordane

Targets associated with OC Pesticides and PCBs are provided to ensure protection of both human health and wildlife, consistent with the beneficial uses associated with the OC Pesticides and PCBs-impaired waterbodies. The OC Pesticides and PCBs targets considered for use in calculating the TMDLs are discussed below by media.

2.2.2.1 Selection of Water Quality Targets

Water column targets for OC Pesticides and PCBs are based on beneficial use. For waters designated MUN, the Basin Plan lists a maximum contaminant level associated with chlordane and PCBs. The Basin Plan also requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Each waterbody addressed in this document is designated WARM, at a minimum, and must meet this requirement. The WQOs intended to protect these beneficial uses defer to numeric water quality criteria included in the California Toxics Rule (CTR) (USEPA, 2000a). To meet the designated beneficial uses, the aquatic life and human health criteria must be met. Acute and chronic criterion in freshwater systems are considered protective of aquatic life. However, the most stringent water column targets are the criteria for protection of human health. The “water and organisms” criterion is applicable to Puddingstone Reservoir, where there is an existing MUN use, while the “organisms only” criterion is applicable to Echo Park Lake and Peck Road Park Lake. The CTR criteria for “water and organisms” or “organisms only” both account for human health risk associated with bioaccumulation directly from the water column.

2.2.2.2 Selection of Sediment Quality Targets

OC Pesticides and PCBs have an affinity for organic matter and will partition from water to organic substances such as sediment, benthic organisms, and fish. The levels of contamination in sediment are important because they are a crucial pathway for pollutant accumulation in fish and other edible species (such as clams and mussels). Partitioning of OC Pesticides and PCBs from water through fish skin is also important, but does not result in the high accumulation caused by the continuous ingestion of contaminated organisms in most fish species. Two target sediment concentrations have been identified that consider the protection of sediment biota and the potential for bioaccumulation in aquatic organisms, as well as the associated hazards to the species that consume aquatic organisms. Consensus-based threshold effect levels are described in Section 2.2.2.2.1 and are designed to protect benthic biota from excessive toxic pollutants. These sediment targets have been used in similar freshwater OC Pesticides and PCBs TMDLs in the Los Angeles region. The other type of sediment targets, included in section 2.2.2.2.2, were calculated to attain the fish tissue target based on a biota-sediment accumulation factor (BSAF). The lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target for each lake. Additionally, these TMDLs include alternative wasteload allocations to be applied when a sufficient demonstration has been made that the fish tissue targets are met. These targets are based on the consensus-based TEC values described below. Details on when each set of targets apply are included in the wasteload allocation section of each relevant lake chapter.

2.2.2.2.1 Consensus-Based Sediment Quality Guidelines Threshold Effects Concentrations (consensus-based TECs)

There are no WQOs in the Basin Plan for OC Pesticides and PCBs in sediments. Instead, the Regional Board assesses the quality of the lake sediments using the Probable Effects Concentration (PEC) values for the consensus-based sediment quality guidelines published by MacDonald et al. (2000). The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008). Sediment quality guidelines (SQGs) are developed from field and laboratory studies to predict the toxicity of pollutants on sediment-dwelling organisms. MacDonald et al. (2000) compiled a set of all published SQGs and used the resulting geometric mean value to establish CBSQGs for threshold and probable effect concentrations of individual contaminants. The PEC is the concentration at which harmful effects on sediment-dwelling organisms are expected to occur, whereas the threshold effect concentration (TECs) describes the level of contaminant that is not expected to have harmful effects on sediment-dwelling organisms. PECs are appropriate when assessing impairments, while TECs are more conservative and best used as the targets for the TMDLs. The consensus-based sediment quality guidelines are designed to protect benthic dwelling organisms.

2.2.2.2.2 Biota-Sediment Accumulation Factor (BSAF)

To ensure protection of both human health and wildlife, it is also important to consider the potential for bioaccumulation in aquatic organisms and the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans). Thus a separate target calculation was conducted to ensure that fish tissue concentration goals are supported by sediment concentration. The fish goals may be translated through biota-sediment accumulation factor (BSAF) calculations to estimate associated sediment targets. This is done on a site-specific basis.

Specifically, a sediment target to achieve FCGs (see Selection of Fish Targets below) can be calculated based on biota-sediment bioaccumulation (a BSAF approach), using the ratio of the FCG to existing fish tissue concentrations. This ratio is applied to the observed in-lake sediment concentration to obtain the site-specific sediment target concentration to achieve fish tissue goals. The fish tissue-based target concentrations were calculated using only recent data (collected in the past 10 years) because the loads and exposure concentrations are likely to have declined steadily since the cessation of production and use of the OC Pesticides and PCBs.

2.2.2.3 Selection of Fish Tissue Targets

Beneficial uses may also be impaired if concentrations of OC Pesticides and PCBs in fish tissue are sufficiently high to pose potential adverse health impacts from the ingestion of sport-caught or local fish. Tissue concentrations of OC Pesticides and PCBs biomagnify in the food chain. OC Pesticides and PCBs levels increase with the species' trophic level and organisms at the top of a food chain system will have the highest accumulation of OC Pesticides and PCBs (note: trophic levels describe the position an organism occupies in the food chain [i.e., what the organism eats and what eats the organism] and are described in greater detail below). The OC Pesticides and PCBs accumulation also increases with the age of the organisms and resides mostly in the lipid portions of the fish. The top predators and fatty fish species in a given lake system tend to have the highest concentrations of OC Pesticides and PCBs, but concentrations are also elevated in fish that feed directly in contaminated sediment. Top predators (such as bass) are often target species for sport fishermen. Risks to human health from the consumption of contaminated fish are based on long-term, cumulative effects, rather than concentrations in individual fish. Therefore, the criterion should not be applied to the extreme case of the most-contaminated fish within a target species; instead, the criterion is most applicable to average concentrations in top predator species and fish that are popular for consumption.

The Office of Environmental Health Hazard Assessment (OEHHA) describes fish contaminant goals (FCGs) as pollutant levels in fish that "pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week (32 g/day), prior to cooking, over a lifetime…" OEHHA also states that FCGs provide a reasonable starting point for criteria development (OEHHA, 2008).

FCGs for OC Pesticides and PCBs are defined for carcinogenic and non- carcinogenic risks. The OEHHA (2008) applied the following methodology to calculate the two sets of FCGs:

For each chemical, the toxicological literature was reviewed to establish an acceptable non-cancer reference dose (RfD; an estimate of daily human exposure to a chemical that is likely to be without significant risk of adverse effects during a lifetime) and/or a cancer slope factor (an upper-bound estimate of the probability that an individual will develop cancer over a lifetime as a consequence of exposure to a given dose of a specific carcinogen).

For all the OC Pesticides and PCBs of concern in these TMDLs, the FCG based on cancer risk is the lower of the two FCG sets and is selected as the target.

2.2.2.4 Chlordane Numeric Targets

Total chlordane consists of a family of related chemicals, including cis- and trans-chlordane, oxychlordane, trans-nonachlor, and cis-nonachlor. As described above, water column targets for chlordane are based on beneficial use. For waters designated MUN, the Basin Plan lists a maximum contaminant level of 0.0001 mg/L, or 0.1 µg/L (100 ng/L). The Basin Plan also requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). This objective is addressed through the CTR water quality criteria.

Acute and chronic criteria for chlordane in freshwater systems are defined by the California Toxics Rule as 2.4 µg/L (2,400 ng/L) and 0.0043 µg/L (4.3 ng/L), respectively (USEPA, 2000a). CTR criteria are considered protective of aquatic life. The CTR also includes human health criteria for the consumption of water and organisms and for the consumption of organisms only as 0.00057 µg/L (0.57 ng/L) and 0.000059 µg/L (0.59 ng/L), respectively (USEPA, 2000a). California often implements these values on a 30 day average. Because the human health criterion for the consumption of water and organisms is the most restrictive criterion, a water column target of 0.00057 µg/L (0.57 ng/L) is the appropriate target for waterbodies with the MUN designated use (Puddingstone Reservoir). The human health criterion for the consumption of organisms only (0.000059 µg/L [0.59 ng/L]) is appropriate for waterbodies without an existing MUN designation (Echo Park Lake and Peck Road Park Lake).

Two target sediment concentrations for chlordane have been identified as potential targets (Section 2.2.2.2). There are no Basin Plan Objectives for toxicity levels in sediment; however sediment quality guidelines are reported by multiple agencies for the protection of sediment biota. MacDonald et al. (2000) compiled and evaluated the guidelines and derived consensus-based sediment quality guidelines that incorporate multiple recommendations. For chlordane, the consensus-based threshold effect concentration (TEC) is 3.24 µg/kg dry weight. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. An additional sediment target based on bioaccumulation in fish was also calculated for each impaired lake to ensure that the FCG is met using the BSAF approach described in Section 2.2.2.2.2. The lower of the two sediment target values is applied in each lake.

Fish tissue targets are described above in Section 2.2.2.3. The fish contaminant goal for chlordane defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) is 5.6 ppb based on cancer risk (the FCG based on non-cancer risk is 100 ppb). The resulting total chlordane targets for each lake are shown in Table 2-3.

Table 2-3. Total Chlordane Targets

Lake	Maximum Contaminant Level (ng/L)	Acute Criterion[1] (ng/L)	Chronic Criterion[2] (ng/L)	Criterion for Consumption of Water and Organisms (ng/L)	Human Health Criterion for Consumption of Organisms Only (ng/L)	Consensus-based TEC Sediment Target (µg/kg)[3]	BSAF-derived Sediment Target (µg/kg)	Fish Contaminant Goal (ppb)
Echo Park Lake	NA	2,400	4.3	0.57	0.59	3.24	2.10	5.6
Peck Road Park Lake	NA	2,400	4.3	0.57	0.59	3.24	1.73	5.6
Puddingstone Reservoir	100	2,400	4.3	0.57	0.59	3.24	0.75	5.6

Note: Shaded cells represent the selected targets for each waterbody.

[1] The acute criterion is a short term average not to be exceeded more than once every three years on the average.

[2] The chronic criterion is the highest four day average not to be exceeded more than once every three years on average.

[3] The consensus-based TEC sediment target value was used for setting alternative wasteload allocations when sufficient demonstration that the fish tissue targets are met has been made. Details on when each set of targets apply are included in the wasteload allocation sections of each relevant lake chapter.

2.2.3 Chlorophyll *a*, Total Nitrogen, and Total Phosphorus

To address the water quality standard for biostimulatory substances (nitrogen and phosphorus), the Regional Board and USEPA have determined that an average summer (May – September) and annual mean chlorophyll *a* concentration of 20 µg/L will protect each waterbody from nuisance aquatic growth. For lakes that are not meeting the chlorophyll *a* target, the NNE BATHTUB model was used to assess target concentrations of nitrogen and phosphorus in each waterbody that will not result in an average summer (May – September) and annual mean chlorophyll *a* concentration exceeding 20 µg/L. The unique conditions in each lake result in unique total nitrogen and total phosphorus targets for each lake that will result in the targeted chlorophyll *a* concentration. For lakes where currently available data indicate the chlorophyll *a* target is being met, the total nitrogen and total phosphorus targets are set at existing nutrient levels. More information on nutrient targets is included below.

2.2.3.1 Chlorophyll *a* Numeric Targets

A summer mean chlorophyll *a* concentration of 25 µg/L represents a general consensus for the boundary between eutrophic and degraded hypereutrophic conditions (Welch and Jacoby, 2004), and average concentrations should be maintained below this level to protect WARM uses. Impairment of recreational uses can occur at somewhat lower levels. Carlson (1977) shows that an average chlorophyll *a* concentration of around 20 µg/L corresponds to a Secchi disc depth of 3 m. The work of Walker (1987) suggests that a mean chlorophyll *a* concentration of 25 µg/L is associated with severe algal blooms (concentration greater than 30 µg/L) occurring about one quarter of the time, while a mean concentration of 20 µg/L should reduce the frequency of severe blooms to about 15-20 percent of the time. Lake aesthetics and recreation potential are generally found to be impaired above about 20 or 25 µg/L chlorophyll *a* (Bachmann and Jones, 1974; Heiskary and Walker, 1988). Based on these and other lines of evidence, Tetra Tech (2006) recommended to the State Water Quality Control Board that summer average chlorophyll *a* concentrations be not greater than 25 µg/L to support WARM uses and not greater than 20 µg/L to support REC-1 uses.

2.2.3.2 Total Nitrogen and Total Phosphorus Numeric Targets

As mentioned above the NNE BATHTUB Tool was used to calculate total nitrogen and total phosphorus targets for each lake. Appendix A (Nutrient TMDL Development) provides more details but a brief description is included here. The NNE BATHTUB tool finds combinations of N and P loading that result in predicted chlorophyll *a* being equal to the selected target. Similar to the chlorophyll *a* targets, the total nitrogen and total phosphorus targets are average summer (May – September) and annual mean values. Because algal growth can be limited by either N or P there is not a unique solution, and the Tool output supplies the user with a curve representing the loading combinations that will result in attainment of the selected chlorophyll *a* target. The loading combination that is predicted to result in an in-lake ratio of total nitrogen concentration to total phosphorus concentration close to 10 was selected. This ratio was chosen to match that typically observed in natural systems and to balance biomass growth and prevent limitation by one nutrient (Thomann and Mueller, 1987). A ratio of 10 typically limits the growth nuisance species, such as cyanobacteria (blue green algae) (Welch and Jacoby, 2004). For lakes with required reductions in loadings, maximum allowable alternative "Approved Lake Management Plan Wasteload Allocations" are also included. These alternative wasteload allocations are concentration-based and are based on USEPA's technical guidance to States not to set phosphorus criteria for lakes and reservoirs any higher than 0.1 mg/L total phosphorus (USEPA, 2000d). A ratio of 10 was then applied to select the corresponding maximum allowable total nitrogen target.

For lakes where the currently available data indicate that the chlorophyll *a* target is being met, the total nitrogen target is based on the existing conditions and the total phosphorus target is based on the typical ratio of 10 between phosphorus and nitrogen in natural systems. The in-lake nitrogen and phosphorus targets as well as the chlorophyll *a* target are summer (May – September) and annual average values. However, compliance with these targets for the lakes that are receiving targets based on existing conditions will be based on a three year average to account for year to year variability. Table 2-4 presents the total phosphorous and total nitrogen targets associated with each lake.

Measuring compliance with the nitrogen and phosphorus targets will occur differently for three categories of lakes. The first category includes lakes where the currently available data indicate that the chlorophyll *a* target is being met. In these lakes compliance with the total phosphorus and total nitrogen allocations is based on a three year average rather than a one year value. Additionally, if applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target are met then the total phosphorus and total nitrogen allocations are considered attained. The second category includes lakes that require reductions to achieve the chlorophyll *a* target and are heavily managed lakes that receive the majority of their water from supplemental water additions to the lake. Responsible jurisdictions that discharge to these lakes may opt to request that alternative wasteload and load allocations apply to them if they develop a lake management plan. In this scenario if applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target are met then the total phosphorus and total nitrogen allocations are considered attained. Finally, the third category of lake is for lakes that require reductions to achieve the chlorophyll *a* target but are not heavily managed lakes and do not receive the majority of their water from supplemental water additions. The only lake in this category is Puddingstone Reservoir. Responsible jurisdictions that discharge to this lake must meet the total phosphorus and total nitrogen allocations as well as the applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target in order to demonstrate compliance. Details are included in the individual lake chapters.

Table 2-4. Total Phosphorus and Total Nitrogen Targets

Lake/Reservoir	Total Phosphorus Target (mg-P/L)	Total Nitrogen Target (mg-N/L)	Maximum Allowable Alternative target for Total Phosphorus (mg-P/L)	Maximum Allowable Alternative target Total Nitrogen (mg-N/L)
Peck Road Park Lake[1]	0.071	0.71	NA	NA
Lincoln Park Lake	0.088	0.88	0.1[2]	1.0[2]
Echo Park Lake[1]	0.12	1.20	NA	NA
Lake Calabasas	0.066	0.66	0.1[2]	1.0[2]
El Dorado Park Lakes Northern System	0.069	0.69	0.1[2]	1.0[2]
El Dorado Park Lakes Southern System[1]	0.125	1.25	NA	NA
Legg Lakes	0.065	0.65	0.1[2]	1.0[2]
Puddingstone Reservoir	0.071	0.71	0.1	1.0
Santa Fe Dam Park Lake[1]	0.063	0.63	NA	NA

[1] Limited data indicate these lakes are meeting the chlorophyll *a* target so the total nitrogen and total phosphorus targets are based on existing conditions. In these lakes compliance with the total phosphorus and total nitrogen allocations is based on a three year average rather than a one year value. Additionally, if applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target are met then the total phosphorus and total nitrogen allocations are considered attained.

[2] In these lakes responsible jurisdictions can request that these alternative allocations are applied to them based on factors set out in the individual lake chapters' wasteload and load allocation sections. Additionally, if applicable water quality criteria for ammonia, dissolved oxygen, and pH and the chlorophyll *a* target are met then the total phosphorus and total nitrogen allocations under the alternative allocations scenario are considered attained.

2.2.4 Copper

The Basin Plan requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Acute and chronic criterion for copper and lead in freshwater systems are included in the California Toxics Rule (CTR) 40 CFR 131.38. (USEPA, 2000a). The CTR establishes short-term (acute) and long-term (chronic) aquatic life criteria for metals in both freshwater and saltwater. The acute criterion, defined in the CTR as the Criteria Maximum Concentration, equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects. The chronic criterion, defined in the CTR as the Criteria Continuous Concentration, equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects.

CTR freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness and/or water quality characteristics that are usually correlated with hardness can reduce or increase the toxicity of some metals. In order to assess compliance with the standards, copper and hardness should be determined at the same time. Hardness is used as a surrogate for a number of water quality characteristics, which affect the toxicity of metals in a variety of ways. Increasing hardness generally has the effect of decreasing the toxicity of metals. Water quality criteria to protect aquatic life may be calculated at different concentrations of hardness measured in milligrams per liter (mg/L) as calcium carbonate ($CaCO_3$). The CTR lists freshwater aquatic life criteria based on a hardness value of 100 mg/L and provides hardness dependent equations to calculate the freshwater aquatic life metals criteria using site-specific hardness data.

In the CTR, freshwater criteria for metals are expressed in terms of the dissolved fraction of the metal in the water column. These criteria were calculated based on methods in USEPA guidance (USEPA, 1985) developed under Section 304(a) of the CWA. This methodology is used to calculate the total recoverable fraction of metals in the water column and then appropriate conversion factors, included in the CTR, are applied to calculate the dissolved criteria.

The CTR allows for the adjustment of criteria through the use of a water-effect ratio (WER) to assure that the metals criteria are appropriate for the site-specific chemical conditions under which they are applied. A WER represents the ratio between metals that are measured and metals that are biologically available and toxic. The WER is used to account for site specific conditions that may alter the bioavailability of a toxicant with respect to laboratory water. For impaired waterbodies where no site specific data are available, a default WER of 1 can be assumed. The coefficients needed for hardness-based calculations are provided in the CTR and listed below in Table 2-5.

The equations for calculating the freshwater criteria for metals are:

$$\text{Acute Criterion} = \text{WER x ACF x EXP}[(m_a)(\ln(\text{hardness}))+b_a] \quad \textbf{Equation 2-5}$$

$$\text{Chronic Criterion} = \text{WER x CCF x EXP}[(m_c)(\ln(\text{hardness}))+b_c] \quad \textbf{Equation 2-6}$$

Where: WER = Water-Effect Ratio (assumed to be 1)

ACF = Acute conversion factor (to convert from the total to the dissolved fraction)

CCF = Chronic conversion factor (to convert from the total to the dissolved fraction)

m_a = slope factor for acute criteria

m_c = slope factor for chronic criteria

b_a = y intercept for acute criteria

b_c = y intercept for chronic criteria

Table 2-5. Coefficients used in Formulas for Calculating CTR Freshwater Criteria for Copper

Metal	ACF	m_a	b_a	CCF	m_C	b_C
Copper	0.960	0.9422	-1.700	0.960	0.8545	-1.702

Chronic copper freshwater targets for each lake are calculated based on the 50th percentile of hardness values measured during copper sampling events, while the acute targets are calculated using the 90th percentile hardness (Appendix G, Monitoring Data). These are presented as example calculations since the actual target varies with the hardness value measured during sample collection. Table 2-6 summarizes the acute and chronic criteria, as well as the human health criterion for the consumption of water and organisms from a waterbody, for each lake impaired by copper.

Table 2-6. Hardness-Dependent Acute and Chronic Copper Targets

Lake	WER	90th Percentile Hardness (mg/L as $CaCO_3$)	Acute Criterion[1] (µg/L dissolved fraction)	50th Percentile Hardness (mg/L as $CaCO_3$)	Chronic Criterion[2] (µg/L dissolved fraction)	Human Health Criterion[3] (µg/L total fraction)
Echo Park Lake	1	231	29.58	208	16.75	1,300
El Dorado Park Lakes	1	124	16.46	95	8.57	1,300
Legg Lakes	1	246	31.38	182	14.94	1,300
Santa Fe Dam Park Lake	1	131	17.33	100	8.96	1,300

Note: The median and 90th percentile hardness values were calculated from the observed data and used in the calculation of the chronic and acute targets, respectively. These are presented as example calculations since the actual target varies with the hardness value determined during sample collection.

[1] The acute criterion is a short term average not to be exceeded more than once every three years on the average.

[2] The chronic criterion is the highest four day average not to be exceeded more than once every three years on average.

[3] The human health criterion was specified for consumption of water and organisms. A human health criterion was not specified for consumption of organisms only.

2.2.5 Dieldrin

Selection of applicable OC Pesticides and PCBs targets are described above in Section 2.2.2.1 through Section 2.2.2.3. Water column targets for dieldrin are based on beneficial use (Section 2.2.2.1). Only one of the three dieldrin-impaired waters has an MUN designated use. The Basin Plan requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). This objective is addressed through the CTR water quality criteria.

Acute and chronic criteria for the protection of aquatic life in freshwater systems are included in the CTR for dieldrin as 0.24 µg/L (240 ng/L) and 0.056 µg/L (56 ng/L), respectively (USEPA, 2000a). CTR criteria are considered protective of aquatic life. The CTR also includes human health criterion for the consumption of organisms only and for the consumption of organisms and water as 0.00014 µg/L (0.14 ng/L) (USEPA, 2000a). California often implements these values on a 30 day average. Because the human health criterion for the consumption of organisms only is the most restrictive criterion, a water column target of 0.00014 µg/L (0.14 ng/L) is the appropriate target for waterbodies without an existing MUN designated use (Echo Park Lake and Peck Road Park Lake). For the MUN use specified in Puddingstone Reservoir the CTR criterion is based on consumption of organisms and water, but is also equal to 0.00014 µg/L (0.14 ng/L).

Two target sediment concentrations for dieldrin have been identified (Section 2.2.2.2). There are no Basin Plan Objectives for toxicity levels in sediment; however sediment quality guidelines are reported by multiple agencies for the protection of sediment biota. MacDonald et al. (2000) compiled and evaluated the guidelines and derived consensus-based sediment quality guidelines that incorporate multiple recommendations. For dieldrin, the consensus-based threshold effect concentration (TEC) is 1.9 µg/kg dry weight. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. An additional sediment target based on bioaccumulation in fish was also calculated for each impaired lake to ensure that the FCG is met using the BSAF approach described in Section 2.2.2.2.2. The lower of the two sediment target values is applied in each lake. Additionally, these TMDLs include alternative wasteload allocations to be applied when a sufficient demonstration has been made that the fish tissue targets are met. These targets are based on the consensus-based TEC values. Details on when each set of targets apply are included in the wasteload allocation section of each relevant lake chapter.

Fish tissue targets are described above in Section 2.2.2.3. The fish contaminant goal for dieldrin defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) is 0.46 ppb based on cancer risk (the FCG based on non-cancer risk is 160 ppb). Similar to the sediment targets, the lowest fish tissue target value is applied in each lake. Table 2-7 summarizes the applicable targets for the two waterbodies listed for dieldrin addressed by this document.

Table 2-7. Dieldrin Targets

Lake	Acute Criterion[1] (ng/L)	Chronic Criterion[2] (ng/L)	Human Health Criterion for Consumption of Organisms Only (ng/L)	Consensus-based TEC Sediment Target (µg/kg)[3]	BSAF-derived Sediment Target (µg/kg)	Fish Contaminant Goal (ppb)
Echo Park Lake	240	56	0.14	1.90	0.80	0.46
Peck Road Park Lake	240	56	0.14	1.90	0.43	0.46
Puddingstone Reservoir	240	56	0.14	1.90	0.22	0.46

Note: Shaded cells represent the selected targets for each waterbody.

[1] The acute criterion is a short term average not to be exceeded more than once every three years on the average.

[2] The chronic criterion is the highest four day average not to be exceeded more than once every three years on average.

[3] The consensus-based TEC sediment target value was used for setting alternative wasteload allocations when sufficient demonstration that the fish tissue targets are met has been made. Details on when each set of targets apply are included in the wasteload allocation sections of each relevant lake chapter.

2.2.6 Dissolved Oxygen

Targets for dissolved oxygen (DO) depend on whether or not the waterbody is designated COLD in addition to the minimum designation of WARM, as is the case with Puddingstone Reservoir. Waterbodies designated COLD have more stringent dissolved oxygen targets. Table 2-8 summarizes the DO targets for each lake listed as impaired by low DO. Targets are specified as minimum values not to be depressed due to waste discharges. Target depths for each lake were set by the Regional Board and USEPA based on site specific conditions. Shallow, well mixed lakes must meet the target in the water column from the surface to 0.3 meters above the bottom of the lake. Deeper lakes that thermally stratify during the summer months, such as Peck Road Park Lake and Puddingstone Reservoir, must meet the DO target throughout the epilimnion of the water column.

The epilimnion is the upper stratum of more or less uniformly warm, circulating, and fairly turbulent water during summer stratification. The epilimnion floats above a cold relatively undisturbed region called the hypolimnion. The stratum between the two is the metalimnion and is characterized by a thermocline, which refers to the plane of maximum rate of decrease of temperature with respect to depth. For the purposes of these TMDLs, the presence of stratification will be defined by whether there is a change in lake temperature greater than 1 degree Celsius per meter. Deep lakes must meet the DO target in the water column from the surface to 0.3 meters above the bottom of the lake when the lake is not stratified. However, when stratification occurs (i.e., a thermocline is present) then the DO target must be met in the epilimnion, the portion of the water column above the thermocline.

Table 2-8. Dissolved Oxygen Targets

Lake/Reservoir	Minimum Mean Annual DO (mg/L)[1]	Minimum Instantaneous DO (mg/L)[2]	Target Depth (m)
Peck Road Park Lake	7.0	5.0	Throughout the epilimnion
Lincoln Park Lake	7.0	5.0	Surface to 0.3 meters above the bottom
Echo Park Lake	7.0	5.0	Surface to 0.3 meters above the bottom
Lake Calabasas	7.0	5.0	Surface to 0.3 meters above the bottom
El Dorado Park Lakes	7.0	5.0	Surface to 0.3 meters above the bottom
Legg Lakes	7.0	6.0	Surface to 0.3 meters above the bottom
Puddingstone Reservoir	7.0	6.0	Throughout the epilimnion
Santa Fe Dam Park Lake	7.0	5.0	Surface to 0.3 meters above the bottom

[1] The mean annual dissolved oxygen concentration shall be greater than 7 mg/L except when natural conditions cause lesser concentrations.

[2] The dissolved oxygen content shall not be depressed below this level as a result of waste discharges.

2.2.7 DDT

Dichlorodiphenyltrichloroethane (DDT) is a synthetic organochlorine insecticide once used throughout the world to control insects. Technical DDT consists of two isomers, 4,4'-DDT and 2,4'-DDT, of which the former is most toxic. In the environment, DDT breaks down to form two related compounds: DDD (tetrachlorodiphenylethane) and DDE (dichlorodiphenyl-dichloroethylene). DDD and DDE often predominate in the environment and USEPA (2000c) recommends that fish consumption guidelines be based on the sum of DDT, DDD, and DDE – collectively referred to as total DDTs.

Selection of applicable OC Pesticides and PCBs targets are described above in Section 2.2.2.1 through Section 2.2.2.3. Water column targets for DDT are based on beneficial use (Section 2.2.2.1). The Basin Plan requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). This objective is addressed through the CTR water quality criteria. Acute and chronic criteria for 4,4'-DDT in freshwater systems are included in the CTR as 1.1 μg/L (1,100 ng/L) and 0.001 μg/L (1 ng/L), respectively (USEPA, 2000a). CTR criteria are considered protective of aquatic life. Acute and chronic values for other DDT compounds were not specified.

The CTR also includes human health criteria for the consumption of water and organisms or organisms only in several DDT compounds, but does not specify a target for total DDTs (USEPA, 2000a). California often implements these values on a 30 day average. These values include a water column target of 0.00059 μg/L (0.59 ng/L) for 4,4'-DDT for consumption of water and organisms as well as organisms only. The CTR also specifies a criterion of 0.00059 μg/L (0.59 ng/L) for 4,4'-DDE (for both consumption of water and organisms or organisms only), while for 4,4'-DDD the criteria are 0.00083 μg/L (0.83 ng/L) for consumption of water and organisms and 0.00084 μg/L (0.84 ng/L) for consumption of organisms only. The lowest applicable DDT target is selected for the purposes of representing Total DDTs. If analytical results that resolve individual DDT compounds are available, all of the CTR criteria should be applied individually. Because the human health criterion for the consumption of water and organisms is the most restrictive criterion, a water column target of 0.00059 μg/L (0.59 ng/L) is the appropriate target for waterbodies with the MUN designated use (Puddingstone Reservoir). The human health criterion for the consumption of organisms only (0.00059 μg/L [0.59 ng/L]) is appropriate for waterbodies without an existing MUN designated use (Peck Road Park Lake).

Two target sediment concentrations for total DDT have been identified (Section 2.2.2.2). There are no Basin Plan Objectives for toxicity levels in sediment; however sediment quality guidelines are reported by multiple agencies for the protection of sediment biota. MacDonald et al. (2000) compiled and evaluated the guidelines and derived consensus-based sediment quality guidelines that incorporate multiple recommendations. The consensus-based TEC for total DDTs is 5.28 µg/kg dry weight (MacDonald el al., 2000). Most data are provided for the total compound; therefore, the total DDTs TEC value is applicable for TMDL analyses. If data for individual compounds are available, separate TECs are also provided: for 4,4'- plus 2,4'-DDT the TEC is 4.16 µg/kg dry weight, for total DDE the TEC is 3.16 µg/kg dry weight, and the TEC for total DDD is 4.88 µg/kg dry weight. The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. An additional sediment target based on bioaccumulation in fish was also calculated for each impaired lake to ensure that the FCG is met using the BSAF approach described in Section 2.2.2.2.2. The lower of the two sediment target values is applied in each lake. Additionally, the Puddingstone Reservoir DDT TMDL includes alternative wasteload allocations to be applied when a sufficient demonstration has been made that the fish tissue targets are met. This target is based on the consensus-based TEC values. Details on when each set of targets apply are included in the wasteload allocation section of the Puddingstone Reservoir DDT impairment chapter.

Fish tissue targets are described above in Section 2.2.2.3. The fish contaminant goal for total DDT defined by the OEHHA is 21 ppb (OEHHA, 2008) based on cancer risk (the FCG based on non-cancer risk is 1,600 ppb). The advisory tissue levels are based on various levels of fish consumption. Table 2-9 summarizes the applicable targets for the two waterbodies listed for DDT addressed by this document.

Table 2-9. DDT Target

Lake	Acute Criterion[1] for 4-4'-DDT (ng/L)	Chronic Criterion[2] for 4-4'-DDT (ng/L)	Human Health Criterion for Consumption of Water and Organisms (ng/L)	Human Health Criterion for Consumption of Organisms Only (ng/L)	Consensus-based TEC Sediment Target (µg/kg)	BSAF-derived Sediment Target (µg/kg)	Fish Contaminant Goal (ppb)
Peck Road Park Lake	1,100	1	0.59	0.59[3]	5.28	6.90	21
Puddingstone Reservoir	1,100	1	0.59[3]	0.59	5.28[4]	3.94	21

Note: Shaded cells represent the selected targets for each waterbody.

[1] The acute criterion is a short term average not to be exceeded more than once every three years on the average.

[2] The chronic criterion is the highest four day average not to be exceeded more than once every three years on the average.

[3] The target water column concentration of 0.59 ng/L specified in the CTR is for 4,4'-DDT. The CTR also specifies targets for DDE and DDD, but does not specify a target for total DDTs. The lowest DDT target is selected for the purposes of representing Total DDTs in this table. If analytical results that resolve individual DDT compounds are available, all of the CTR criteria should be applied individually.

[4] For Puddingstone Reservoir, the consensus-based TEC sediment target value was used for setting alternative wasteload allocations when sufficient demonstration that the fish tissue targets are met has been made. Details on when each set of targets apply are included in the wasteload allocation sections of the Puddingstone Reservoir DDT impairment chapter.

2.2.8 Lead

The Basin Plan requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). CTR 40 CFR 131.38 establishes short-term (acute) and long-term (chronic) aquatic life criteria for metals in both freshwater and saltwater (USEPA, 2000a). Refer to Section 2.2.4 for a detailed explanation of the procedure used to calculate metal targets. Coefficients for calculating lead criteria are listed in Table 2-10.

In addition to the CTR discussion in Section 2.2.4, the chronic and acute conversion factors for lead in freshwater are dependent on hardness and, therefore, should be calculated for each waterbody evaluated. In order to assess compliance with the standards, lead and hardness should be determined at the same time. The following equations can be used to calculate the acute and chronic lead conversion factors based on site-specific hardness data:

$$\text{Lead ACF} = 1.46203 - [(\ln\{\text{hardness}\})(0.145712)]$$ **Equation 2-7**

$$\text{Lead CCF} = 1.46203 - [(\ln\{\text{hardness}\})(0.145712)]$$ **Equation 2-8**

Table 2-10. Coefficients Used in Formulas for Calculating CTR Freshwater Criteria for Lead

Metal	ACF	m_a	b_a	CCF	m_C	b_C
Lead	*	1.273	-1.460	*	1.273	-4.705

*The ACF and CCF for lead are hardness-dependent, and are therefore calculated for each lake specifically (see Table 2-11).

Chronic lead freshwater targets for each lake are calculated based on the 50th percentile of hardness values measured during lead sampling events, while the acute targets are calculated using the 90th percentile hardness (Appendix G, Monitoring Data). These are presented as example calculations since the actual target varies with the hardness value measured during sample collection. Table 2-11 summarizes the acute and chronic criterion for each lake impaired by lead (note that CTR does not include a human health criterion for lead).

Table 2-11. Hardness-Dependent Acute and Chronic Lead Targets

Lake	WER	90th Percentile Hardness (mg/L as $CaCO_3$)	ACF[4]	Acute Criterion[1] (µg/L dissolved fraction)	50th Percentile Hardness (mg/L as $CaCO_3$)	CCF[4]	Chronic Criterion[2] (µg/L dissolved fraction)
Peck Road Park Lake	1	121	0.763	79.43	84	0.816	2.08
Lincoln Park Lake	1	332	0.616	231.75	315	0.624	8.55
Echo Park Lake	1	231	0.669	158.58	208	0.684	5.53
El Dorado Park Lakes	1	124	0.760	81.56	95	0.798	2.38
Legg Lakes	1	246	0.660	169.44	182	0.704	4.80
Santa Fe Dam Park Lake	1	131	0.752	86.54	100	0.791	2.52
Westlake Lake	1	468[3]	0.589	280.85	336	0.614	9.14

Note: The median and 90th percentile hardness values were calculated from the observed data and used in the calculation of the chronic and acute targets, respectively. These are presented as example calculations since the actual target varies with the hardness value measured during sample collection.

[1] The acute criterion is a short-term average not to be exceeded more than once every three years on the average.

[2] The chronic criterion is the highest four-day average not to be exceeded more than once every three years on average.

[3] The 90th percentile hardness was greater than 400 mg/L. According to CTR, if hardness is over 400 mg/L, a hardness of 400 mg/L should be used with a default WER of 1.0. Therefore, hardness of 400 mg/L was used in the acute target calculations for Westlake Lake.

[4] Conversion factors are hardness dependent. Refer to Equation 2-7 and Equation 2-8 to calculate the ACF and CCF, respectively.

2.2.9 Mercury

Mercury targets are provided to ensure protection of both human health and wildlife, consistent with the beneficial uses associated with the mercury-impaired waterbodies. As discussed below, the human health targets are considered protective of wildlife; therefore, the values presented in Table 2-13 are used for TMDL calculations and confirmation of impairments.

Table 2-12. Mercury Targets

Lake/Reservoir	Total Mercury Maximum Contaminant Level (µg/L)	Total Mercury Human Health Criterion for Consumption of Water and Organisms (µg/L total fraction)	Total Mercury Human Health Criterion for Consumption of Organisms Only (µg/L total fraction)	Dissolved Methyl-mercury Water Quality Targets (ng/L)	Methylmercury Fish Tissue Concentration in 350 mm (average length) Largemouth Bass (ppm)
El Dorado Park Lakes	2.0	0.050	0.051	0.081	0.22
Puddingstone Reservoir	2.0	0.050	0.051	0.081	0.22
Lake Sherwood	2.0	0.050	0.051	0.081	0.22

Note: Shaded cells represent the selected targets for each waterbody.

2.2.9.1 Protection of Human Health

Fish tissue and water column targets for methylmercury and mercury are chosen based on applicable beneficial uses. For waters designated MUN, the Basin Plan lists a water column maximum contaminant level of 0.002 mg/L, or 2 µg/L. The California Toxics Rule (CTR) includes human health criteria for the consumption of water and organisms or organisms only as 0.050 µg/L and 0.051 µg/L, respectively (USEPA, 2000a). California often implements these values on a 30 day average. Because the human health criterion for the consumption of water and organisms is the most restrictive criterion, a water column target of 0.050 µg/L is the appropriate target for waterbodies with the MUN designated use (Puddingstone Reservoir). The human health criterion for the consumption of organisms only (0.051 µg/L) is appropriate for waterbodies without the MUN designated use (El Dorado Park lakes and Lake Sherwood).

The fish contaminant goal for methylmercury defined by the California Office of Environmental Health Hazard Assessment (OEHHA, 2008) is 220 ppb or 0.22 ppm. This concentration is a chronic target designed to protect human health from the cumulative effects of long-term exposure to contaminated fish. It is based on a consumption rate of 8 ounces of fish per week, prior to cooking and is more restrictive than the federal Clean Water Act (CWA) 304(a) guidance criterion for the protection of human health of 0.3 ppm (USEPA, 2001a). The assessment data available for the three mercury impaired lakes report concentrations of total mercury in fish tissue, of which most is in the form of methylmercury. Comparison of the assessment data to the methylmercury fish contaminant goal results in slightly conservative TMDL calculations and is considered part of the implicit margin of safety.

In addition, a water column target for dissolved methylmercury of 0.081 ng/L is applicable for all three mercury-impaired lakes. This value is calculated by dividing the fish contaminant goal (0.22 ppm) with a national bioaccumulation factor (for dissolved methylmercury) of 2,700,000 applicable for trophic level 4 fish (and multiplying by a factor of 10^6 to convert from milligrams to nanograms) (USEPA, 2001a, Appendix A). A bioaccumulation factor or BAF is the ratio of the concentration of a chemical in the water column to the concentration of the chemical in fish tissue and are in units of liters per kilograms (L/kg).

The applicable numeric targets for these TMDLs are the California ambient water quality criterion of 50 ng/L or 51 ng/L total mercury in the water column, the calculated dissolved methylmercury water column concentration of 0.081 ng/L, and the OEHHA fish contaminant goal of 0.22 ppm methylmercury in fish tissue. As it is primarily methylmercury that accumulates in fish, the 0.22 ppm target may be applied to the total mercury concentration in the edible portion of fish. Total mercury concentrations in edible fish from each lake exceed the contaminant goal. Fish in each lake accumulate unacceptable tissue concentrations of mercury even though the ambient water column criterion appears to be met. The most restrictive target is the fish contaminant goal of 0.22 ppm methylmercury, and is selected as the primary numeric target for calculating these TMDLs.

Mercury bioaccumulates in the food chain, which means larger fish that consume smaller fish have higher concentrations. Within a lake fish community, top predators usually have higher mercury concentrations than forage fish, and size and tissue concentrations generally increase with age. Top predator fish (such as bass) are often target species for sport fishermen. Risks to human health from the consumption of mercury-contaminated fish are based on long-term, cumulative effects, rather than concentrations in individual fish. Therefore, the target is not applied to the extreme case of the most-contaminated fish within a target species; instead, the target is applied to average concentrations in a top predator species of a size likely to be caught and consumed.

Within each of the mercury-impaired lakes, the top predator sport fish, and also the fish with the highest reported tissue methylmercury body burden, is largemouth bass (*Micropterus salmoides*). Largemouth bass continue to bioaccumulate mercury with increasing size and age. The California Department of Fish and Game requires that anglers release largemouth bass less than 12 inches (305 mm) in length and that each angler keep no more than five fish per day. The largemouth bass caught for determination of fish tissue contaminant concentrations in these three lakes ranged in size from 200 to 598 mm in length, and exceedances of the fish contaminant goal occurred in largemouth bass ranging in length from 286 to 598 mm (Appendix G, Monitoring Data).

The range of length for assessing compliance with this fish tissue target is 325-375 mm for largemouth bass. However, an average of 350 mm largemouth bass is used for TMDL calculations. This length has been identified by two separate studies as the average length of largemouth bass caught with fishing lines from California lakes (personal communication, Aroon Melwani, San Francisco Estuary Institute (SFEI), to Valentina Cabrera-Stagno, US EPA Region IX, October 22, 2009). Setting the fish tissue target to this length protects human health over the average range of fish caught. Setting the fish tissue target to the minimum length where exceedances have been detected will be less protective of human health because all fish greater than that length may exceed the criterion. Setting the fish tissue target to the maximum length may be overly protective since most fish that are caught will be less than the maximum length.

Error! Reference source not found. above summarizes the applicable targets for the three waterbodies listed for mercury addressed by this document. The shaded cells in this table represent the selected targets for each waterbody. The fish tissue concentration targets are consistent; however, the water column targets differ. Specifically, Puddingstone Reservoir has an MUN designated use; therefore, the human health criterion for the consumption of water and organisms is appropriate (0.50 μg/L), while the target for El Dorado Park lakes and Lake Sherwood is 0.051 μg/L, associated with consumption of organisms only because these lakes do not have an existing MUN designated use so the criterion consistent with the REC-1 beneficial use is selected. The dissolved methylmercury water column target of 0.081 ng/L is applicable for all three lakes.

2.2.9.2 Protection of Wildlife

Wildlife species that eat fish or other aquatic organisms containing mercury are potentially at risk from the toxic effects of mercury. This risk is a function of ecosystem dynamics and understanding the risk requires evaluation of the potential for contaminants to move through an ecosystem via trophic levels. Trophic levels describe the position an organism occupies in the food chain (i.e., what the organism eats and what eats the organism). In a simple example of an aquatic ecosystem, plants (or primary producers) are at the base of the food chain (trophic level 1), followed by primary consumers in trophic level 2 (i.e., herbivorous organisms (fish, snails, macroinvertebrates, etc.)), secondary consumers in trophic level 3 (i.e., invertebrate feeding fish, predatory macroinvertebrates, etc.), and tertiary consumers in trophic level 4 (i.e., fish-eating fish, water snakes, etc.). The top-level consumers are followed by top-level predators, such as eagles, raccoons, and other carnivorous animals. It is important to note that organisms above trophic level 1 (plants) often occupy a number of trophic levels. For example, turtles are considered trophic level 2 when they feed on vegetation, trophic level 3 when they eat herbivorous invertebrates and fish, and trophic level 4 when they feed on predatory fish. Generally, the trophic level for a carnivore is one level higher than the trophic level of the animal it eats.

To evaluate risk associated with the toxic effects of mercury, the fish tissue concentration target of 0.22 ppm methylmercury in largemouth bass (a trophic level 4 fish) of 350 mm in length was analyzed to see whether it is protective of wildlife species (Note: this is the average size largemouth bass caught by humans with fishing lines in California lakes based on a minimum catch size of 305 mm; therefore, 350 mm is considered a large fish because many smaller fish [less than 305 mm] are also part of trophic level 4). The analysis draws on previous studies conducted by US Fish and Wildlife Service (USFWS) to determine safe levels of mercury in fish tissue for wildlife in California and looks at both generic wildlife receptor categories and specific threatened and endangered species found at the mercury-impaired lakes. USFWS recommended that the analysis include the following six receptor categories: fish, small piscivorous birds, large piscivorous birds, insectivorous passerine birds, carnivorous waterfowl, and piscivorous mammals (personal communication, Katie Zeeman, USFWS Carlsbad Office, to Valentina Cabrera-Stagno, USEPA Region IX, October 1, 2009). The target was found to be protective of wildlife, as described below.

In deriving the national CWA 304(a) guidance criterion to protect human health, USEPA developed draft national bioaccumulation factors (BAFs) that describe the bioaccumulation and biomagnifications between trophic levels (USEPA, 2001a). The national BAFs are ratios (in L/kg) which relate the concentration of dissolved methylmercury in the water column to its expected concentration in commonly consumed aquatic organisms in a specified trophic level. In addition, food chain multipliers can be calculated from the national BAFs. Food chain multipliers are the ratio of the BAF for one trophic level to the BAF for the trophic level directly below (for example, the food chain multiplier from trophic level 3 to 4 is the BAF for trophic level 4 divided by the BAF for trophic level 3 (2,700,000/680,000 = 4)). The BAFs and calculated food chain multipliers are shown Table 2-13. Using the food chain multipliers, one can calculate trophic level 3 and 2 concentrations from a trophic level 4 target. The methylmercury concentrations calculated for trophic levels 2 and 3 based on the trophic level 4 target in these TMDLs (0.22 ppm methylmercury) are shown in Table 2-13 (i.e., trophic level 3 concentration is the trophic level 4 target divided by the food chain multiplier from trophic level 3 to 4 (0.22 ppm/4 = 0.055 ppm)). The target in trophic level 4 is set for a large sized fish and is lower for the trophic level as a whole. Using this number to estimate trophic level 3 and 2 concentrations is highly conservative and leads to overestimates of the trophic level 3 and 2 concentrations.

Table 2-13. National Bioaccumulation Factors (BAFs) and Food Chain Multipliers

Bioaccumulation Factors and Food Chain Multipliers	Value
Draft National BAF for Trophic Level 4	2,700,000 L/kg
Draft National BAF for Trophic Level 3	680,000 L/kg
Draft National BAF for Trophic Level 2	120,000 L/kg
Food chain multiplier from trophic level 3 to 4 biota	4
Food chain multiplier from trophic level 2 to 3 biota	5.7

Table 2-14. Trophic Level Concentrations

Trophic Level	Methylmercury Fish Tissue Concentration (ppm wet weight)
Trophic Level 4 target concentration*	0.22
Calculated corresponding trophic level 3 concentration	0.055
Calculated corresponding trophic level 2 concentration	0.0096

*Note: The TMDL target is actually set for a large sized fish (350 mm) not for the trophic level as a whole. The trophic level concentration as a whole is lower and consequently the trophic level 3 and 2 levels will be lower than the values presented above.

2.2.9.2.1 Generic Wildlife Receptor Category Analysis

2.2.9.2.1.1 Fish

When USFWS evaluated the USEPA national CWA 304(a) human health 0.3 ppm methylmercury criterion, it found that threatened and endangered fish species in California were not likely to be adversely affected (USFWS, 2003). Since the USEPA criterion is higher than the selected target (0.22 ppm methylmercury fish tissue guideline (OEHHA, 2008)), these TMDLs are protective of threatened and endangered freshwater fish species, and thus, in general protective of any freshwater fish species, that may be living in the mercury-impaired lakes.

2.2.9.2.1.2 Small Piscivorous Birds

The Belted Kingfisher is a small piscivorous bird that has been previously evaluated by USFWS for a safe level of mercury. In the analysis of the numeric wildlife targets for the Guadalupe River Watershed TMDL, USFWS found that concentrations of 0.05 ppm methylmercury in 50-150 mm trophic level 3 fish would be protective of the Belted Kingfisher (USFWS, 2005). The fish tissue target in these TMDLs is expected to be as protective as those found necessary in the Guadalupe River Watershed TMDL analysis, for fish in the same size range and trophic level.

2.2.9.2.1.3 Large Piscivorous Birds

The Bald Eagle is a large piscivorous bird that has been sighted (albeit rarely) at these mercury-impaired lakes. When USFWS evaluated the USEPA national CWA 304(a) human health 0.3 ppm methylmercury criterion, it found that a target of 0.3 ppm methylmercury in trophic level 4 fish would be protective of bald eagles (USFWS, 2003). The target for these TMDLs (0.22 ppm methylmercury fish contaminant goal (OEHHA, 2008)) is lower than the CWA 304(a) human health criterion and is therefore considered protective of large piscivorous birds.

2.2.9.2.1.4 Insectivorous Passerine Birds

No studies on fish tissue mercury concentration impacts to insectivorous passerine bird species were readily available, so this endpoint was not assessed. The level of mercury anticipated to be in trophic level two species is very low (0.0096 ppm wet weight; Table 2-13.) and it is not expected to be a concern for insect-eating birds.

2.2.9.2.1.5 Carnivorous Waterfowl

The Common Merganser is a carnivorous waterfowl that has been evaluated in previous USFWS studies for a safe level of mercury. In the evaluation of numeric wildlife targets for the Guadalupe River Watershed TMDL, USFWS found that concentrations of 0.1 ppm methylmercury in 150-350 mm trophic level 3 fish would be protective of the Common Merganser (USFWS, 2005). The level anticipated in these TMDLs for trophic level 3 fish (0.055 ppm; Table 2-13.) is about half of that number and is therefore protective of the Common Merganser and other carnivorous waterfowl.

2.2.9.2.1.6 Piscivorous Mammals

Mink is a piscivorous mammal species that has been evaluated previously. USFWS previously evaluated mink. In its analysis of numeric wildlife targets for the Cache Creek and Sacramento-San Joaquin Delta Watersheds TMDL, USFWS found that concentrations of 0.077 ppm methylmercury in trophic level 3 fish smaller than 150 mm would be protective of mink (USFWS, 2004). The methylmercury level anticipated in these TMDLs for trophic level 3 fish (0.055 ppm; Table 2-13.) is well below that number and is therefore protective of piscivorous mammals.

2.2.9.2.2 Specific Threatened and Endangered Species Analysis

Threatened and endangered species are considered separately for Lake Sherwood, Puddingstone Reservoir, and El Dorado Park lakes. Species lists were requested from USFWS for each of the mercury-impaired lakes. Audubon Society bird lists and the California Department of Fish and Game's California Natural Diversity Database were also consulted.

2.2.9.2.2.1 Lake Sherwood

The USFWS Ventura Office indicated that the only federally listed or candidate species that may occur in proximity to Lake Sherwood is the endangered plant *Pentachaeta lyonii* (Lyon's pentachaeta) (Dellith, 2009). Additionally, a bird list provided by lake resident Mary Hansen did not include any federally listed or candidate species (personal communication, Mary Hansen to Valentina Cabrera-Stagno, USEPA Region IX, September 7, 2010). Plants will not be impacted by this fish tissue target.

2.2.9.2.2.2 Puddingstone Reservoir

The USFWS Carlsbad Office indicated that the federally threatened fish species Santa Ana sucker (*Catostomus santaanae*) may exist in San Dimas Creek and feed in Puddingstone Reservoir. As explained in the generic wildlife receptor category analysis above (Section 2.2.9.2.1.1), fish species are not anticipated to be adversely affected by the proposed mercury target. In addition, the federally threatened coastal California Gnatcatcher (*Polioptila californica californica*) occupies habitat surrounding the reservoir and feeds on insects that could be affected by water quality (personal communication, Christine Medak, USFWS Carlsbad Office, to Valentina Cabrera-Stagno, USEPA Region IX, November 24, 2009). The coastal California Gnatcatcher has not been specifically analyzed. Of the species that USFWS has analyzed previously, its life history is most similar to California Clapper Rail another invertivore. When USFWS evaluated the USEPA CWA 304(a) human health 0.3 ppm methylmercury criterion, it found that a target of 0.3 ppm methylmercury in trophic level 4 fish would be protective of California Clapper Rail (USFWS, 2003). The target for these TMDLs (0.22 ppm methylmercury fish tissue guideline (OEHHA, 2008)) is lower than the CWA 304(a) criterion and is therefore considered to be protective of California Clapper Rail and likely of the coastal California Gnatcatcher.

2.2.9.2.2.3 El Dorado Park Lakes

The USFWS Carlsbad Office did not respond to a request for species of concern at El Dorado Park lakes. The California Department of Fish and Game's California Natural Diversity Database (accessed on August 21, 2009) indicated the California Least Tern (*Sterna antillarum Browni*) may be the only rare or endangered avian species living in the area of the lakes. The Least Tern is also identified on the El Dorado Audubon Society's bird list as occasionally present in the summer (El Dorado Audubon Society, 2003). Fortunately, the California Least Tern was evaluated by USFWS in their 2003 evaluation of the USEPA CWA 304(a) human health 0.3 ppm methylmercury criterion. USFWS found that safe dietary levels for California Least Tern would be 0.005 ppm methylmercury wet weight for trophic level 2 fish, 0.03 ppm for trophic level 3 fish, and 0.12 ppm for trophic level 4 fish (USFWS, 2003). At first glance the trophic level 4 dietary value for California Least Tern looks lower than the chosen target of 0.22 ppm; however, terns are small birds that feed on small fish. The NatureServe Explorer online encyclopedia (accessed on November 24, 2009) indicates that this bird is both insectivorous and piscivorous and feeds on small fish generally less than 9 cm in length such as anchovy, topsmelt, surf-perch, killifish, and mosquitofish (NatureServe, 2009). No data exist for current concentrations of mercury in trophic level 4 fish in such a small size range (less than 90 mm) because the minimum fish size for the 2007 lakes survey was 200 mm. However, analyses have shown that fish size and mercury concentration generally have a linear relationship (Appendix C, Mercury TMDL Development), so smaller size fish will have lower mercury concentrations. Table 2-15 lists the concentration of mercury in all fish tissue samples less 250 mm in length at El Dorado Park lakes. Only total mercury was analyzed so the corresponding methylmercury concentrations will be slightly lower.

Table 2-15. El Dorado Park Lakes Fish Tissue Concentrations for Fish <250 mm in Length

Fish Length (mm)	Total Mercury Concentration (ppm wet weight)
206	0.15
219	0.13

As indicated in this table, existing concentrations for fish more than twice the size of the 90 mm California Least Tern's maximum prey size are close to the 0.12 ppm methylmercury safe level indentified by USFWS. Fish that are 90 mm in length or shorter are likely already meeting this target at El Dorado Park lakes. Additionally, the target for 350 mm trophic level 4 fish in these TMDLs will reduce mercury levels in all size classes. This will lead to even lower concentrations in these small size class fish. USFWS found that safe dietary levels for California Least Tern would be 0.005 ppm methylmercury wet weight for trophic level 2 fish and 0.03 ppm for trophic level 3 fish (USFWS, 2003). As described above, given that the trophic level 4 fish target is likely already being met at El Dorado Park lakes, it is likely that trophic levels 2 and 3 fish targets for tern are also being met in the small size class that California Least Tern prey upon.

2.2.10 PCBs

Polychlorinated biphenyls (PCBs) consist of a family of many related congeners. The individual congeners are often referred to by their "BZ" number. Environmental analyses may address individual congeners, homologs (groups of congeners with the same number of chlorine atoms), equivalent concentrations of the commercial mixtures of PCBs known as Aroclors, or total PCBs. The environmental measurements and targets described in this document are in terms of total PCBs, defined as the "sum of all congener or isomer or homolog or aroclor analyses" (CTR, 40 CFR 131.38(b)(1) footnote v).

Selections of applicable OC Pesticides and PCBs targets are described above in Section 2.2.2.1 through Section 2.2.2.3. Water column targets for PCBs are based on beneficial use (Section 2.2.2.1). For waters designated MUN, the Basin Plan lists a maximum contaminant level of 0.0005 mg/L, or 500 ng/L. The Plan also requires that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). This objective is addressed through the CTR water quality criteria.

A chronic criterion for the sum of PCB compounds in freshwater systems is included in the CTR as 0.014 µg/L (14 ng/L; USEPA, 2000a). The CTR also provides a human health criterion for the consumption of both water and organisms and organisms only of 0.00017 µg/L (0.17 ng/L). California often implements these values on a 30 day average. The human health criterion is the most restrictive of the criterion specified for water column concentrations and was selected as the target concentration for Echo Park Lake, Peck Road Park Lake, and Puddingstone Reservoir. CTR criteria are considered protective of aquatic life.

Two target sediment concentrations for total PCBs have been identified (Section 2.2.2.2). There are no Basin Plan Objectives for toxicity levels in sediment; however sediment quality guidelines are reported by multiple agencies for the protection of sediment biota. MacDonald et al. (2000) compiled and evaluated the guidelines and derived consensus-based sediment quality guidelines that incorporate multiple recommendations. The consensus-based TEC for total PCBs is 59.8 µg/kg dry weight, defined by CBSQG (MacDonald el al., 2000). The consensus-based guidelines have been incorporated into the most recent set of NOAA Screening Quick Reference Tables (SQuiRT) (Buchman, 2008) and are recommended by the State Water Resources Control Board for interpretation of narrative sediment objectives under the 303(d) listing policy. An additional sediment target based on bioaccumulation in fish was also calculated for each impaired lake to ensure that the FCG is met using the BSAF approach described in Section 2.2.2.2.2. The lower of the two sediment target values is applied in each lake. Additionally, these TMDLs include alternative wasteload allocations to be applied when a sufficient demonstration has been made that the fish tissue targets are met. These targets are based on the consensus-based TEC values. Details on when each set of targets apply are included in the wasteload allocation section of each relevant lake chapter.

Fish tissue targets are described above in Section 2.2.2.3. The fish contaminant goal for PCBs defined by the OEHHA (2008) is 3.6 ppb based on cancer risk (the FCG based on non-cancer risk is 63 ppb). Table 2-16 summarizes the applicable targets for the three waterbodies listed for total PCBs addressed by this document.

Table 2-16. Total PCB Targets

Lake	Maximum Contaminant Level (ng/L)	Chronic Criterion[1] (ng/L)	Human Health Criterion[2] (ng/L)	Consensus-based TEC Sediment Target (µg/kg)[3]	BSAF-derived Sediment Target (µg/kg)	Fish Contaminant Goal (ppb)
Echo Park Lake	500	14	0.17	59.8	1.77	3.6
Peck Road Park Lake	500	14	0.17	59.8	1.29	3.6
Puddingstone Reservoir	500	14	0.17	59.8	0.59	3.6

Note: Shaded cells represent the selected targets for each waterbody.

[1]The chronic criterion is the highest four day average not to be exceeded more than once every three years on the average.

[2]The human health criterion applies to both consumption of water and organisms and organisms only.

[3]The consensus-based TEC sediment target value was used for setting alternative wasteload allocations when sufficient demonstration that the fish tissue targets are met has been made. Details on when each set of targets apply are included in the wasteload allocation sections of each relevant lake chapter.

2.2.11 pH

As specified in the Basin Plan, lake waters must not be depressed below 6.5 or raised above 8.5 as a result of waste discharges or be changed by more than 0.5 units from the natural conditions as a result of waste discharges. These serve as the numeric targets for pH in these TMDLs.

Lakes listed as impaired by pH include Echo Park Lake, Lake Calabasas, El Dorado Park lakes, Legg Lake, and Santa Fe Dam Park Lake. Target depths for each lake were set by the Regional Board and USEPA based on site specific conditions. Shallow, well mixed lakes must meet the target in the water column from the surface to 0.3 meters above the bottom of the lake. Deeper lakes that thermally stratify during the summer months, such as Peck Road Park Lake and Puddingstone Reservoir, must meet the pH target throughout the epilimnion of the water column.

The epilimnion is the upper stratum of more or less uniformly warm, circulating, and fairly turbulent water during summer stratification. The epilimnion floats above a cold relatively undisturbed region called the hypolimnion. The stratum between the two is the metalimnion and is characterized by a thermocline, which refers to the plane of maximum rate of decrease of temperature with respect to depth.

For the purposes of these TMDLs, the presence of stratification will be defined by whether there is a change in lake temperature greater than 1 degree Celsius per meter. Deep lakes must meet the pH target in the water column from the surface to 0.3 meters above the bottom of the lake when the lake is not stratified. However, when stratification occurs (i.e., a thermocline is present) then the pH target must be met in the epilimnion, the portion of the water column above the thermocline.

2.2.12 Trash

The target for trash is "zero trash." Lakes listed as impaired by trash include Echo Park Lake, Peck Road Park Lake, Lincoln Park Lake, and Legg Lake. Legg Lake has an existing TMDL for trash, the remaining three lakes are addressed in this document.

2.3 Basis for Listing

The Los Angeles Regional Board provided the basis for listing each of the 10 lakes addressed in this document on the State's 303(d) list in its *Water Quality Assessment & Documentation Report* (LARWQCB, 1996). Waterbody-pollutant combinations found to be either not supporting or partially supporting a beneficial use were identified as impairments on the 303(d) list. Impairments in the *Water Quality Assessment & Documentation Report* (LARWQCB, 1996) are described relative to the USEPA 305(b) beneficial uses, which are broad federal beneficial use categories described under the federal guidance for 305(b) reporting. For consistency with the state of California beneficial use categories, the California beneficial uses for the waterbodies addressed in this document are related to federal beneficial uses as shown in Table 2-17. The California use "NAV" was not assessed in the report (LARWQCB, 1996). It should be noted that the water quality standards or assessment methodology used in the 1996 assessment report are often not the same as current standards used to confirm impairments and calculate TMDLs in this report. Current standards and targets selected in these TMDLs are summarized in Section 2.2 and included in specific lake chapters. Regional Board currently follows California's Impaired Waters Guidance (SWRCB, 2005) in making 303(d) listing and delisting decisions (SWRCB, 2005). One of the major differences between the assessment methodology employed in developing the 1996 *Water Quality Assessment & Documentation Report* and current practice is that the partially supporting category no longer exists.

Table 2-17. Linkage Between California and Federal Beneficial Uses

Federal Beneficial Use	California Beneficial Use Code
Aquatic Life	WARM, WILD, WET, COLD, RARE
Primary Contact Recreation	REC1
Secondary Contact Recreation	REC2
Drinking Water Supply	MUN, GWR (where appropriate)
Agriculture	AGR, GWR (where appropriate)
Fish Consumption	REC1

This section summarizes the listing information by impairment. In some cases, more recent data may have resulted in additional impairments included on the 2008-2010 303(d) list (SWRCB, 2010) or identification of new impairments not currently on the 303(d) list. Data collected after the original listing are not included in this section, but are discussed in lake-specific sections of the report and are included in the summary in Table 2-31.

2.3.1 Algae

According to the *Water Quality Assessment & Documentation Report*, a waterbody was listed as impaired by algae if field observations indicated excessive growth impacting the primary or secondary contact recreation use (LARWQCB, 1996). Visual observations of algae were classified either as "none" or "significant amount observed." Waterbodies were considered "not supporting" these uses if field observations indicated impairment in more than 25 percent of observations. Waterbodies were considered "partially supporting" if field observations indicated impairment in 11 to 25 percent of observations. "Fully supporting" waterbodies had indications of impairment in less than 11 percent of observations. Lake assessments were completed during the University of California, Riverside urban lakes study (UC Riverside, 1994).

Two of the lakes addressed by this document were listed for impairment due to algae (Table 2-18). Both are listed as "not supporting" the primary and secondary contact recreation uses.

Table 2-18. Listing Information for Lakes Impaired by Algae

Lake	Use: Support Status
Echo Park Lake	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting
El Dorado Park Lakes	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting

2.3.2 Ammonia

Ammonia impairments in these lakes were based on the support status for aquatic life use, primary recreation, and secondary recreation (LARWQCB, 1996). Lakes classified as "not supporting" the aquatic life use were found to exceed the temperature/pH-based ammonia criteria in more than 10 percent of samples. Those classified as "partially supporting" exceeded criteria more than twice within a 6-year period, but in fewer than 10 percent of samples. A status of "fully supporting" resulted from no more than two violations of chronic criteria (acute criteria if no chronic criteria were available) within a 6-year period based on at least 20 grab or 1-day composite samples; if fewer than 20 samples were available, then best professional judgment was used considering the number of pollutants having violations and the magnitudes of the exceedance(s).

Lakes classified as not supporting the primary or secondary contact recreation use due to ammonia exceeded the taste and odor criterion of 0.037 mg/L in more than 25 percent of measurements. Partially supporting lakes exceeded the criterion in 11 to 25 percent of samples, and fully supporting lakes exceeded the criterion in less than 11 percent of samples.

Table 2-19 summarizes the federal beneficial uses and support status of the lakes impaired by ammonia. Summary statistics reported in the assessment report (LARWQCB, 1996) are also included. A value of "ND" indicates the sample concentration was non detect. The symbol "#" denotes that no standard deviation has been calculated because there was not a normal distribution or because there were less than three samples.

Table 2-19. Listing Information for Lakes Impaired by Ammonia

Lake	Use: Support Status	Number of Samples, Range (mg/L), Average ± Standard Deviation (mg/L)
Lincoln Park Lake	Aquatic Life: Not Supporting Primary Contact Recreation: Not Supporting	28, ND - 1.14, 0.34 ± 0.32
Echo Park Lake	Aquatic Life: Not Supporting Primary Contact Recreation: Not Supporting	31, ND - 0.71, 0.11#
Lake Calabasas	Aquatic Life: Not Supporting Primary Contact Recreation: Not Supporting	28, ND - 0.45, 0.06#
El Dorado Park Lakes	Aquatic Life: Not Supporting Primary Contact Recreation: Not Supporting	45, ND - 1.92, 0.30#
Legg Lakes	Aquatic Life: Partially Supporting	43, ND - 0.35, 0.05#

2.3.3 Chlordane

Chlordane impairments were assessed for both the aquatic life use and the fish consumption use against the Maximum Tissue Residue Level (MTRL) of 1.1 ppb (LARWQCB, 1996). MTRLs were established for fish filet samples by multiplying the human health water quality criteria in the CTR and the bioconcentration factor (BCF) for each substance. Waters with a support status of “not supporting” the fish consumption use were supposedly under a “no consumption” ban for fish and shellfish. Each water was also listed as “not supporting” the aquatic life use, indicating impairment of at least one assemblage of the biological community.

Fish tissue monitoring was conducted as part of the Toxic Substances Monitoring Program (TSMP). Summary data in the assessment report included the sample type, the year of sample collection, and the criterion exceeded by the sample (Table 2-20). Chlordane fish tissue samples were comprised of seven-fish composites for Peck Road Park Lake and six-fish composites for Puddingstone Reservoir. Samples from Peck Road Park Lake exceeded the MTRL in 1991 (14.1 ppb); samples from Puddingstone exceeded the MTRL in both 1991 (16.1 ppb) and 1992 (31.7 ppb).

Table 2-20. Listing Information for Lakes Impaired by Chlordane

Lake/Reservoir	Use: Support Status	Sample Type (Year): Impairment (Criterion)
Peck Road Park Lake	Aquatic Life: Not Supporting Fish Consumption: Not Supporting	Tissue ('91): chlordane (MTRLs) Tissue ('92): No organic chemicals at elevated levels
Puddingstone Reservoir	Aquatic Life: Not Supporting Fish Consumption: Not Supporting	Tissue ('91): chlordane (MTRLs) Tissue ('92): chlordane (MTRLs)

2.3.4 Copper

Copper impairments were assessed in relation to the aquatic life use. The criterion was based on a four-day average total recoverable copper concentration calculated from the following equation, which was based on USEPA National Ambient Water Quality Criteria published in 1986:

$$TotalCopper(\mu g / L) = \exp^{\{0.8545[\ln(hardness)]-1.465\}} \qquad \textbf{Equation 2-9}$$

Four lakes addressed by this document were classified as “not supporting” the aquatic life use, indicating the criterion was exceeded in more than 10 percent of samples. The summary table provided in the *Water*

Quality Assessment & Documentation Report lists the maximum total recoverable copper concentration observed at each lake; corresponding hardness values were not provided (Table 2-21) (LARWQCB, 1996).

Table 2-21. Listing Information for Lakes Impaired by Copper

Lake	Use: Support Status	Maximum Concentration of Total Recoverable Copper (µg/L)
Echo Park Lake	Aquatic Life: Not Supporting	105
El Dorado Park Lakes	Aquatic Life: Not Supporting	99
Legg Lakes	Aquatic Life: Not Supporting	97
Santa Fe Dam Park Lake	Aquatic Life: Not Supporting	56

2.3.5 Dieldrin

Dieldrin impairments were not identified in the assessment report (LARWQCB, 1996), but were subsequently observed after sample collection and analyses. These impairments and analyses are discussed in greater detail in the Peck Road Park Lake, Echo Park Lake, and Puddingstone Reservoir sections.

2.3.6 Dissolved Oxygen

Dissolved oxygen impairments were assessed relative to the aquatic life use. A support status of "not supporting" was assigned to waterbodies where more than 25 percent of measurements exceeded the criteria; "partially supporting" waterbodies had exceedances observed in 11 to 25 percent of measurements.

Table 2-22 summarizes the beneficial uses and support status of the lakes impaired by dissolved oxygen. Summary statistics reported in the assessment report (LARWQCB, 1996) are also included.

Table 2-22. Listing Information for Lakes Impaired by Low Dissolved Oxygen

Lake/Reservoir	Use: Support Status	Number of Samples, Range (mg/L), Average ± Standard Deviation (mg/L)
Peck Road Park Lake	Aquatic Life: Not Supporting	195, 0.2 – 15.2, 6.0 ± 4.0
Lincoln Park Lake	Aquatic Life: Partially Supporting	78, 0.1 - 13.7, 6.9 ± 3.3
Lake Calabasas	Aquatic Life: Partially Supporting	92, 0.2-15.7, 8.7 ± 3.3
Puddingstone Reservoir	Aquatic Life: Not Supporting	187, 0.1-14.9, 4.3 ± 3.5

2.3.7 DDT

DDT impairments were assessed for both the aquatic life use and the fish consumption use against the MTRL for DDT (32 ppb) (LARWQCB, 1996). Waters with a support status of "not supporting" the fish consumption use were supposedly under a "no consumption" ban for fish and shellfish. Each water was also listed as “not supporting” the aquatic life use, indicating impairment of at least one biological community assemblage.

Fish tissue monitoring was conducted as part of the TSMP. Summary data in the assessment report included the sample type, the year of sample collection, and the criterion exceeded by the sample (Table 2-23). The DDT seven-fish composite tissue sample from Peck Road Park Lake exceeded the MTRL in 1991 with a concentration of 39 ppb; the six-fish composite sample from Puddingstone exceeded the MTRL in 1992 (36 ppb).

Table 2-23. Listing Information for Lakes Impaired by DDT

Lake/Reservoir	Use: Support Status	Sample Type (Year): Impairment (Criterion)
Peck Road Park Lake	Aquatic Life: Not Supporting Fish Consumption: Not Supporting	Tissue ('91): DDT (MTRLs) Tissue ('92): No organic chemicals at elevated levels
Puddingstone Reservoir	Aquatic Life: Not Supporting Fish Consumption: Not Supporting	Tissue ('91): DDT not at elevated levels Tissue ('92): DDT (MTRLs)

2.3.8 Eutrophication

The eutrophication impairment was based on an assessment of the aquatic life use. An assessment of “fully supporting” indicated functioning, sustainable biological communities (e.g., macroinvertebrates, fish, or algae) none of which had been modified significantly beyond the natural range of the reference condition. “Partially supporting” waterbodies had at least one assemblage that indicated less than full support with slight to moderate modification of the biological community noted. Waterbodies listed as “not supporting” had at least one assemblage indicating nonsupport with data clearly indicating severe modification of the biological community (LARWQCB, 1996).

Further information regarding the eutrophication impairment was not specified in the *Water Quality Assessment & Documentation Report*. Four lakes addressed by this document were considered impaired by eutrophication (Table 2-24).

Table 2-24. Listing Information for Lakes Impaired by Eutrophication

Lake	Use: Support Status
Lincoln Park Lake	Aquatic Life: Not Supporting
Echo Park Lake	Aquatic Life: Not Supporting
Lake Calabasas	Aquatic Life: Not Supporting
El Dorado Park Lakes	Aquatic Life: Not Supporting

2.3.9 Lead

Lead impairments were assessed in relation to the aquatic life use. The criterion was based on a four-day average total recoverable lead concentration calculated from the following equation, which was based on USEPA National Ambient Water Quality Criteria published in 1986:

$$TotalLead(\mu g/L) = \exp^{\{1.273[\ln(hardness)]-4.705\}} \quad \textbf{Equation 2-10}$$

Seven lakes addressed by this document were classified as “not supporting” the aquatic life use, indicating the criterion was exceeded in more than 10 percent of samples. The summary table provided in the *Water Quality Assessment & Documentation Report*, lists the maximum total recoverable lead concentration observed at each lake; corresponding hardness values were not provided (Table 2-25) (LARWQCB, 1996).

Table 2-25. Listing Information for Lakes Impaired by Lead

Lake	Use: Support Status	Maximum Concentration of Total Recoverable Lead (µg/L)
Peck Road Park Lake	Aquatic Life: Not Supporting	73
Lincoln Park Lake	Aquatic Life: Not Supporting	94
Echo Park Lake	Aquatic Life: Not Supporting	105
El Dorado Park Lakes	Aquatic Life: Not Supporting	108
Legg Lakes	Aquatic Life: Not Supporting	70
Santa Fe Dam Park Lake	Aquatic Life: Not Supporting	51
Westlake Lake	Aquatic Life: Not Supporting	91

2.3.10 Mercury

Mercury impairments were assessed for the aquatic life use and fish consumption use. Three waterbodies were listed as “not supporting” the aquatic life use due to mercury impairment, indicating the criterion was exceeded in more than 10 percent of samples. Summary data for water column measurements were not provided in the assessment report.

Three criteria were used to assess the fish consumption use. The *Water Quality Assessment & Documentation Report* lists a Food and Drug Administration (FDA) action level for freshwater and marine fish of 1,000 ppb (1 ppm), a MTRL for inland surface waters of 1,000 ppb (1 ppm), and a range of Median International Standards (MIS) for freshwater fish and marine shellfish of 100 to 1,000 ppb (0.1 to 1 ppm) (LARWQCB, 1996). Three of the waterbodies addressed by this document were found “not supporting” the fish consumption use, indicating that a “no consumption” ban for fish or shellfish is in effect for the general population, or a subpopulation that could be at potentially greater risk, for one or more fish or shellfish species; or a commercial fishing or shellfishing ban is in effect.

Waterbodies designated MUN were also assessed for drinking water use against a criterion of 2 µg/L of total mercury. Each waterbody was found “fully supporting” this use, indicating that the median value of total mercury concentrations was less than the criterion.

Table 2-26 summarizes the listing information for the lakes addressed by this document that are impaired by mercury.

Table 2-26. Listing Information for Lakes Impaired by Mercury

Lake/Reservoir	Use: Support Status	Sample Type (Year): Impairment (Criterion)
El Dorado Park Lake	Aquatic Life: Not Supporting	NA
Puddingstone Reservoir	Aquatic Life: Not Supporting Fish Consumption: Not Supporting	Tissue ('91): mercury (MIS)
Lake Sherwood	Aquatic Life: Not Supporting Fish Consumption: Not Supporting	Tissue ('91): mercury (MIS) Tissue ('92): mercury (MTRLs,FDA)

NA: Information not included for this waterbody.

2.3.11 Odor

The *Water Quality Assessment & Documentation Report* (LARWQCB, 1996) says that the odor impairments were based on observations recorded during the University of California, Riverside urban lakes study (UC Riverside, 1994). Waterbodies listed as “not supporting” either recreational beneficial use noted the “presence” of odor in more than 25 percent of observations.

Table 2-27 summarizes the support status for the lakes addressed by this document that are listed as impaired by odor. The University of California, Riverside urban lakes study (UC Riverside, 1994) described odors at each of these lakes as either fishy or related to ducks.

Table 2-27. Listing Information for Lakes Impaired by Odor

Lake	Use: Support Status	Odor Description (UC Riverside, 1994)
Peck Road Park Lake	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting	Fishy
Lincoln Park Lake	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting	Ducks
Echo Park Lake	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting	Duck feces
Lake Calabasas	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting	Ducks
Legg Lakes	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting	Ducks

2.3.12 PCBs

PCB impairments were assessed for both the aquatic life use and the fish consumption use against the MTRL of 2.2 ppb (LARWQCB, 1996). Waters with a support status of “not supporting” the fish consumption use were supposedly under a “no consumption” ban for fish and shellfish. Each water was also listed as “not supporting” the aquatic life use, indicating impairment of at least one biological community assemblage.

Fish tissue monitoring was conducted as part of the TSMP. Summary data in the assessment report included the sample type, the year of sample collection, and the criterion exceeded by the sample (Table 2-28). PCB fish tissue composite samples were comprised of three fish at each of the waterbodies impaired by PCBs addressed by this document. Samples collected at Puddingstone Reservoir exceeded the MTRL in both 1991 and 1992. Samples collected at Echo Park Lake exceeded the MTRLs in 1987 and 1992. The 1991 composite sample from Echo Park Lake did not have detectable levels of PCBs.

Table 2-28. Listing Information for Lakes Impaired by PCBs

Lake/Reservoir	Use: Support Status	Sample Type (Year): Impairment (Criterion)
Echo Park Lake	Aquatic Life: Not Supporting Fish Consumption: Not Supporting	Tissue ('91): No PCBs detected Tissue ('92): PCBs (MTRLs)
Puddingstone Reservoir	Aquatic Life: Not Supporting Fish Consumption: Not Supporting	Tissue ('91): PCBs (MTRLs) Tissue ('92): PCBs (MTRLs)

2.3.13 pH

In the 1996 *Water Quality Assessment & Documentation Report*, the criterion for assessing the aquatic life use with respect to pH was a range of 6.5 to 9.0 (LARWQCB, 1996). Five waterbodies addressed by this document were listed as "partially supporting" the aquatic life use, indicating that pH measurements were out of the allowable range in 11 to 25 percent of measurements. This report also presented a criterion for assessing the primary contact recreation use based on secondary MCLs for drinking water (ranging from pH of 6.5 to 8.5). Three of the five waterbodies were listed as "not supporting" this use, indicating that more than 25 percent of measurements were outside the allowable range. Three waterbodies were also listed as "not supporting" the drinking water use based on secondary MCL criteria. Table 2-29 summarizes the listing information for the five lakes addressed by this document that were impaired by pH.

Table 2-29. Listing Information for Lakes Impaired by pH

Lake	Use: Support Status	Number of Samples, Range (mg/L), Average ± Standard Deviation (mg/L)
Echo Park Lake	Aquatic Life: Partially Supporting Primary Contact Recreation: Not Supporting	69, 7.0-9.4, 8.5 ± 0.5
Lake Calabasas	Aquatic Life: Partially Supporting Drinking Water: Not Supporting	85, 7.4-9.3, 8.6 ± 0.4
El Dorado Park Lakes	Aquatic Life: Partially Supporting Primary Contact Recreation: Not Supporting	116, 6.9-9.4, 8.5 ± 0.6
Legg Lakes	Aquatic Life: Partially Supporting Drinking Water: Not Supporting	84, 7.6-8.9, 8.3 ± 0.3
Santa Fe Dam Park Lake	Aquatic Life: Partially Supporting Primary Contact Recreation: Not Supporting Drinking Water: Not Supporting	95, 7.5-9.6, 8.7 ± 0.3

2.3.14 Trash

Trash impairments were assessed for the primary and secondary contact recreation uses. Four lakes addressed by this document were listed as "not supporting" both recreation uses (Table 2-30), indicating that the presence of trash was observed during at least 25 percent of field observations (LARWQCB, 1996). The Regional Board has adopted a TMDL for trash for Legg Lake (LARWQCB, 2007).

Table 2-30. Listing Information for Lakes Impaired by Trash

Lake	Use: Support Status
Peck Road Park Lake	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting
Lincoln Park Lake	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting
Echo Park Lake	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting
Legg Lakes	Primary Contact Recreation: Not Supporting Secondary Contact Recreation: Not Supporting

2.4 SUMMARY OF IMPAIRMENTS

This TMDL document addresses impairments for 10 lakes in the Los Angeles Region. Table 2-31 identifies the waterbody-pollutant combinations addressed by this document. Table 2-31 also identifies for each lake: the impairments governed by the consent decree entered in Heal the Bay Inc. v. Browner; impairments addressed by a previous TMDL; and impairments listed in a prior 303(d) list but not listed on the current 303(d) list. Table 2-31 also identifies five impairments (Peck Road Park Lake, for dieldrin and PCBs; Echo Park Lake, for chlordane and dieldrin; and Puddingstone Reservoir for dieldrin) which are not on the current 303(d) list but which, after consideration of more recent data, USEPA has determined to address by this TMDL document. Further, Table 2-31 identifies 15 listings on the current 303(d) list which, after consideration of more recent data, USEPA believes no longer meet the Federal requirements for listing; USEPA is recommending that those listings be omitted from the next 303(d) list.

Table 2-31. Waterbody-pollutant Combinations for Ten Los Angeles Region Lakes

Lake/ Reservoir	Algae	Ammonia	Chlordane	Copper	DDT	Dieldrin	Eutrophication	Lead	Organic Enrichment / Low Dissolved Oxygen	Mercury	Odor	PCBs	pH	Trash
Peck Road Park Lake			●		●	○	● /	● /	◑		●	○		●
Lincoln Park Lake		●					●	● /	◑		●			●
Echo Park Lake	●	● /	○	● /		○	●	● /			◑	●	● /	●
Lake Calabasas		●			● /		●		◑		●		●	
El Dorado Park Lakes	●	●		● \			●	● /		●			●	
Legg Lakes		● /		● /				● /			●		●	◑ \
Puddingstone Reservoir			●		●	○			●	●		●		
Santa Fe Dam Park Lake				● /				● /					● /	
Lake Sherwood	● \	● \					● \		● \	●				
Westlake Lake	● \	● \		● /			● \	● /	● \					

● Impairment included in the consent decree.

◑ Impairment listed since the consent decree and included in the 2008-2010 303(d) list.

○ Impairment identified by new data analyses (after the 2008-2010 303(d) list data cutoff).

/ Impairment is no longer identified as impaired and not included on the 303(d) list.

\ Impairment is addressed by another TMDL.

/ No longer showing impairment in recent data analyses (see lake-specific chapters); USEPA recommends these impairments not be included in California's next 303(d) list.

3 Summary of Approach

The United States Environmental Protection Agency (USEPA) Region IX is establishing Total Maximum Daily Loads (TMDLs) for impairments in nine lakes in the Los Angeles Region. USEPA was assisted in this effort by the Los Angeles Water Quality Control Board (Regional Board). These lakes are currently on the State's 303(d) list for nutrient related impairments, mercury, OC Pesticides and PCBs, and trash and TMDLs have been developed to address these impairments.

This section of the TMDL report describes the general approach that was used to develop the TMDLs for each impairment. Lake specific information is contained in the individual sections devoted to each impaired lake.

3.1 General Source Assessment

This section identifies the potential sources of pollutants that discharge into the impaired lakes. In general, pollutants can enter surface waters from both point and nonpoint sources. Point sources include discharges from a discrete human-engineered outfall. These discharges are regulated through National Pollutant Discharge Elimination System (NPDES) permits. Nonpoint sources, by definition, include pollutants that reach surface waters from a number of diffuse land uses and activities that are not regulated through NPDES permits. Specific sources for each lake are described in the lake chapters, while pollutant-specific sources are discussed in the appendices; the discussion below presents general information for point and nonpoint sources.

3.1.1 Point Sources

The NPDES permits in the watersheds draining to impaired lakes include municipal separate storm sewer system (MS4) permits, a California Department of Transportation (Caltrans) stormwater permit, general construction stormwater permits, general industrial stormwater permits, and a general NPDES permit (Table 3-1). Point sources associated with each lake are presented in the lake-specific chapters.

Table 3-1. NPDES Permits in the Watersheds Draining to Impaired Lakes

Type of NPDES Permit	Number of Permits
Municipal Separate Storm Sewer System (MS4)	3
California Department of Transportation Stormwater	1
General Construction Stormwater	1
General Industrial Stormwater	66
General NPDES Permits (Groundwater Discharges)	1
Total	**72**

3.1.1.1 Stormwater Permits

Stormwater runoff is regulated through the City of Long Beach MS4 permit, the Los Angeles County MS4 permit, the Ventura County MS4 permit, the statewide stormwater permit issued to Caltrans, the statewide Construction Activities Stormwater General Permit, and the statewide Industrial Activities Stormwater General Permit. The permitting process defines these discharges as point sources because the stormwater is discharged from the end of a stormwater conveyance system. Since the industrial and construction stormwater discharges are governed under NPDES permits, these discharges are treated as point sources in these TMDLs.

3.1.1.1.1 MS4 Stormwater Permits

In 1990, USEPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent pollutants from being washed by stormwater runoff into MS4s (or from being discharged directly into the MS4s) and then discharged into local waterbodies. Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement a stormwater management program as a means to control polluted discharges.

Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations, and hazardous waste treatment. Large and medium MS4 operators are required to develop and implement Stormwater Management Plans that address, at a minimum, the following elements:

- Structural control maintenance
- Areas of significant development or redevelopment
- Roadway runoff management
- Flood control related to water quality issues
- Municipally owned operations such as landfills and wastewater treatment plants
- Municipally owned hazardous waste treatment, storage, or disposal sites
- Application of pesticides, herbicides, and fertilizers
- Illicit discharge detection and elimination
- Regulation of sites classified as associated with industrial activity
- Construction site and post-construction site runoff control
- Public education and outreach

The Los Angeles County MS4 Permit was renewed in December 2001 (Regional Board Order No. 01-182; CAS004001) and is on a five-year renewal cycle. There are 85 co-permittees covered under this permit, including 84 incorporated cities and the County of Los Angeles. The City of Long Beach MS4 permit was renewed on June 30, 1999 (Order No. R4-99-060; CAS004003) and is on a five-year renewal cycle. It solely covers the City of Long Beach. The Ventura County MS4 Permit was renewed in July 2010 (Order R4 2010-0108; CAS004002) and is on a five-year renewal cycle. This permit covers 12 co-permittees, including 10 incorporated cities, the County of Ventura, and the Ventura County Flood Control District (Principal Permittee).

3.1.1.1.2 Caltrans Stormwater Permit

Caltrans is regulated by a statewide stormwater discharge permit that covers all municipal stormwater activities and construction activities (State Board Order No. 99-06-DWQ; CAS000003). The Caltrans stormwater permit authorizes stormwater discharges from Caltrans properties such as the state highway system, park and ride facilities, and maintenance yards. The stormwater discharges from most of these Caltrans properties and facilities eventually end up in either a city or county storm drain.

3.1.1.1.3 General Stormwater Permits

In 1990, USEPA issued regulations for controlling pollutants in stormwater discharges from industrial sites (40 Code of Federal Regulations [CFR] Parts 122, 123, and 124) equal to or greater than five acres. The regulations require dischargers of stormwater associated with industrial activity to obtain an NPDES permit and to implement Best Available Technology Economically Achievable (BAT) to reduce or prevent nonconventional and toxic pollutants, including metals, in stormwater discharges and authorized non-storm discharges. On December 8, 1999, USEPA expanded the NPDES program to include stormwater discharges from construction sites that resulted in land disturbances equal to or greater than one acre (40 CFR Parts 122, 123, and 124).

On April 17, 1997, the State Board issued a statewide general NPDES permit for Discharges of Stormwater Associated with Industrial Activities Excluding Construction Activities Permit (Order No. 97-03-DWQ; CAS000002). This Order regulates stormwater discharges and authorized non-stormwater discharges from 10 specific categories of industrial facilities, including but not limited to, manufacturing facilities, oil and gas mining facilities, landfills, and transportation facilities. Potential pollutants from an industrial site will depend on the type of facility and operations that take place at that facility.

During wet weather, runoff from industrial sites has the potential to contribute pollutant loadings. During dry weather, the potential contribution of pollutant loadings from industrial stormwater is low because non-stormwater discharges are prohibited or authorized by the permit only under the following circumstances: when they do not contain significant quantities of pollutants, where Best Management Practices (BMPs) are in place to minimize contact with significant materials and reduce flow, and when they are in compliance with Regional Board and local agency requirements.

On September 2, 2009, the State Board adopted the statewide general NPDES permit for Discharges of Stormwater Associated with Construction and Land Disturbance Activities (Order No. 2009-0009-DQW;CAS000002). This General Construction Permit became effective on July 1, 2010. During wet weather, runoff from construction sites has the potential to contribute pollutant loadings. During dry weather, the potential contribution of pollutant loadings is low because discharges of non-stormwater are authorized by the permit only where they do not cause or contribute to a violation of any water quality standard and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants.

3.1.1.2 Other NPDES Permits

There are two types of non-stormwater NPDES permits: individual and general permits. An individual NPDES permit is classified as either a major or a minor permit. Other than the MS4 and Caltrans stormwater permits, there are no major individual NPDES permits in the watersheds draining to the impaired lakes. The discharge flows associated with minor individual NPDES permits and general NPDES permits are typically less than 1 million gallons per day (MGD). General NPDES permits often regulate episodic discharges (e.g., dewatering operations) rather than continuous flows.

Pursuant to 40 CFR parts 122 and 123, the State Board and the regional boards have the authority to issue general NPDES permits to regulate a category of point sources if the sources involve the same or substantially similar types of operations, discharge the same type of waste, require the same type of effluent limitations, and require similar monitoring. The Regional Board has issued general NPDES permits for six categories of discharges: construction and project dewatering, petroleum fuel cleanup sites, volatile organic compounds (VOCs) cleanup sites, potable water, non-process wastewater, and hydrostatic test water.

There is one facility in the Peck Road Park Lake watershed associated with the potable water general NPDES permit. The general NPDES permit for Discharges of Groundwater from Potable Water Supply

Wells to Surface Waters (Order No. R4-2003-0108; CAG994005) covers discharges of groundwater from potable supply wells generated during well purging, well rehabilitation and redevelopment, and well drilling, construction and development. The applicable numeric effluent limitations for these facilities can be found in Order No. R4-2003-0108.

3.1.2 Nonpoint Sources

A nonpoint source is a source that discharges via sheet flow or natural discharges, as well as agricultural stormwater discharges and return flows from irrigated agriculture. Nonpoint sources include atmospheric deposition directly onto lakes, areas that do not drain to a storm drain system, irrigation of parkland, and agricultural flows. Specific sources are described in the lake-specific chapters.

3.2 POLLUTANT-SPECIFIC APPROACH

This section provides a brief description of the technical approach used to develop TMDLs for nutrient-related, mercury, OC Pesticides and PCBs, and trash impairments. More details on the nutrient, mercury, and OC Pesticides and PCBs analyses are provided in Appendix A (Nutrient TMDL Development), Appendix C (Mercury TMDL Development), and Appendix H (Organochlorine Compounds TMDL Development), respectively.

3.2.1 Nutrient-related Impairments

Excessive algae in the urban lakes of the Los Angeles Region has resulted in several waterbodies not supporting their designated beneficial uses associated with aquatic life and recreation (LARWQCB, 1996). Algal biomass can lead to impairment of swimming and wading activities. In addition, the proliferation of algae can result in loss of invertebrate taxa through habitat alteration (Biggs, 2000). Algal growth in some instances has produced algal mats in the lakes (UC Riverside, 1994); these mats may result in eutrophic conditions where fluctuations in dissolved oxygen concentration and pH negatively affect aquatic life in the waterbody. The decay of these mats may also cause problems with scum and odors that affect recreational uses of the affected waterbody. In addition, the concentration of ammonia, a nitrogen compound, has been present in concentrations exceeding objectives designed to protect aquatic life (LARWQCB, 1996).

3.2.1.1 Source Assessment

Sources of nutrient loading to a lake may include both point and nonpoint sources. For purposes of allocations among nutrient sources, federal regulations distinguish between allocations for point sources regulated under NPDES permits (for which wasteload allocations are established) and nonpoint sources that are not regulated through NPDES permits (for which load allocations are established) (see 40 CFR 130.2). Point sources are discharges that occur at a defined point, or points, such as a pipe or storm drain outlet. Most point sources are regulated through the NPDES permitting process. Point sources include MS4 dischargers and other NPDES discharges as well as additional inputs such as groundwater wells or potable water sources. Nutrient loading from nonpoint sources originates from sources that do not discharge at a defined point, including direct atmospheric deposition and watershed loadings not associated with an MS4 system. Appendices D and F (Wet and Dry Weather Loading, respectively) describe how loading from these point and nonpoint sources was estimated.

3.2.1.2 Linkage Analysis

To simulate the impacts of nutrient loading on each impaired lake, the Nutrient Numeric Endpoints (NNE) BATHTUB model was set up and calibrated to lake specific conditions (Appendix A, Nutrient TMDL Development, provides additional details). The NNE BATHTUB model is a risk-based approach for estimating site-specific nutrient numeric endpoints (NNE) for California waters (Tetra Tech, 2006). In recognizing the limitation of using ambient nutrient concentrations alone in predicting the impairment of beneficial uses, this approach uses secondary indicators. Secondary indicators are defined as parameters that are related to nutrient concentrations, but are more directly linked to beneficial uses than nutrient levels alone. The tool has been tested for several waterbodies in California as a series of case studies. The secondary indicator chosen to support TMDL development for these eight waterbodies is algal density, represented by chlorophyll *a*.

The NNE BATHTUB Tool was set up individually for each impaired lake. Bathymetry data for each lake were acquired from various sources to represent the general characteristics of the waterbody, such as surface area, volume, and average depth.

Cumulative nitrogen and phosphorus loads were input to each lake model as a sum of all known, quantifiable sources. Sources of loading resulting from wet weather are discussed in Appendix D; Appendix F summarizes the loading originating during dry weather conditions. Atmospheric deposition to each lake surface is quantified in Appendix E. Internal nutrient loading is discussed in Appendix B, but is not quantified directly due to lack of data (the BATHTUB model accounts for internal loading indirectly by using a net sedimentation rate (sedimentation minus resuspension)).

Once the bathymetry and loading inputs were set up, each model was calibrated to fit observed summer (May – September) mean concentrations of phosphorus, nitrogen, and chlorophyll *a*. The calibrated models were then used to determine the allowable loads of nitrogen and phosphorus that result in attainment of the chlorophyll *a* target concentration. Allowable loads were allocated among the wasteload allocations, load allocations, and margins of safety.

For Santa Fe Dam Park Lake, which is impaired by pH, the NNE BATHTUB Tool indicated that it is not directly impaired by elevated nutrient loads or excessive algal growth. To investigate the likely source of the pH impairment, a steady-state, chemical equilibrium model was also set up. Specifically, the geochemical speciation model, Visual MINTEQ V2.61 (Gustafsson, 2009), was used to investigate the pH conditions in the lake. The model was selected to perform pH simulation based on the available data for Santa Fe Dam Park Lake. The model requires total analytical concentrations and physical inputs to evaluate various geochemical reactions. The results were used to evaluate whether elevated pH was due to natural conditions, algal impacts, or the addition of chlorine in the form of sodium hypochlorite ($NaOCl$), for disinfection of the swim beach area.

3.2.2 Mercury Impairment

Mercury, like other metals, has great persistence due to its inability to be broken down. However, because bacterial processes can methylate it to create methylmercury, it also has some properties of a bioaccumulative organic chemical. Methylmercury is easily taken up by organisms and tends to bioaccumulate; it is very effectively transferred through the food web, magnifying at each trophic level. This can result in high levels of mercury in organisms high on the food chain, despite nearly unmeasurable quantities of mercury in the water column. While mercury can be toxic to fish and other aquatic organisms at high levels, the primary concerns at the levels found in these lakes are neurological and developmental effects in higher animals and humans. The two primary endpoints of concern are wildlife species that eat fish and people that consume sport fish.

Methylmercury is highly toxic to mammals, including people, and causes a number of adverse effects. Health studies and information showing neurotoxicity, particularly in developing organisms, are most abundant. The brain is the most sensitive organ for which suitable data are available to quantify a dose-response relationship. A study by the National Academy of Science (NRC, 2000) concluded that the population at highest risk is the children of women who consume large amounts of fish and seafood during pregnancy, and that the risk to that population may result in an increase in the number of children struggling to keep up in school and requiring remedial classes or special education (USEPA, 2001a). Each of the three lakes impaired by mercury have mercury levels in largemouth bass, a trophic level four species (see Section 2.2.9), above the recommended fish consumption guideline (OEHHA, 2008). Methylmercury is also toxic to fish-eating wildlife, including both mammals and birds. In addition to neurotoxic effects, methylmercury is implicated in reduced reproductive success in wildlife such as eagles, osprey, otter, and mink (Wiener et al., 2002).

3.2.2.1 Source Assessment

Sources of mercury loading to a lake may include both point and nonpoint sources. For purposes of allocating among mercury sources, federal regulations distinguish between allocations for point sources regulated under NPDES permits (for which wasteload allocations are established) and nonpoint sources that are not regulated through NPDES permits (for which load allocations are established) (see 40 CFR 130.2). The most significant source of mercury in point source discharges is wastewater associated with the placement or removal of mercury amalgam dental fillings. Significant sources in the watershed include junkyards housing automobiles where mercury-containing switches have not been removed prior to crushing, and landfills where fluorescent light bulbs have not been properly disposed. Significant releases to the atmosphere may occur from coal-power plants, cement manufacturing facilities, oil refineries, and chlor-alkali plants.

Point sources are discharges that occur at a defined point, or points, such as a pipe or storm drain outlet. Most point sources are regulated through the NPDES permitting process. Point sources include MS4 dischargers and other NPDES discharges as well as additional inputs such as groundwater wells or potable water sources. Mercury loading from nonpoint sources originates from sources that do not discharge at a defined point, including direct atmospheric deposition, watershed loadings not associated with an MS4 system, methylation, and direct and indirect geologic sources. Appendices D and F (Wet and Dry Weather Loading, respectively) describe how loading from these point and nonpoint sources was estimated.

3.2.2.2 Linkage Analysis

The linkage analysis defines the connection between numeric targets and identified pollutant sources and may be described as the cause-and-effect relationship between the selected indicators, the associated numeric targets, and the identified sources. This provides the basis for estimating total assimilative capacity and any needed load reductions. Specifically, models of watershed loading of mercury are combined with an estimated rate of bioaccumulation in the lake. This enables a translation between the numeric target (expressed as a fish tissue concentration of mercury) and mercury loading rates. The loading capacity is then determined via the linkage analysis as the mercury loading rate that is consistent with meeting the target fish tissue concentration. This process is described in detail in Appendix C (Mercury TMDL Development) and summarized below.

For the three mercury-impaired lakes addressed by this document, models of lake response and fish bioaccumulation have not been created at this time. Rather, it is assumed that, in the long term, fish tissue concentrations will respond approximately linearly to reductions in mercury load (see Appendix C, Mercury TMDL Development). Calculating the loading capacity first requires an estimate of the existing mercury concentration in largemouth bass, the predominant trophic level 4 fish in each waterbody. To do this, a linear regression analysis was performed on tissue concentrations versus length from data collected in each lake, which was then used to predict the existing concentration associated with the target size fish.

Both the observed data and the predicted concentrations show that mercury concentrations in largemouth bass typically exceed the target of 0.22 ppm in each lake. The target is established for a 350 mm largemouth bass to be measured in fish 325-375 mm in length. The predicted mercury concentration based on a one-sided 95 percent upper confidence limit on mean predictions about the regression line (95 percent UCL) for this length is compared to the target fish concentration to determine the required reduction in mercury loading, which includes a margin of safety as described in Appendix C (Mercury TMDL Development).

3.2.3 Organochlorine Pesticides and PCBs Impairments

Organochlorine (OC) Pesticides and PCBs are chemical substances that persist in the environment, bioaccumulate through the food web, and pose a risk of causing adverse effects to human health and the environment. In particular, they include a number of chlorinated legacy pollutants known or suspected to be carcinogenic and/or toxic to humans and wildlife. OC Pesticides and PCBs include a number of now-banned chlorinated pesticides (e.g., chlordane, dieldrin, and DDT) and polychlorinated biphenyls (PCBs) that are causes of impairment in Los Angeles Region lakes. OC Pesticides and PCBs are problematic because they do not break down easily, concentrate in organisms, and can be transported great distances. The primary concerns for the listed lakes are the high levels found in popularly consumed fish. Their continuous cycling in the food chain and accumulation in sediments creates difficulties in their removal from lake systems. While concentration in sediment and organisms may be high, concentrations in the water column are often undetectable.

The US has banned the manufacture or use of all the pollutants considered OC Pesticides (chlordane, DDT, and dieldrin) and PCBs that are listed as causes of impairment in the lakes. However, the past use of these chemicals was so widespread and unrestricted that there are still loads of these chemicals coming from waste and storage facilities as well as old equipment that used or contained the contaminants. Chlordane, DDT, and dieldrin were also widely applied for agricultural and domestic pest control purposes. Continued research and findings repeatedly demonstrate that these pollutants are ubiquitous.

3.2.3.1 Source Assessment

Sources of OC Pesticides and PCBs loading to a lake may include both point and nonpoint sources. All OC Pesticides and PCBs listed for the impaired lakes were banned from domestic and industrial use by the 1980s. Areas of concern include waste facilities that may contain old transformers, industrial sites, agriculture lands, and some residences that were treated heavily for pests (for example: chlordane was a popular termiticide in the 1970s). Even areas that do not have a history of OC Pesticides and PCBs use or storage are vulnerable due to atmospheric deposition, often derived from transcontinental transport.

Point sources are discharges that occur at a defined point, or points, such as a pipe or storm drain outlet. Most point sources are regulated through the NPDES permitting process. Point sources include MS4 dischargers and other NPDES discharges, as well as additional inputs such as groundwater wells or potable water sources. Loading from nonpoint sources originates from sources that do not discharge at a defined point, including direct atmospheric deposition and watershed loadings not associated with an MS4 system. The only sources of OC Pesticides and PCBs in the local area are watershed loadings, which were divided into wasteload allocations or load allocations, depending on the presence of storm drain systems in the drainage areas (i.e., areas draining to a storm drain will receive wasteload allocations). Atmospheric deposition is incorporated into the indirect loading from watershed runoff. Direct deposition to the lake surface is considered negligible. Appendix D (Wet Weather Loading) describes how loading from these point and nonpoint sources was estimated, and the calculated loadings and allocations are described in detail in Appendix H (Organochlorine Compounds TMDL Development).

3.2.3.2 Linkage Analysis

The linkage analysis defines the connection between numeric targets and identified pollutant sources and may be described as the cause-and-effect relationship between the selected indicators, the associated numeric targets, and the identified sources. This provides the basis for estimating total assimilative capacity and any needed load reductions. Specifically, equilibrium models of watershed loading of OC Pesticides and PCBs, lake processes, and pollutant bioaccumulation in the fish have been developed. This enables a translation between numeric targets (expressed as a fish tissue concentration for each listed contaminant) and loading rates. This process is described in detail in Appendix H (Organochlorine Compounds TMDL Development) and summarized below.

The OC Pesticides and PCBs of concern have low solubility and a high affinity for organic solids and lipids. Thus, concentrations present in the sediment can result in unacceptable concentrations in fish tissue, due to food chain accumulation pathways that lead back to the lake sediment, even when concentrations in the water column are below criteria or non-detectable. The sediment concentration target is estimated using the Biota-Sediment Accumulation Factor (BSAF) of each contaminant. Starting from the fish tissue concentration target, the BSAF allows calculation of the necessary sediment concentration to support uses, and the allowable load to achieve the target sediment concentration. This is explained in detail in Appendix H (Organochlorine Compounds TMDL Development).

The target for fish tissue is provided by the 2008 Office of Environmental Health Hazard Assessment (OEHHA) Fish Contaminant Goal (FCG). The target fish concentrations are discussed further in Section 2 and Appendix H (Organochlorine Compounds TMDL Development). Addressing the fish tissue concentrations as the assessment endpoint also achieves most other applicable targets for sediment and water concentrations. The loading capacity for sediment-associated OC Pesticides and PCBs is then determined from the lower of the sediment concentration target to meet the FCG and any other applicable targets for sediment, such as the consensus-based sediment quality guidelines (MacDonald et al., 2000) designed to protect benthic organisms. This loading capacity is expressed as a sediment concentration (ng of pollutant per gram of dry sediment), which is applicable to both sediments already stored in the lake and new sediment washed into the lake. Runoff from the watershed must achieve this sediment concentration to satisfy the TMDL. Both wasteload allocations and load allocations may be translated into pollutant mass units by multiplying the OC Pesticides and PCBs concentration on sediment times the sediment load.

3.2.4 Trash Impairment

Trash in waterways causes significant water quality problems. Small and large floatables can inhibit the growth of aquatic vegetation, leading to shrinking spawning areas and habitats for fish and other living organisms. Wildlife living in lakes and riparian areas can be harmed by ingesting or becoming entangled in floating trash. With the exception of large items, settleables are not always obvious to the eye. This includes glass, cigarette butts, rubber, and construction debris. Settleables can be a problem for bottom feeders and can contribute to sediment contamination. Some debris (e.g., diapers, medical and household waste, and chemicals) are sources of bacteria and toxic substances.

For aquatic life, buoyant (floatable) materials tend to be more harmful than settleable elements, due to their ability to be transported throughout the waterbody and ultimately to the marine environment. Persistent elements such as plastics, synthetic rubber and synthetic cloth tend to be more harmful than degradable elements such as paper or organic waste. Glass and metal are less persistent because wave action and rusting can cause them to break into smaller pieces that are less sharp and harmful. Natural rubber and cloth can degrade but not as quickly as paper (USEPA, 2002). Smaller elements such as plastic resin pellets (a byproduct of plastic manufacturing) and cigarette butts can be ingested by a large number of small organisms which can then suffer malnutrition or internal injuries. Larger plastic elements such as plastic grocery bags are also harmful to larger aquatic life, which can mistake the trash for floating prey and ingest it, leading to starvation or suffocation.

Trash impaired waterbodies can threaten the health of people who swim and recreate in them. Of particular concern are bacteria and viruses associated with diapers, medical waste (e.g., used hypodermic needles and pipettes), and human or pet waste. Additionally, broken glass or sharp metal fragments in streams can cause puncture or laceration injuries. Such injuries can expose a person's bloodstream to microbes in the stream's water causing serious illnesses. Some trash items such as containers or tires can cause a pooling of water and create opportunities for mosquito production and increase health risks, such as encephalitis and West Nile virus.

Leaf litter is considered trash when there is evidence of intentional dumping. Leaves and pine needles in streams provide a natural source of food for organisms, but excessive amounts due to human influence can cause nutrient imbalance and oxygen depletion in streams. Clumps of leaf litter and yard waste from trash bags should be treated as trash during water quality assessments, and should not be confused with natural inputs of leaves to streams. In some instances, leaf litter may be trash if it originated from dense ornamental stands of nearby human planted trees that are overloading the stream's assimilative capacity for leaf inputs. Other biodegradable trash, such as food waste, can also negatively impact natural dissolved oxygen levels in the waterbodies.

Wildlife impacts due to trash occur in Peck Road Park Lake, Lincoln Park Lake, and Echo Park Lake. The two primary problems that trash poses to wildlife are entanglement and ingestion, with entanglement being the more common documented effect (Laist and Liffmann, 2000). Marine mammals, turtles, birds, fish, and crustaceans all have been affected by entanglement or ingestion of floatable debris. The most vulnerable species to floatable debris are those endangered or threatened by extinction.

Entanglement results when an animal becomes encircled or ensnared by debris. It can occur accidentally, or when the animal is attracted to the debris. Entanglement is harmful to wildlife for several reasons. Not only can it cause wounds leading to infections or loss of limbs, it can also cause strangulation or suffocation. In addition, entanglement can impair an animal's ability to swim, which can result in drowning, difficulty in moving, finding food, or escaping predators (USEPA, 2001a).

Ingestion occurs when an animal swallows floatable debris. It sometimes occurs accidentally, but usually animals feed on debris because it looks like food (e.g., plastic bags look like jellyfish, a prey item of sea turtles). Ingestion can lead to starvation or malnutrition if the ingested items block the intestinal tract and prevent digestion, or accumulate in the digestive tract, making the animal feel "full" and lessening its desire to feed. Ingestion of sharp objects can damage the mouth, digestive tract and/or stomach lining and cause infection or pain. Ingested items can also block air passages and prevent breathing, thereby causing death (USEPA, 2001a).

Common settled debris includes glass, cigarettes, rubber, and construction debris. Settleables are a problem for bottom feeders and dwellers and can contribute to sediment contamination.

In conclusion, trash in waterbodies can adversely affect humans, fish, and wildlife. Not all water quality effects of trash are equal in severity or duration. The water quality effects of trash depend on individual items and their buoyancy, degradability, size, potential health hazard, and potential hazards to fish and wildlife.

The prevention and removal of trash in waterbodies will ultimately lead to improved water quality, protection of aquatic life and habitat, improved opportunities for public recreational access and restoration activities, enhancement of public interest in the lakes, propagation of the vision of the watershed as a whole, and enhancement of the quality of life of riparian residents.

3.2.4.1 Source Assessment

The major source of trash in these lakes is due to litter, which is intentionally or accidentally discarded to the lake and watershed. Potential sources can be categorized as point sources and nonpoint sources depending on the transport mechanisms. For example:

1. Storm drains: trash deposited throughout the watershed and carried to various sections of the lake during and after rainstorms via storm drains. This is a point source.
2. Wind action: trash blown into the lake directly. This is a nonpoint source.
3. Direct disposal: direct dumping or littering into the lake. This is a nonpoint source.

3.2.4.1.1 Point Sources

Litter is the primary source of trash for point sources. This includes trash deposited throughout the watershed and carried to the waterbodies during and after rain events via storm drains.

3.2.4.1.2 Nonpoint Sources

Litter is also intentionally or accidentally discarded to the lake and shoreline. Trash deposited near the lake has the potential to be blown or transported by wildlife or overland flow into the lake. Trash directly dumped into the lake is also a nonpoint source.

3.2.4.2 Linkage Analysis

These TMDLs are based on numeric targets derived from narrative water quality objectives in the Los Angeles Basin Plan (LARWQCB, 1994) for floating materials and solid, suspended, or settleable materials. The narrative objectives state that waters shall not contain these materials in concentrations that cause nuisance or adversely affect beneficial uses. Since any amount of trash impairs beneficial uses, the loading capacity of all waterbodies is set to zero allowable trash.