U.S. Environmental Protection Agency

Los Angeles Area Lakes TMDLs
March 2012

Section 6 Echo Park Lake TMDLs

6 Echo Park Lake TMDLs

Echo Park Lake (#CAL4051501020000228155002) is listed as impaired by algae, ammonia, copper, eutrophication, lead, odor, PCBs, pH, and trash (SWRCB, 2010). In addition, chlordane and dieldrin impairments have been identified by new data analyses since the 2008-2010 303(d) list data cut off. This section of the TMDL report describes the impairments, and the TMDLs developed to address them: nutrients (see Section 6.2), organochlorine (OC) pesticides and PCBs (Section 6.5 through Section 6.7), and trash (Section 6.8). Nutrient TMDLs are identified here based on existing conditions since nitrogen and phosphorus levels are achieving the chlorophyll *a* target level. Comparison of metals data to their associated hardness-dependent water quality objectives indicates that copper and lead are currently achieving numeric targets at Echo Park Lake; therefore, TMDLs are not included for these pollutants. Analyses are presented below for lead (Section 6.3) and copper (Section 6.4).

6.1 Environmental Setting

Echo Park Lake is located in the Los Angeles River (HUC 18070105) (Figure 6-1). The waterbody was originally constructed as the Arroyo de los Reyes reservoir in 1898 and became Echo Park Lake in 1907. The lake now has a surface area of 14.1 acres (based on Southern California Association of Governments [SCAG] 2005 land use), an average depth of five feet (estimated from 2009 sampling events and the Urban Lakes Study [UC Riverside, 1994]), and a volume of 70.5 ac-ft (calculated from the land use estimated surface area and estimated average depth). Two primary storm drains provide inflows to the lake; the lake then discharges to a storm drain that ultimately reaches the Los Angeles River.

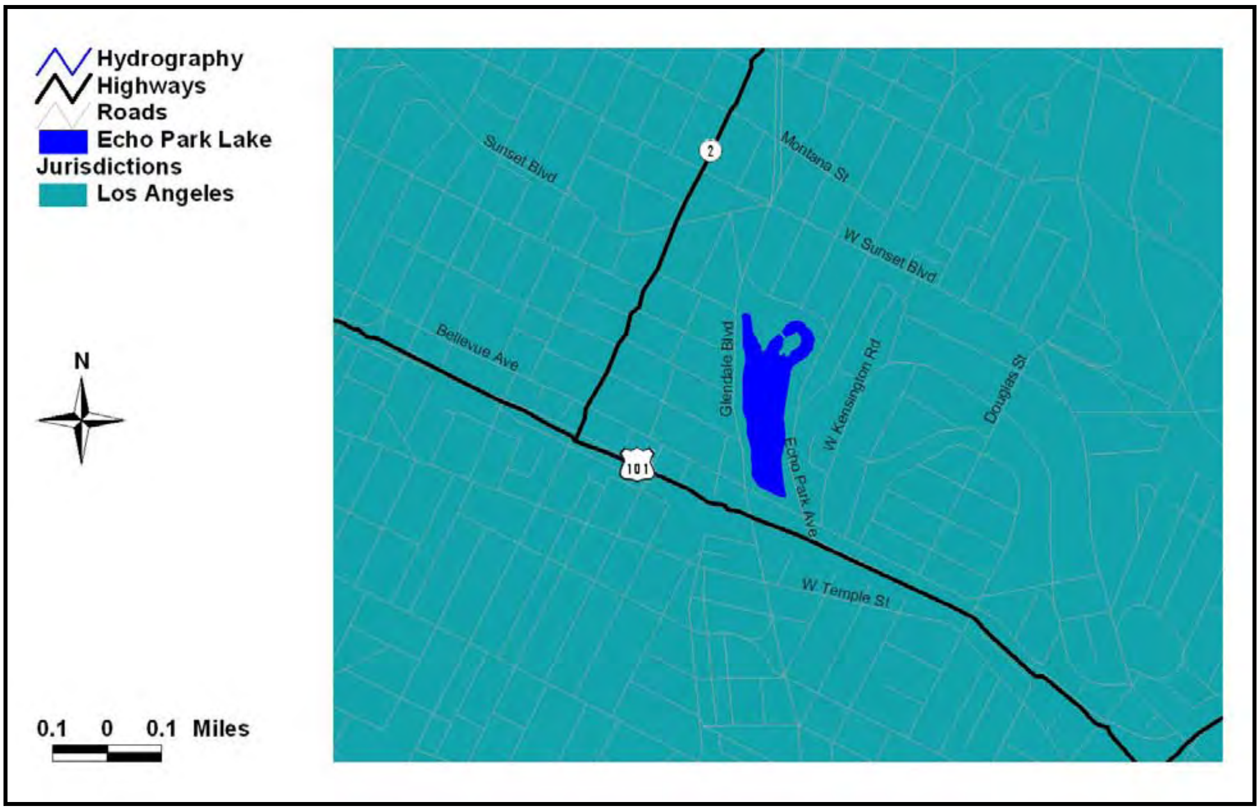

Figure 6-1. Location of Echo Park Lake

Mixing and aeration of the lake is currently performed by a mechanical aeration system, including the lake's notable fountain located near the tip of the western peninsula. Objectives of aeration include increasing dissolved oxygen and decreasing nuisance surface scum and algal growth. In addition to aeration, four floating hydroponic wetlands were constructed for additional water quality treatment. An island, managed by the city of Los Angeles, located in the northeastern lobe of the lake, also provides habitat for waterfowl and turtles. Figure 6-2 shows the fountain and one of the hydroponic islands in the lake; Figure 6-3 shows the bubbles that result from one of the aerators.

Figure 6-2. Fountain and Hydroponic Island at Echo Park Lake

Figure 6-3. An Aerator North of the Bridge at Echo Park Lake

Echo Park Lake harbors a historically and culturally significant population of lotus beds; it is believed that the current population is a descendent of lotus plants imported in 1920. Once believed to be the largest population in the western United States, recent decline of the lotus beds has been attributed to buildup of hydrogen-sulfide in the sediment. Due to the stress associated with the hydrogen-sulfide, it is not expected that the existing-historic lotus beds will reestablish. For this reason, a lotus restoration plan, completed in 2009, will be vital to the future sustainability of the lotus beds (Black & Veatch, 2009). A critical feature to reduce the concentration of hydrogen sulfide and augment the success of the lotus beds is proper lake circulation and improved aeration.

A small strip of parkland surrounds the lake, offering a slight buffer from the surrounding roads and dense residential development. The park provides public access to the lake and restrooms located in the park are connected to the city sewer system. According to California Department of Fish and Game, trout are periodically stocked (CDFG, 2009). Catch and release fishing and paddle boating are the primary recreational uses (Figure 6-4). Bird feeding is another recreational activity at Echo Park Lake and heavy feeding has been observed during recent fieldwork, likely contributing to larger resident bird populations. Visitors are not allowed to swim in the lake. Lake managers use algaecides to control algal growth in the lake on an as-needed basis.

Note: recreational uses include catch and release fishing and paddle boating.

Figure 6-4. Echo Park Lake Recreational Uses

Additional characteristics of the watershed are summarized below.

6.1.1 Elevation, Storm Drain Networks, and Subwatershed Boundaries

The Echo Park Lake watershed is 784 acres in size and ranges in elevation from 115 meters to 229 meters (Figure 6-5). The TMDL subwatershed boundaries selected for Echo Park Lake were based on boundaries obtained from the county of Los Angeles and are labeled on the figure accordingly. The county of Los Angeles southern-subwatershed was sub-delineated based on a digital elevation model to remove the drainage area downstream of the lake. The subwatershed draining the northern part of the watershed is 614 acres, and the southern subwatershed drains 170 acres. The majority of wet weather and dry weather flows from the northwestern and northeastern storm drains are diverted around the lake (Appendix D, Wet Weather Loading; Appendix F, Dry Weather Loading). Because both subwatersheds drain to a storm drain system and because many storm drains drain to the lake, all allocations except atmospheric deposition will be wasteload allocations. The trash TMDL includes load allocations due to direct dumping of trash along the shoreline and in the water by park visitors in the area indicated in Figure 6-6.

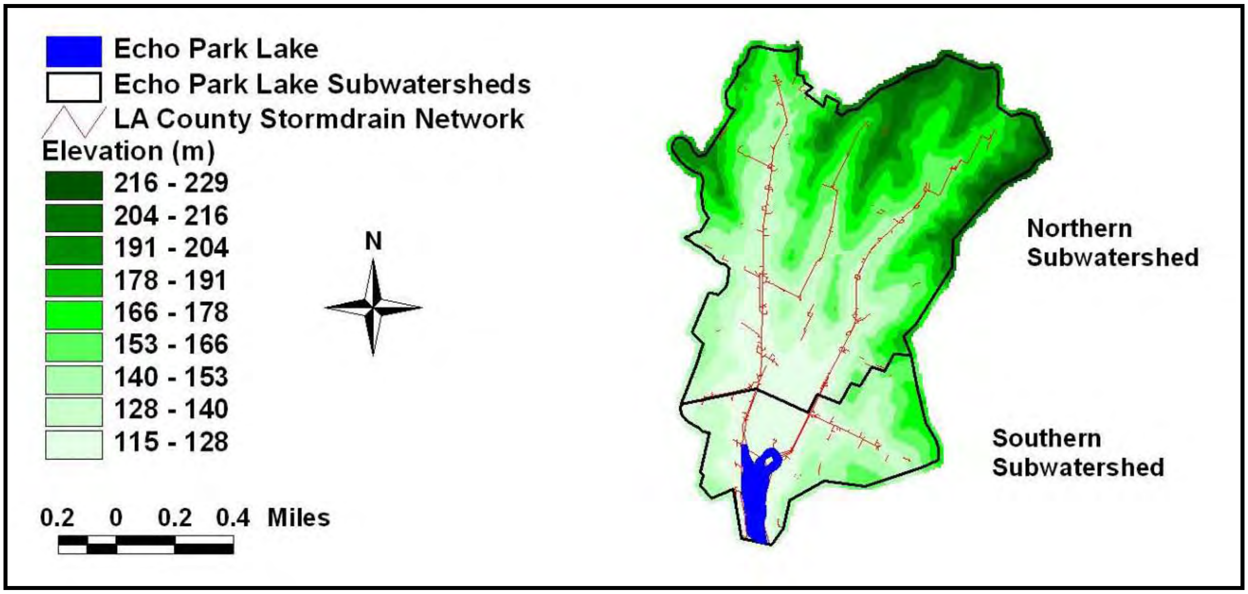

Figure 6-5. Elevation, Storm Drain Network, and TMDL Subwatershed Boundaries for Echo Park Lake

6.1.2 MS4 Permittees

Figure 6-6 shows the MS4 stormwater permittees in the Echo Park Lake watershed. Both subwatersheds are located entirely within the city of Los Angeles with a small portion in Caltrans area. Figure 6-7 shows one of the main storm drain inlets at the lake. The park is comprised of 15.5 acres of land adjacent to the lake.

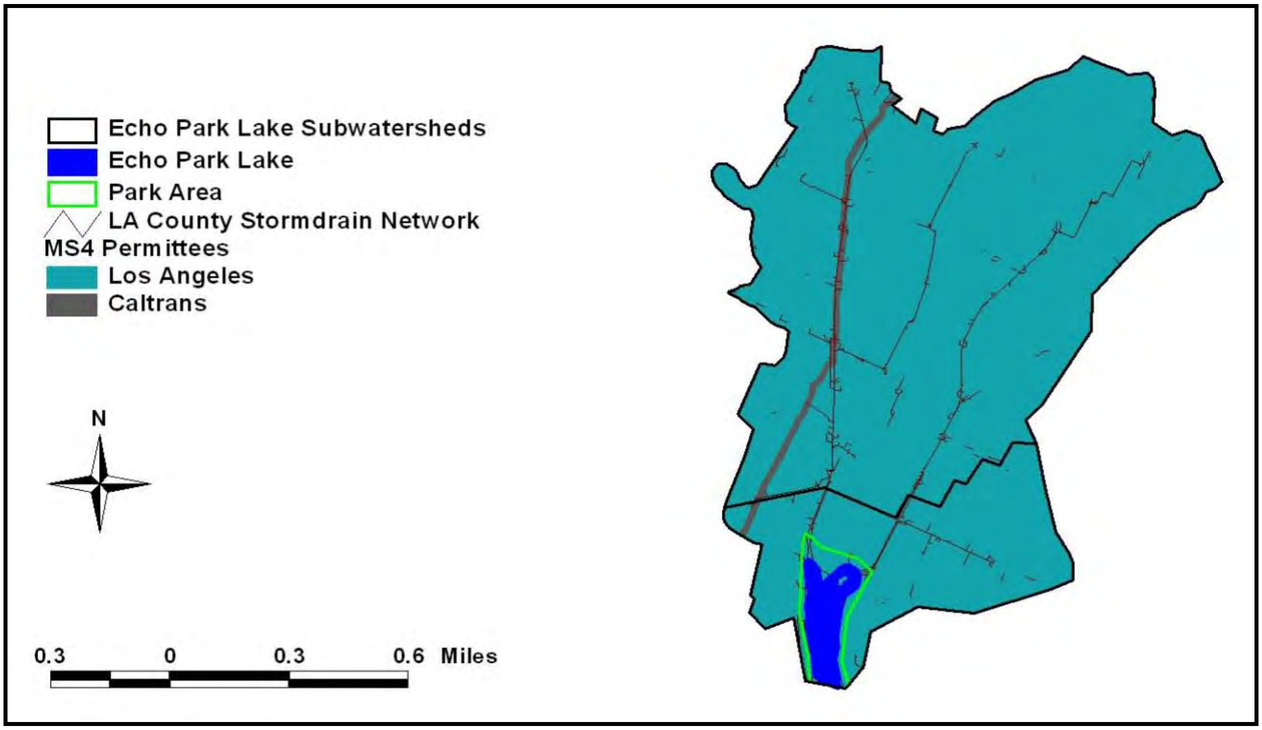

Figure 6-6. MS4 Permittees and the County of Los Angeles Storm Drain Network in the Echo Park Lake Subwatersheds

Figure 6-7. Echo Park Lake Northeast Storm Drain Input

6.1.3 Non-MS4 NPDES Dischargers

The primary permitted discharger in the watershed is the county of Los Angeles MS4 system. There is one additional NPDES permitted discharger (non-MS4) in the Echo Park Lake watershed (Table 6-1 and Figure 6-8) that is a discharger covered under a general industrial stormwater permit (see Section 3.1 for a detailed discussion of this permit type). This permit was identified by querying excel files of permits from the Regional Board website (Excel files for each watershed are available from this link, www.waterboards.ca.gov/losangeles/water_issues/programs/regional_program/index.shtml#watershed, accessed on October 5, 2009). This permittee is located in the city of Los Angeles in the northern subwatershed (Section 6.1.1) and has two disturbed acres. The disturbed area associated with this permit drains to the northwestern storm drain which is diverted around the lake in most cases except during high flow events. Loads from this permittee were therefore not calculated; however, concentration-based wasteload allocations for this permittee are included in the TMDLs.

Table 6-1. Non-MS4 Permits in the Echo Park Lake Subwatersheds

Type of NPDES Permit	Number of Permits	Subwatershed	Jurisdiction	Disturbed Area
General Industrial Stormwater (Order No. 97-03-DWQ, CAS000003)	1	Northern	City of Los Angeles	2 acres

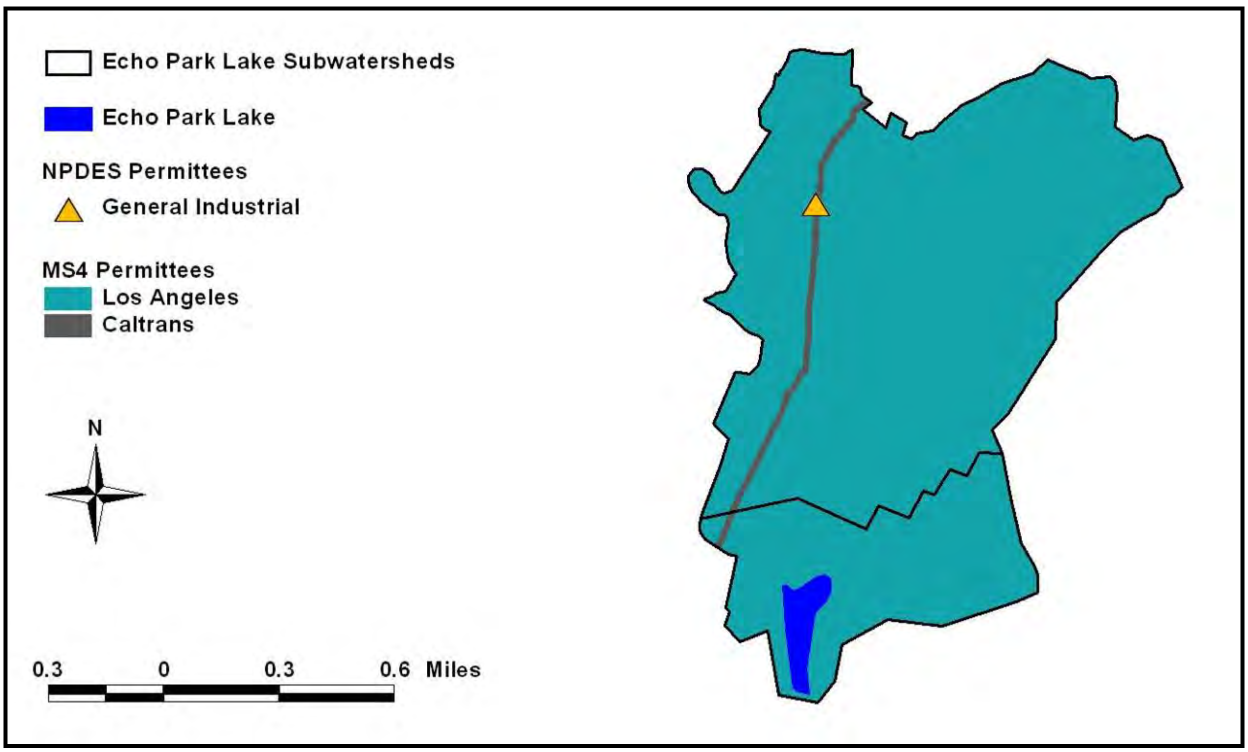

Figure 6-8. Non-MS4 Permits in the Echo Park Lake Subwatersheds

6.1.4 Land Uses and Soil Types

The analysis for this watershed includes source loading estimates obtained from the Los Angeles River Basin LSPC Model discussed in Appendix D (Wet Weather Loading) of this TMDL report. Land uses identified in the Los Angeles River Basin LSPC model are shown in Figure 6-9. The watershed is comprised primarily of residential development as well as commercial, other urban, industrial, and open space areas. Table 6-2 and Table 6-3 summarize the land use areas by TMDL subwatershed and jurisdiction.

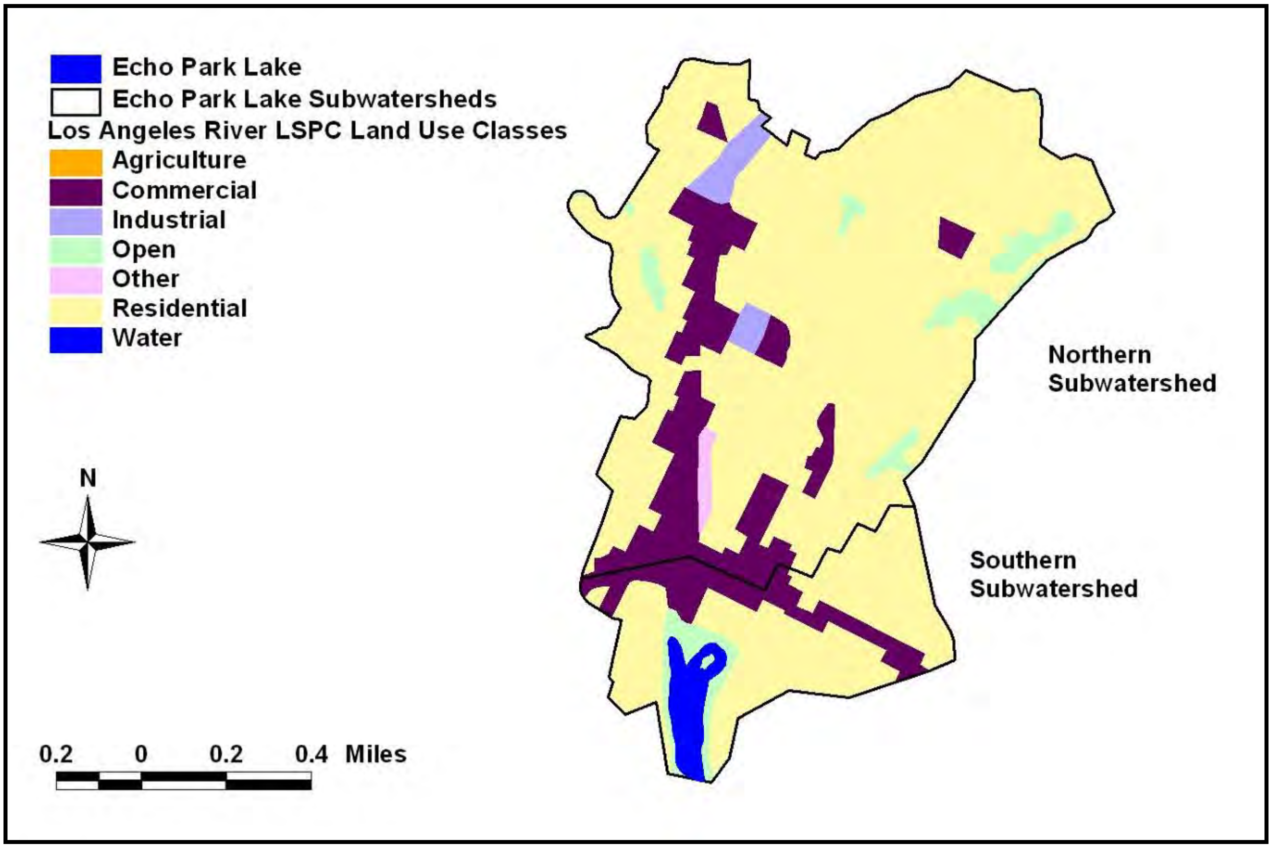

Figure 6-9. LSPC Land Use Classes for the Echo Park Lake Subwatersheds

Table 6-2. Land Use Areas (ac) Draining to Echo Park Lake from the Northern Subwatershed

Land Use	Los Angeles	Caltrans	Total
Agriculture	0	0	**0**
Commercial	78.4	0	**78.4**
Industrial	12.2	13.0	**25.2**
Open	27.5	0	**27.5**
Other Urban	4.67	0	**4.67**
Residential	479	0	**479**
Total	**601**	**13.0**	**614**

Table 6-3. Land Use Areas (ac) Draining to Echo Park Lake from the Southern Subwatershed

Land Use	Los Angeles	Caltrans	Total
Agriculture	0	0	**0**
Commercial	31.6	0	**31.6**
Industrial	0	1.10	**1.10**
Open	15.5	0	**15.5**
Other Urban	0	0	**0**
Residential	122	0	**122**
Total	**169**	**1.10**	**170**

There are no Resource Conservation and Recovery Act (RCRA) contaminated industrial facilities located near the Echo Park Lake watershed. The USDA STATSGO state soils coverage identifies all soils within the Echo Park Lake watershed as Urban Land – Lithic Xerorthents – Hambright – Castaic (MUKEY 660489). These soils are classified as belonging to soil hydrologic group D, which is characterized by high runoff potential, very low infiltration rates, and generally high clay content.

6.1.5 Additional Inputs

In addition to stormwater runoff, a natural spring exists in the center of Echo Park Lake (UC Riverside, 1994); however, the addition of potable water is required to maintain the lake level. A potable water source at Echo Park Lake is used for both supplemental water additions to the lake and irrigation of surrounding parklands (Figure 6-10). According to a hydrologic study of the park lake conducted by Black & Veatch (2008), 162 ac-ft/yr of potable water is pumped annually for these purposes. Staff at Echo Park indicate that a portion of the pumped water is used to irrigate approximately 9 acres in the vicinity of the lake at a rate of approximately 1 foot per year. Some of this irrigation water may reach the lake (4.6 percent of the total irrigation volume is assumed to reach the lake).

Figure 6-10. Echo Park Lake Potable Water Source and Northwestern Storm Drain Input

6.2 NUTRIENT RELATED IMPAIRMENTS

A number of the assessed impairments for Echo Park Lake are associated with nutrients and eutrophication. Nutrient-related impairments for Echo Park Lake include algae, ammonia, eutrophication, odor, and pH (SWRCB, 2010). The loading of excess nutrients enhances algal growth (eutrophication). Algal photosynthesis removes carbon dioxide from the water, which can lead to elevated pH in poorly buffered systems. Algal blooms may also contribute to odor problems.

6.2.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. The existing beneficial uses assigned to Echo Park Lake include REC1, REC2, WARM, WILD, and MUN. Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated nutrient levels are currently impairing the REC1, REC2, and WARM uses by stimulating algal growth that may form mats that impede recreational and drinking water use, alter pH and dissolved oxygen (DO) levels, and alter biology that impair the aquatic life use, and cause odor and aesthetic problems. At high enough concentrations WILD and MUN uses could become impaired.

6.2.2 Numeric Targets

The Basin Plan for the Los Angeles Region (LARWQCB, 1994) outlines the numeric targets and narrative criteria that apply to Echo Park Lake. The following targets apply to the algae, ammonia, eutrophication, odor, and pH impairments (see Section 2 for additional details and Table 6-4 for a summary):

- 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, the pH, temperature and ammonia must be determined at the same time. For the purposes of setting a target for Echo Park Lake in these TMDLs, a median temperature of 19.7 ºC and a 95th percentile pH of 9.1 were used, as explained in Section 2. The resultant acute (one-hour) ammonia target is 1.14 mg-N/L, the four-day average is 0.76 mg-N/L, and the 30-day average (chronic) target is 0.30 mg-N/L (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 varies with the temperature and pH values determined during sample collection).
- 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." The Regional Board has not adopted numeric targets for biostimulatory nutrients or chlorophyll *a* in Echo Park Lake; however, as described in Tetra Tech (2006), summer (May to September) mean and annual mean chlorophyll *a* concentration of 20 µg/L are selected as the maximum allowable level consistent with full support of contact recreational use and is also consistent with supporting warm water aquatic life. The mean chlorophyll *a* target must be met at half of the Secchi depth during the summer (May – September) and annual averaging periods.

- 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."
- The Basin Plan states "at a minimum 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." Shallow, well-mixed lakes, such as Echo Park Lake, must meet the DO target in the water column from the surface to 0.3 meters above the bottom of the lake.
- 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." Shallow, well-mixed lakes, such as Echo Park Lake, must meet the pH target in the water column from the surface to 0.3 meters above the bottom of the lake.

Nitrogen and phosphorus target concentrations within the lake are based on existing conditions as explained in Sections 6.2.5 and 6.2.6:

- 1.2 mg-N/L summer average (May – September) and annual average
- 0.12 mg-P/L summer average (May – September) and annual average

Table 6-4. Nutrient-Related Numeric Targets for Echo Park Lake

Parameter	Numeric Target	Notes
Ammonia[1]	1.14 mg-N/L acute (one-hour) 0.76 mg-N/L four-day average 0.30 mg-N/L chronic (30-day average)	Based on median temperature and 95th percentile pH
Chlorophyll *a*	20 µg/L summer average (May – September) and annual average	
Dissolved Oxygen	7 mg/L minimum mean annual concentrations and 5 mg/L single sample minimum except when natural conditions cause lesser concentrations	
pH	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. (Basin Plan) 6.5 – 9.0 (EPA's 1986 Recommended Criteria)	The existing water quality criteria for pH is very broad and in cases where waste discharges are not causing the alteration of pH it allows for a wider range of pH than EPA's recommended criteria. For this reason, EPA's recommended criteria is included as a secondary target for pH.
Total Nitrogen	1.2 mg-N/L summer average (May – September) and annual average	Conservatively based on existing conditions, which are maintaining chlorophyll *a* levels below the target of 20 µg/L

Parameter	Numeric Target	Notes
Total Phosphorous	0.12 mg-P/L summer average (May – September) and annual average	Conservatively based on existing conditions, which are maintaining chlorophyll *a* levels below the target of 20 µg/L

[1] 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..

6.2.3 Summary of Monitoring Data

Water quality monitoring has occurred in Echo Park Lake in 1992, 1993, and 2003 through 2009. This section summarizes the monitoring data relevant to the nutrient impairments. Additional details regarding monitoring are discussed in Appendix G (Monitoring Data).

During the 1992/1993 Urban Lakes Study, sampling occurred near the center of the lower half of the lake (UC Riverside, 1994). Total Kjeldahl nitrogen (TKN) concentrations during this sampling period ranged from 0.9 mg-N/L to 1.9 mg-N/L. Ammonium concentrations were less than the reporting limit for 22 of 31 samples, and the maximum observed ammonium concentration was 0.7 mg-N/L which is less than the acute target assuming the analysis methodology converted all ammonia to ammonium. Nitrite concentrations were less than the detection limit (0.1 mg-N/L) in all samples and 24 of 31 nitrate samples were less than the detection limit (0.1 mg-N/L). The maximum observed nitrate concentration was 0.2 mg-N/L. Orthophosphate concentrations were generally less than or equivalent to the detection limit (0.1 mg-P/L) with some observations of 0.2 mg-P/L. Total phosphorus concentrations ranged from less than the detection limit (0.1 mg-P/L) to 0.3 mg-P/L. pH measurements ranged from 7.7 to 9.4 throughout the water column, and TOC ranged from 4.8 mg/L to 7.6 mg/L. The summary table from the 1994 Lakes Study Report (UC Riverside, 1994) lists chlorophyll *a* concentrations ranging from 6 µg/L to 66 µg/L with an average of 24 µg/L. For this period, exceedances of the pH and chlorophyll *a* targets were observed. The report stated that aquatic weeds were present near the fountain, lotus plants were located at the northwest end of the lake, and algal blooms were observed during the summer. A strong odor resulting from duck feces was also reported. Nutrient levels were generally low during the study period and it was reported that the level of algae in the lake was not problematic.

There were no stations in Echo Park Lake or its drainage area in the Regional Board Water Quality Assessment Database. The Water Quality Assessment Report, however, states that pH was not supporting the contact recreation use and partially supporting the aquatic life use: 69 measurements of pH were collected which ranged from 7.0 to 9.4. Thirty-one ammonium samples were collected with values ranging from non-detect to 0.71 mg-N/L; ammonia was listed as not supporting the aquatic life and contact recreation uses. Raw data are not available to assess location, date, time, depth, temperature, or pH with regard to these samples. Odor and algae were both listed as not supporting the contact and non-contact recreation uses. Eutrophication was listed as not supporting the aquatic life use.

In 2003, the City of Los Angeles Bureau of Sanitation, Watershed Protection Division began collecting water quality samples from Echo Park Lake at three in-lake stations. Of the 84 samples collected during this period, 38 were non-detect for ammonia (less than 0.1 mg-N/L); the maximum ammonia concentration was 0.93 mg-N/L which does not exceed the acute or chronic ammonia criteria based on the associated pH and temperature measurements. Organic nitrogen concentrations ranged from 0.28 mg-N/L to 3.14 mg-N/L. Thirty-five nitrate samples were below the detection limit (0.02 mg-N/L), and the maximum observed nitrate concentration was 1.0 mg-N/L. Fifty-five of the nitrite samples were below the detection limit (0.02 mg-N/L); the other two samples had concentrations of 0.02 mg-N/L and 0.09 mg-N/L. Total nitrogen concentrations, calculated from the sum of ammonia, organic nitrogen, nitrate, and nitrite, ranged from 0.28 mg-N/L to 3.48 mg-N/L. Total phosphate measurements generally ranged from 0.06 mg-P/L to 0.51 mg-P/L with three measurements less than detection (0.05 mg-P/L). No chlorophyll *a* data were reported.

Vertical profile data using datasondes were also collected by the City of Los Angeles Bureau of Sanitation during 2003. For a given collection day, there was little variability between the stations or depths for temperature, specific conductivity, dissolved oxygen, or pH, indicating absence of significant stratification. Dissolved oxygen concentrations ranged from 5.62 mg/L to 15.9 mg/L; pH ranged from 7.46 to 9.04 throughout the water column. Twenty-seven percent of pH measurements exceeded the maximum allowable value.

In 2008, the Regional Board sampled Echo Park Lake on two occasions. As the lake is relatively shallow and well mixed by wind action and aerators, the sampling team collected analytical samples from the lake surface only. On June 25, 2008, ammonia concentrations in Echo Park Lake were fairly similar at all three sampled locations and ranged from 0.131 mg-N/L to 0.136 mg-N/L. TKN at the lake midpoint and near the hydroponic island ranged from 1.38 mg-N/L to 1.49 mg-N/L; the concentration was higher in the lotus beds at 4.72 mg-N/L. Concentrations of nitrate, nitrite, orthophosphate, and total phosphate were all less than the reporting limits of 0.1 mg-N/L, 0.1 mg-N/L, 0.4 mg-P/L, and 0.5 mg-P/L, respectively. Dissolved oxygen concentrations ranged from 4.95 mg/L to 9.82 mg/L, and pH ranged from 8.21 to 8.56. The pH levels showed slight exceedances relative to the target. The DO target for waters designated WARM is 5 mg/L and after rounding to the appropriate decimal place the lowest observed measurement of 4.95 mg/L meets the target. Note that the pH meter was not producing calibration results within the acceptable range and that exceedances of the pH target were only observed along the shoreline near two storm drain outlets. Chlorophyll *a* samples generally ranged from 10.9 μg/L to 26.7 μg/L. There were two outlier chlorophyll *a* concentrations of 0.8 μg/L and 53.6 μg/L. The average concentration in the lake on this sampling day, including the outliers, was 17.3 μg/L. A description of the methodology or equipment used to measure chlorophyll *a* concentrations in the field was not provided.

Regional Board also collected samples on December 18, 2008 from five shoreline locations at a depth of approximately 4 inches. pH ranged from 7.7 to 8.1. No exceedances of the acute ammonia target or chlorophyll *a* target were observed on this day. These samples are not discussed in detail in this section as shoreline samples may not be reflective of conditions in the lake as a whole.

On March 10, 2009, USEPA and the Regional Board sampled Echo Park Lake at three locations. Ammonia concentrations ranged from 0.04 mg-N/L to 0.06 mg-N/L, and TKN ranged from 0.7 mg-N/L to 1.3 mg-N/L. Nitrate was approximately 0.15 mg-N/L at each station, and nitrite was less than the detection limit (0.01 mg-N/L). Orthophosphate was less than the detection limit (0.008 mg-P/L) at each station, and total phosphorus generally ranged from 0.033 mg-P/L to 0.071 mg-P/L. One total phosphorus sample measured 0.762 mg-P/L, though the field duplicate had a value of 0.071 mg-P/L. Chlorophyll *a* measurements in the lake ranged from 14.2 μg/L to 15.2 μg/L.

Two in-lake stations were sampled by USEPA and the Regional Board on August 4^{th}, 2009. All nitrogen parameters (ammonia, TKN, nitrate, and nitrite) were below detection limits (0.03 mg-N/L, 0.456 mg-N/L, 0.01 mg-N/L, 0.01 mg-N/L, respectively) at both sites. Total phosphorus measurements were 0.196 mg-P/L and 0.195 mg-P/L. The orthophosphate concentrations were 0.0850 mg-P/L and 0.0917 mg-P/L. The chlorophyll *a* measurements were 15.0 μg/L and 15.5 μg/L.

Profile data were collected in Echo Park Lake during both USEPA/Regional Board sampling events. On both days the lake appeared well-mixed both vertically and spatially. On March 10^{th}, DO concentrations in the lake generally ranged from 7.0 mg/L to 8.6 mg/L with one reading of 10.0 mg/L from a surface sample; pH ranged from 7.5 to 7.9. On August 4^{th}, DO concentrations in the lake ranged from 6.4 mg/L to 7.6 mg/L. The pH ranged from 8.3 to 8.6 throughout the water column and therefore exceeded the allowable range during the August 4^{th} sampling event. Potable water measured during the August 4^{th} sampling event was 7.54 pH units.

In summary, recent samples show the chlorophyll *a* target is being met. The 1994 Urban Lakes Study suggested that the fountain and aeration system were effective in managing DO concentrations (UC Riverside, 1994). That appears to be the case today as well, as the DO measurements are above 5 mg/L and averaged greater than the target of 7 mg/L. No odors were observed during five recent sampling events by USEPA and/or Regional Board. It is unlikely that the source of the odor reported at Echo Road Park Lake is due to elevated nutrient and algal biomass levels. They are likely associated with the trash impairment addressed in Section 6.8.

6.2.3.1 Summary of pH Non-Impairment

The Basin Plan states *"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."* There were nine elevations of pH in 36 recent samples. All elevations occurred during dry weather and therefore are not due to stormwater flow. Potable water which accounts for 89 percent of influent water measured 7.54 pH units. There are no other waste discharges that could be elevating the pH. Therefore, the elevated pH levels are meeting the water quality objective. In addition, the chlorophyll *a* target is being met, so nutrient loading is not elevating pH. Based on these multiple lines of evidence, Echo Park Lake is attaining beneficial uses and meets pH water quality standards. USEPA concludes that preparing a TMDL for pH is unwarranted at this time. USEPA recommends that Echo Park Lake not be identified as impaired by pH in California's next 303(d) list.

6.2.3.2 Summary of Ammonia Non-Impairment

Echo Park Lake was listed as impaired for ammonia in 1996 based on an assessment in the Regional Board's Water Quality Assessment and Documentation Report (LARWQCB, 1996). Consistent with project plan recommendations provided in California's Impaired Waters Guidance (SWRCB, 2005), EPA and local agencies collected 35 additional samples (7 wet weather) between May 2003 and February 2010 to evaluate current water quality conditions. There was one ammonia exceedance in 35 samples (Appendix G, Monitoring Data). Therefore, Echo Park Lake meets ammonia water quality standards and USEPA concludes that preparing a TMDL for ammonia is unwarranted at this time. USEPA recommends that Echo Park Lake not be identified as impaired for ammonia in California's next 303(d) listing.

6.2.4 Source Assessment

The source assessment for Echo Park Lake includes load estimates from the surrounding watershed (Appendix D, Wet Weather Loading; Appendix F, Dry Weather Loading) including irrigation (4.6 percent of the total irrigation volume is assumed to reach the lake), potable water used supplementing lake levels (Appendix F, Dry Weather Loading), and atmospheric deposition (Appendix E, Atmospheric Deposition). Loads generated from upland areas located in the city of Los Angeles in the northern and southern watersheds contribute 29 percent of the total phosphorus load and 28 percent of the total nitrogen load (the majority of runoff from these areas is diverted downstream of the lake). The potable water used for supplemental water additions contributes 46 percent of the total phosphorus load and 64 percent of the total nitrogen load to Echo Park Lake. In addition to these sources, there are other sources of loading to Echo Park Lake for which loading estimates were not available (Appendix F, Dry Weather Loading). These may include excessive fertilization relative to product recommendations, internal loading from lake sediments, natural wildlife populations, excessive resident bird populations caused by the improper disposal of food waste, and pet wastes. During calibration of the NNE BATHTUB model, loads in the category, "Additional Parkland Loading," were increased until simulated concentrations of total phosphorus and total nitrogen matched those observed (see Section 6.2.5). For this waterbody, these additional sources of loading comprise 24 percent of the total phosphorus load and 5.5 percent of the total nitrogen load. All existing loads to Echo Park Lake are summarized in Table 6-5.

Table 6-5. Summary of Average Annual Flows and Nutrient Loading to Echo Park Lake

Subwatershed	Responsible Jurisdiction	Input	Flow (ac-ft)	Total Phosphorus (lb-P/yr) (percent of total load)	Total Nitrogen (lb-N/yr) (percent of total load)
Northern	Caltrans	State Highway Stormwater[1]	0.385	0.608 (0.6)	4.77 (0.7)
Northern	City of Los Angeles	MS4 Stormwater[1]	13.2	24.7 (22.7)	156 (21.3)
Southern	Caltrans	State Highway Stormwater[1]	0.033	0.051 (0.05)	0.403 (0.06)
Southern	City of Los Angeles	MS4 Stormwater[1]	4.16	6.99 (6.4)	48.4 (6.6)
Southern	City of Los Angeles	Supplemental Water Additions (Potable Water)	153	50.8 (46.6)	471 (64.4)
Southern	City of Los Angeles	Parkland Irrigation	0.418	0.139 (0.1)	1.29 (0.2)
Southern	City of Los Angeles	Additional Parkland Loading	NA	26.1 (23.9)	40 (5.4)
Lake Surface		Atmospheric Deposition[2]	18.0	NA	9.0 (1.2)
Total			**188**	**109**	**731**

[1]This input includes effluent from storm drain systems during both wet and dry weather.

[2] Loads for atmospheric deposition are based on direct precipitation to the lake (calculated by the annual average precipitation multiplied by the surface area of the lake).

A significant portion of loading from the additional parkland sources is likely due to excessive resident bird populations. According to a recent water quality modeling study conducted by Black and Veatch (2010), there is a year-round, resident bird population of approximately 1,000 Rock Doves and American Coots. Estimates of nutrient loading from these birds were based on literature values and an assumption that all waste generated by the birds would reach the lake (i.e., no uptake or trapping on adjacent areas). The estimated total phosphorus loading from these birds is 78 lb-P/yr, and the estimated total nitrogen loading is 780 lb-N/yr. Both loading estimates are greater than the additional parkland loading estimated from the BATHTUB model. This overestimation may be due to 1) an inaccurate estimate of the year-round bird population at Echo Park Lake, and 2) the conservative assumption that 100 percent of bird waste and associated nutrient loading reach the lake. Regardless of the accuracy of the estimated loading associated with bird waste, this analysis indicates that nutrient loading associated with the excess bird population comprises a significant portion of the additional parkland loading.

6.2.5 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. To simulate the impacts of nutrient loading on Echo Park Lake, the nutrient numeric endpoints (NNE) BATHTUB Tool was set up and calibrated to lake-specific conditions. The NNE BATHTUB Tool is a version of the US Army Corps of Engineers (USACE) BATHTUB model and was developed to support risk-based nutrient numeric endpoints in California (Tetra Tech, 2006).

BATHTUB is a steady-state model that calculates nutrient concentrations, chlorophyll *a* concentration (or algal density), turbidity, and hypolimnetic oxygen depletion based on nutrient loadings, hydrology, lake morphometry, and internal nutrient cycling processes. BATHTUB uses a typical mass balance modeling approach that tracks the fate of external and internal nutrient loads between the water column, outflows, and sediments. External loads can be specified from various sources including stream inflows, nonpoint source runoff, atmospheric deposition, groundwater inflows, and point sources. Internal nutrient loads from cycling processes may include sediment release and macrophyte decomposition. The net sedimentation rates for nitrogen and phosphorus reflect the balance between settling and resuspension of nitrogen and phosphorus within the waterbody. Thus, internal loading is implicitly accounted for in the model. Since BATHTUB is a steady-state model, it focuses on long-term average conditions rather than day-to-day variations in water quality.

Target nutrient loads and resulting allocations are determined based on the secondary target – summer mean chlorophyll *a* concentration. The NNE spreadsheet tool allows the user to specify a chlorophyll *a* target and predicts the probability that current conditions will exceed the target, as well as showing a matrix of allowable nitrogen and phosphorus loading combinations to meet the target. The user-defined chlorophyll *a* target can be input directly by the user, or can be calculated based on an allowable change in water transparency measured as Secchi depth. Appendix A (Nutrient TMDL Development) describes additional details on the NNE BATHTUB Tool and its use in determining allowable loads of nitrogen and phosphorus.

In addition to loading rates of nitrogen and phosphorus, the NNE BATHTUB Tool requires basic bathymetry data for the simulation of chlorophyll *a* during the summer. For Echo Park Lake, the following inputs apply: surface area of 14.1 acres, average depth of 5 ft, and volume of 70.5 ac-ft. Based on the turnover ratios for both nitrogen and phosphorus (Walker, 1987), the annual averaging period is most appropriate (i.e., annual loads are input to the model rather than summer season loads). Based on the results of a recent exfiltration and flow monitoring study of the lake (Black and Veatch, 2008), exfiltration losses through the lake liner are approximately 52.6 ac-ft/yr. Loads of nitrogen and phosphorus associated with these losses were estimated from average in-lake water quality data multiplied by the annual rate of exfiltration.

The NNE BATHTUB Tool was calibrated to average summer season water quality data observed over twice the Secchi depth (2*0.8 m = 1.6 m). Because simulated phosphorus concentrations could not be calibrated within the default range specified in the BATHTUB User's Manual (Walker, 1987), loads from additional parkland sources were increased to predict the average summer concentrations of total phosphorus (0.115 mg-P/L) and total nitrogen (1.16 mg-N/L), leaving the net sedimentation rates at 1.0 for both nutrients. Additional loading associated with parkland areas is 40 lb-N/yr and 40 lb-P/yr. The amount of the additional parkland loading of phosphorus due to internal recycling was calculated with the method discussed in Appendix A (Nutrient TMDL Development) and is 13.9 lb-P/yr. This portion of the phosphorus load was subtracted out of the additional parkland sources category, and the model was recalibrated with a loading of 26.1 lb-P/yr. The resulting calibration factor on the net phosphorus settling rate is 0.74, which allows the model to account for internal loading implicitly. Though internal loading is not explicitly assigned a load allocation, reductions in external loading of phosphorus will ultimately result in reductions of internal cycling processes. Internal loading of nitrogen was not calculated because 1) internal loading is typically insignificant relative to external loading, and 2) empirical relationships for the estimation of internal nitrogen loading have not been developed. Thus, the additional parkland source loading and calibration factor for nitrogen were not changed. To simulate the average observed summer chlorophyll *a* concentration, the calibration factor on chlorophyll *a* concentration was set to 0.45 for a predicted concentration of 17.8 µg/L.

Because of the way Echo Park Lake is currently managed (fountain, aeration system, hydroponic islands, etc.), the density of algae is typically below the target summer average concentration (20 µg/L). However pH and chlorophyll *a* exceedances have occurred. To be adequately protective, nutrient TMDLs are allocated at existing levels as an antidegradation measure to ensure that future loading does not increase the chlorophyll *a* concentration.

6.2.6 TMDL Summary

A waterbody's loading capacity represents the maximum load of a pollutant that can be assimilated without violating water quality standards (40 CFR 130.2(f)). This is the maximum nutrient load consistent with meeting the numeric target of 20 µg/L of chlorophyll *a* as a summer average. The methodology for determining the loading capacity is described briefly in this section. For more detail, refer to Appendix A (Nutrient TMDL Development).

Based on observed levels of chlorophyll *a* and DO in Echo Park Lake, existing levels of nitrogen and phosphorus loading result in attainment of both the chlorophyll *a* and DO targets. Monitoring data indicate that the average in-lake total nitrogen concentration is 1.16 mg-N/L (Appendix G, Monitoring Data). Because the majority of in-lake phosphorous samples have been less than the detection limits for the analytical laboratory, the phosphorus target concentration is based on an in-lake ratio of total nitrogen concentration to total phosphorus concentration close to 10. This ratio was selected to match that typically observed in natural systems and to balance biomass growth and prevent limitation by one nutrient (Thomann and Mueller, 1987). The corresponding in-lake concentrations of nitrogen and phosphorus are

- 1.2 mg-N/L summer average (May – September) and annual average
- 0.12 mg-P/L summer average (May – September) and annual average

To prevent degradation of this waterbody, nutrient TMDLs will be allocated based on existing loading. These TMDLs are broken down into the wasteload allocations (WLAs), load allocations (LAs), and Margins of Safety (MOS) using the general TMDL equation. Note that the MOS is zero because the TMDLs are equal to the existing load.

$$TMDL = \sum WLA + LA + MOS$$

For total nitrogen, the allocatable load is equal to the existing load and is divided among WLAs and LAs. The resulting TMDL equation for total nitrogen is then:

731 lb-N/yr = 682 lb-N/yr + 49.0 lb-N/yr + 0 lb-N/yr

For total phosphorus, the allocatable load is equal to the existing load and allocated to WLAs only; LAs are zero as explained in Section 6.2.6.2. The resulting TMDL equation for total phosphorous is then:

109 lb-P/yr = 83.3 lb-P/yr + 26.1 lb-P/yr + 0 lb-P/yr

Allocations are assigned for these TMDLs by requiring equal percentage reductions of all sources. Details associated with the WLAs, LAs, and MOS are presented in the following three sections.

As previously mentioned, in-lake concentrations of nitrogen and phosphorus have been determined for the lake based on recent and historical monitoring data (see Section 6.2.3). These in-lake concentrations reflect internal cycling processes (see Appendix A, Nutrient TMDL Development) and, therefore, differ from concentrations associated with various inflows. Nutrient concentrations associated with the WLA and LA inputs are described below. These values are provided as examples as they are calculated based on existing flow volumes (and will need to be recalculated if flow volumes change). Because the input concentrations do not consider internal cycling processes and are based on existing flow volumes, they do not match the allowable in-lake nitrogen and phosphorous concentrations.

6.2.6.1 Wasteload Allocations

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs). These TMDLs establish WLAs and alternative WLAs for total phosphorous and total nitrogen. The alternative WLAs will be effective and supersede the WLAs listed in Table 6-6 if the conditions described in Section **Error! Reference source not found.** are met.

Under any of the wasteload allocation schemes responsible jurisdictions are encouraged to consider the construction of wetland systems and bioswales (or other retention and treatment options) to treat the stormwater and supplemental water flows entering the lake, as well as stormwater diversion and infiltration using methods such as porous pavements and rain gardens. Implementing these options can reduce the lake's nutrient loads and, in the case of recirculation through constructed wetlands, reduce in-lake nutrient concentrations. In the case of Echo Park Lake, the City of Los Angeles has already modeled expected nutrient concentration reductions to stormwater flows to Echo Park Lake from such best management practices and construction is currently underway on a major lake rehabilitation project.

Additionally, persons that apply algaecides as part of an overall lake management strategy must comply with the Aquatic Pesticide General Permit (General Permit Order No. 2004-0009-DWQ, CAG990005).

The Echo Park Lake watershed drains to a series of storm drains prior to discharging to the lake. Therefore, all nutrient loads associated with the surrounding drainage area are assigned WLAs (Note: the loading associated with irrigation is included in the City of Los Angeles' WLA). The potable water input used for supplemental water addition to the lake discharges at a single point and is also assigned a WLA. Relevant permit numbers are

- County of Los Angeles (including the city of Los Angeles): Board Order 01-182 (as amended by Order No. R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003

Note that WLAs are equal to existing loading rates because no reductions in loading are required. WLAs are presented in Table 6-6. These loading values (in pounds per year) represent the TMDLs wasteload allocations (Table 6-6). All responsible jurisdictions must meet the WLAs at the point of discharge as a mass load except for stormwater permittees under the general industrial stormwater permit that are receiving concentration-based WLAs. In Table 6-6 below, stormwater permittees under the general industrial stormwater permit must meet the concentration values to achieve compliance with the WLAs. The phosphorous and nitrogen WLA concentrations were calculated by dividing the allowable load (in lbs/yr; Table 6-6) by total inflow volume (**Error! Reference source not found.**). Each wasteload allocation must be met at the point of discharge. A three-year average will be used to evaluate compliance. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met in the lake, then the total phosphorous and total nitrogen allocations are considered attained.

Table 6-6. Wasteload Allocations of Phosphorus and Nitrogen Loading to Echo Park Lake

Subwatershed	Responsible Jurisdiction	Input	Wasteload Allocation Total Phosphorus (lb-P/yr)[4]	Wasteload Allocation Total Nitrogen (lb-N/yr)[4]
Northern	Caltrans	State Highway	0.608	4.77

Subwatershed	Responsible Jurisdiction	Input	Wasteload Allocation Total Phosphorus (lb-P/yr)[4]	Wasteload Allocation Total Nitrogen (lb-N/yr)[4]
		Stormwater[1]		
Northern	City of Los Angeles	MS4 Stormwater[1]	24.7	156
Northern	General Industrial Stormwater Permittees (in the City of Los Angeles)[3]	General Industrial Stormwater[1]	0.16 mg/L P[2]	1.33 mg/L N[2]
Southern	Caltrans	State Highway Stormwater[1]	0.051	0.403
Southern	City of Los Angeles	MS4 Stormwater[1]	7.129	49.69
Southern	City of Los Angeles	Supplemental Water Additions	50.8	471
Total			**83.3**	**682**

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] The discharges governed by the general industrial stormwater permit are currently in the City of Los Angeles. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] For these responsible jurisdictions, the concentration-based WLA will be use to evaluate compliance.

[4] Each wasteload allocation must be met at the point of discharge. A three year average will be used to evaluate compliance. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met in the lake, then the total phosphorous and total nitrogen allocations are considered attained. In assessing compliance with wasteload allocations, responsible jurisdictions assigned both northern and southern subwatershed allocations may combine allocations.

6.2.6.2 Load Allocations

Atmospheric deposition of nitrogen to the lake surface is a nonpoint source and is assigned a load allocation (LA). Table 6-7 presents the LA for atmospheric deposition, which is equivalent to existing loading rates because no reductions in loading are required. Atmospheric deposition does not contribute significant loads of phosphorus (Appendix E, Atmospheric Deposition). LAs are provided for each responsible jurisdiction and input. These loading values (in pounds per year) represent the TMDLs load allocations (Table 6-7). Each load allocation must be met at the point of discharge. A three-year average will be used to evaluate compliance. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met in the lake, then the total phosphorous and total nitrogen allocations are considered attained.

Table 6-7. Load Allocations of Phosphorus and Nitrogen Loading to Echo Park Lake

Subwatershed	Responsible Jurisdiction	Input	Load Allocation Total Phosphorus (lb-P/yr)[1]	Load Allocation Total Nitrogen (lb-N/yr)[1]
Southern	City of Los Angeles	Additional Parkland Loading	26.1	40
Lake Surface		Atmospheric Deposition[2]	NA	9.0
Total			**26.1**	**49.0**

[1] Each load allocation must be met at the point of discharge. A three year average will be used to evaluate compliance. However, if applicable water quality criteria for ammonia, dissolved oxygen and pH, and the chlorophyll *a* target are met in the lake, then the total phosphorous and total nitrogen allocations are considered attained. In assessing compliance with wasteload allocations, responsible jurisdictions assigned both northern and southern subwatershed allocations may have their allocations combined.

[2] Loads for atmospheric deposition are based on direct precipitation to the lake (calculated by the annual average precipitation multiplied by the surface area of the lake).

6.2.6.3 Margin of Safety

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. This lake is currently achieving the in-lake chlorophyll *a* target and TMDLs are being established at the existing loads. This conservative anti-degradation measure is the implicit margin of safety for these TMDLs.

6.2.6.4 Critical Conditions/Seasonality

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. Critical conditions for nutrient impaired lakes typically occur during the warm summer months when water temperatures are elevated and algal growth rates are high. Elevated temperatures not only reduce the saturation levels of DO, but also increase the toxicity of ammonia and other chemicals in the water column. Excessive rates of algal growth may cause large swings in DO, elevated pH, odor, and aesthetic problems. Loading of nutrients to lakes during winter months are often biologically available to fuel algal growth in summer months. These nutrient TMDLs account for summer season critical conditions by using the NNE Bathtub model to calculate possible annual loading rates consistent with meeting the summer chlorophyll *a* target concentration of 20 µg/L. These TMDLs are based on existing conditions as an anti-degradation measure since nitrogen and phosphorus levels are currently achieving the chlorophyll *a* target level. These TMDLs therefore protect for critical conditions.

6.2.6.5 Daily Load Expression

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. These TMDLs present a maximum daily load according to the guidelines provided by USEPA (2007). The majority of nutrient loading to Echo Park Lake comes from the supplemental water additions. These maximum loads are not allowed each day of the year because the annual loads specified by the TMDLs must also be achieved. The WLA and LA loads presented above are annual loading caps that cannot be exceeded.

The maximum daily loads from the supplemental water additions were calculated from average daily water volume and the long-term average concentration consistent with meeting the TMDLs. For the supplemental water addition, the allowable concentrations are 1.13 mg-N/L and 0.122 mg-P/L (Section 6.2.6.1). The daily average flow rate is 0.419 ac-ft/d (153 ac-ft/yr divided by 365 d/yr). The maximum daily nutrient loads from this source are 1.29 lb-N/d and 0.139 lb-P/d.

As described above, in order to achieve in-lake nutrient targets as well as annual load-based allocations, the maximum allowable daily loads cannot be discharged to the lake every day. The WLA and LA loads presented above are annual loading caps that cannot be exceeded.

6.2.6.6 Future Growth/Conditions

The Echo Park Lake watershed is nearly fully developed, with the exception of small park areas that are not likely to be converted in the near future. If land use changes do occur in the watershed, BMPs will be required such that loading rates are consistent with the allocations established by these TMDLs. Therefore, no load allocation has been set aside for future growth.

Though future growth is not expected to impact conditions in Echo Park Lake, the city of Los Angeles is in the process of designing and constructing a large scale rehabilitation project at the park, which will impact the conditions of the lake system. In addition to treating runoff flows with a hydrodynamic separator and constructed wetland system, the City is considering the use of reclaimed/recycled water for supplemental water additions to the lake rather than the potable water source that is currently used.

The design engineers indicate that the rehabilitation project will have the following impacts on the system (personal communication, James Rasmus, Black and Veatch, April 16, 2010):

- Wet weather flows to the lake from the storm drain system will increase from 16.7 ac-ft/yr to 131 ac-ft/yr. Dry weather flows to the lake from the storm drain system will increase from 0 ac-ft/yr to 123 ac-ft/yr.
- Exfiltration losses through the lake liner will decrease to 0.896 ac-ft/yr.
- The vortex and constructed wetland treatment system will treat 121 ac-ft/yr of wet weather flows, 123 ac-ft/yr of dry weather flows, and all water used for supplementing lake levels. Lake water will be recirculated through the constructed wetland system at a rate of 600 gpm.
- The vortex/constructed wetland system will remove 68 percent of the total nitrogen and 77 percent of the total phosphorus loads from treated flows. Recirculation of lake water will increase reduction efficiencies to 80 percent for total nitrogen and 86 percent for total phosphorus. These values represent updated efficiencies from the City of Los Angeles (personal communication, City of Los Angeles, June 2010).

To simulate the impacts of the rehabilitation project on lake water quality, the following conservative assumptions were made:

- Reclaimed water from the Glendale Water Reclamation Plant will be used for irrigation of park areas and supplemental water additions (see Appendix G [Monitoring Data] for water quality data for this source).
- The volume of reclaimed water used for supplemental water additions will be 15.5 ac-ft/yr based on a worst case scenario of evaporative losses of 55,000 gpd for three months straight with no wet or dry weather flows to offset these losses.

Simulating this future scenario for Echo Park Lake with the calibrated NNE BATHTUB model yields a total nitrogen concentration of 0.79 mg-N/L, a total phosphorus concentration of 0.10 mg-P/L, and a chlorophyll *a* concentration of 12µg/L. These simulated in-lake concentrations are based on the reduction efficiencies reported for the vortex/constructed wetland/recirculation system. If reductions are based on the vortex/constructed wetland system without recirculation, the simulated in-lake total phosphorus concentration is not predicted to meet the target of 0.12 mg-P/L regardless of the assumptions regarding supplemental water additions (potable versus reclaimed, with or without supplemental water additions, etc.). If the rehabilitation project does not result in the assumed reduction efficiencies of 80 percent for total nitrogen and 86 percent for total phosphorus, pre-treatment or additional treatment of the wet weather and dry weather flows may be necessary to meet the in-lake target concentrations.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

6.3 Lead Impairment

Echo Park Lake was listed as impaired for lead in 1996 based on an assessment in the Regional Board's Water Quality Assessment and Documentation Report (LARWQCB, 1996). Consistent with project plan recommendations provided in California's Impaired Waters Guidance (SWRCB, 2005), USEPA and local agencies collected 61 additional samples (12 wet weather) between November 2004 and March 2010 to evaluate current water quality conditions. There were only four dissolved lead exceedances in 61 samples (Appendix G, Monitoring Data). Therefore, Echo Park Lake meets lead water quality standards, and USEPA concludes that preparing a TMDL for lead is unwarranted at this time. USEPA recommends that Echo Park Lake not be identified as impaired by lead in California’s next 303(d) list.

6.4 Copper Impairment

Echo Park Lake was listed as impaired for copper in 1996 based on an assessment in the Regional Board's Water Quality Assessment and Documentation Report (LARWQCB, 1996). Consistent with project plan recommendations provided in California's Impaired Waters Guidance (SWRCB, 2005), USEPA and local agencies collected 60 additional samples (12 wet weather) between November 2004 and March 2010 to evaluate current water quality conditions. There were only four dissolved copper exceedances in 60 samples (Appendix G, Monitoring Data). Therefore, Echo Park Lake meets copper water quality standards, and USEPA concludes that preparing a TMDL for copper is unwarranted at this time. USEPA recommends that Echo Park Lake not be identified as impaired by copper in California’s next 303(d) list.

6.5 PCB Impairment

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 by the trade name Aroclors, or total PCBs. The environmental measurements and targets described in this section 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).

The PCB impairment of Echo Park Lake affects beneficial uses related to recreation, municipal water supply, wildlife health, and fish consumption. PCBs are no longer in production. While some loading of PCBs continues to occur in watershed runoff, the primary source of PCBs in the water column and aquatic life in Echo Park Lake is from historic loads stored in the lake sediments. Like other organochlorine compounds, PCBs accumulate in aquatic organisms and biomagnify in the food chain. As a result, low environmental exposure concentrations can result in unacceptable levels in higher trophic level fish in the lake.

6.5.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. The existing beneficial uses assigned to Echo Park Lake include REC1, REC2, WARM, WILD, and MUN. Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated levels of PCBs are currently impairing the REC1, REC2, and WARM uses by causing toxicity to aquatic organisms and raising fish tissue concentrations to levels that are unsafe for human consumption (which can result in fish consumption advisories) and impair sport fishing recreational uses. At high enough concentrations WILD and MUN uses could become impaired.

6.5.2 Numeric Targets

The Basin Plan designates water column concentrations associated with MUN and WARM beneficial uses. There are no numeric criteria specified for sediment or fish tissue concentrations of PCBs in the Basin Plan. For the purposes of this TMDL, additional numeric targets for these endpoints are based on the consensus-based sediment quality guidelines defined in MacDonald et al. (2000) and the fish tissue concentration goal, referred to as the fish contaminant goal (FCG), defined by the OEHHA (2008) for fish consumption. The numeric targets used for PCBs are listed below. The fish tissue concentration goal was also used to back calculate site-specific targets in sediment, with the most stringent target applying. See Section 2 of this TMDL report for additional details.

The water column criteria for PCBs in the Basin Plan are associated with a specific beneficial use. For waters designated MUN, the Basin Plan lists a maximum contaminant level of 0.0005 mg/L, or 0.5 μg/L, total PCBs in water. The Plan also contains a narrative criterion that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Each waterbody addressed in this report is designated WARM, at a minimum, and must meet this requirement. A chronic criterion for the sum of PCB compounds in freshwater systems to protect aquatic life is included in the CTR as 0.014 μg/L (USEPA, 2000a). The CTR also provides a human health-based water quality criterion for the consumption of both water and organisms and organisms only of 0.00017 μg/L (0.17 ng/L). The human health criterion of 0.17 ng/L is the most restrictive applicable criteria specified for water column concentrations and is selected as the water column target.

For sediment, the consensus-based sediment quality guidelines provided in Macdonald et al. (2000) for the threshold effects concentration (TEC) for total PCBs in sediment is 59.8 μg/kg (ng/dry g) 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. This target is designed to protect benthic dwelling organisms and explicitly does not consider "the potential for bioaccumulation in aquatic organisms nor the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans)." The existing sediment PCB concentrations in Echo Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Thus, a separate sediment target calculation based on a biota-sediment accumulation factor (BSAF) is carried out to ensure that fish tissue concentration goals are met.

The fish contaminant goal for PCBs defined by the OEHHA (2008) is 3.6 ppb wet weight in muscle tissue (filets). Elevated fish tissue concentrations are largely attributable to foodweb bioaccumulation derived from contaminated sediment. A biota-sediment accumulation factor (BSAF) approach is appropriate to correlate sediment and fish tissue targets. For total PCBs, the corresponding sediment concentration target determined using the BSAF is 1.77 μg/kg dry weight, as described in detail in Section 6.5.5. All applicable targets are shown below in Table 6-8. For sediment, the lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target.

Table 6-8. PCB Targets Applicable to Echo Park Lake

Medium	Source	Target
Fish (ppb wet weight)	OEHHA FCG	3.6
Sediment (µg/kg dry weight)	Consensus-based TEC	59.8
Sediment (µg/kg dry weight)	BSAF-derived target	1.77
Water (ng/L)	CTR	0.17

Note: Shaded cells represent the selected targets for this TMDL.

6.5.3 Summary of Monitoring Data

This section summarizes the monitoring data for Echo Park Lake related to the PCB impairment. Additional details regarding monitoring data are discussed in Appendix G (Monitoring Data). For PCBs, as well as other organochlorine compounds, sample analyses include both a detection limit and a method reporting limit. For example, a typical detection limit for total PCBs in sediment reported by UCLA is 0.53 µg/kg dry weight, while the reporting limit is 15 µg/kg dry weight.

Water column sampling was conducted as part of an organics study performed by UCLA (funded by a grant managed by the Regional Board) in the summer of 2008. In all three samples PCB congeners were detected, but below reporting limits of 15 ng/L. Water samples from Echo Park Lake were also collected by the Regional Board on December 18, 2008 at four stations. PCBs at all stations were below the detection limit of 1 ng/L. A summary of the water column data is shown in Table 6-9.

Table 6-9. Summary of Water Column Samples for PCBs in Echo Park Lake

Station	Average Water Concentration (ng/L)[1]	Number of Samples	Number of Samples above Detection Limits	Number of Samples between Detection and Reporting Limits
NE near LA City Storm Drain	(0.5)	1	0	0
W near County Storm Drain	(0.5)	1	0	0
South	[2.72]	3	2	2
North, Lotus Bed	[4.47]	2	1	1
Northeast	(0.5)	1	0	
In-Lake Average[2]	[1.74]			
CTR Water Column Target	0.17			

[1] Total PCBs in a sample represents the sum of all quantified PCB congeners, including results reported below the method reporting limit. If all congeners were non-detect, the total is represented as one-half the detection limit. Results of any laboratory duplicate analyses of the same sample were averaged. Results for each station represent the average of individual samples. Results in parentheses indicate that the sample average is based only on the detection limits of the samples and that no PCBs were quantified in any of the collected samples. Sample averages based only on detected results below the reporting limit plus non-detects are shown in square brackets.

[2] Overall average is the average of individual station averages.

Echo Park Lake samples from summer 2008 were analyzed for pollutant concentrations associated with suspended sediments in the lake. Samples were analyzed at two stations with detection limits ranging from 3.19 µg/kg to 10.05 µg/kg dry weight, and reporting limits ranging from 31.95 µg/kg to 100.5 µg/kg dry weight. In one sample, PCB congener BZ-31 was detected at 117 µg/kg dry weight, while congener BZ-153 was also detected, but not above the reporting limit.

UCLA collected bed sediment samples at four locations in Echo Park Lake in summer and fall 2008. Samples related to tributaries were collected in the lake near the tributary outfalls. Several PCB congeners were detected in the summer 2008 sediment samples, with only one station with all congeners below detection limits.

Sediment sampling was also conducted by the Regional Board at three stations on December 1, 2009. PCBs were quantified at all three stations. PCB congeners BZ-18, BZ-95, BZ-101, and BZ-110 were quantified at all locations. Other congeners were also quantified at one or two locations. A summary of the sediment data is shown in Table 6-10. The lake-wide average of 40.29 µg/kg dry weight is greater than the concentration near outfalls (24.16 µg/kg dry weight), and both are less than the consensus-based TEC of 59.8 µg/kg dry weight.

Table 6-10. Summary of Sediment Samples for PCBs in Echo Park Lake, 2008-2009

Station	Average Sediment Concentration (µg/kg dry weight)[1]	Number of Samples	Number of Samples above Detection Limits	Number of Samples between Detection and Reporting Limits
NE near LA City Storm Drain	2.98	3	3	2
W near County Storm Drain	31.41	2	1	0
South	29.85	1	1	0
North, Lotus Bed	70.01	2	1	0
Northeast	(0.30)	1	0	0
NW Arm near outfall	38.10	1	1	0
Center Lake	72.55	2	2	0
Center Lake South	77.10	1	1	0
In-Lake Average[2]	40.29			
Influent Average	24.16			
Consensus-based TEC	59.8			

[1] Total PCBs in a sample represents the sum of all quantified PCB congeners, including results reported below the method reporting limit. If all congeners were non-detect, the total is represented as one-half the detection limit. Results of any laboratory duplicate analyses of the same sample were averaged. Results for each station represent the average of individual samples. Results in parentheses indicate that the sample average is based only on the detection limits of the samples and that no PCBs were quantified in any of the collected samples. Sample averages based only on detected results below the reporting limit plus non-detects are shown in square brackets.

[2] Overall average is the average of individual station averages.

Four fish samples (composites of filets from five fish) were collected and analyzed for PCBs as Aroclor equivalents between 1987 and 1991. In 1987, a largemouth bass and bullhead sample reported 84 ppb and 50 ppb wet weight, respectively. Another largemouth bass sample was analyzed in 1991 and reported as 0 ppb (the detection limits for the historical fish samples are not reported). In 1992, the PCB concentration in a largemouth bass composite sample was 60 ppb. The average reported PCB concentration in all samples from the 1980s and 1990s was 48.5 ppb, including the reported zero. Results from the individual samples are shown in Appendix G (Monitoring Data).

Considering only data collected in the past 10 years, the average concentration of total PCBs in largemouth bass was 49.0 ppb wet weight, based on the two largemouth bass composite samples collected by SWAMP in the summer of 2007 with an average lipid fraction of 0.396 percent and an additional sample from April 2010 with a lipid fraction of 0.315 percent. Three composite samples of bottom-feeding carp (Trophic Level 3) were also analyzed. These yielded an average total PCB concentration of 81.8 ppb wet weight with an average lipid fraction of 1.263 percent. The recent fish-tissue data for Echo Park Lake are summarized in Table 6-11.

Table 6-11. Summary of Recent Fish Tissue Samples for PCBs in Echo Park Lake

Sample Date	Fish Species	Total PCBs (ppb wet weight)[1]
11 June 2007	Largemouth Bass	64.7
11 June 2007	Largemouth Bass	31.5
13 April 2010	Largemouth Bass	50.9
11 June 2007	Common Carp	119.0
11 June 2007	Common Carp	82.6
13 April 2010	Common Carp	43.9
2007 - 2010 Average – Largemouth Bass		49.0
2007 - 2010 Average – Common Carp		81.8
FCG		3.6

[1] Composite sample of filet from five individuals.

In sum, recent fish tissue samples collected from Echo Park Lake are all elevated above the OEHHA fish consumption guidelines for total PCBs. Concentrations in sediment are, on average, below the consensus-based TEC, although individual samples exceed this value. Concentrations in water have not been quantified; however, several 2008 samples were above detection limits that exceed the CTR criterion, although less than the reporting limit.

6.5.4 Source Assessment

PCBs in Echo Park Lake are primarily due to historical loading and storage within the lake sediments, with some ongoing contribution by watershed wet weather loads. Dry weather loading is assumed to be negligible because hydrophobic contaminants primarily move with particulate matter that is mobilized by higher flows. Stormwater loads from the watershed were estimated based on simulated sediment load and observed PCB concentrations on sediment near inflows to the lake. Watershed loads of PCBs may arise from spills from industrial and commercial uses, improper disposal, and atmospheric deposition. Industrial and commercial spills will tend to be associated with specific land areas, such as older industrial districts, junk yards, and transformer substations. Improper disposal could have occurred at various locations (indeed, waste PCB oils were sometimes used for dust control on dirt roads in the 1950s). Atmospheric deposition occurs across the entire watershed.

There is no definitive information on specific sources of elevated PCB load within the watershed at this time. Therefore, an average concentration on sediment is applied to all contributing areas. Although supplemental water additions of potable water makes up a significant amount of the flow to Echo Park Lake it does not contribute sediment load and is considered to not contribute significantly to PCB loading (total suspended sediment measured non-detect in two samples collected August 4th 2009).

The average concentration of PCBs on incoming sediment was estimated to be 24.16 µg/kg dry weight and the estimated annual sediment load to Echo Park Lake is 1.32 tons/yr (see Appendix D, Wet Weather Loading). The resulting estimated wet weather load of PCBs is approximately 0.029 g/yr. Table 6-12 shows the annual PCB load estimated from each jurisdiction.

Table 6-12. Total PCB Loads Estimated for Each Jurisdiction and Subwatershed in the Echo Park Watershed (g/yr)

Subwatershed	Responsible Jurisdiction	Input	Sediment Load (tons/yr)	Total PCB Load (g/yr)	Percent of Total Load
Northern	Caltrans	State Highway Stormwater[1]	0.044	0.0010	3.35%
Northern	City of Los Angeles	MS4 Stormwater[1]	0.98	0.021	74.24%
Southern	Caltrans	State Highway Stormwater[1]	0.0037	0.0001	0.28%
Southern	City of Los Angeles	MS4 Stormwater[1]	0.29	0.0064	22.13%
Total Load from Watershed			1.32	0.029	100%

[1] This input includes effluent from storm drain systems during both wet and dry weather.

As described in Appendix E (Atmospheric Deposition), Section E.5, the net atmospheric deposition of PCBs directly to the lake surface is estimated to be close to zero, with deposited loads balanced by volatilization losses. Atmospheric deposition onto the watershed is implicitly included in the estimates of watershed load.

6.5.5 Linkage Analysis

The linkage analysis provides the quantitative basis for determining the loading capacity of PCBs into Echo Park Lake consistent with achieving water quality standards. The loading capacity is used to calculate the TMDL and corresponding allocations of that load to permitted point sources (wasteload allocations) and nonpoint sources (load allocations).

Lake sediments are often the predominant source of PCBs in biota. The bottom sediment serves as a sink for organochlorine compounds that can be recycled through the aquatic life cycle. PCBs are strongly sorbed to sediments and have long half-lives in sediment and water. Incoming loads of PCBs will mainly be adsorbed to particulates from stormwater runoff (eroded sediments from legacy contamination sites or from atmospheric deposition).

The use of bioaccumulation models and the fish tissue data from Echo Park Lake are discussed in detail in Appendix H (Organochlorine Compounds TMDL Development) and Appendix G (Monitoring Data), respectively. The existing sediment PCB concentrations in Echo Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Therefore, a sediment target based on biota-sediment bioaccumulation (a BSAF approach) is calculated from the smaller of the ratio of the FCG to existing fish tissue concentrations obtained from trophic level 4 fish (TL4; e.g., largemouth bass) and bottom-feeding, trophic level 3 fish (TL3; e.g., common carp). In general, the TL3 number is expected to be more restrictive due to additional uptake of organochlorine compounds from the sediment by bottom feeding fish. The existing fish tissue concentrations were calculated using only recent data (collected in the past 10 years) because the loads and exposure concentrations of PCBs are likely to have declined steadily since the cessation of production and use of the chemical. For PCBs in Echo Park Lake the ratios of the FCG to existing concentrations are:

TL4: 3.6/49.0 = 0.0735

TL3: 3.6/81.8 = 0.0440

The lower ratio, obtained for the TL3 fish, corresponds to the trophic level requiring the greatest reductions to achieve the fish tissue target. This ratio is applied to the observed in-lake sediment concentration of 40.29 µg/kg dry weight to obtain the site-specific sediment target concentration to achieve fish tissue goals of 1.77 µg/kg dry weight (Table 6-13).

Table 6-13. Fish Tissue-Based Total PCB Concentration Targets for Sediment in Echo Park Lake

Total PCB Concentration	Sediment (µg/kg dry weight)
Existing	40.29
BSAF-derived Target	1.77
Required Reduction	95.6%

The BSAF-derived sediment target is less than the consensus-based sediment quality guideline TEC of 59.8 µg/kg dry weight. (The consensus-based sediment quality guideline is for the protection of benthic organisms, and explicitly does not address bioaccumulation and human-health risks from the consumption of contaminated fish.) The lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target. In addition, the CTR criterion for human health (0.17 ng/L) is the selected numeric target for the water column and protects both aquatic life and human health.

The toxicant loading model described in Appendix H (Organochlorine Compounds TMDL Development) can be used to estimate the loading rate that would be required to yield the existing sediment concentration under steady-state conditions. This yields an estimate that a load of 3,230 g/yr would be required to maintain observed sediment concentrations under steady-state conditions. The estimated current watershed loading rate is 0.76 g/yr, or 0.02 percent of this amount. Therefore, impairment due to elevated fish tissue concentrations of PCBs in Echo Park Lake is primarily due to the storage of historic loads of PCBs in the lake sediment.

6.5.6 TMDL Summary

Because PCB impairment in Echo Park Lake is predominantly due to historic loads stored in the lake sediment, this impairment is not amenable to a standard, load-based TMDL analysis. Instead, allocations are first assigned on a concentration basis, with the goal of attaining the concentrations identified above for water and sediment as well as fish tissue. The concentration targets apply to water and sediment entering the lake and within the lake

The PCB TMDL will be allocated to ensure achievement of the loading capacity. TMDLs are broken down into the wasteload allocations (WLAs), load allocations (LAs), and Margins of Safety (MOS) using the general TMDL equation.

$$TMDL = \sum WLA + LA + MOS$$

Note that since this TMDL is being expressed as a concentration in sediment, in this scenario, the loading capacity is equal to 1.77 µg/kg dry weight total PCBs. The wasteload allocations and load allocations are also equal to 1.77 µg/kg dry weight total PCBs in sediment. There is no explicit MOS. Allocations are assigned for this TMDL by requiring equal concentrations of all sources. Details associated with the WLAs, LAs, and MOS are presented in the following three sections.

6.5.6.1 Wasteload Allocations

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs). This TMDL establishes WLAs at their point of discharge. This TMDL also establishes alternative wasteload allocations for total PCBs ("Alternative WLAs if the Fish Tissue Target is Met") described in Section 0. The alternative wasteload allocations will supersede the wasteload allocations in Section 6.5.6.1.1 if the conditions described in Section 0 are met.

6.5.6.1.1 Wasteload Allocations

The entire watershed of Echo Park Lake is contained in an MS4 jurisdiction, and watershed loads are therefore assigned WLAs. Relevant permit numbers are

- County of Los Angeles (including the city of Los Angeles): Board Order 01-182 (as amended by Order No. R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003

PCBs in water flowing into Echo Park Lake are below detection limits, and most PCB load is expected to move in association with sediment. Therefore, suspended sediment in water flowing into the lake is assigned wasteload allocations. Additionally, the TMDL establishes wasteload allocations for PCBs in the water column equal to the CTR based water column target. The CTR based water column target includes both dissolved PCBs and PCBs associated with suspended sediment. The existing average concentration of sediment entering the lake is 24.16 µg/kg dry weight. Therefore, a reduction of (24.16 – 1.77)/24.16 = 92.7 percent is required on the sediment-associated load from the watershed.

The wasteload allocations are shown in Table 6-14 and each wasteload allocation must be met at the point of discharge.

Table 6-14. Wasteload Allocations for Total PCBs in Echo Park Lake

Subwatershed	Responsible Jurisdiction	Input	Wasteload Allocation for PCBs Associated with Suspended Sediment[3] (µg/kg dry weight)	Wasteload Allocation for PCBs in the Water Column[3] (ng/L)
Northern	Caltrans	State Highway Stormwater[1]	1.77	0.17
Northern	City of Los Angeles	MS4 Stormwater[1]	1.77	0.17
Northern	General Industrial Stormwater Permittees (in the City of Los Angeles)[2]	General Industrial Stormwater[1]	1.77	0.17
Southern	Caltrans	State Highway Stormwater[1]	1.77	0.17
Southern	City of Los Angeles	MS4 Stormwater[1]	1.77	0.17

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] The discharges governed by the general industrial stormwater permit are currently in the City of Los Angeles. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

6.5.6.1.2 Alternative Wasteload Allocations if the Fish Tissue Target is Met

The wasteload allocations listed in Table 6-14 will be superseded, and the wasteload allocations in Table 6-15 will apply, if:

1. The responsible jurisdictions submit to USEPA and the Regional Board material describing that the fish tissue target of 3.6 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five common carp each measuring at least 350 mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative wasteload allocations in Table 6-15, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

Each wasteload allocation must be met at the point of discharge.

Table 6-15. Alternative Wasteload Allocations for Total PCBs in Echo Park Lake if the Fish Tissue Target is Met

Subwatershed	Responsible Jurisdiction	Input	Wasteload Allocation for PCBs Associated with Suspended Sediment[3] (µg/kg dry weight)	Wasteload Allocation for PCBs in the Water Column[3] (ng/L)
Northern	Caltrans	State Highway Stormwater[1]	59.8	0.17
Northern	City of Los Angeles	MS4 Stormwater[1]	59.8	0.17
Northern	General Industrial Stormwater Permittees (in the City of Los Angeles)[2]	General Industrial Stormwater[1]	59.8	0.17
Southern	Caltrans	State Highway Stormwater[1]	59.8	0.17
Southern	City of Los Angeles	MS4 Stormwater[1]	59.8	0.17

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] The discharges governed by the general industrial stormwater permit are currently in the City of Los Angeles. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

6.5.6.2 Load Allocations

This TMDL establishes load allocations (LAs) at their point of discharge. This TMDL also establishes alternative load allocations for total PCBs ("Alternative LAs if the Fish Tissue Target is Met") described in Section 6.5.6.2.2. The alternative load allocations will supersede the load allocations in Section 6.5.6.2.1 if the conditions described in Section 6.5.6.2.2 are met.

6.5.6.2.1 Load Allocations

No part of the watershed of Echo Park Lake is outside MS4 jurisdiction; therefore no LAs are assigned to watershed loads. No load is allocated to atmospheric deposition of PCBs. The legacy PCB stored in lake sediment is the major cause of use impairment associated with elevated fish tissue concentrations, and is assigned a load allocation. The in-lake allocation is in concentration terms: specifically, the responsible jurisdiction (City of Los Angeles) should achieve a PCB concentration of 1.77 µg/kg dry weight in lake bottom sediments (Table 6-16).

Table 6-16. Load Allocations for Total PCBs in Echo Park Lake

Subwatershed	Responsible Jurisdiction	Input	Load Allocation (µg/kg dry weight)
Lake Surface	City of Los Angeles	Lake bottom sediments	1.77

6.5.6.2.2 Alternative Load Allocations if the Fish Tissue Target is Met

The load allocations listed in Table 6-16 will be superseded, and the load allocations in Table 6-17 will apply, if:

1. The responsible jurisdiction submits to USEPA and the Regional Board material describing that the fish tissue target of 3.6 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five largemouth bass each measuring at least 350mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative load allocations in Table 6-17, and
3. USEPA does not object to the Regional Board’s determination within 60 days of receiving notice of it.

Table 6-17. Alternative Load Allocations for Total PCBs in Echo Park Lake if the Fish Tissue Target is Met

Subwatershed	Responsible Jurisdiction	Input	Load Allocation (µg/kg dry weight)
Lake Surface	City of Los Angeles	Lake bottom sediments	59.8

6.5.6.3 Margin of Safety

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. This TMDL contains an implicit MOS based on conservative assumptions. The allocations are set based on the lower of either the BSAF-derived sediment target or the consensus-based TEC sediment target to ensure achievement of the OEHHA FCG target in fish tissue. The selected BSAF-derived target concentration in sediment is considerably lower than the consensus-based TEC target.

6.5.6.4 Critical Conditions/Seasonality

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. This TMDL protects beneficial uses by reducing fish tissue concentrations to the FCG target and protecting benthic biota in sediment. Because fish bioaccumulate PCBs, concentrations in tissues of edible sized game fish integrate exposure over a number of years. As a result, overall average loading is more important for the attainment of standards than instantaneous or daily concentrations. WLAs and LAs in this TMDL are assigned as concentrations and protect during all seasons and in both high and low flow conditions. This TMDL therefore protects for critical conditions.

6.5.6.5 Daily Load Expression

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. This TMDL includes a maximum daily load estimated according to the guidelines provided by USEPA (2007).

Because the PCB WLAs are expressed as concentrations on sediment, the daily maximum allowable load is calculated from the maximum daily sediment load multiplied by the TMDL WLA concentration. The maximum daily sediment load is estimated from the 99th percentile daily flow and the sediment event mean concentration that yields the estimated annual sediment load.

No USGS gage currently exists in the Echo Park Lake watershed. USGS Station 11102000, Mission Creek near Montebello, CA, was selected as a surrogate for flow determination. This gage is the closest USGS StreamStats gage in the Los Angeles River Basin with a relatively small drainage area (2,662 acres). The 99th percentile flow was chosen to represent the peak flow for this drainage. Choosing the 99th percentile flow eliminates errors due to outliers and is reasonable for development of a daily load expression.

The USGS StreamStats program was used to determine the 99th percentile flow for Mission Creek (30.2 cfs) (Wolock, 2003). To estimate the peak flow to Echo Park Lake, the 99th percentile flow for Mission Creek was scaled down by the ratio of drainage areas (784 acres/2,662 acres; Echo Park Lake watershed area/Mission Creek watershed area at the gage). The resulting peak flow estimate for Echo Park Lake is 8.89 cfs.

The event mean concentration of sediment in stormwater (55.8 mg/L) was calculated from the estimated existing watershed sediment load of 1.32 tons/yr (Table 6-12) divided by the total storm flow volume entering the lake (17.4 ac-ft/yr). Multiplying the sediment event mean concentration by the 99th percentile peak daily flow (8.98 cfs) yields a daily maximum sediment load from stormwater of1226 kg/d (1.35 tons/d). Applying the wasteload allocation concentration of 1.77 µg total PCBs per dry kg of sediment yields the stormwater daily maximum allowable load of 0.0022 g/d of total PCBs. This load is associated with the MS4 stormwater permittees. The maximum allowable daily load must be met on all days, and the concentration-based WLAs must be met to ensure compliance with the TMDL.

6.5.6.6 Future Growth

USEPA regulates PCBs under the Toxic Substances Control Act (TSCA), which generally bans the manufacture, use, and distribution in commerce of the chemicals in products at concentrations of 50 parts per million or more, although TSCA allows USEPA to authorize certain uses, such as to rebuild existing electrical transformers during the transformers' useful life. Therefore, no additional allowance is made for future growth in the PCB TMDL.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

6.6 CHLORDANE IMPAIRMENT

Total chlordane consists of a family of related chemicals, including cis- and trans-chlordane, oxychlordane, trans-nonachlor, and cis-nonachlor. Observations and targets discussed in this section all refer to total chlordane. Chlordane was used as a pesticide in field, commercial, and residential uses. Chlordane is no longer in production, but persists in the environment from legacy loads.

The chlordane impairment of Echo Park Lake affects beneficial uses related to recreation, municipal water supplies, wildlife health, and fish consumption. While some loading of chlordane continues to occur in watershed runoff, the primary source of chlordane in the water column and aquatic life in Echo Park Lake is from historic loads stored in the lake sediments. Chlordane, like other OC pesticides and PCBs, accumulates in aquatic organisms and biomagnifies in the food chain. As a result, low environmental concentrations can result in unacceptable levels in higher trophic level fish in the lake. The approach for chlordane is similar to that for PCBs.

6.6.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. The existing beneficial uses assigned to Echo Park Lake include REC1, REC2, WARM, WILD, and MUN. Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated levels of chlordane are currently impairing the REC1,REC2 and WARM uses by causing toxicity to aquatic organisms and raising fish tissue concentrations to levels that are unsafe for human consumption (which can result in fish consumption advisories) and impair sport fishing recreational uses. At high enough concentrations WILD and MUN uses could become impaired.

6.6.2 Numeric Targets

The Basin Plan designates water column concentrations associated with MUN and WARM beneficial uses. There are no numeric criteria specified for sediment or fish tissue concentrations of chlordane listed in the Basin Plan. For the purposes of this TMDL, additional numeric targets for these endpoints are based on the consensus-based sediment quality guidelines defined in MacDonald et al. (2000) and the fish tissue concentration goal, referred to as the fish contaminant goal (FCG), for chlordane defined by the Office of Environmental Health Hazard Assessment (OEHHA) for fish consumption. The numeric targets used for chlordane are listed below. The fish tissue concentration goal was also used to back calculate site-specific targets in sediment, with the most stringent target applying. See Section 2 of this TMDL report for additional details.

The water column criteria for chlordane in the Basin Plan are associated with a specific beneficial use. For waters designated MUN, the Basin Plan lists a maximum contaminant level of 0.0001 mg/L, or 0.1 μg/L. The Basin Plan also contains a narrative criterion that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Acute and chronic criterion for chlordane in freshwater systems are defined by the California Toxics Rule as 2.4 μg/L and 0.0043 μg/L, respectively (USEPA, 2000a). 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 and 0.00059 µg/L, respectively (USEPA, 2000a). For Echo Park Lake, the Regional Board has determined that the appropriate human health criterion is 0.00059 µg/L (0.59 ng/L) as the MUN use is not an existing use and may be removed.

For sediment, the consensus-based sediment quality guidelines provided in Macdonald et al. (2000) for the threshold effects concentration (TEC) for chlordane is 3.24 µg/kg (µg/kg dry weight) 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. This target is designed to protect benthic dwelling organisms and explicitly does not consider "the potential for bioaccumulation in aquatic organisms nor the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans)." The existing sediment chlordane concentrations in Echo Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Thus, a separate sediment target calculation based on a biota-sediment accumulation factor (BSAF) is carried out to ensure that fish tissue concentration goals are met.

The fish contaminant goal for chlordane defined by the OEHHA (2008) is 5.6 ppb wet weight in muscle tissue (filets). Elevated fish tissue concentrations are largely attributable to foodweb bioaccumulation derived from contaminated sediment. A biota-sediment accumulation factor (BSAF) approach is appropriate to correlate sediment and fish tissue targets. For chlordane, the corresponding sediment concentration target determined using the BSAF is 2.10 µg/kg dry weight, as described in Section 6.6.5. All applicable targets are shown below in Table 6-18. For sediment the lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target.

Table 6-18. Total Chlordane Targets for Echo Park Lake

Media	Source	Target
Fish (ppb wet weight)	OEHHA FCG	5.6
Sediment (ng /dry g)	Consensus-based TEC	3.24
Sediment (µg/kg dry weight)	BSAF-derived target	2.10
Water (ng/L)	CTR	0.59

Note: Shaded cells represent the selected targets for this TMDL.

6.6.3 Summary of Monitoring Data

This section summarizes the monitoring data for Echo Park Lake related to the chlordane impairment. Addition details regarding monitoring data are discussed in Appendix G (Monitoring Data).

Water column sampling was conducted as part of an organics study performed by UCLA (funded by a grant managed by the Regional Board) in the summer of 2008 at two locations within Echo Park Lake. These analyses measured cis- and trans-chlordane, but not oxychlordane or nonachlor. All water column samples were less than the detection limit for chlordane (1.5 ng/L; the detection limit for chlordane is higher than the water column criterion of 0.59 ng/L). No additional water column sampling for chlordane has been conducted in Echo Park Lake.

A summary of the water column data is shown in Table 6-19.

Table 6-19. Summary of Water Column Samples for Total Chlordane in Echo Park Lake

Station	Average Water Concentration(ng/L)	Number of Samples	Number of Samples Above Detection Limits[1]
South	(0.75)[2]	2	0
North, Lotus Bed	(0.75)	1	0
In-Lake Average[3]	(0.75)		
CTR Criterion	0.59		

[1] Non-detect samples were included in reported averages at one-half of the sample detection limit.

[2] Numbers in parentheses indicate that sample is based only on the detection limits of the samples, and that no chlordanes were quantified in any of the collected samples.

[3] Overall average is the average of individual station averages.

Concentrations of chlordane on suspended sediment were also analyzed at two in-lake stations during the summer of 2008 by UCLA; both were less than the detection limits (3.19 µg/kg to 10.05 µg/kg dry weight). Porewater was sampled by UCLA in both the fall and spring of 2008. Specifically, chlordane concentrations in the porewater sampled at four sites during the summer of 2008 were all less than the detection limit of 15 ng/L; both sites sampled during the fall of 2008 were also below detection limits of 15 ng/L to 1,500 ng/L.

UCLA also collected sediment samples at five locations in Echo Park Lake during summer and fall 2008. As with the water column analyses by UCLA, these report cis- and trans-chlordane, but not oxychlordane or nonachlor. Of the nine total samples, all but one resulted in chlordane concentrations below the detection limit (which ranged from 0.44 µg/kg to 1.23 µg/kg dry weight). One sediment sample collected during summer 2008 resulted in a sample average concentration of 4.14 µg/kg dry weight, which is greater than the consensus-based TEC of 3.24 µg/kg dry weight. Three in-lake locations were sampled by the Regional Board and USEPA on December 1, 2009, resulting in reportable concentrations of 4.1 µg/kg to 22.25 µg/kg dry weight. These analyses do include oxychlordane and nonachlor.

All lake stations were averaged to estimate an exposure concentration for total chlordane in Echo Park Lake sediments of 4.43 µg/kg dry weight (with non-detects included at one-half the detection limit for each sample). Stations located near outfalls are taken as an estimate of the concentrations on incoming sediment. A summary of the sediment data is shown in Table 6-20.

Table 6-20. Summary of Sediment Samples for Total Chlordane in Echo Park Lake

Station	Average Sediment Concentration (µg/kg dry weight)[1]	Number of Samples	Number of Samples above Detection Limits	Number of Samples between Detection and Reporting Limits
NE near LA City Storm Drain	(0.44)	3	0	0
W near County Storm Drain	2.25	2	1	0
South	(0.46)	1	0	0
North, Lotus Bed	(0.53)	2	0	0
Northeast	(0.30)	1	0	0
NW Arm, near outfall	22.25	1	1	0

Station	Average Sediment Concentration (µg/kg dry weight)[1]	Number of Samples	Number of Samples above Detection Limits	Number of Samples between Detection and Reporting Limits
Center Lake	5.15	2	1	0
Center Lake S	4.10	1	1	0
In-Lake Average[2]	4.43			
Influent Average	8.31			
Consensus-based TEC	3.24			

[1] Total chlordane in a sample represents the sum of all reported measurements for alpha and gamma chlordane, oxychlordane, and cis- and trans-nonachlor, including results reported below the method reporting limit. If all components were non-detect, the total is represented as one-half the detection limit. Results of any laboratory duplicate analyses of the same sample were averaged. Results for each station represent the average of individual samples. Results in parentheses indicate that the sample average is based only on the detection limits of the samples and that no chlordane quantified in any of the collected samples. Sample averages based only on detected results below the reporting limit plus non-detects are shown in square brackets.

[2] Overall average is the average of individual station averages.

Fish tissue concentrations of total chlordane from Echo Park Lake have been analyzed in largemouth bass, common carp, and bullhead (SWAMP and TSMP). Four fish samples (composites of filets from five fish) were collected and analyzed for total chlordane between 1987 and 1991. In 1987, concentrations in a largemouth bass and a bullhead composite sample were reported at 17.8 and 66 ppb wet weight, respectively. Two additional largemouth bass samples were analyzed in 1991, with concentrations reported as 0 ppb (the detection limits for the historical fish samples are not reported).

Considering only data collected in the past 10 years, the average concentration of chlordane in largemouth bass was 4.70 ppb wet weight, based on the three largemouth bass composite samples collected in the summer of 2007 and April 2010 with an average lipid fraction of 0.37 percent. Three composite samples of bottom-feeding common carp (Trophic Level 3) were also analyzed. These yielded an average total chlordane concentration of 11.85 ppb wet weight with an average lipid fraction of 1.26 percent. The recent fish-tissue data for Echo Park Lake are summarized in Table 6-21.

Table 6-21. Summary of Recent Fish Tissue Samples for Total Chlordane in Echo Park Lake

Sample Date	Fish Species	Total Chlordane (ppb wet weight)[1]
11 June 2007	Largemouth Bass	8.534
11 June 2007	Largemouth Bass	2.037
13 April 2010	Largemouth Bass	2.517
11 June 2007	Common Carp	18.41
11 June 2007	Common Carp	12.92
13 April 2010	Common Carp	4.216
2007 - 2010 Average – Largemouth Bass		4.70
2007 - 2010 Average – Common Carp		11.85
FCG		5.6

[1] Composite samples of filet from five individuals.

In sum, recent fish tissue concentrations in Echo Park Lake are above the FCG in two of three samples for common carp, and in one of three largemouth bass composite samples. The average concentration in sediment is below the consensus-based TEC, although individual samples exceed the TEC. Water column samples have all been below detection limits.

6.6.4 Source Assessment

Chlordane in Echo Park Lake is primarily due to historical loading and storing within the lake sediments, with some ongoing contribution by watershed wet weather loads. Dry weather loading is assumed to be negligible because hydrophobic contaminants primarily move with particulate matter that is mobilized by higher flows. Stormwater loads from the watershed were estimated based on simulated sediment load and observed chlordane concentrations on sediment near inflows to the lake. Watershed loads of chlordane may arise from past pesticide applications, improper disposal, and atmospheric deposition. Pesticide applications were most likely associated with agricultural, commercial, and residential areas. Improper disposal could have occurred at various locations, while atmospheric deposition occurs across the entire watershed.

There is no definitive information on specific sources within the watershed at this time. Therefore, an average concentration on sediment is applied to all contributing areas. Although supplemental water additions of potable water makes up a significant amount of the flow to Echo Park Lake it does not contribute sediment load and is considered to no contribute significantly to chlordane loading (total suspended sediment measured non-detect in two samples collected August 4th 2009).

The average concentration of total chlordane on incoming sediment is estimated to be 8.31 µg/kg dry weight (Table 6-20) and the annual sediment load to Echo Park Lake is 1.32 tons/yr (see Appendix D, Wet Weather Loading). The resulting estimated wet weather load of chlordane is approximately 0.0099 g/yr (Table 6-22).

Table 6-22. Total Chlordane Loads Estimated for Each Jurisdiction and Subwatershed in the Echo Park Watershed (g/yr)

Subwatershed	Responsible Jurisdiction	Input	Sediment Load (tons/yr)	Total Chlordane Load (g/yr)	Percent of Total Load
Northern	Caltrans	State Highway Stormwater[1]	0.044	0.0003	3.35%
Northern	City of Los Angeles	MS4 Stormwater[1]	0.98	0.0074	74.24%
Southern	Caltrans	State Highway Stormwater[1]	0.0037	0.00003	0.28%
Southern	City of Los Angeles	MS4 Stormwater[1]	0.29	0.0022	22.13%
Total Load from Watershed			**1.32**	**0.0099**	**100.00%**

[1] This input includes effluent from storm drain systems during both wet and dry weather.

As described in Appendix E (Atmospheric Deposition), Section E.5, the net atmospheric deposition of total chlordane directly to the lake surface is estimated to be close to zero, with deposited loads balanced by volatilization losses. Atmospheric deposition onto the watershed is implicitly included in the estimates of watershed load.

6.6.5 Linkage Analysis

The linkage analysis provides the quantitative basis for determining the loading capacity of total chlordane into Echo Park Lake consistent with achieving water quality standards. The loading capacity is used to calculate the TMDL and corresponding allocations of that load to permitted point sources (wasteload allocations) and nonpoint sources (load allocations).

Lake sediments are often the predominant source of total chlordane in biota. The bottom sediment serves as a sink for organochlorine compounds that can be recycled through the aquatic life cycle. Chlordanes are strongly sorbed to sediments and have long half-lives in sediment and water. Incoming loads of total chlordane will mainly be adsorbed to particulates from stormwater runoff (eroded sediments from legacy contamination sites or from atmospheric deposition).

The use of bioaccumulation models and the fish tissue data from Echo Park Lake are discussed in detail in Appendix H (Organochlorine Compounds TMDL Development) and Appendix G (Monitoring Data), respectively. The existing sediment chlordane concentrations in Echo Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Therefore, a sediment target based on biota-sediment bioaccumulation (a BSAF approach) is calculated from the smaller of the ratio of the FCG to existing fish tissue concentrations obtained from trophic level 4 fish (TL4; e.g., largemouth bass) and bottom-feeding, trophic level 3 fish (TL3; e.g., common carp). In general, the TL3 number is expected to be more restrictive due to additional uptake of organochlorine compounds from the sediment by bottom feeding fish. The existing fish tissue concentrations were calculated using only recent data (collected in the past 10 years) because the loads and exposure concentrations of chlordane are likely to have declined steadily since the cessation of production and use of the chemical. For chlordane in Echo Park Lake the ratios of the FCG to existing concentrations are:

TL4: 5.6/4.70 = 1.191

TL3: 5.6/11.85 = 0.473

The lower ratio, obtained for the TL3 fish, corresponds to the trophic level requiring the greatest reductions to achieve the fish tissue target. This ratio is applied to the observed sediment concentration of 4.43 µg/kg dry weight to obtain the site-specific sediment target concentration to achieve fish tissue goals of 2.10 µg/kg dry weight (Table 6-23).

Table 6-23. Fish Tissue-Based Chlordane Concentration Targets for Sediment in Echo Park Lake

Total Chlordane Concentration	Sediment (µg/kg dry weight)
Existing	4.43
BSAF-derived Target	2.10
Required Reduction	52.8%

The BSAF-derived sediment target is less than the consensus-based sediment quality guideline TEC of 3.24 µg/kg dry weight. (The consensus-based sediment quality guideline is for the protection of benthic organisms, and explicitly does not address bioaccumulation and human-health risks from the consumption of contaminated fish.) The lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target. In addition, the CTR criterion for human health (0.59 ng/L) is the selected numeric target for the water column and protects both aquatic life and human health.

The toxicant loading model described in Appendix H (Organochlorine Compounds TMDL Development) can be used to estimate the loading rate required to yield the existing sediment concentration under steady-state conditions. This yields an estimate that a load of 63.8 g/yr would be required to maintain observed sediment concentrations under steady-state conditions. The estimated current watershed loading rate is 0.0099 g/yr, or 0.02 percent of this amount. Therefore, impairment due to elevated fish tissue concentrations of chlordane in Echo Park Lake is primarily due to the storage of historic loads of chlordane in the lake sediment.

6.6.6 TMDL Summary

Because chlordane impairment in Echo Park Lake is predominantly due to historic loads stored in the lake sediment, this impairment is not amenable to a standard, load-based TMDL analysis. Instead, allocations are first assigned on a concentration basis, with the goal of attaining the concentrations identified above for water and sediment, as well as fish tissue. The concentration targets apply to water and sediment entering the lake and within the lake.

The chlordane TMDL will be allocated to ensure achievement of the loading capacity. TMDLs are broken down into the wasteload allocations (WLAs), load allocations (LAs), and Margins of Safety (MOS) using the general TMDL equation.

$$TMDL = \sum WLA + LA + MOS$$

Note that since this TMDL is being expressed as a concentration in sediment, in this scenario, the loading capacity is equal to 2.10 µg/kg dry weight chlordane. The wasteload allocations and load allocations are also equal to 2.10 µg/kg dry weight chlordane in sediment. There is no explicit MOS. Allocations are assigned for this TMDL by requiring equal concentrations of all sources. Details associated with the WLAs, LAs, and MOS are presented in the following three sections.

6.6.6.1 Wasteload Allocations

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs). This TMDL establishes WLAs at their point of discharge. This TMDL also establishes alternative wasteload allocations for chlordane (“Alternative WLAs if the Fish Tissue Target is Met”) described in Section 6.6.6.1.2. The alternative wasteload allocations will supersede the wasteload allocations in Section 6.6.6.1.1 if the conditions described in Section 6.6.6.1.2 are met.

6.6.6.1.1 Wasteload Allocations

The entire watershed of Echo Park Lake is contained in an MS4 jurisdiction, and therefore receives WLAs. Relevant permit numbers are

- County of Los Angeles (including the city of Los Angeles): Board Order 01-182 (as amended by Order No. R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003

Total chlordane concentrations in water flowing into Echo Park Lake are below detection limits, and most chlordane load is expected to move in association with sediment. Therefore, the suspended sediment in water flowing into the lake is assigned wasteload allocations. Additionally, the TMDL establishes wasteload allocations for chlordane in the water column equal to the CTR based water column target. The CTR based water column target includes both dissolved chlordane and chlordane associated with suspended sediment. The existing concentration of sediment entering the lake is 8.31 µg/kg dry weight. Therefore, a reduction of (8.31 – 2.10)/8.31 = 74.7 percent is required on the sediment-associated load from the watershed. The reduction in watershed load is slightly greater than the reduction needed for in-lake sediments because the estimated concentration on influent sediment is greater than the lake-wide average.

The wasteload allocations are shown in Table 6-24 and each wasteload allocation must be met at the point of discharge.

Table 6-24. Wasteload Allocations for Total Chlordane in Echo Park Lake

Subwatershed	Responsible Jurisdiction	Input	Wasteload Allocation for Chlordane Associated with Suspended Sediment[3] (µg/kg dry weight)	Wasteload Allocation for Chlordane in the Water Column[3] (ng/L)
Northern	Caltrans	State Highway Stormwater[1]	2.10	0.59
Northern	City of Los Angeles	MS4 Stormwater[1]	2.10	0.59
Northern	General Industrial Stormwater Permittees (in the City of Los Angeles)[2]	General Industrial Stormwater[1]	2.10	0.59
Southern	Caltrans	State Highway Stormwater[1]	2.10	0.59
Southern	City of Los Angeles	MS4 Stormwater[1]	2.10	0.59

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] The discharges governed by the general industrial stormwater permit are currently in the City of Los Angeles. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

6.6.6.1.2 Alternative Wasteload Allocations if the Fish Tissue Target is Met

The wasteload allocations listed in Table 6-24 will be superseded, and the wasteload allocations in Table 6-25 will apply, if:

1. The responsible jurisdictions submit to USEPA and the Regional Board material describing that the fish tissue target of 5.6 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five common carp each measuring at least 350mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative wasteload allocations in Table 6-25, and
3. USEPA does not object to the Regional Board's determination within sixty days of receiving notice of it.

Each wasteload allocation must be met at the point of discharge.

Table 6-25. Alternative Wasteload Allocations for Total Chlordane in Echo Park Lake if Fish Tissue Targets are Met

Subwatershed	Responsible Jurisdiction	Input	Wasteload Allocation for Chlordane Associated with Suspended Sediment[3] (µg/kg dry weight)	Wasteload Allocation for Chlordane in the Water Column[3] (ng/L)
Northern	Caltrans	State Highway Stormwater[1]	3.24	0.59
Northern	City of Los Angeles	MS4 Stormwater[1]	3.24	0.59
Northern	General Industrial Stormwater Permittees (in the City of Los Angeles)[2]	General Industrial Stormwater[1]	3.24	0.59
Southern	Caltrans	State Highway Stormwater[1]	3.24	0.59
Southern	City of Los Angeles	MS4 Stormwater[1]	3.24	0.59

[1] This input includes effluent from storm drain systems during both wet and dry weather.

[2] The discharges governed by the general industrial stormwater permit are currently in the City of Los Angeles. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3] Each wasteload allocation must be met at the point of discharge.

6.6.6.2 Load Allocations

This TMDL establishes load allocations (LAs) at their point of discharge. This TMDL also establishes alternative load allocations for chlordane ("Alternative LAs if the Fish Tissue Target is Met") described in Section 6.6.6.2.2. The alternative load allocations will supersede the load allocations in Section 6.6.6.2.1 if the conditions described in Section 6.6.6.2.2 are met.

6.6.6.2.1 Load Allocations

No part of the watershed of Echo Park Lake is outside MS4 jurisdiction; therefore no LAs are assigned to the watershed loads. No load is allocated to atmospheric deposition of chlordane. The legacy chlordane stored in lake sediment is the major cause of impairment associated with elevated fish tissue concentrations, and is assigned a load allocation. The in-lake allocation is in concentration terms: specifically, the responsible jurisdiction (city of Los Angeles) should achieve a total chlordane concentration of 2.10 µg/kg dry weight in lake bottom sediments (Table 6-26).

Table 6-26. Load Allocations for Total Chlordane in Echo Park Lake

Subwatershed	Responsible Jurisdiction	Input	Load Allocation (µg/kg dry weight)
Lake Surface	City of Los Angeles	Lake bottom sediments	2.10

6.6.6.2.2 Alternative Load Allocations if the Fish Tissue Target is Met

The load allocations listed in Table 6-26 will be superseded, and the load allocations in Table 6-27 will apply, if:

1. The responsible jurisdiction submits to USEPA and the Regional Board material describing that the fish tissue target of 5.6 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five largemouth bass each measuring at least 350mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative load allocations in Table 6-27, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

Table 6-27. Alternative Load Allocations for Total Chlordane in Echo Park Lake if the Fish Tissue Target is Met

Subwatershed	Responsible Jurisdiction	Input	Load Allocation (µg/kg dry weight)
Lake Surface	City of Los Angeles	Lake bottom sediments	3.24

6.6.6.3 Margin of Safety

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. This TMDL contains an implicit MOS based on conservative assumptions. The allocations are set based on the lower of either the BSAF-derived sediment target or the consensus-based TEC sediment target to ensure achievement of the OEHHA FCG target in fish tissue. The selected BSAF-derived target concentration in sediment is considerably lower than the consensus-based TEC target.

6.6.6.4 Critical Conditions/Seasonality

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. This TMDL protects beneficial uses by reducing fish tissue concentrations to the FCG target and protecting benthic biota in sediment. Because fish bioaccumulate chlordane, concentrations in tissues of edible sized game fish integrate exposure over a number of years. As a result, overall average loading is more important for the attainment of standards than instantaneous or daily concentrations. WLAs and LAs in this TMDL are assigned as concentrations and protect during all seasons and in both high and low flow conditions. This TMDL therefore protects for critical conditions.

6.6.6.5 Daily Load Expression

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. This TMDL includes a maximum daily load estimated according to the guidelines provided by USEPA (2007).

Because the total chlordane WLAs are expressed as concentrations on sediment, the daily maximum allowable load is calculated from the maximum daily sediment load multiplied by the TMDL WLA concentration. The maximum daily sediment load is estimated from the 99th percentile daily flow and the sediment event mean concentration that yields the estimated annual sediment load.

The daily maximum allowable load in Echo Park Lake is calculated from the estimated 99th percentile flow to the Lake multiplied by the event mean concentration consistent with achieving the long-term loading targets, described above in the PCBs section. USGS Station 11102000, Mission Creek near Montebello, CA, was selected as a surrogate for flow determination for flow to the lake, as described in the PCBs section (Section 6.5.6.5).

The event mean concentration of sediment in stormwater (55.8 mg/L) was calculated from the estimated existing watershed sediment load of 1.32 tons/yr (Table 6-22) divided by the total storm flow volume reaching the lake (17.4 ac-ft/yr). Multiplying the sediment event mean concentration by the 99th percentile peak daily flow (8.98 cfs) yields a daily maximum sediment load from stormwater of 1226 kg/d (1.35 tons/d). Applying the wasteload allocation concentration of 2.10 µg total chlordane per dry kg of sediment yields the stormwater daily maximum allowable load of 0.0026 g/d of total chlordane. This load is associated with the MS4 stormwater permittees. The maximum allowable daily load must be met on all days, and the concentration-based WLAs must be met to ensure compliance with the TMDL.

6.6.6.6 Future Growth

The manufacture and use of chlordane is currently banned. Therefore, no additional allowance is made for future growth in the chlordane TMDL.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

6.7 Dieldrin Impairment

Dieldrin is a chlorinated insecticide originally developed as an alternative to DDT and was in wide use from the 1950s to the 1970s. Dieldrin in the environment also arises from use of the insecticide aldrin. Aldrin is not itself toxic to insects, but is metabolized to dieldrin in the insect body. The use of both dieldrin and aldrin was discontinued in the 1970s.

The dieldrin impairment of Echo Park Lake affects beneficial uses related to recreation, municipal water supplies, wildlife health, and fish consumption. Dieldrin, like PCBs and chlordane, is an organochlorine compound that is strongly sorbed to sediment and is no longer in production. As such, the approach for dieldrin impairment is similar to that for PCBs and chlordane.

6.7.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. The existing beneficial uses assigned to Echo Park Lake include REC1, REC2, WARM, WILD, and MUN. Descriptions of these uses are listed in Section 2 of this TMDL report. Elevated levels of dieldrin are currently impairing the REC1,REC2 and WARM uses by causing toxicity to aquatic organisms, raising fish tissue concentrations to levels that are unsafe for human consumption (which can result in fish consumption advisories), and impair sport fishing recreational uses. At high enough concentrations WILD and MUN uses could become impaired.

6.7.2 Numeric Targets

The Basin Plan designates water column concentrations associated with MUN and WARM beneficial uses. There are no numeric criteria specified for sediment or fish tissue concentrations of dieldrin in the Basin Plan. For the purposes of this TMDL, additional numeric targets for these endpoints are based on the consensus-based sediment quality guidelines defined in MacDonald et al. (2000) and the fish tissue concentration goal, referred to as the fish contaminant goal (FCG), defined by the OEHHA (2008) for fish consumption. The numeric targets for dieldrin are listed below. The fish tissue concentration goal was also used to back calculate site-specific targets in sediment, with the most stringent target applying. See Section 2 of this TMDL report for additional details.

The water column targets for dieldrin in the Basin Plan are associated with a specific beneficial use. The Plan also contains a narrative criterion that toxic chemicals not be present at levels that are toxic or detrimental to aquatic life (LARWQCB, 1994). Each waterbody addressed in this TMDL is designated WARM, at a minimum, and must meet this requirement. Acute and chronic criteria for the protection of aquatic life and wildlife in freshwater systems are included in the CTR for dieldrin as 0.24 µg/L and 0.056 µg/L, respectively (USEPA, 2000a). The CTR also provides a human health-based water quality criterion for the consumption of organisms only and the consumption of water and organisms as 0.00014 µg/L (USEPA, 2000a). The human health criterion of 0.00014 µg/L (0.14 ng/L) is the most restrictive of the applicable criteria specified for water column concentrations and is selected as the water column target.

For sediment, the consensus-based sediment quality guidelines provided in MacDonald et al. (2000) for the threshold effects concentration (TEC) of dieldrin in sediment is 0.46 µg/kg (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. This target is designed to protect benthic dwelling organisms and explicitly does not consider "the potential for bioaccumulation in aquatic organisms nor the associated hazards to the species that consume aquatic organisms (i.e., wildlife and humans)." The estimated existing sediment dieldrin concentrations in Echo Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Thus, a separate sediment target calculation based on a biota-sediment accumulation factor (BSAF) is carried out to ensure that fish tissue concentration goals are met.

The fish contaminant goal for dieldrin defined by the OEHHA (2008) is 0.46 ppb wet weight in muscle tissue (filets). Elevated fish tissue concentrations are largely attributable to foodweb bioaccumulation derived from contaminated sediment. A biota-sediment accumulation factor (BSAF) approach is appropriate to correlate sediment and fish tissue targets. For dieldrin, the corresponding sediment concentration target estimated using the BSAF approach is 0.80 µg/kg dry weight, as described in Section 6.7.5. All applicable targets are shown below in Table 6-28. For sediment the lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target.

Table 6-28. Dieldrin Targets for Echo Park Lake

Media	Source	Target
Fish (ppb wet weight)	OEHHA FCG	0.46
Sediment (µg/kg dry weight)	Consensus-based TEC	1.90
Sediment (µg/kg dry weight)	BSAF-derived target	0.80
Water (ng/L)	CTR	0.14

Note: Shaded cells represent the selected targets for this TMDL.

6.7.3 Summary of Monitoring Data

This section summarizes the monitoring data for Echo Park Lake related to the dieldrin impairment. Additional details regarding monitoring data are discussed in Appendix G (Monitoring Data).

Water column sampling was conducted as part of an organics study performed by UCLA (funded by a grant managed by the Regional Board) in the summer of 2008 with three samples at two locations within Echo Park Lake. All three water column samples were less than the detection limit for dieldrin (3 ng/L; the detection limit for dieldrin is higher than the water column criterion of 0.14 ng/L). No additional water column sampling for dieldrin has been conducted in Echo Park Lake.

A summary of the water column data is shown in Table 6-29.

Concentrations of dieldrin in suspended sediment were also analyzed at two in-lake stations during the summer of 2008 by UCLA, both were less than the detection limits (6.39 µg/kg to 20.10 µg/kg dry weight). Porewater was sampled by UCLA in both the summer and fall of 2008; dieldrin concentrations in all samples were less than the detection limits of 30 ng/L to 3,000 ng/L.

Table 6-29. Summary of Water Column Samples for Dieldrin in Echo Park Lake

Station	Average Water Concentration (ng/L)[1]	Number of Samples	Number of Samples Above Detection Limits
South	(1.50)[2]	2	0
North, Lotus Bed	(1.50)	1	0
In-Lake Average[2]	(1.50)		
CTR Criterion	0.14		

[1] Non-detect samples were included in reported averages at one-half of the sample detection limit. Numbers in parentheses indicate that sample is based only on the detection limits of the samples, and that no dieldrin was quantified in any of the collected samples.

[2] Overall average is the average of individual station averages.

UCLA collected bed sediment samples at five locations in Echo Park Lake in summer and fall 2008. All nine samples analyzed by UCLA resulted in dieldrin concentrations below the detection limit (which ranged from 0.83 µg/kg to 2.46 µg/kg dry weight). Since the upper end of this range is greater than the consensus-based TEC for dieldrin sediment (1.9 µg/kg dry weight), exceedances cannot be ruled out. Three in-lake locations were sampled by the Regional Board and USEPA on December 1, 2009; all were below the detection limit (1 µg/kg dry weight). Stations located near outfalls are taken as an estimate of the concentrations on incoming sediment. Because dieldrin does appear in fish at levels greater than the FCG, and because these body burdens of dieldrin are believed to arise from the sediment, EPA decided to represent statistical estimates for the sediment concentrations of dieldrin by setting the concentration of non-detected samples to the detection limit. The estimated lake-wide average of < 1.39 µg/kg dry weight is less than the consensus-based TEC of 1.90 µg/kg dry weight. A summary of the sediment sampling is provided in Table 6-30.

Table 6-30. Summary of Sediment Samples for Dieldrin in Echo Park Lake

Station	Average Sediment Concentration (µg/kg dry weight)[1]	Number of Samples	Number of Samples Above Detection Limits
NE near LA City Storm Drain	(1.76)	3	0
W near County Storm Drain	(1.19)	2	0

Station	Average Sediment Concentration (µg/kg dry weight)[1]	Number of Samples	Number of Samples Above Detection Limits
South	(1.83)	1	0
North, Lotus Bed	(2.13)	2	0
Northeast	(1.20)	1	0
NW Arm, near outfall	(1.00)	1	0
Center Lake	(1.00)	1	0
Center Lake S	(1.00)	1	0
In-Lake Average[2]	(1.39)		
Influent Average	(1.32)		
Consensus-based TEC	1.90		

[1] Non-detect samples are included in reported averages at the detection limit. Numbers in parentheses indicate that sample is based only on the detection limits of the samples, and that no dieldrin was detected in any of the collected samples.

[2] Overall average is the average of individual station averages.

Fish tissue concentrations of dieldrin from Echo Park Lake have been analyzed in largemouth bass, common carp, and bullhead (SWAMP and TSMP). Four fish samples (composites of filets from five fish) were collected and analyzed for total dieldrin between 1987 and 1991. In 1987, concentrations in a largemouth bass and a bullhead composite sample were reported at 0 and 7 ppb wet weight, respectively. Two additional largemouth bass samples were analyzed in 1991, with concentrations reported as 0 ppb (the detection limits for the historical fish samples are not reported).

Considering only data collected in the past 10 years, the average concentration of dieldrin in largemouth bass was 0.716 ppb wet weight, based on the three largemouth bass composite samples collected by SWAMP in the summer of 2007 and April 2010 with an average lipid fraction of 0.37 percent. Three composite samples of bottom-feeding common carp (Trophic Level 3) were also analyzed. These yielded an average dieldrin concentration of 0.935 ppb wet weight with an average lipid fraction of 1.26 percent. The recent fish-tissue data for Echo Park Lake are summarized in Table 6-31.

Table 6-31. Summary of Recent Fish Tissue Samples for Dieldrin in Echo Park Lake

Sample Date	Fish Species	Dieldrin (ppb wet weight)[1]
11 June 2007	Largemouth Bass	0.848
11 June 2007	Largemouth Bass	0.585
13 April 2010	Largemouth Bass	[0.453][2]
11 June 2007	Common Carp	1.08
11 June 2007	Common Carp	0.79
13 April 2010	Common Carp	0.538
2007 - 2010 Average – Largemouth Bass		0.650

Sample Date	Fish Species	Dieldrin (ppb wet weight)[1]
2007 - 2010 Average – Common Carp		0.803
FCG		0.46

[1] Composite samples of filet from five individuals.

[2] Values in square brackets are reported concentrations below the practical reporting limit and are included in the averages.

In sum, five of six recent fish tissue concentrations in Echo Park Lake are above the FCG for dieldrin in both common carp and largemouth bass composite samples. Sediment and water column concentrations have all been below detection limits; however, the maximum detection limit in sediment is less than the consensus-based TEC.

6.7.4 Source Assessment

Dieldrin in Echo Park Lake is suspected to be primarily due to historical loading and storage within the lake sediments, with some ongoing contribution by watershed wet weather loads. Dry weather loading and direct atmospheric deposition to the lake are considered negligible sources of dieldrin. Stormwater loads from the watershed could not be directly estimated because all sediment and water samples were below detection limits. Watershed loads of dieldrin may arise from past pesticide applications, improper disposal, and atmospheric deposition. Pesticide applications were most likely associated with agricultural, commercial, and residential areas. Improper disposal could have occurred at various locations, while atmospheric deposition occurs across the entire watershed.

There is no definitive information on specific sources within the watershed at this time. Therefore, an average concentration of sediment is applied to all contributing areas. Although supplemental water additions of potable water makes up a significant amount of the flow to Echo Park Lake it does not contribute sediment load and is considered to not contribute significantly to dieldrin loading (total suspended sediment measured non-detect in two samples collected August 4th 2009).

An upper-bound analysis for dieldrin is performed using the sediment load and detection limit to determine the maximum potential loading rate of dieldrin from the watershed. The dieldrin sediment concentration is assigned based on the estimate of concentration on influent sediment from sample detection limits of 1.32 µg/kg dry weight and the annual sediment load to Echo Park Lake is 1.32 tons/yr (see Appendix D, Wet Weather Loading). The resulting estimated upper bound on the wet weather load from the watershed is 0.0016 g/yr or less (Table 6-32).

Table 6-32. Maximum Potential Dieldrin Loads for Each Jurisdiction and Subwatershed in the Echo Park Watershed (g/yr)

Subwatershed	Responsible Jurisdiction	Input	Upper-Bound Potential Current Dieldrin Load (g/yr)
Northern	Caltrans	State Highway Stormwater[1]	<0.00005
Northern	City of Los Angeles	MS4 Stormwater[1]	<0.00117
Southern	Caltrans	State Highway Stormwater[1]	<0.00000
Southern	City of Los Angeles	MS4 Stormwater[1]	<0.00035
Total Load from Watershed			<0.0016

This input includes effluent from storm drain systems during both wet and dry weather. As described in Appendix E (Atmospheric Deposition), Section E.5, the net atmospheric deposition of dieldrin directly to the lake surface is estimated to be close to zero, with deposited loads balanced by volatilization losses. Atmospheric deposition onto the watershed is implicitly included in the estimates of watershed load.

6.7.5 Linkage Analysis

The linkage analysis provides the quantitative basis for determining the loading capacity of dieldrin into Echo Park Lake consistent with achieving water quality standards. The loading capacity is used to calculate the TMDL and corresponding allocations of that load to permitted point sources (wasteload allocations) and nonpoint sources (load allocations).

Lake sediments are often the predominant source of dieldrin in biota. The bottom sediment serves as a sink for organochlorine compounds that can be recycled through the aquatic life cycle. Dieldrin is strongly sorbed to sediments and has a long half-life in sediment and water. Incoming loads of dieldrin will mainly be adsorbed to particulates from stormwater runoff (eroded sediments from legacy contamination sites or from atmospheric deposition).

The use of bioaccumulation models and the fish tissue data from Echo Park Lake are discussed in detail in Appendix H (Organochlorine Compounds TMDL Development) and Appendix G (Monitoring Data), respectively. The estimated existing sediment dieldrin concentrations in Echo Park Lake are lower than the consensus-based TEC target, and existing fish tissue concentrations are higher than the fish tissue target. Therefore, a sediment target based on biota-sediment bioaccumulation (a BSAF approach) is calculated from the smaller of the ratio of the FCG to existing fish tissue concentrations obtained from trophic level 4 fish (TL4; e.g., largemouth bass) and bottom-feeding, trophic level 3 fish (TL3; e.g., common carp). In general, the TL3 number is expected to be more restrictive due to additional uptake of OC pesticides and PCBs from the sediment by bottom feeding fish. The existing fish tissue concentrations were calculated using only recent data (collected in the past 10 years) because the loads and exposure concentrations of dieldrin are likely to have declined steadily since the cessation of production and use of the chemical. For dieldrin in Echo Park Lake the ratios of the FCG to existing concentrations are:

TL4: 0.46/0.650 = 0.708

TL3: 0.46/0.803 = 0.573

The lower ratio, obtained for the TL3 fish, corresponds to the trophic level requiring the greatest reductions to achieve the fish tissue target. This ratio is applied to the estimated in-lake sediment concentration. Analyses of sediment concentrations are, however, below detection limits. Using an estimated concentration of 1.39 µg/kg dry weight based on the sample detection limits, the resulting target concentration would be 0.80 µg/kg dry weight to obtain FCGs. Calculation with a literature-based BSAF (Appendix G, Monitoring Data) suggests that even lower concentrations might be needed. However, the literature-based BSAF is highly uncertain and may not be directly applicable to conditions in Echo Park Lake. Therefore, the target based on the detection limits is used, with acknowledgment that the estimate may need to be refined if additional data are collected at lower detection limits. The resulting fish tissue based target concentration of dieldrin in the sediment of Echo Park Lake is shown in Table 6-33.

Table 6-33. Fish Tissue-Based Dieldrin Concentration Targets for Sediment in Echo Park Lake

Dieldrin Concentration	Sediment (µg/kg dry weight)
Existing	< 1.39
BSAF-derived Target	0.80
Required Reduction	< 50.7%

The BSAF-derived sediment target is less than the consensus-based sediment quality guideline TEC of 1.90 µg/kg dry weight. (The consensus-based sediment quality guideline is for the protection of benthic organisms, and explicitly does not address bioaccumulation and human-health risks from the consumption of contaminated fish.) The lower value of the consensus-based TEC target or the BSAF-derived target is selected as the final sediment target. In addition, the CTR criterion for human health (0.14 ng/L) is the selected numeric target for the water column and protects both aquatic life and human health.

6.7.6 TMDL Summary

Because the dieldrin impairment in Echo Park Lake is most likely due to historic loads stored in the lake sediment, this impairment is not amenable to a standard, load-based TMDL analysis. Instead, allocations are first assigned on a concentration basis, with the goal of attaining the concentrations identified above for water and sediment, as well as fish tissue. The concentration targets apply to water and sediment entering the lake and within the lake

The dieldrin TMDL will be allocated to ensure achievement of the loading capacity. TMDLs are broken down into the wasteload allocations (WLAs), load allocations (LAs), and Margins of Safety (MOS) using the general TMDL equation.

$$TMDL = \sum WLA + LA + MOS$$

Note that since this TMDL is being expressed as a concentration in sediment, in this scenario, the loading capacity is equal to 0.80 µg/kg dry weight dieldrin. The wasteload allocations and load allocations are also equal to 0.80 µg/kg dry weight dieldrin in sediment. There is no explicit MOS. Allocations are assigned for this TMDL by requiring equal concentrations of all sources. Details associated with the WLAs, LAs, and MOS are presented in the following three sections.

6.7.6.1 Wasteload Allocations

Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs). This TMDL establishes WLAs at their point of discharge. This TMDL also establishes alternative wasteload allocations for dieldrin (“Alternative WLAs if the Fish Tissue Target is Met”) described in Section 6.7.6.1.2. The alternative wasteload allocations will supersede the wasteload allocations in Section 6.7.6.1.1 if the conditions described in Section 6.7.6.1.2 are met.

6.7.6.1.1 Wasteload Allocations

The entire watershed of Echo Park Lake is contained in an MS4 jurisdiction, and therefore receives WLAs. Relevant permit numbers are

- County of Los Angeles (including the city of Los Angeles): Board Order 01-182 (as amended by Order No. R4-2006-0074 and R4-2007-0042), CAS004001

- Caltrans: Order No 99-06-DWQ, CAS000003

Dieldrin concentrations in sediment and water flowing into Echo Park Lake are below detection limits, but most dieldrin load is expected to move in association with sediment. Therefore, suspended sediment in water flowing into the lake is assigned wasteload allocations. Additionally, the TMDL establishes wasteload allocations for dieldrin in the water column equal to the CTR based water column target. The CTR based water column target includes both dissolved dieldrin and dieldrin associated with suspended sediment. Comparing the sediment concentration target to the average detection limit for the influent samples of 1.32 µg/kg dry weight suggests that a reduction of approximately 39 percent in dieldrin loads is needed. The wasteload allocations are shown in Table 6-34 and each wasteload allocation must be met at the point of discharge.

Table 6-34. Wasteload Allocations for Dieldrin in Echo Park Lake

Subwatershed	Responsible Jurisdiction	Input	Wasteload Allocation for Dieldrin Associated with Suspended Sediment[3] (µg/kg dry weight)	Wasteload Allocation for Dieldrin in the Water Column[3] (ng/L)
Northern	Caltrans	State Highway Stormwater[1]	0.80	0.14
Northern	City of Los Angeles	MS4 Stormwater[1]	0.80	0.14
Northern	General Industrial Stormwater Permittees (in the City of Los Angeles)[2]	General Industrial Stormwater[1]	0.80	0.14
Southern	Caltrans	State Highway Stormwater[1]	0.80	0.14
Southern	City of Los Angeles	MS4 Stormwater[1]	0.80	0.14

[1]This input includes effluent from storm drain systems during both wet and dry weather.

[2]The discharges governed by the general industrial stormwater permit are currently in the City of Los Angeles. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3]Each wasteload allocation must be met at the point of discharge.

6.7.6.1.2 Alternative Wasteload Allocations if the Fish Tissue Target is Met

The wasteload allocations listed in Table 6-34 will be superseded, and the wasteload allocations in Table 6-35 will apply, if:

1. The responsible jurisdictions submit to USEPA and the Regional Board material describing that the fish tissue target of 0.46 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five common carp each measuring at least 350mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative wasteload allocations in Table 6-35, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

Each wasteload allocation must be met at the point of discharge.

Table 6-35. Alternative Wasteload Allocations for Dieldrin in Echo Park Lake if the Fish Tissue Target is Met

Subwatershed	Responsible Jurisdiction	Input	Wasteload Allocation for Dieldrin Associated with Suspended Sediment[3] (µg/kg dry weight)	Wasteload Allocation for Dieldrin in the Water Column[3] (ng/L)
Northern	Caltrans	State Highway Stormwater[1]	1.90	0.14
Northern	City of Los Angeles	MS4 Stormwater[1]	1.90	0.14
Northern	General Industrial Stormwater Permittees (in the City of Los Angeles)[2]	General Industrial Stormwater[1]	1.90	0.14
Southern	Caltrans	State Highway Stormwater[1]	1.90	0.14
Southern	City of Los Angeles	MS4 Stormwater[1]	1.90	0.14

[1]This input includes effluent from storm drain systems during both wet and dry weather.

[2]The discharges governed by the general industrial stormwater permit are currently in the City of Los Angeles. Any future discharges governed by the general construction and general industrial stormwater permits will receive the same concentration-based wasteload allocations.

[3]Each wasteload allocation must be met at the point of discharge.

6.7.6.2 Load Allocations

This TMDL establishes load allocations (LAs) at their point of discharge. This TMDL also establishes alternative load allocations for dieldrin ("Alternative LAs if the Fish Tissue Target is Met") described in Section 6.7.6.2.2. The alternative load allocations will supersede the load allocations in Section 6.7.6.2.1 if the conditions described in Section 6.7.6.2.2 are met.

6.7.6.2.1 Load Allocations

None of the watershed of Echo Park Lake is outside MS4 jurisdiction; therefore no LAs are assigned to watershed loads. No load is allocated to atmospheric deposition of dieldrin. The legacy dieldrin stored in lake sediment is believed to be the major cause of impairment associated with elevated fish tissue concentrations, and is assigned a load allocation. The in-lake allocation is in concentration terms: specifically, the responsible jurisdiction (city of Los Angeles) should achieve a dieldrin concentration of 0.80 µg/kg dry weight in lake bottom sediments (see Table 6-36).

Table 6-36. Load Allocations for Dieldrin in Echo Park Lake

Subwatershed	Responsible Jurisdiction	Input	Load Allocation (µg/kg dry weight)
Lake Surface	City of Los Angeles	Lake bottom sediments	0.80

6.7.6.2.2 Alternative Load Allocations if the Fish Tissue Target is Met

The load allocations listed in Table 6-36 will be superseded, and the load allocations in Table 6-37 will apply, if:

1. The responsible jurisdiction submits to USEPA and the Regional Board material describing that the fish tissue target of 0.46 ppb wet weight has been met for the preceding three or more years. A demonstration that the fish tissue target has been met in any given year must at minimum include a composite sample of skin off fillets from at least five largemouth bass each measuring at least 350mm in length,
2. The Regional Board Executive Officer approves the request and applies the alternative load allocations in Table 6-37, and
3. USEPA does not object to the Regional Board's determination within 60 days of receiving notice of it.

Table 6-37. Alternative Load Allocations for Dieldrin in Echo Park Lake if the Fish Tissue Target is Met

Subwatershed	Responsible Jurisdiction	Input	Load Allocation (µg/kg dry weight)
Lake Surface	City of Los Angeles	Lake bottom sediments	1.90

6.7.6.3 Margin of Safety

TMDLs must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. This TMDL contains an implicit MOS based on conservative assumptions. The allocations are set based on the lower of either the BSAF-derived sediment target or the consensus-based TEC sediment target to ensure achievement of the OEHHA FCG target in fish tissue. The selected BSAF-derived target concentration in sediment is considerably lower than the consensus-based TEC target.

6.7.6.4 Critical Conditions/Seasonality

TMDLs must include consideration of critical conditions and seasonal variation to ensure protection of the designated uses of the waterbody at all times. This TMDL protects beneficial uses by reducing fish tissue concentrations to the FCG target and protecting benthic biota in sediment. Because fish bioaccumulate dieldrin, concentrations in tissues of edible sized game fish integrate exposure over a number of years. As a result, overall average loading is more important for the attainment of standards than instantaneous or daily concentrations. WLAs and LAs in this TMDL are assigned as concentrations and protect during all seasons and in both high and low flow conditions. This TMDL therefore protects for critical conditions.

6.7.6.5 Daily Load Expression

USEPA recommends inclusion of a daily load expression for all TMDLs to comply with the 2006 D.C. Circuit Court of Appeals decision for the Anacostia River. This TMDL includes a maximum daily load estimated according to the guidelines provided by USEPA (2007).

Because the dieldrin WLAs are expressed as concentrations on sediment, the daily maximum allowable load is calculated from the maximum daily sediment load multiplied by the TMDL WLA concentration. The maximum daily sediment load is estimated from the 99^{th} percentile daily flow and the sediment event mean concentration that yields the estimated annual sediment load.

The daily maximum allowable load in Echo Park Lake is calculated from the estimated 99th percentile flow to the Lake multiplied by the event mean concentration consistent with achieving the long-term loading targets, described above in the PCBs section. USGS Station 11102000, Mission Creek near Montebello, CA, was selected as a surrogate for flow determination for flow to the lake, as described in the PCBs section (Section 6.5.6.5).

The event mean concentration of sediment in stormwater (55.8 mg/L) was calculated from the estimated existing watershed sediment load of 1.32 tons/yr (Table 6-12) divided by the total storm flow volume reaching the lake (17.4 ac-ft/yr). Multiplying the sediment event mean concentration by the 99th percentile peak daily flow (8.98 cfs) yields a daily maximum sediment load from stormwater of 1226 kg/d (1.35 tons/d). Applying the wasteload allocation concentration of 0.80 µg dieldrin per dry kg of sediment yields the stormwater daily maximum allowable load of 0.00098 g/d of dieldrin. This load is associated with the MS4 stormwater permittees. The maximum allowable daily load must be met on all days, and the concentration-based WLAs must be met to ensure compliance with the TMDL.

6.7.6.6 Future Growth

The manufacture and use of dieldrin is currently banned. Therefore, no additional allowance is made for future growth in the dieldrin TMDL.

If any sources currently assigned load allocations are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality-based effluent limitations pursuant to 40 CFR 122.44(d)(1).

6.8 TRASH IMPAIRMENT

6.8.1 Beneficial Uses

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan, designed to be protective of the beneficial uses of each waterbody in the region. The existing beneficial uses assigned to Echo Park Lake include REC1, REC2, WARM, and WILD. Descriptions of these uses are listed in Section 2 of this TMDL report. Trash can potentially impair the REC1, REC2, WARM, and WILD in a variety of ways, including causing toxicity to aquatic organisms, damaging habitat, impairing aesthetics, and impeding recreation.

6.8.2 Numeric Targets

The numeric target is derived from the narrative water quality objective in the Los Angeles Basin Plan (LARWQCB, 1994) for floating material:

> *"Waters shall not contain floating materials, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses";*

and for solid, suspended, or settleable materials:

> *"Waters shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses."*

The numeric target for the Echo Park Lake Trash TMDL is 0 (zero) trash in or on the water and on the shoreline. Zero trash is defined as no allowable trash discharged into the waterbody of concern, shoreline, and channels. No information has been found to justify any value other than zero that would fully support the designated beneficial uses. Furthermore, court rulings have found that a numeric target of zero trash is legally valid (*City of Arcadia et al. v. Los Angeles Regional Water Quality Control Board et al. (2006) 135 Cal.App.4th 1392*). The numeric target was used to calculate the waste load allocations for point sources and load allocations for nonpoint sources, as described in the following sections of this report.

6.8.3 Summary of Monitoring Data

The existing beneficial uses are impaired by the accumulation of suspended and settled debris. Common items observed include plastic pieces, paper items, Styrofoam, food waste, glass pieces, aluminum foil, and cigarette butts.

According to California's 2006 303(d) Impaired Waterbodies list, trash is causing water quality problems in Echo Park Lake. USEPA and Regional Water Quality Control Board staff confirmed the trash impairment during a site visit to Echo Park Lake on March 9, 2009. Staff conducted quantitative trash assessments and documented the trash impairment with photographs. Trash was observed in the lake, along the shorelines, and at the outlet of storm drains discharging into the lake.

Two quantitative trash assessments were conducted according to the Rapid Trash Assessment protocol which gives each shoreline a numeric score out of a possible 120 points (SWAMP, 2007). Higher scores correspond to cleaner areas, with 120 points representing a clean area. The severity of the trash problem was scored based upon the condition of the following parameters: level of trash, actual number of trash items found, threat to aquatic life, threat to human health, illegal dumping and littering, and accumulation of trash. Trash assessments were conducted within a 100 feet long by 10 feet wide area. The site visit evaluated different land use types surrounding Echo Park Lake, including recreational uses near a roadway and near picnic tables.

Echo Park has many visitors and is located in a densely populated urban area surrounded by busy streets. The lake is down a short steep slope from the streets which delineates the nonpoint source subwatershed boundary. Echo Park Lake has a shallow lotus bed on the northwest side, an inaccessible island on the northeast side, multiple small wetlands in the center, and a large fountain. The Park includes picnic tables near the lake, a playground on the northern shore, paddle boats for rent along the eastern shore, a fence along the southern corner, and a paved path around the entire lake, used for jogging and walking. Uncovered trash cans are located along the park path approximately every 100 feet, potentially leading to the transport of trash by wildlife or wind. Staff also observed approximately 300 birds in this small lake resulting in excessive bird droppings. Scum and small floatable pieces of trash were observed to accumulate in corners of the lake with stagnant water (Figure 6-11 and Figure 6-12).

Figure 6-11. Trash Accumulation in the Lotus Bed Section of Echo Park Lake

Figure 6-12. Floating Debris Observed on December 2, 2009

6.8.3.1 Picnic Area

A 100 ft. trash assessment was conducted near the playground and picnic tables on the northern shore of the lake. This area scored a 95/120. Only small trash items were observed. Trash was likely transported due to people littering in the picnic area and along the path. Some items were found in the water but no accumulation of trash was observed.

6.8.3.2 Near Glendale Boulevard

A trash assessment, conducted on the western shore near Glendale Boulevard, scored a 95/120. Trash was likely transported from the road and people littering along the park path.

6.8.3.3 Wildlife Feeding

Dumping of food waste, such as piles of rice or whole loaves of bread, to feed the birds was observed. Human food is unhealthy to wildlife and the massive quantities discarded cause an overabundance of birds to inhabit this area. An unnaturally large bird population leads to greater excrement quantities, which can worsen the nutrient problem in the lake.

Locations of the quantitative monitoring sites are shown in the map below (Figure 6-13).

Figure 6-13. Quantitative Trash Assessment Locations at Echo Park Lake

During a follow-up visit to Echo Park Lake on August 4, 2009, trash was similarly observed in the lake and on the shore. No quantitative surveys were conducted.

In summary, trash was present in and along the shore of Echo Park Lake during all visits. The prevalence of trash was evenly distributed around the lake. The main trash problems were caused by feeding wildlife and small trash items, such as cigarette butts.

6.8.4 Source Assessment

The major source of trash in Echo Park Lake results from litter, which is intentionally or accidentally discarded to the lake and watershed. Potential sources are categorized as point 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.

Since the Echo Park Lake watershed includes residential areas, open space, parks, roads, and storm drains, both point and nonpoint sources contribute trash to the lake.

6.8.4.1 Point Sources

Based on reports from similar watersheds, the amount and type of trash transported is a function of the surrounding land use. The city of Long Beach recorded trash quantity collected at the mouth of the Los Angeles River; the results suggest total trash amount is linearly correlated with precipitation (Figure 6-14,

R^2=0.90, Signal Hill, 2006). A similar study found that the amount of gross pollutants entering the stormwater system is rainfall dependent but does not necessarily depend on the source (Walker and Wong, 1999). The amount of trash entering the stormwater system depends on the energy available to re-mobilize and transport deposited gross pollutants on street surfaces, rather than the amount of available gross pollutants deposited on street surfaces. Where gross pollutants exist, a clear relationship is established between the gross pollutant load in the stormwater system and the magnitude of the storm event. The limiting mechanism affecting the transport of gross pollutants, in the majority of cases, appears to be re-mobilization and transport processes (i.e., stormwater rates and velocities).

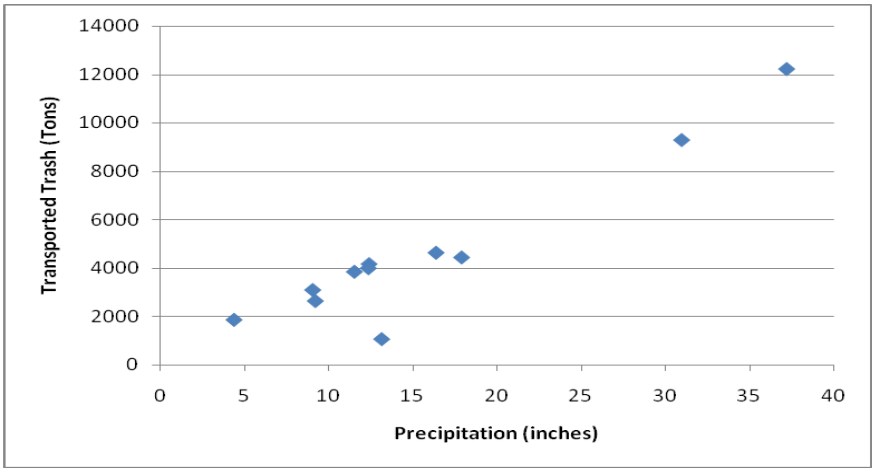

Figure 6-14. Storm Debris Collection Summary for Long Beach (Signal Hill, 2006)

In order to estimate trash generation rates, data from a comparable watershed was analyzed.

The city of Calabasas completed a study on a Continuous Deflective Separation (CDS) unit installed to catch runoff from Calabasas Park Hills to Las Virgenes. The CDS unit is a hydrodynamic separator that uses vortex settling to remove sediment, trap debris and trash, and separate floatables such as oil and grease. It is assumed that this CDS unit prevented all trash from passing through. The calculated area drained by this CDS Unit is approximately 12.8 square miles. Regional Board staff estimated the waterbody's urbanized area to be 0.10 square miles. The results of this clean-out, which represents approximately half of the 1998-1999 rainy season, were 2,000 gallons of sludgy water and a 64-gallon bag two-third full of plastic food wrappers. Part of the trash accumulated in this CDS unit for over half of the rainy season is assumed to have decomposed due to the absence of paper products. Since the CDS unit was cleaned out after slightly more than nine months of use, it was assumed that this 0.10 square mile urbanized area produced a volume of 64 gallons of trash. Therefore, 640 gallons of trash were generated per square mile per year. This estimate is used to determine trash loads.

During the 1998/1999 and 1999/2000 rain seasons, a Litter Management Pilot Study (LMPS) was conducted by Caltrans to evaluate the effectiveness of several litter management practices in reducing litter discharged from Caltrans storm water conveyance systems. The LMPS employed four field study sites, each of which was measured with the amount of trash produced when separate BMPs were applied. The average total load for each site normalized by the total area of control catchments was 6,677 gallons/mi^2/year. Other trash generation rates and studies exist but the LMPS study is the most applicable to Echo Park Lake because of similar land use, population density, and average daily traffic conditions. Therefore, this analysis will use 6,677 gal/mi^2/yr as the baseline estimate of trash for Caltrans roads.

Table 6-38 shows the current estimated volume of trash deposited within each of the responsible jurisdictions, in gallons per year, assuming a trash generation rate of 6,677 gallons of uncompressed trash/mi^2/year for Caltrans and a trash generation rate of 640 gallons of uncompressed trash per square mile per year for other jurisdictions. For responsible jurisdictions that are only partially located in the watershed, the square mileage indicated is for the portion in the watershed only. The current loads need to be reduced 100 percent to meet the TMDL target of zero trash.

Table 6-38. Echo Park Lake Estimated Point Source Trash Loads

Responsible Jurisdictions	Point Source Area (mi^2)	Current Point Source Trash Load (gal/year)
CA DOT (Caltrans)	0.022	150
City of Los Angeles	1.2	750

Note:
For Caltrans: Current Point Source Trash Load (gal/yr) = Point Source Area (mi2) * 6,677 (gal/ mi2/yr).
For all other jurisdictions: Current Point Source Trash Load (gal/yr) = Point Source Area (mi2) * 640 (gal/ mi2/yr)

6.8.4.2 Nonpoint Sources

Nonpoint source pollution is a source of trash in Echo Park Lake. Trash deposited in the lake from nonpoint sources is a function of transport via wind, wildlife, and overland flow and direct dumping.

Few studies have evaluated the relationship between wind strength and movement of trash from land surfaces to a waterbody. Lighter trash with a sufficient surface area to be blown in the wind, such as plastic bags, beverage containers, and paper or plastic food containers, are easily lifted and carried to waterbodies. Also, overland flow carries trash from the shoreline to waterbodies. Transportation of pollutants from one location to another is determined by the energy of both wind and overland stormwater flow.

Existing trash surrounding the lake is the fundamental cause of nonpoint source trash loading. Land use directly surrounding Echo Park Lake includes recreational areas. Visitors may intentionally or accidentally discard trash to grass or trails in the park, which initiate the journey of trash to waterbodies via wind or overland water flow. Varying uses of the park are responsible for different degrees of trash impairment. For example, areas with picnic tables generate more trash than parking lots. Visitation rates are also likely linked to the amount of trash from nonpoint sources.

Table 6-39 summarizes the nonpoint source area and current estimate of nonpoint source trash loads for responsible jurisdictions (see Figure 6-6 for an illustration of the park area surrounding the lake), assuming a trash generation rate of 640 gallons of uncompressed trash per square mile per year. The current loads need to be reduced 100 percent to meet the TMDL target of zero trash.

Table 6-39. Echo Park Lake Estimated Nonpoint Source Trash Loads

Responsible Jurisdictions	Nonpoint Source Area (Mile^2)	Current Nonpoint Source Trash Loads (Gal/year)
City of Los Angeles	0.024	16

Note: Current Nonpoint Source Trash Load (gal/yr) = Nonpoint Source Area (mi^2) * 640 (gal/ mi^2/yr)

6.8.5 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 Echo Park Lake is set to zero allowable trash.

6.8.6 TMDL Summary

Both point sources and nonpoint sources are identified as sources of trash in Echo Park Lake. For point sources, water quality standards are attained by assigning waste load allocations (WLAs) to Permittees of the Los Angeles County Municipal Separate Storm Sewer System (MS4) Permit and Caltrans (hereinafter referred to as responsible jurisdictions); these WLAs will be implemented through permit requirements. For nonpoint sources, water quality standards are attained by assigning load allocations (LAs) to municipalities and agencies having jurisdictions over Echo Park Lake and its subwatershed. These LAs may be implemented through regulatory mechanisms that implement the State Board's 2004 Nonpoint Source Policy such as conditional waivers, waste discharge requirements, or prohibitions.

The TMDL of zero trash requires that current loads are reduced by 100 percent. Final WLAs and LAs are zero trash (Table 6-40).

Table 6-40. Echo Park Lake Trash WLAs and LAs

Echo Park Lake	Allocation
Trash WLA	0
Trash LA	0

6.8.6.1 Wasteload Allocations

The geographical boundary contributing to point sources is defined by watershed areas which contain conveyances discharging to the waterbodies of concern. Conveyances include, but are not limited to, natural and channelized tributaries, and stormwater drains and conveyances. Federal regulations require that NPDES permits incorporate water quality based effluent limitations (WQBELs) consistent with the requirements and assumptions of any available wasteload allocations (WLAs).

Wasteload allocations are set to 0 (zero) allowable trash.

The permits affected are:

- County of Los Angeles (includes all cities in Los Angeles County except Long Beach): Board Order 01-182 (as amended by Board Orders R4-2006-0074 and R4-2007-0042), CAS004001
- Caltrans: Order No 99-06-DWQ, CAS000003
- General Industrial Stormwater: Order No 97-03-DWQ, CAS000001

6.8.6.2 Load Allocations

Nonpoint source areas refer to locations where trash may be carried by overland flow, wildlife, or wind to waterbodies. Due to the transportation mechanism by wind, wildlife, and overland flow to relocate trash from land to waterbodies, the nonpoint source area may be smaller than the watershed. In addition, trash loadings frequently occur immediately around or directly into the lake making the load allocation a significant source of trash. According to the study by the city of Calabasas, the trash generation rate is 640 gallons per square mile per year from nonpoint sources areas (including, but not limited to, schools, commercial areas, residential areas, public services, road, and open space and parks areas). Current trash rates were calculated in the nonpoint source section.

Load allocations (LAs) for nonpoint sources are zero trash. Zero is defined as no allowable trash found in and on the lake, and along the shoreline. According to the Porter-Cologne Act, load allocations may be addressed by the conditional Waivers of WDRs, or WDRs. Responsible jurisdictions should monitor the trash quantity deposited in the vicinities of the waterbodies of concern as well as on the waterbody to comply with the load allocation.

The area adjacent to Echo Park Lake or defined as nonpoint sources includes parking lots, recreational areas, picnic areas, and walking paths. Assuming that trash within a reasonable distance from Echo Park Lake has a high potential to reach the waterbody, the nonpoint source jurisdiction is the city of Los Angeles. All load allocations are set to zero allowable trash.

6.8.6.3 Margin of Safety

A margin of safety (MOS) accounts for uncertainties in the TMDL analysis. The MOS can be expressed as an explicit mass load, or included implicitly in the WLAs and LAs that are allocated. Because this TMDL sets WLAs and LAs as zero trash, the TMDL includes an implicit MOS. Therefore, an explicit MOS is not necessary.

6.8.6.4 Critical Conditions/Seasonality

Critical conditions for Echo Park Lake are based on three conditions that correlate with loading conditions:

- Major storms
- Wind advisories issued by the National Weather Service
- High visitation – On weekends and holidays from May 15 to October 15.

Critical conditions do not affect wasteload or load allocations because zero trash is a conservative target. However, implementation efforts should be heightened during critical conditions in order to ensure that no trash enters the waterbody.

6.8.6.5 Future Growth

If any sources, currently assigned load allocations, are later determined to be point sources requiring NPDES permits, those load allocations are to be treated as wasteload allocations for purposes of determining appropriate water quality based effluent limitations pursuant to 40 CFR 122.44(d)(1).

6.9 Implementation Recommendations

Implementation measures may be developed in the future by the Regional Board through an implementation plan, NPDES permits, or non-point source enforcement. This section describes USEPA's recommendations to the Regional Board as to the implementation procedures and regulatory mechanisms that could be used to provide reasonable assurances that water quality standards will be met. General information about various lake management strategies can be found in a USEPA document titled *Managing Lakes and Reservoirs (EPA 841-B-01-006)*. Lake management options that can reduce pollutant loading to lakes include but are not limited to: increasing the volume of the lake that is aerated; installing hydroponic islands to remove nutrients; increasing flow volume or circulation in the lake;

reducing stormwater discharges by improved infiltration; treating stormwater or supplemental water inputs with a wetland system; alum treatment to immobilize nutrients in sediments; dredging in lake sediments; and/or fisheries management actions to reduce nutrient availability from sediments.

Additionally, responsible jurisdictions implementing these TMDLs are encouraged to utilize Los Angeles County's Structural Best Management Practice (BMP) Prioritization Methodology which helps identify priority areas for constructing BMP projects. The tool is able to prioritize based on multiple pollutants. The pollutants that it can prioritize includes bacteria, nutrients, trash, metals and sediment. Reducing sediment loads would reduce OC pesticides and PCBs delivery to the lake in many instances. More information about this prioritization tool is available at: labmpmethod.org.

If necessary, these TMDLs may be revised as the result of new information (See Section 6.10 Monitoring Recommendations).

6.9.1 Nonpoint Sources and the Implementation of Load Allocations

Regional Board may regulate nonpoint pollutant sources through the authority contained in sections 13263 and 13269 of the California Water Code, in conformance with the State Water Resources Control Board's Nonpoint Source Implementation and Enforcement Policy. Additionally, South Coast Air Quality Management District has authority to regulate air emissions throughout the basin that affect air deposition. Load allocations are expressed in Table 6-7, Table 6-16, Table 6-26, Table 6-36, and Table 6-40 for nutrients, PCBs, chlordane, dieldrin, and trash, respectively.

6.9.2 Point Sources and the Implementation of Wasteload Allocations

Wasteload allocations apply to MS4 and Caltrans Stormwater permits as well as supplemental water additions. Wasteload allocations are expressed in Table 6-6, **Error! Reference source not found.**, Table 6-14, Table 6-24,
Table 6-34, and Table 6-40 for individual and grouped nutrients, PCBs, chlordane, dieldrin, and trash, respectively. The concentration and mass-based wasteload allocations will be incorporated into the Caltrans and Los Angeles County MS4 permits.

6.9.3 Source Control Alternatives

Echo Park Lake has nutrient-related, chlordane, dieldrin, PCB, and trash impairments. There are some management strategies that would address multiple impairments (i.e., sediment removal BMPs in the watershed) while other pollutants require a more specific management plan. The City of Los Angeles Department of Recreation and Parks submitted a recommendation to develop the Echo Park Lake Rehabilitation plan to the Proposition O program funds in 2006 (CDM, 2006), developed the concept plan and presented it to the Prop O Citizens Oversight Committee for bond funding approval. BMP and restoration efforts associated with this plan are now underway and will impact several of the Echo Park Lake impairments and initial modeling predicts that TMDL targets will be met upon its full implementation. An explicit goal of this project is to provide multiple environmental benefits by also enhancing open water, wetland, and nesting island habitat for native migratory waterfowl, turtles and gamefish.

The objective of the Plan is to improve water quality in both Echo Park Lake and the Los Angeles River watershed. Funds were allocated to general tasks including: site investigation and preliminary studies, engineering design tasks, permitting costs, construction of structural improvements to the lake and storm drain system, implementation of water quality BMPs, habitat restoration, educational efforts regarding water quality improvements, and post-construction monitoring. Due to the wide range of components, the

Plan is divided into four phases: pre-design, design, construction, and post-construction. Major lake improvements are summarized below; however, additional improvements are discussed in the Plan.

In-lake improvements, as part of the construction phase, will begin with draining the lake and removing contaminated soils. Fishes will also be removed. Once contaminated soils are properly disposed of offsite, an impermeable liner will be placed on the lake's bottom to eliminate infiltration, thus conserving the potable water used to supplement water levels in the lake. Structural BMPs to the lake's infrastructure will include the installation of trash capture and pollution control devices at the city's storm drain inlets. Sedimentation basins at all storm drains will be designed as stilling basins to enhance sedimentation and additional biological filters will trap pollutants, trash, and debris before stormwater flows into the lake. In-lake habitat and vegetation improvements will include lotus bed reconditioning as well as enhancement of the wetland and the lake's edge. Finally, the Plan details specific BMPs to be implemented throughout the surrounding park area, including grass swales, infiltration strips, porous pavement, "smart" irrigation systems, and educational signage.

Proposition O improvements to Echo Park Lake will assist with achieving local and regional water quality goals, including load reductions specific to the impairments addressed within these TMDLs. While there are some management strategies that would address multiple impairments (i.e., sediment removal BMPs in the watershed), their differences warrant separate implementation and monitoring discussions.

6.9.3.1 Nutrient-Related Impairments

The Echo Park Lake Rehabilitation Plan identified a number of BMPs that may help prevent degradation of this waterbody due to nutrient loading associated with future land use changes. Several of the recommended BMPs would function as sediment removal devices, which may also result in decreased concentrations of nitrogen and phosphorus in the runoff water. The sediment removal BMPs proposed in the plan include:

- Hydrodynamic sediment and trash removal units within the city's concrete stormdrain structure or at the forebay of the lake
- Sediment removal device at the county stormdrain outfall
- Sediment basins at stormdrain outfall locations

The plan also proposes BMPs that provide that provide filtration, infiltration, and vegetative uptake and these removal processes may reduce nutrient loads. These BMPs include:

- Lotus bed reconditioning
- Submerging of existing floating wetland islands
- Lake edge vegetation
- Grassy swales/infiltration strips
- Porous pavement
- New "smart" irrigation system

The rehabilitation plan also proposes educational signage and kiosks regarding the above improvements. In addition to these efforts, education of park maintenance staff regarding the proper placement, timing, and rates of fertilizer application will also result in reduced nutrient loading to the lake. Staff should be advised to follow product guidelines regarding fertilizer amounts and to spread fertilizer when the chance of heavy precipitation in the following days is low. Encouraging pet owners to properly dispose of pet wastes will also reduce nutrient loading associated with fecal material that may wash directly into the lake or into storm drains that eventually discharge to the lake. Discouraging feeding of birds at the lake will reduce nutrient loading associated with excessive resident bird populations. The NNE BATHTUB model indicated Additional Parkland Loading is present in Echo Park Lake. This lake is heavily frequented by bird feeders and the additional bird feces produced by bird feeding contributes to this load; loads linked to trash and associated food scraps would also be reduced.

In order to meet the fine particulate ($PM_{2.5}$) and ozone (O_3) national ambient air quality standards by their respective attainment dates of 2015 and 2024, the South Coast Air Quality Management District and the California Air Resources Board have prepared an air quality management plan that commits to reducing nitrogen oxides (NOx, a precursor to both $PM_{2.5}$ and ozone) by over 85 percent by 2024. These reductions will come largely from the control of mobile sources of air pollution such as trucks, buses, passenger vehicles, construction equipment, locomotives, and marine engines. These reductions in NOx emissions will result in reductions of ambient NOx levels and atmospheric deposition of nitrogen to the lake surface.

6.9.3.2 Organochlorine Pesticides and PCB Impairments

The manufacture and use of chlordane, dieldrin, and PCBs are currently banned in the U.S. except for certain limited uses of PCBs authorized by USEPA. Therefore, no additional allowances for future growth are needed in the TMDLs. Source control BMPs and pollutant removal are the most suitable courses of action to reduce OC pesticides and PCBs in Echo Park Lake. The TMDL calculations performed for each pollutant (described above in their individual sections) indicated internal lake storage as the greatest contributing source and driving factor affecting fish tissue concentrations. Additionally, the watershed loads for chlordane and PCBs are less than one percent of the total loading that would be required to maintain the current sediment concentrations in the lake under steady-state conditions. Therefore, the most effective remedial actions and/or implementation efforts will focus on addressing the internal lake storage, such as capping or removal of contaminated lake sediments. As described above in Section 6.9.3, the Echo Park Lake Rehabilitation Plan proposes the draining of the lake, removal of sediments, and placement of an impermeable layer to address any residual contaminated soil.

A thorough remedial design study should be conducted prior to implementing removal of lake sediments and impermeable layer placement for Echo Park Lake. When properly conducted, removal of contaminated lake sediments, or dredging, can be an effective remediation option. The object of sediment dredging is to eliminate the pollutants that have accumulated in sediments at the lake bottom. Dredging is optimal in waterbodies with known spatial distribution of contamination because sediment removal can focus on problem areas. However, no spatial pattern of pollutant contamination was apparent in Echo Park Lake. Removal of the contaminated sediments reduces the pollutants available to the in-lake cycling by discontinuing exposure to benthic organisms, water column loading, and consequent bioaccumulation in higher trophic level fish. Potential negative effects of dredging include increased turbidity and lowered dissolved oxygen concentrations in the short term, and disturbance to the benthic community and reactivation of buried sediment and any associated pollutants. These negative impacts could be avoided through a plan that combines thorough removal of sediments and placement of an impermeable layer or cap.

In some cases, sediment capping may be appropriate to sequester contaminated sediments below an uncontaminated layer of sediment, clay, gravel, or media material. Capping is effective in restricting the mobility of OC pesticides and PCBs; however, it is most useful in deep lakes and capping alone may not be a viable solution at Echo Park Lake. Capping of in-place sediments without removal should be restricted to areas with sediments that can support the weight of a capped layer, and to areas where hydrologic conditions of the waterbody will not disturb the cap. The combination of sediment removal and capping of any residuals could be an effective solution if properly designed.

The in-lake options for remediation are costly, but would be the only way to achieve full use support in a short timeframe. It is, however, also true that the OC pesticides and PCBs in question are no longer manufactured and will tend to decline in concentration due to dilution by clean sediment and natural attenuation. Natural attenuation includes the chemical, biological, and physical processes that degrade compounds, or remove them from lake sediments in contact with the food chain, and reduce the concentrations and bioavailability of contaminants. These processes occur naturally within the environment and do not require additional remediation efforts; however, the half-lives of OC pesticides and PCBs in the environment are long, and natural attenuation often requires decades before observing significant improvement.

Loading from the watershed can also be expected to decline over time due to natural attenuation. While reductions are called for in watershed loads, these loads are a small fraction of the historic loads already stored in the lakes. Limited sampling has not identified any hotspots of elevated loading under current conditions. It may, however, be necessary to further investigate potential sources of OC pesticide and PCBs loading in the watershed, such as active and abandoned industrial sites, waste disposal areas, former chemical storage areas, and other potential hotspots, if sediment concentration is found to be elevated after the planned dredging project.

6.9.3.3 Trash Impairment

WLA may be complied with via full capture systems, partial capture systems, nonstructural BMPs, or any other lawful method which meet the target of zero trash. USEPA recommends the installation of full capture systems throughout the watershed. The Linear Radial, Inclined Screen, Baffle Box, and Catch Basin Insert are examples of full capture systems that fulfill the criteria of capturing all trash greater than 5 mm during flows less than the 1-year 1-hour storm. The Linear Radial utilizes a casing with louvers to serve as screens or mesh screen. Flows are routed through the louvers and into a vault. The Inclined Screen uses a wedge-wire screen with the slotting perpendicular or parallel to the direction of flow. This device is configured with an influent trough to allow solids to settle. The Baffle Box applies a two-chamber concept: the first chamber utilizes an underflow weir to trap floatable solids, and the second chamber uses a bar rack to capture material. The catch basin has an opening cover screen which is a coarse mesh screen at street level that is paired with a catch basin insert, a 5 mm screen inside the catch basin which filters out smaller trash. USEPA recommends implementation plans be consistent with the Los Angeles River trash TMDL. A monitoring plan should be developed in order to understand the effectiveness of the implementation efforts.

Similar devices to those described above were proposed in the Echo Park Lake Rehabilitation Plan. The plan proposes the installation of hydrodynamic units (either Continuous Deflective Separation (CDS) or Vortechnics units) which are estimated to capture 100 percent of floatables as well as provide sediment, nutrient, and other pollutant removal. These devices would be installed in the city’s concrete stormdrain structure or at the forebay of the lake, adjacent to the inlet structure. The Prop O recirculation system will also assist in removal of small pieces of trash.

LA may be complied with through the implementation of nonstructural BMPs or any other lawful methods which meet the target of zero trash. A minimum frequency of trash collection and assessment should be established at an interval that prevents trash from accumulating in deleterious amounts in between collections. Trash should be prevented by providing effective public education about littering impacts. Signs dissuading littering and wildlife feeding along roadways and around the lake are recommended. A city ban, tax, or incentive program reducing single-use plastic bags, Styrofoam containers, and other commonly discarded items which cannot decompose is recommended (Los Angeles County Department of Public Works, 2007).

Echo Park’s grounds and facilities are maintained by the city of Los Angeles. Trash is currently collected and removed from the park every other day during typical conditions and daily during windy or rainy weather. USEPA recommends continuation and expansion of the current trash pickups by the city of Los Angeles, including the collection of small trash items, such as cigarette butts.

The city of Los Angeles is also responsible for collection of trash in the lake. Currently a boat is used to remove large trash items from the lake. USEPA recommends a more frequent in-lake trash removal schedule to prevent the accumulation of small trash pieces.

The prevention and removal of trash in Echo Park Lake will lead to enhanced aesthetics, improved water quality, and the protection of habitat.

6.10 MONITORING RECOMMENDATIONS

Although estimates of the loading capacity and allocations are based on best available data and incorporate a MOS, these estimates may potentially need to be revised as additional data are obtained. The mass-based loading capacity will be affected by changes in flow volumes; therefore, loading capacities may be reconsidered if significant volume reductions or additions occur.

To provide reasonable assurances that the assigned allocations result in compliance with the chlorophyll *a*, fish tissue, and trash targets a commitment to continued monitoring and assessment is warranted. The purposes of such monitoring will be: 1) to determine compliance with wasteload and load allocations, 2) to determine if numeric targets are being attained, 3) to evaluate whether numeric targets and allocations need to be adjusted to attain beneficial uses, 4) to evaluate the efficacy of control measures instituted to achieve the needed load reductions, and 5) to document trends over time in algal densities and bloom frequencies, fish tissue organochlorine compounds concentrations and trash levels..

6.10.1 Nutrient Related Impairments

To assess compliance with the nutrient TMDLs, monitoring for nutrients and chlorophyll *a* should occur at least twice during the summer months and once in the winter. At a minimum, compliance monitoring should measure the following in-lake water quality parameters: ammonia, TKN or organic nitrogen, nitrate plus nitrite, orthophosphate, total phosphorus, total suspended solids, total dissolved solids and chlorophyll *a*. Measurements of the temperature, dissolved oxygen, pH and electrical conductivity should also be taken throughout the water column with a water quality probe along with Secchi depth measurement. All parameters must meet target levels at half the Secchi depth. DO and pH must meet target levels from the surface of the water to 0.3 meters above the lake bottom. Additionally, in order to accurately calculate compliance with wasteload allocations to the lake expressed in yearly loads, monitoring should include flow estimation or monitoring as well as the water quality concentration measurements. Wasteload allocations are assigned to stormwater inputs and supplemental water additions. These sources should be measured near the point where they enter the lakes twice a year for at minimum: ammonia, TKN or organic nitrogen, nitrate plus nitrite, orthophosphate, total phosphorus, total suspended solids and total dissolved solids.

The nutrient-response analysis for Echo Park Lake indicates that existing levels of nitrogen and phosphorus loading are resulting in attainment of the summer average chlorophyll *a* target concentration of 20 µg/L. As an antidegradation measure, nitrogen and phosphorus TMDLs are allocated based on existing loading. As an example of concentrations that responsible jurisdictions may need to target in order to meet and comply with the mass-based WLAs and LAs, this discussion provides concentrations calculated based on existing flow volumes (a recalculation is needed if flow volumes change). Assuming flow volumes remain at existing levels (Table 6-5), the target concentrations of total phosphorus and total nitrogen that may be 0.58 mg-P/L and 4.5 mg-N/L for the Caltrans areas, and 0.71 mg-P/L and 4.5 mg-N/L for the city of Los Angeles areas. Targeted concentrations in the supplemental water additions may be 0.12 mg-P/L and 1.13 mg-N/L assuming volumes remain at existing levels. Assuming average precipitation depths, the targeted concentration of nitrogen in precipitation may be 0.204 mg-N/L. The flows associated with the additional parkland sources are unknown, so LA concentrations cannot be estimated. As stated above, these concentrations are provided as guidelines; however, mass-based WLAs must be achieved.

6.10.2 Organochlorine Pesticides and PCB Impairments

To assess compliance with the organochlorine compounds TMDLs, monitoring should include monitoring of fish tissue at least every three years as well as once yearly sediment and water column sampling. For the OC pesticides and PCBs TMDLs a demonstration that fish tissue targets have been met in any given year must at minimum include a composite sample of skin off fillets from at least five common carp each measuring at least 350 mm in length. At a minimum, compliance monitoring should measure the following in-lake water quality parameters: total suspended sediments, total PCBs, total chlordane and dieldrin; as well as the following in-lake sediment parameters: total organic carbon, total PCBs, total chlordane, and dieldrin. Environmentally relevant detection limits should be used (i.e., detection limits lower than applicable target), if available at a commercial laboratory. Measurements of the temperature, dissolved oxygen, pH and electrical conductivity should also be taken throughout the water column with a water quality probe along with Secchi depth measurement. Wasteload allocations are assigned to stormwater inputs and supplemental water additions. These sources should be measured near the point where they enter the lakes once a year during a wet weather event. Sampling should be designed to collect sufficient volumes of suspended solids to allow for the analysis of at minimum: total organic carbon, total suspended solids, total PCBs, total chlordane, and dieldrin. Measurements of the temperature, dissolved oxygen, pH and electrical conductivity should also be taken.

WLAs and LAs for each pollutant are assigned to the sediment-associated load from the watershed as well as the lake bottom sediments. The concentration-based WLAs and LAs are 2.10 µg/kg dry weight for total chlordane, 1.77 µg/kg dry weight for total PCBs, and 0.80 µg/kg dry weight for dieldrin. The associated reductions from the watershed load needed to meet the WLAs are 74.7 percent for total chlordane, and 92.7 percent for total PCBs. A quantitative percent reduction cannot be calculated for dieldrin because all sediment samples are below detection limits (which are greater than the TMDL target concentration); however, the needed reduction appears to be on the order of 39 percent.

6.10.3 Trash Impairments

Responsible jurisdictions should monitor the trash quantity deposited in the vicinity of Echo Park Lake as well as on the waterbody to comply with the load allocation and to understand the effectiveness of various implementation efforts. Quarterly monitoring using the Rapid Trash Assessment Method is recommended. The trash TMDL target is zero trash; a 100 percent reduction is required.